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Where the letter *r* follows number of page, it indicates that a reference only to a previous patent appears on that page; or, in the case of matter other than patents, that the subject is only referred to by title.

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14,329	1183	15,432	1075	16,560	324	18,125	963	100,447	1096	101,264	1078	101,935	1251
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14,331	1101	15,455	869	16,592	686	18,205	1148	100,547	827	101,301	1056	101,941	1209
14,358	310	15,456	1255	16,617	522	18,218	1255	100,549	849	101,306	1006	101,947	1252
14,391	1054	15,474	418	16,634	1100	18,222	897	100,580	831	101,307	1108	101,983	1254
14,468	1222	15,547	821	16,725	960			100,581	831	101,308	1079	101,988	1255
14,486	963	15,559	1175	16,729	640			100,599	849	101,316	1056	101,998	1264
14,487	1168	15,585	462	16,760	887	1916.		100,603	821	101,318	1057	102,007	1252
14,490	1226	15,643	1267	16,799	611			100,611	821	101,332	1052	102,010	1252
14,492	1145	15,663	1273	16,825	822	1480	1236	100,628	828	101,363	1172	102,066	1273
14,511	1236	15,683	557	16,876	1238	2509	1101	100,637	1161	101,365	1123	102,093	1253
14,520	642	15,695	965	16,883	1226	2530	957	100,657	851	101,386	1096	102,100	1262
14,535	1145	15,706	859	16,887	1176	4634	1267	100,675	860	101,387	1129	102,106	1253
14,543	188	15,717	412	16,891	1211	6223	1209	100,679	1161	101,393	1060	102,114	1267
14,668	1148	15,733	835	16,901	953	100,009	629	100,692	1031	101,394	1100	102,136	1272
14,709	653	15,749	1015	16,918	1206	100,033	631	100,697	915	101,428	1131		
14,714	708	15,750	384	16,935	686	100,063	694	100,719	915	101,433	1105		
14,720	459	15,752	329	16,979	891	100,064	475	100,727	899	101,440	1109		

UNITED STATES PATENTS.

(*Note.*—" R " *indicates that a re-issue of the Patent is referred to.*)

759,387R	980	1,161,173	35	1,162,149	123	1,162,908	66	1,163,654	527	1,164,408	168	1,165,358	270
851,946R	365	1,161,209	48	1,162,150	124	1,162,926	41	1,163,693	145	1,164,413	102	1,165,367	250
978,583R	60	1,161,226	54	1,162,152	68	1,162,944	133	1,163,752	176	1,164,429	104	1,165,368	272
1,059,327R	1253	1,161,239	47	1,162,178	125	1,163,025	104	1,163,753	176	1,164,464	186	1,165,371	250
1,091,781R	295	1,161,272	63	1,162,179	125	1,163,050	130	1,163,759	138	1,164,487	183	1,165,393	259
1,111,812R	653	1,161,366	54	1,162,186	125	1,163,052	57	1,163,768	126	1,164,619	173	1,165,448	260
1,122,460R	345	1,161,398	56	1,162,210	115	1,163,058	138	1,163,813	184	1,164,636	259	1,165,498	263
1,143,332R	932	1,161,473	61	1,162,212	137	1,163,095	115	1,163,827	188	1,164,647	198	1,165,531	249
1,148,152R	316	1,161,475	53	1,162,226	55	1,163,130	133	1,163,828	184	1,164,649	254	1,165,567	242
1,150,675	531	1,161,481	56	1,162,244	102	1,163,168	137	1,163,829	184	1,164,653	259	1,165,569	245
1,151,002	550	1,161,585	55	1,162,259	42	1,163,174	116	1,163,856	186	1,164,667	200	1,165,570	251
1,151,003	550	1,161,600	68	1,162,339	125	1,163,221	102	1,163,875	163	1,164,670	263	1,165,633	242
1,151,928R	385	1,161,603	60	1,162,340	125	1,163,234	125	1,163,876	184	1,164,676	259	1,165,646	271
1,151,929R	385	1,161,612	54	1,162,341	125	1,163,251	109	1,163,911	186	1,164,677	259	1,165,657	245
1,152,834	59	1,161,620	468	1,162,342	125	1,163,252	109	1,163,922	177	1,164,705	250	1,165,689	250
1,152,835	59	1,161,634	56	1,162,346	102	1,163,253	109	1,163,932	192	1,164,710	180	1,165,692	260
1,152,836	60	1,161,696	39	1,162,357	104	1,163,254	109	1,164,008	184	1,164,728	247	1,165,693	260
1,152,837	60	1,161,731	74	1,162,415	48	1,163,270	117	1,164,036	130	1,164,761	259	1,165,715	245
1,154,161	32	1,161,750	32	1,162,449	125	1,163,271	117	1,164,037	109	1,164,766	255	1,165,741	272
1,154,575	32	1,161,790	56	1,162,452	104	1,163,286	124	1,164,049	125	1,164,838	259	1,165,742	260
1,156,044	142	1,161,826	134	1,162,452R	593	1,163,329	105	1,164,063	136	1,164,850	187	1,165,743	255
1,156,045	142	1,161,839	101	1,162,453	542	1,163,339	138	1,164,065	164	1,164,860	264	1,165,753	256
1,156,361	192	1,161,844	104	1,162,496	38	1,163,342	126	1,164,081	168	1,164,983	260	1,165,774	241
1,156,452	185	1,161,866	73	1,162,515	136	1,163,367	145	1,164,084	109	1,165,055	261	1,165,803	251
1,156,662	254	1,161,867	141	1,162,532	124	1,163,417	108	1,164,087	116	1,165,062	250	1,165,815	255
1,157,270	276	1,161,885	124	1,162,533	124	1,163,423	32	1,164,130	184	1,165,065	254	1,165,865	241
1,157,455	175	1,161,886	124	1,162,534	124	1,163,438	42	1,164,131	184	1,165,068	164	1,165,866	241
1,157,988	352	1,161,904	60	1,162,600	125	1,163,439	56	1,164,132	184	1,165,124	196	1,165,867	241
1,158,406	275	1,161,944	124	1,162,617	48	1,163,453	136	1,164,141	176	1,165,154	254	1,165,868	241
1,159,741	31	1,161,965	130	1,162,623	73	1,163,454	136	1,164,162	169	1,165,199	271	1,165,869	241
1,159,878	60	1,161,966	130	1,162,624	68	1,163,467	55	1,164,170	144	1,165,220	271	1,165,870	241
1,159,879	60	1,161,967	130	1,162,634	124	1,163,475	115	1,164,187	185	1,165,222	187	1,165,877	246
1,160,244	259	1,161,981	102	1,162,729	34	1,163,496	73	1,164,188	185	1,165,281	254	1,165,878	246
1,160,406	249	1,162,024	68	1,162,755	123	1,163,498	48	1,164,189	185	1,165,306	241	1,165,889	247
1,160,509	475	1,162,036	104	1,162,757	144	1,163,570	104	1,164,193	193	1,165,323	259	1,165,909	246
1,160,849	31	1,162,044	55	1,162,773	124	1,163,584	116	1,164,287	193	1,165,338	258	1,165,920	260
1,160,850	31	1,162,109	38	1,162,797	108	1,163,585	117	1,164,295	104	1,165,347	169	1,165,956	242
1,161,063	40	1,162,130	48	1,162,802	133	1,163,593	118	1,164,383	186	1,165,348	168	1,166,063	251
1,161,135	31	1,162,131	129	1,162,907	73	1,163,605	118	1,164,397	186	1,165,355	256	1,166,067	260

No. of Patent.	Page	No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent	Page.	No. of Patent.	Page.	No. of Patent	Page.	No. of Patent.	Page.
1,166,104	268	1,167,915	294	1,169,956	349	1,172,885	476	1,175,146	550	1,177,166	601	1,179,625	648
1,166,121	276	1,167,956	324	1,170,000	550	1,172,887	476	1,175,147	469	1,177,167	615	1,179,636	702
1,166,122	276	1,167,998	260	1,170,056	329	1,172,908	423	1,175,169	550	1,177,171	592	1,179,791	643
1,166,123	276	1,168,046	256	1,170,102	356	1,172,925	413	1,175,191	527	1,177,193	523	1,179,877	650
1,166,139	244	1,168,050	260	1,170,110	322	1,172,930	462	1,175,224	490	1,177,225	590	1,179,903	641
1,166,142	260	1,168,055	298	1,170,184	295	1,172,998	433	1,175,230	531	1,177,236	591	1,179,927	633
1,166,160	255	1,168,070	265	1,170,247	366	1,173,005	627	1,175,246	541	1,177,267	596	1,179,928	624
1,166,170	259	1,168,164	251	1,170,313	316	1,173,012	423	1,175,247	541	1,177,359	539	1,179,952	624
1,166,171	260	1,168 211	311	1,170,342	364	1,173,077	416	1,175,252	548	1,177,375	539	1,180,025	642
1,166,175	245	1,168 227	330	1,170,375	364	1,173,160	466	1,175,266	476	1,177,394	606	1,180 027	626
1,166,183	245	1,168,230	318	1,170,376	364	1,173,182	480	1,175,294	468	1,177,396	606	1,180,061	635
1,166,206	275	1,168,255	320	1,170,397	348	1,173,183	479	1,175,331	545	1,177,405	593	1,180,066	627
1,166,273	243	1,168,266	276	1,170,418	360	1,173,188	459	1,175,370	547	1,177,429	606	1,180,089	639
1,166,294	244	1,168,280	314	1,170,426	318	1,173,195	465	1,175,422	533	1,177,584	592	1,180,118	640
1,166,311	244	1,168,281	314	1,170,428	295	1,173,196	465	1,175,423	533	1,177,586	592	1,180,137	653
1,166,319	244	1,168,401	475	1,170,440	630	1,173,303	482	1,175,424	533	1,177,648	623	1,180,159	627
1 166,342	258	1,168,404	295	1,170,468	317	1,173,317	653	1,175,425	533	1,177,678	644	1,180,209	641
1,166,346	249	1,168,417	309	1,170,469	326	1,173,330	463	1,175,426	533	1,177,680	641	1,180,210	641
1,166,347	242	1,168,418	309	1,170,487	356	1,173,336	465	1,175,427	534	1,177,725	623	1,180,237	626
1,166,373	273	1,168,451	294	1,170,488	356	1,173,337	465	1,175,439	469	1,177,727	625	1,180,248	640
1 166,375	246	1,168,495	309	1,170,496	348	1,173,346	469	1,175,467	554	1,177,746	648	1,180,249	640
1,166,414	261	1,168,534	299	1,170,510	348	1,173,370	462	1,175,490	554	1,177,816	626	1,180,255	655
1,166,422	246	1,168,543	294	1,170,540	386	1,173,385	469	1,175,495	480	1,177,832	647	1,180,264	627
1,166,447	259	1,168,573	293	1,170,554	344	1,173,390	460	1,175,538	534	1,177,858	591	1,180,372	643
1,166,464	247	1,168,626	317	1,170,558	344	1,173,417	469	1,175,539	535	1,177,859	591	1,180,435	641
1,166,509	251	1,168,626R	479	1,170,624	384	1,173,428	460	1,175,565	468	1,177,865	635	1,180,449	623
1,166,524	255	1,168,663	313	1,170,637	365	1,173,429	490	1,175,572	535	1,177,896	642	1,180,455	634
1,166,546	277	1,168,664	313	1,170,665	365	1,173,467	475	1,175,587	537	1,177,904	1005	1,180,497	655
1,166,547	254	1,168,678	314	1,170,699	357	1,173,474	466	1,175,634	535	1,177,911	642	1,180,545	624
1,166,576	255	1,168,722	325	1,170,814	367	1,173,510	461	1,175,655	546	1,178,016	839	1,180,599	642
1,166,654	260	1,168,746	329	1,170,849	349	1,173,524	468	1,175,693	546	1,178,027	635	1,180,614	641
1,166,674	271	1,168,752	314	1,170,868	375	1,173,532	460	1,175,724	476	1,178,039	650	1,180,616	651
1,166,721	260	1,168,758	293	1,170,884	349	1,173,550	489	1,175,732	530	1,178,040	650	1,180,627	654
1,166,731	276	1,168,785	309	1,170,962	357	1,173,566	469	1,175,747	553	1,178 081	640	1,180,657	655
1,166,777	264	1,168,789	325	1,171,046	379	1,173,570	477	1,175,751	479	1,178,086	625	1,180,694	655
1,166,784	264	1,168,823	325	1,171,066	363	1,173,597	460	1,175,791	534	1,178,108	623	1,180,704	643
1,166,790	263	1,168,869	329	1,171,117	364	1,173,698	486	1,175,844	528	1,178,119	857	1,180,765	641
1,166,792	247	1,168,882	310	1,171,183	349	1,173,699	477	1,175,853	533	1,178,142	642	1,180,775	636
1,166,802	242	1,168,901	330	1,171,187	371	1,173,708	461	1,175,854	465	1,178,187	623	1,180,786	624
1,166,808	263	1,168,931	309	1,171,246	361	1,173,709	486	1,175,867	546	1,178,191	607	1,180,816	639
1,166,819	256	1,168,962	314	1,171,255	365	1,173,747	465	1,175,876	485	1,178,205	633	1,180,840	633
1,166,845	265	1,169,017	299	1,171,299	384	1,173,748	465	1,175,905	550	1,178,223	617	1,180,844	640
1,166,846	265	1,169,069	314	1,171,306	377	1,173,749	465	1,175,909	462	1,178,352	607	1,180,902	629
1,166,847	250	1,169,075	294	1,171,321	386	1,173,750	465	1,175,910	462	1,178,384	634	1,180,964	628
1,166,848	250	1,169,114	309	1,171,360	361	1,173,779	461	1,175,933	849	1,178,391	593	1,180,968	635
1,166,922	255	1,169,122	295	1,171,408	428	1,173,878	485	1,175,944	528	1,178,418	594	1,180,985	628
1,166,927	260	1,169,139	314	1,171,418	412	1,173,931	465	1,175,954	547	1,178,440	633	1,180,994	639
1,166,982	246	1,169,154	317	1,171,434	349	1,173,951	476	1,175,958	602	1,178,459	650	1,180,996	640
1,166,989	251	1,169,155	317	1,171,464	345	1,173,960	476	1,175,997	535	1,178,469	635	1,181,077	640
1,167,006	270	1,169,205	295	1,171,500	426	1,173,965	477	1,176,006	542	1,178,483	644	1,181,086	648
1,167,016	258	1,169,253	550	1,171,524	413	1,173,999	460	1,176,018	547	1,178,487	654	1,181,116	683
1,167,021	245	1,169,267	304	1,171,542	839	1,174,008	861	1,176,040	522	1,178,501	641	1,181,183	695
1,167,026	547	1,169,270	315	1,171,583	426	1,174,086	522	1,176,056	556	1,178,532	626	1,181,184	695
1,167,030	250	1,169,289	311	1,171,637	426	1,174,176	482	1,176,066	527	1,178,546	635	1,181,202	687
1,167,061	255	1,169,316	329	1,171,648	410	1,174,199	526	1,176,067	527	1,178,549	635	1,181,205	697
1,167,118	260	1,169,321	322	1,171,660	319	1,174,245	550	1,176,070	523	1,178,550	635	1,181,244	695
1,167,135	256	1,169,322	325	1,171,676	361	1,174,248	485	1,176,078	521	1,178,551	641	1,181,264	684
1,167,149	245	1,169,325	303	1,171,696	413	1,174,250	469	1,176,094	528	1,178,556	629	1,181,283	691
1,167,150	245	1,169,329	531	1,171,719	427	1,174,390	527	1,176,150	553	1,178,591	641	1,181,286	687
1,167,176	260	1,169,341	329	1,171,720	410	1,174,447	533	1,176,176	546	1,178,708	654	1,181,301	683
1,167,193	271	1,169,344	531	1,171,739	433	1,174,464	476	1,176,199	560	1,178,720	654	1,181,314	687
1,167,204	243	1,169,349	311	1,171,782	427	1,174,466	545	1,176,284	542	1,178,721	644	1,181,409	691
1,167,230	276	1,169,365	310	1,171,832	427	1,174,511	527	1,176,292	546	1,178,731	654	1,181,410	691
1,167,264	263	1,169,371	315	1,171,856	426	1,174,537	462	1,176,345	530	1,178,794	650	1,181,411	690
1,167,280	212	1,169,384	314	1,171,892	411	1,174,546	490	1,176,363	535	1,178,808	650	1,181,424	707
1,167,326	266	1,169,392	314	1,171,902	428	1,174,631	527	1,176,378	550	1,178,858	626	1,181,431	684
1,167,327	266	1,169,397	315	1,172,061	356	1,174,646	545	1,176,412	522	1,178,863	641	1,181,460	703
1,167,359	265	1,169,404	301	1,172,062	642	1,174,662	535	1,176,428	605	1,178,888	635	1,181,465	691
1,167,373	299	1,169,437	318	1,172,073	429	1,174,663	468	1,176,429	592	1,178,901	651	1,181,485	708
1,167,434	324	1,169,444	315	1,172,120	411	1,174,667	468	1,176,432	527	1,178,927	641	1,181,549	1023
1,167,447	298	1,169,479	295	1,172,133	422	1,174,668	468	1,176,441	546	1,178,957	623	1,181,553	686
1,167,460	309	1,169,494	314	1,172,222	426	1,174,669	490	1,176,462	553	1,178,962	634	1,181,555	708
1,167,470	297	1,169,506	545	1,172,223	426	1,174,697	533	1,176,528	553	1,178,979	636	1,181,570	694
1,167,471	297	1,169,529	315	1,172,226	412	1,174,727	545	1,176,540	547	1,179,001	626	1,181,588	698
1,167,472	297	1,169,530	315	1,172,240	357	1,174,728	545	1,176,541	547	1,179,009	640	1,181,624	692
1,167,484	315	1,169,536	314	1,172,270	434	1,174,729	545	1,176,551	601	1,179,051	654	1,181,677	681
1,167,485	315	1,169,571	310	1,172,291	459	1,174,730	546	1,176,571	546	1,179,176	643	1,181,697	707
1,167,492	311	1,169,592	303	1,172,303	482	1,174,731	546	1,176,597	558	1,179,180	634	1,181,729	681
1,167,518	265	1,169,597	303	1,172,321	427	1,174,732	545	1,176,603	546	1,179,185	624	1,181,741	695
1,167,594	316	1,169,611	330	1,172,398	460	1,174,795	468	1,176,613	539	1,179,192	623	1,181,857	686
1,167,622	276	1,169,615	298	1,172,414	465	1,174,820	463	1,176,633	551	1,179,243	626	1,181,858	686
1,167,637	294	1,169,634	317	1,172,420	468	1,174,888	462	1,176,644	551	1,179,311	651	1,181,859	687
1,167,642	326	1,169,681	310	1,172,429	459	1,174,903	480	1,176,706	822	1,179,313	640	1,181,860	687
1,167,700	314	1,169,726	309	1,172,479	476	1,174,912	534	1,176,744	606	1,179,327	651	1,181,905	687
1,167,701	314	1,169,753	314	1,172,506	476	1,174,944	469	1,176,747	592	1,179,357	645	1,181,906	687
1,167,705	316	1,169,756	303	1,172,528	433	1,174,946	477	1,176,813	556	1,179,390	640	1,181,944	691
1,167,728	251	1,169,764	348	1,172,551	461	1,174,967	551	1,176,858	606	1 179,394	634	1,181,967	686
1,167,755	309	1,169,765	348	1,172,575	459	1,174,970	527	1,176,878	590	1,179,408	654	1,181,973	681
1,167,763	308	1,169,766	348	1,172,576	459	1,174,971	527	1,176,982	610	1,179,413	853	1,181,976	681
1,167,770	297	1,169,817	316	1,172,597	474	1,174,979	528	1,176,999	553	1,179,414	642	1,182,013	748
1,167,788	309	1,169,821	365	1,172,659	470	1,174,995	532	1,177,037	555	1,179,415	628	1,182,071	699
1,167,800	303	1,169,825	365	1,172,674	469	1,175,001	522	1,177,038	555	1,179,420	635	1,182,096	695
1,167,827	260	1,169,893	366	1,172,682	462	1,175,007	469	1,177,058	590	1,179,421	655	1,182,172	690
1,167,853	294	1,169,919	343	1,172,723	470	1,175,079	463	1,177,109	591	1,179,484	623	1,182,213	704
1,167,883	314	1,169,942	299	1,172,741	468	1,175,091	554	1,177,117	613	1,179,522	640	1,182,220	681
1,167,884	299	1,169,943	547	1,172,796	424	1,175,113	482	1,177,119	608	1,179,569	623	1,182,270	704
1,167,909	298	1,169,944	311	1,172,863	468	1,175,114	482	1,177,156	542	1,179,616	626	1,182,316	706

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1,182,320	695	1,184,649	839	1,186,500	855	1,188 718	887	1,190,960	882	1,193,359	954	1,195,211	1059
1,182,465	681	1,184,656	739	1,186,522	843	1,188,740	905	1,190,982	897	1,193,429	961	1,195,227	1034
1,182,501	699	1,184,665	753	1,186,524	861	1,188,755	903	1,191,033	881	1,193,430	961	1,195,236	1067
1,182,513	695	1,184,693	738	1,186,525	870	1,188,759	891	1,191,034	907	1,193,474	979	1,195,325	1010
1 182,543	683	1,184,694	738	1,186,564	863	1,188,769	890	1,191,053	930	1,193,477	976	1,195,376	1067
1,182,544	683	1,184,727	731	1,186,604	843	1,188,770	890	1,191,072	883	1,193,496	969	1,195,391	1079
1,182,601	684	1,184,772	755	1,186,608	863	1,188,771	890	1,191,075	881	1,193,540	958	1,195,421	1067
1,182,640	683	1,184,806	839	1,186,611	840	1,188,772	890	1,191,104	889	1,193,541	958	1,195,424	1067
1,182,668	690	1,184,817	745	1,186,629	833	1,188,775	898	1,191,105	889	1,193,552	962	1,195,425	1067
1,182,691	704	1,184,818	745	1,186,655	833	1,188,776	898	1,191,106	889	1,193,566	961	1,195,431	1057
1,182,738	683	1,184,819	821	1,186,687	828	1,188,777	898	1,191,108	881	1,193,596	954	1,195,432	1035
1 182,739	691	1,184,839	737	1,186,855	828	1,188,797	887	1,191,291	930	1,193,613	961	1,195,459	1022
1,182,760	692	1,184,841	730	1,186,893	860	1,188,798	887	1,191,300	931	1,193,634	979	1,195,521	1022
1,182,851	710	1,184,842	730	1,186,894	860	1,188,799	887	1,191,324	937	1,193,649	979	1,195,537	1079
1,182,880	690	1,184,854	745	1,186,898	851	1,188,800	887	1,191,328	932	1,193,650	979	1,195,560	1059
1,182,890	744	1,184,869	734	1,186,921	840	1,188,838	890	1,191,338	915	1,193,651	979	1,195,604	1026
1,182,893	729	1,184,925	729	1,186,936	851	1,188,867	895	1,191,356	931	1,193,680	969	1,195,606	1010
1,182,915	738	1,184,926	822	1,186,937	851	1,188,893	905	1,191,383	927	1,193,697	954	1,195,607	1067
1,182,947	821	1,185,005	744	1,186,993	828	1,188,898	900	1,191,386	931	1,193,734	970	1,195,616	1067
1,182,951	743	1,185,009	751	1,187,025	842	1,188,922	898	1,191,390	934	1,193,741	971	1,195,617	1067
1,182,995	746	1,185,028	736	1,187,048	827	1,188,936	884	1,191,439	924	1,193,743	976	1,195,641	1052
1,183.022	747	1.185,029	736	1,187,049	827	1,188,939	907	1,191,440	940	1,193,763	958	1,195,646	1010
1,183,023	747	1,185,074	734	1,187,050	827	1,188,961	883	1,191,451	924	1,193,779	953	1,195,647	1010
1,183,055	979	1,185,075	746	1,187,051	827	1,189,023	904	1,191,480	935	1,193,783	969	1,195,655	1016
1,183,086	743	1,185 135	739	1,187,061	828	1,189,062	891	1,191,495	927	1,193,786	971	1,195,673	1026
1,183,091	730	1,185,136	739	1,187,225	842	1,189,083	883	1,191,526	933	1,193,788	965	1,195,677	1068
1,183,094	754	1,185,187	741	1,187,229	853	1,189,110	899	1,191,527	935	1,193,794	963	1,195,698	1067
1,183,097	858	1,185,213	746	1,187,230	853	1,189,114	905	1,191,544	944	1,193,795	963	1,195,704	1022
1,183,098	822	1,185,216	738	1,187,231	853	1,189,229	890	1,191,545	944	1,193,796	963	1,195,720	1006
1,183,142	753	1,185,227	745	1,187,232	853	1,189,238	908	1,191,552	920	1,193,797	963	1,195,752	1052
1,183,152	733	1,185,252	742	1,187,246	823	1,189,254	889	1,191,580	944	1,193,798	963	1,195,888	1009
1,183,172	744	1,185,254	738	1,187,282	828	1,189,265	884	1,191,585	916	1,193,799	963	1,195,923	1032
1,183,188	745	1,185,262	746	1,187,305	828	1 189,282	934	1,191,615	937	1,193,800	963	1,195,934	1005
1,183,201	747	1,185,265	754	1,187,314	843	1,189,300	883	1,191,630	927	1,193,829	960	1,195,955	1067
1,183,207	736	1,185,280	744	1,187,380	828	1,189,313	896	1,191,647	941	1,193,830	958	1,196,020	1052
1,183,217	742	1,185,290	743	1,187,392	858	1,189,351	899	1,191,673	933	1,193,838	960	1,196,029	1016
1,183,255	739	1,185,342	822	1,187,399	822	1,189,356	898	1,191,752	926	1,193,879	980	1,196,030	1016
1,183,258	741	1,185,361	744	1,187,410	849	1,189,373	896	1,191,799	931	1,193,882	971	1,196,031	1016
1,183,266	731	1,185,394	742	1,187,411	849	1,189,431	909	1,191,801	924	1,193,911	982	1,196,047	1000
1,183,315	737	1,185,395	742	1,187,412	849	1,189,502	900	1,191,804	927	1,193,922	965	1,196,048	1000
1,183,316	737	1,185,396	742	1,187,421	868	1,189,503	900	1,191,869	919	1,193,924	958	1,196,049	1022
1,183,317	731	1,185,397	742	1,187,584	915	1,189,551	1262	1,191,870	919	1,193,951	975	1,196,056	1052
1,183,353	743	1,185,407	745	1,187,585	915	1,189,557	915	1,191,880	921	1,194,000	976	1,196,080	1035
1,183,378	734	1,185,413	735	1,187,614	885	1,189,602	907	1,191,890	930	1,194,013	972	1,196,101	1006
1,183,401	827	1,185,414	746	1,187,623	896	1,189,638	905	1,191,916	944	1,194,014	972	1,196,118	1067
1,183,408	750	1,185,499	754	1,187,630	897	1,189,653	890	1,191,921	916	1,194,015	972	1,196,123	1022
1,183,411	730	1,185,500	754	1,187,633	890	1,189,664	884	1,191,941	944	1,194,033	958	1,196,127	1008
1,183,423	745	1,185,514	747	1,187,702	904	1,189,696	907	1,191,943	918	1,194,077	974	1,196,128	1024
1,183,431	822	1,185,526	729	1,187,703	904	1,189,711	916	1,191,952	916	1,194,095	980	1,196,184	1034
1,183,445	827	1,185,529	739	1,187,717	891	1,189,721	934	1,191,982	915	1,194,101	970	1,196,185	1066
1,183,446	734	1,185,550	730	1,187,772	896	1,189,725	897	1,191,997	944	1,194,118	954	1,196,202	1068
1,183,457	730	1,185,588	732	1,187,775	898	1,189,736	885	1,192,037	930	1,194,151	959	1,196,259	1035
1,183,458	730	1,185,592	732	1,187,797	883	1,189,756	887	1,192,048	927	1,194,155	965	1,196,274	1025
1,183,591	979	1,185,594	729	1,187,864	888	1,189,761	916	1,192,050	931	1,194,157	954	1,196,276	1026
1,183,640	745	1,185,603	753	1,187,865	888	1,189,772	881	1,192,061	931	1,194 201	973	1,196,290	1010
1,183,665	747	1,185 604	747	1,187,869	933	1,189,777	915	1,192,062	927	1,194,219	974	1,196,306	1085
1,183,711	754	1,185,605	748	1,187,871	883	1,189,780	891	1,192,075	941	1,194,289	958	1,196,329	1059
1,183,736	743	1 185,637	868	1,187,890	887	1,189,817	932	1,192,084	916	1,194,344	966	1,196,334	1028
1,183,748	735	1,185,641	853	1,187,903	897	1,189,841	899	1,192,099	928	1,194,354	979	1,196,342	1022
1,183,749	732	1,185,654	854	1,187,927	895	1,189,896	884	1,192,163	933	1,194,389	960	1,196,343	1022
1,183,831	733	1,185,682	823	1,187,932	887	1,189,904	891	1,192,310	935	1,194,438	970	1,196,357	1078
1,183,838	729	1,185,704	852	1,187,933	898	1,189,961	881	1,192,394	930	1,194,464	1016	1,196,376	1052
1,183,885	737	1,185,731	857	1,187,949	890	1,190,006	919	1,192,424	944	1,194,465	1261	1,196,422	1256
1,183,889	729	1,185,747	828	1,187,950	890	1,190,122	896	1,192,460	936	1,194,495	976	1,196,470	1006
1,183,891	744	1,185,757	840	1,187,999	1031	1,190,127	881	1,192,474	927	1,194,556	999	1,196,481	1079
1,184,006	744	1,185,773	843	1,188,014	933	1,190,160	916	1,192,492	916	1,194,558	1111	1,196,505	1069
1,184,015	747	1,185,774	843	1,188,057	884	1,190,161	916	1,192,529	919	1,194,561	980	1,196,595	1026
1,184,071	855	1,185,775	843	1,188,081	891	1,190,162	884	1,192,545	937	1,194,577	1005	1,196,597	1024
1,184,086	746	1,185,817	851	1,188,111	894	1,190,317	937	1,192,559	943	1,194,606	1023	1,196,639	1016
1,184,095	756	1,185,830	869	1,188,128	1265	1,190,369	940	1,192,560	943	1,194,608	1032	1,196,657	1016
1,184,109	738	1,185,902	851	1,188,188	895	1,190,458	941	1,192,569	942	1,194,648	970	1,196,693	1017
1,184,131	738	1,185,943	834	1,188,191	890	1,190,478	919	1,192,581	919	1,194,669	970	1,196,699	1067
1,184,164	717	1,185,959	851	1,188,237	895	1,190,510	881	1,192,584	938	1,194,717	999	1,196,705	1023
1,184,177	754	1,185,961	828	1,188,244	908	1,190,538	919	1,192,640	924	1,194,730	958	1,196,708	1009
1,184,184	739	1,186,000	868	1,188,245	908	1,190,549	896	1,192,653	919	1,194,734	1000	1,196,718	1035
1,184,194	742	1,186,014	870	1,188,246	908	1,190,609	941	1,192,709	1261	1,194,750	1005	1,196,726	1067
1,184,206	734	1,186,052	834	1,188,255	884	1,190,633	919	1,192,729	918	1,194,756	969	1,196,734	1059
1,184,261	730	1,186,065	869	1,188,259	886	1,190,652	930	1,192,756	934	1,194,839	973	1,196,767	1066
1,184,295	752	1,186,076	842	1,188,340	880	1,190,659	907	1,192,861	982	1,194,866	1009	1,196,829	1068
1,184,306	734	1,186,104	849	1,188,356	923	1,190,678	896	1,192,903	960	1,194,899	1009	1,196,889	1074
1,184,307	734	1,186,106	863	1,188,376	887	1,190,679	896	1,192,942	958	1,194,906	970	1,196,910	1075
1,184,308	734	1,186,161	863	1,188,382	941	1,190,702	881	1,192,945	969	1,194,926	966	1,197,019	1082
1,184,316	755	1,186,167	823	1,188,421	886	1,190,712	896	1,192,946	954	1,194,933	976	1,197,097	1061
1,184,320	737	1,186,172	849	1,188,430	895	1,190,765	934	1,192,987	958	1,194,940	970	1,197,123	1079
1,184,323	734	1,186,175	823	1,188,439	934	1,190,806	935	1,193,066	958	1,194,949	1000	1,197,137	1068
1,184,359	730	1,186,217	849	1,188,502	881	1,190,807	935	1,193,067	958	1,195,000	1000	1,197,142	1080
1,184,360	730	1,186,253	828	1,188,505	890	1,190,814	897	1,193,068	958	1,195,040	961	1,197,150	1083
1,184,370	751	1,186,269	823	1,188,530	891	1,190,815	897	1,193,069	958	1,195,044	1075	1,197,167	1058
1,184,397	823	1,186,300	834	1,188,543	886	1,190,827	940	1,193,143	976	1,195,067	976	1,197,171	1071
1,184,398	823	1,186,306	851	1,188,544	886	1,190,829	915	1,193,173	976	1,195,075	1015	1,197,199	1066
1,184,456	744	1,186,335	851	1,188,545	886	1,190,842	881	1,193,178	961	1,195,087	965	1,197,256	1066
1,184,480	746	1,186,367	840	1,188,566	895	1,190,845	944	1,193,197	969	1,195,099	1029	1,197,270	1078
1,184,518	734	1,186,370	821	1,188,567	895	1,190,856	897	1,193,209	976	1,195,152	1031	1,197,275	1068
1,184,520	744	1,186 373	839	1,188,651	890	1,190,889	899	1,193,210	964	1,195,153	1031	1,197,295	1260
1,184,523	744	1,186,440	833	1,188,655	898	1,190,937	930	1,193,333	953	1,195,154	1031	1,197,316	1071
1,184,576	738	1,186,476	822	1,188,665	904	1,190,953	940	1,193,334	953	1,195,158	1005	1,197,327	1060
1,184,585	744	1,186,477	853	1,188,705	895	1,190,957	884	1,193,335	953	1,195,295	1034	1,197,329	1060

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1,197,331	1058	1,198,152	1118	1,199,233	1151	1,200,433	1153	1,201,143	1209	1,202,457	1252	1,203,615	1261
1,197,442	1078	1,198,162	1101	1,199,234	1151	1,200,442	1210	1,201,191	1237	1,202 474	1233	1,203,642	1256
1,197,456	1054	1,198,171	1060	1,199,271	1149	1,200,466	1207	1,201,202	1224	1,202,512	1223	1,203,740	1261
1,197,458	1069	1,198,172	1060	1,199,273	1153	1,200,488	1165	1,201,208	1206	1,202,534	1264	1,203,756	1256
1,197,459	1069	1,198,203	1109	1,199,315	1207	1,200,534	1223	1,201,224	1224	1,202,535	1264	1,203,779	1267
1,197,462	1272	1,198,241	1068	1,199,371	1173	1,200,546	1153	1,201,225	1224	1,202,543	1215	1,203,856	1257
1,197,495	1057	1,198,245	1096	1,199,380	1207	1,200,559	1208	1,201,260	1256	1,202,556	1218	1,203,857	1257
1,197,512	1059	1,198,282	1096	1,199,381	1208	1,200,560	1208	1,201,298	1207	1,202,557	1233	1,203,897	1264
1,197,519	1072	1,198,304	1129	1,199,387	1175	1,200,606	1212	1,201,301	1225	1,202,567	1236	1,203,911	1267
1,197,556	1059	1,198,356	1131	1,199,395	1215	1,200,617	1225	1,201,344	1229	1,202,652	1216	1,203,941	1270
1,197,589	1117	1,198,373	1107	1,199,429	1222	1,200,631	1212	1,201,380	1267	1,202,712	1237	1,203,944	1253
1,197,590	1117	1,198,377	1105	1,199,433	1152	1,200,645	1157	1,201,385	1231	1,202,758	1227	1,203,966	1267
1,197,599	1123	1,198,393	1129	1,199,434	1153	1 200 677	1153	1,201,386	1223	1,202,759	1227	1,203,983	1270
1,197,601	1123	1,198,434	1118	1,199,457	1233	1 200,678	1153	1,201,388	1216	1,202,760	1227	1,203,991	1264
1,197,615	1117	1,198,440	1123	1,199,458	1151	1,200,682	1224	1,201,396	1217	1,202,760	1256	1,204,056	1257
1,197,616	1117	1,198,441	1123	1,199,463	1210	1,200,692	1226	1,201,402	1215	1,202,803	1257	1,204,069	1265
1,197,622	1096	1,198,442	1123	1,199,464	1210	1,200,696	1156	1,201,481	1267	1,202,821	1216	1,204,070	1265
1,197,625	1101	1,198,519	1097	1,199,472	1224	1,200,713	1225	1,201,531	1212	1,202,823	1254	1,204,085	1262
1,197,626	1110	1,198,542	1102	1,199,514	1233	1,200,719	1210	1,201,541	1218	1,202,837	1266	1 204,086	1262
1,197,629	1102	1,198,597	1097	1,199,642	1177	1,200,726	1151	1,201,544	1214	1,202,886	1264	1,204,121	1253
1,197,632	1057	1,198,616	1120	1,199,697	1150	1,200,731	1226	1,201,586	1218	1,202,931	1272	1,204,141	1260
1,197,633	1058	1,198,618	1118	1,199,700	1145	1,200,763	1173	1,201,601	1213	1,202,969	1267	1,204,142	1260
1,197,640	1080	1,198,625	1116	1,199,701	1145	1,200,770	1148	1,201,607	1224	1,202 995	1218	1,204,143	1260
1,197,693	1068	1,198,626	1116	1,199,745	1153	1,200,774	1152	1,201,611	1212	1 203,008	1256	1,204,211	1261
1,197,694	1117	1,198,703	1119	1,199,798	1215	1,200,787	1229	1,201,625	1225	1,203,011	1262	1,204,234	1267
1,197,695	1117	1,198,769	1262	1,199,799	1215	1,200,805	1156	1,201,633	1222	1,203,032	1272	1,204,238	1268
1,197,705	1054	1,198,816	1111	1,199,800	1215	1,200,806	1229	1,201,671	1266	1,203,038	1262	1,204,300	1270
1,197,707	1128	1,198,817	1111	1,199,861	1225	1,200,832	1223	1,201,831	1236	1,203,069	1227	1,204,315	1269
1,197,804	1101	1,198,827	1119	1,199,890	1151	1,200,848	1151	1,201,850	1236	1,203,180	1264	1,204,349	1267
1,197,855	1106	1,198,867	1106	1,199,903	1211	1,200,857	1210	1,201,873	1231	1,203,233	1267	1,204,374	1267
1,197,856	1106	1,198,880	1118	1,199,909	1211	1,200,871	1210	1,201 899	1223	1,203,241	1227	1,204,479	1272
1,197,859	1116	1,198,882	1118	1,199,945	1206	1,200,886	1152	1,201,955	1218	1,203,246	1254	1,204,492	1255
1,197,932	1100	1,198,943	1131	1,199,974	1208	1,200,889	1157	1,201,961	1216	1,203,276	1224	1,204,521	1253
1,197,944	1052	1,198,944	1131	1,199,982	1153	1,200,940	1177	1,201,968	1214	1,203,302	1256	1,204,537	1261
1,197,946	1100	1,198,965	1109	1,199,996	1147	1,200,974	1147	1,201,994	1226	1,203,303	1256	1,204,554	1253
1,197,971	1131	1,198,975	1124	1,200,011	1233	1,200,982	1181	1,202,006	1264	1,203,312	1254	1,204,608	1271
1,197,983	1106	1,198,987	1109	1,200,025	1223	1,200,996	1145	1,202,040	1212	1,203,341	1223	1,204,638	1254
1,107,997	1061	1,198,990	1102	1,200,028	1210	1,201,021	1208	1,202,061	1216	1,203,357	1260	1,204,639	1256
1,198,010	1101	1,199,015	1110	1,200,055	1153	1,201,023	1157	1,202,065	1237	1,203,372	1223	1,204,646	1253
1,198,011	1117	1,199,016	1110	1,200,116	1208	1,201,027	1229	1,202,081	1218	1,203,373	1223	1,204,647	1253
1,198,024	1120	1,199,020	1118	1,200,117	1208	1,201,042	1225	1,202,109	1208	1,203,374	1223	1,204,716	1253
1,198,028	1106	1,199,032	1097	1,200,132	1207	1,201,043	1156	1,202,130	1233	1,203,375	1223	1,204,789	1255
1,198,033	1060	1,199,041	1220	1,200,138	1220	1,201,044	1156	1,202,149	1223	1,203,409	1262	1,204,843	1265
1,198,037	1101	1,199,042	1220	1,200,146	1165	1,201,058	1222	1,202,215	1217	1,203,419	1254	1,204,845	1253
1,198,039	1096	1,199,044	1220	1,200,165	1233	1,201,062	1230	1,202,260	1214	1,203,499	1272	1,204,933	1261
1,198,040	1061	1,199,091	1207	1,200,226	1165	1,201,093	1226	1,202,278	1223	1,203,500	1272	1,205,007	1254
1,198,069	1102	1,199,098	1177	1,200,281	1208	1,201,101	1152	1,202,282	1235	1,203,511	1257	1,205,056	1261
1,198,086	1118	1,199,099	1177	1,200,296	1165	1,201,104	1229	1,202,317	1215	1,203,555	1264	1,205,080	1255
1,198,095	1118	1,199,120	1220	1,200,324	1233	1,201,131	1208	1,202,327	1221	1,203,567	1252	1,205,081	1267
1,198,100	1124	1,199,124	1233	1,200,325	1233	1,201,132	1176	1,202,385	1236	1,203,594	1270	1,205,138	1272
1,198,116	1120	1,199,200	1223	1,200,334	1156	1,201,133	1176	1,202,397	1208	1,203,613	1265		
1,198,129	1132	1,199,220	1212	1,200,352	1224	1,201,134	1222	1,202,421	1207	1,203,614	1253		

FRENCH PATENTS.

(*Note.*—“ A ” *indicates that an addition to the Patent is referred to.*)

410,073A	63	475,195	46	475,639	67	476,304	54	476,856	379	477,261	349	477,620	357
432,047A	40	475,197	34	475,642	46	476,330	57	476,858	349	477,267	617	477,622	596
432,264A	40	475,235A	1016	475,649	53	476,346	54	476,860	357	477,268	591	477,623	608
435,936A	54	475,245	39	475,654	72	476,362	36	476,876	349	477,270	607	477,625	365
442,881A	73	475,250	64	475,665	36	476,383	41	476,878	365	477,284	614	477,646	365
453,111A	49	475,253	49	475,702	53	476,390	48	476,880	609	477,293	643	477,653	606
455,936A	63	475,255	31	475,716	33	476,454	48	476,901	634	477,294	597	477,655	597
459,141A	64	475,297	31	475,727	49	476,465	47	476,912	349	477,306	598	477,667	593
462,252A	1105	475,299	74	475,749	46	476,470	56	476,913	591	477,324	603	477,668	593
464,642A	47	475,302	54	475,758	64	476,471	56	476,930	386	477,343	618	477,678	618
464,947A	63	475,303	34	475,758A	64	476,509	131	476,931	386	477,349	607	477,681	618
465,471A	597	475,328	49	475,783	54	476,512	67	476,953	349	477,353	601	477,682	603
465,807A	1156	475,338	42	475,791	64	476,512A	1176	476,956	379	477,371	378	477,691	601
468,312A	596	475,343	39	475,792	64	476,576	56	476,960	357	477,377	361	477,698	596
468,645A	361	475,346	31	475,793	39	476,630	45	476,961	356	477,404	593	477,719	372
469,054A	34	475,351	73	475,794	42	476,633	46	476,976	366	477,407	350	477,725	356
469,554A	633	475,367	32	475,853	72	476.635	610	476,991	597	477,409	349	477,726	601
469,979A	591	475,382	55	475,908	46	476,643	357	476,994	601	477,411	594	477,732	607
470,242A	1172	475,387	31	475,938A	1102	476,655	365	476,998	366	477,427	593	477,735	597
470,919A	33, 1100	475,407	33	475,969	61	476,676	345	477,001	368	477,429	634	477,743	601
472,587A	56	475,427	67	475,974	53	476,690	386	477,015	357	477,450	379	477,746	633
473,183A	39	475,431A	596	475,998	48	476,693	631	477,044	361	477,459	349	477,748	593
473,399A	1106	475,433	36	476,059	131	476,696	613	477,046	367	477,476	608	477,753	607
474,318A	602	475,445	67	476,061	42	476,706	345	477,073	365	477,478	609	477,761	592
474,321A	606	475,455	46	476,061	56	476,719	614	477,077	613	477,480	607	477,767	610
474,322A	633	475,476	48	476,120	42	476,751	361	477,083	592	477,492	597	477,771	349
474,327A	591	475,485	47	476,127	33	476,756	594	477,145	593	477,493	597	477,776	618
474,365A	633	475,487	64	476,128	33	476,782	593	477,173	617	477,511	357	477,777	618
474,426A	1124	475,487A	64	476,150	31	476,796	593	477,173A	1131	477,523	378	477,795	598
474,669A	611	475,528	33	476,154	47	476,805	349	477,174	602	477,527	605	477,802	349
475,152	60	475,543	60	476,213	73	476,806	349	477,204	644	477,546	607	477,829	1102
475,154	33	475,550	67	476,260	47	476,816	634	477,212	628	477,560	617	477,857	1106
475,160	40	475,565	130	476,268	67	476,852	357	477,238	644	477,579	378	477,880	1119
475,184	35	475,601	131	476,294	46	476,855	345	477,260	349	477,586	610	477,891	1006

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477,906	1119	478,185	1126	478,436	1009	478,831	1102	479,056	1169	479,298	1005	479,569	1023
477,918	1109	478,193	1131	478,461	1152	478,832	1229	479,067	1031	479,304	1010	479,599	1118
477,927	1170	478,194	1131	478,478	1119	478,836	1006	479,086	1107	479,312	1010	479,606	1068
477,928	1218	478,212	1016	478,491	1120	478,839	1099	479,097	1130	479,316	1010	479,614	1164
477,949	1031	478,213	1016	478,508	1016	478,872	1102	479,110	1103	479,319	1164	479,635	1005
477,953	1172	478,232	1022	478,548	1106	478,873	1102	479,143	1025	479,320	1016	479,640	1006
477,958	1102	478,234	1153	478,585	1017	478,874	1102	479,152	1129	479,321	1017	479,645	1131
477,961	1023	478,247	1119	478,608	1031	478,884	1164	479,154	1032	479,332	1017	479,646	1035
477,962	1016	478,260	1147	478,614	1006	478,885	1172	479,160	1035	479,333	1009	479,656	1179
477,964	1016	478,280	1028	478,635	1130	478,885A	1172	479,162	1100	479,370	1022	479,657	1032
477,983	1035	478,288	1009	478,641	1009	478,886	1016	479,164	1218	479,372	1006	479,665	1035
477,988	1218	478,289	1026	478,652	1006	478,907	1106	479,164A	1218	479,373	1006	479 668	1145
477,995	1009	478,290	1125	478,663	1000	478,909	1000	479,168	1022	479,379	1016	479,670	1000
477,998	1006	478,292	1031	478,669	1129	478,911	1122	479,196	1109	479,387	1164	479,683	1118
478,007	1107	478,299	1035	478,684	1097	478,919	1109	479,210	1102	479,390	1010	479,702	1023
478,011	1035	478,315	1152	478,693	1006	478,928	1035	479,211	1103	479,426	1029	479,719	1119
478,023	1152	478,316	1006	478,694	1120	478,936	1017	479,219	1026	479.435	1179	479,720	1017
478,040	1006	478,351	1181	478,702	1009	478,940	1163	479,236	1029	479,436	1107	479,726	1010
478,063	1106	478,360	1017	478,707	1029	478,941	1163	479,249	1025	479,444	1023	479,749	1145
478,070	1006	478,367	1036	478,717	1025	478,942	1118	479,275	1023	479,455	1032	479,751	1006
478,076	1006	478,369	1028	478,739	1097	478,946	1173	479,277	1102	479,492	1108	479,757	1119
478,102	1035	478,371	1156	478,746	1000	478,951	1179	479,279	1023	479,493	1119	479,770	1016
478,117	1035	478,383	1181	478,770	1119	478,972	1172	479,289	1010	479,497	1022	479,780	1105
478,133	1163	478,384	1181	478,778	1119	478,976	1016	479,292	1017	479,506	1169	479,785	1124
478,138	1029	478,401	1111	478,792	1126	479,000	1031	479,294	1106	479,509	1119	479,786	1103
478,158	1119	478,404	1009	478,797	1129	479,004	1023	479,295	1008	479,518	1000	479,796	1132
478,166	1016	478.405	1909	478,823	1096	479,005	1023	479,296	1008	479,543	1124	479,797	1132
478,167	1156	478,435	1131	478,830	1027	479,039	1119	479,297	1008	479,545	1109	479.806	1124

GERMAN PATENTS.

278,282	106	286,784	276	287,271	171	287,951	344	288,524	348	289,108	353	289,766	425
282,657	927	286,789	128	287,288	372	287,955	174	288,530	411	289,111	355	289,774	538
285,665	104	286,798	130	287,301	180	287,959	384	288 532	418	289,112	355	289,795	423
285,817	164	286,812	72	287,309	169	287,961	352	288,533	364	289,126	523	289,709	542
285,981	47	286,824	164	287,318	243	287,962	352	288,571	365	289,133	353	289,827	424
286,074	173	286,825	164	287,319	258	287,992	246	288,572	365	289,157	385	289,844	538
286,106	192	286,854	142	287,360	115	287,993	384	288,582	439	289,161	523	289,879	528
286,107	192	286,855	142	287,372	245	287,994	352	288,588	348	289,162	422	289,908	420
286,125	190	286,912	243	287,373	354	288,006	187	288,616	426	289.163	438	289,909	423
286,136	164	286,913	196	287,387	173	288,018	356	288,644	363	289,179	522	289,910	557
286,187	190	286,914	193	287,471	115	288,055	354	288,682	356	289,182	438	289,944	431
286,206	180	286,918	176	287,487	271	288,062	178	288,684	426	289,188	430	289,945	530
286,221	164	286,919	176	287,513	243	288,076	386	288,687	357	289,190	550	289,946	557
286,228	185	286,920	142	287.565	142	288,087	384	288,688	437	289,207	538	289,950	557
286,229	185	286,925	196	287,586	344	288,095	372	288,695	424	289,208	538	289,959	522
286,242	115	286,933	199	287,587	295	288,114	558	288,701	427	289,220	435	289,984	553
286,270	173	286,946	109	287,588	360	288,154	196	288,702	352	289,243	424	289,990	542
286,295	196	286,947	176	287,590	171	288,158	435	288.721	424	289,245	423	289,992	544
286,297	173	286,950	171	287,592	344	288,159	177	288,727	424	289 246	438	290,054	541
286,303	47	286,960	177	287,601	170	288,162	363	288,728	420	289,247	439	290,064	531
286,362	63	286,961	177	287,606	243	288,190	355	288,729	423	289,248	438	290,065	531
286,365	164	286,967	180	287,614	171	288,209	186	288,750	420	289,249	413	290,078	532
286,366	47	286,971	116	287,615	171	288,223	344	288,751	419	289,260	427	290,079	532
286,397	164	286,973	114	287,616	246	288,224	366	288,765	433	289,270	438	290,126	486
286,398	164	286,977	142	287,648	243	288,243	384	288,778	424	289,271	438	290,131	533
286,464	183	286,984	164	287,659	433	288,262	180	288,817	538	289,272	438	290,150	534
286,489	107	286,989	186	287,660	197	288,263	180	288.824	355	289,273	438	290,156	1181
286,491	190	286,991	116	287,664	185	288,207	356	288,825	355	289,274	438	290,186	512
286,514	48	286,992	176	287,665	258	288,271	385	288,838	355	289,279	415	290,188	482
286,535	185	287,003	171	287,704	180	288,282	364	288,841	356	289,280	419	290,204	555
286.545	47	287,004	171	287,706	241	288,283	364	288,865	384	289,290	463	290,205	557
286,557	185	287,006	176	287,709	197	288,294	435	288,878	355	289,314	419	290,210	557
286,573	47	287,013	171	287,730	173	288,300	348	288,879	429	289,342	439	290,309	544
286,607	185	287,015	103	287,743	197	288,301	348	288,896	521	289,365	537	290,398	531
286,620	185	287,016	103	287,744	361	288,303	384	288,899	416	289,418	427	290,425	522
286,640	131	287,017	142	287,752	174	288,318	357	288,901	538	289,426	438	290,426	557
286,647	185	287,020	107	287,754	174	288,320	542	288,922	427	289,454	415	290,445	538
286,650	106	287,042	419	287,755	176	288,321	372	288,952	437	289,493	427	290,499	606
286,651	173	287,043	918	287,756	170	288.322	360	288,963	420	289,494	542	290,508	532
286,657	199	287,071	171	287,775	173	288,328	386	288,965	437	289,495	435	290,509	527
286,664	196	287,078	184	287,783	243	288,337	345	288,966	423	289,504	424	290,521	532
286,667	141	287,080	184	287,794	174	288,338	385	288,968	429	289,505	421	290,522	558
286,668	141	287,092	115	287,796	198	288,347	368	288,969	427	289 519	413	290,523	558
286,690	187	287,122	185	287,797	198	288,362	558	288,990	429	289,524	422	290,528	526
286,691	197	287,126	142	287,798	198	288,375	385	288,996	353	289,525	435	290,529	602
286,712	170	287,149	368	287,799	199	288,390	364	289,001	437	289,538	533	290,530	690
286,727	199	287,157	104	287,800	198	288,393	385	289,026	522	289,569	523	290,531	558
286,731	73	287,159	178	287,801	198	288,411	375	289,027	353	289,589	414	290,534	606
286,739	173	287,189	243	287,802	198	288,413	353	289,028	353	289,597	430	290,540	595
286,740	173	287,215	109	287,803	170	288,417	178	289,030	356	289,618	412	290,558	558
286,741	187	287,216	142	287,804	198	288,448	415	289,039	433	289,644	432	290,563	528
286,742	537	287,234	245	287,805	198	288,459	558	289,061	435	289,645	529	290,577	529
286,743	197	287,236	169	287,831	184	288,464	355	289,063	413	289,655	429	290,581	560
286,744	107	287,240	174	287,855	344	288,474	355	289,066	423	289,670	482	290.598	598
286.752	36	287,241	187	287,862	176	288,488	435	289,069	412	289,687	613	290,599	530
286,760	197	287,242	109	287,867	355	288,496	360	289,070	412	289,701	427	290,600	558
286,761	106	287,243	242	287,884	357	288,497	360	289,082	527	289,710	538	290,601	530
286,762	106	287,250	354	287,897	377	288,498	361	289,093	434	289,720	427	290,604	592
286,764	243	287,252	348	287,907	355	288,522	344	289,103	424	289.727	425	290,606	602
286,775	199	287,270	170	287,932	352	288,523	361	289,106	523	289,742	419	290,610	651

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290,611	651	291,010	624	291,603	691	292,195	920	292,894	932	293,359	1058	293,971	1151
290,616	554	291,021	834	291,614	867	292,209	857	292,959	962	293,365	1164	293,981	1149
290,631	605	291,023	685	291,686	843	292,218	839	292,961	979	293,394	1106	293,982	1119
290,643	641	291,038	683	291,712	832	292,234	894	292,992	959	293,400	1057	293,998	1180
290,657	602	291,043	641	291,751	823	292,257	927	292,998	1056	293,415	1111	294,009	1100
290,690	606	291,053	683	291,759	1213	292,284	867	293,004	1083	293,416	1145	294,014	1157
290,703	594	291,065	624	291,775	829	292,310	867	293,041	1072	293,430	1147	294,015	1102
290,707	526	291,077	654	291,782	823	292,336	827	293,042	1072	293,455	1153	294,016	1149
290,708	526	291,138	834	291,788	823	292,352	1083	293,043	969	293,470	1066	294,021	1157
290,719	617	291,159	833	291,793	839	292,356	830	293,047	935	293,473	1056	294,025	1147
290,720	617	291,161	704	291,834	842	292,357	830	293,059	1082	293,496	1071	294,028	1153
290,736	611	291,163	634	291,836	850	292,393	867	293,064	958	293,551	1056	294,045	1157
290 739	624	291,164	685	291,848	861	292,394	830	293,070	1082	293,557	1056	294,072	1152
290,740	654	291,185	707	291,878	867	292,395	830	293,094	1055	293,558	1056	294,084	1151
290,747	601	291,198	833	291,883	922	292 454	827	293,100	922	293,559	1130	294,098	1176
290,750	523	291,222	654	291,886	850	292,456	868	293,101	922	293,576	1056	294,107	1164
290,783	597	291,240	690	291,902	927	292,457	830	293,104	970	293,582	1181	294,119	1119
290,799	603	291,265	690	291,906	832	292,471	850	293,116	1148	293,613	1083	294,130	1210
290,804	602	291,299	698	291,911	867	292,482	938	293,124	966	293,657	1150	294,136	1163
290,808	617	291,302	833	291,913	843	292,517	868	293,153	916	293,658	1151	294,159	1180
290,814	595	291,316	648	291,930	823	292,530	927	293,158	920	293,659	1150	294,184	1257
290,818	610	291,349	751	291,935	867	292,541	827	293,163	980	293,660	1151	294,267	1156
290,839	542	291,351	654	291,945	843	292,542	1123	293,171	970	293,668	1085	294 275	1218
290,856	644	291,380	681	291,955	834	292,545	868	293,184	922	293,692	1083	294,281	1208
290,876	634	291,401	694	291,984	830	292,546	979	293,185	1056	293,693	1072	294,287	1161
290,878	634	291,405	654	292,004	850	292,554	1181	293,186	1056	293,694	1149	294,310	1229
290,883	698	291,410	742	292,031	849	292,561	928	293,187	922	293,715	1111	294,312	1208
290,902	603	291,417	690	292,089	867	292,590	921	293,221	966	293,724	1156	294,447	1214
290,908	684	291,421	654	292,090	857	292,622	916	293,232	1057	293,751	1165	294,481	1221
290,909	634	291,423	683	292,104	843	292,645	928	293,258	937	293,798	1116	294,539	1262
290,910	654	291,426	691	292,105	842	292,681	921	293,267	959	293,825	1109	294,547	1213
290,938	655	291,456	834	292,118	1151	292,694	916	293,283	1111	293,858	1150	294,571	1258
290,961	615	291,457	1227	292 127	832	292,723	1083	293,287	1083	293,866	1165	294,572	1257
290,975	598	291,461	854	292,140	927	292,754	914	293,310	1164	293,884	1106	294,609	1622
290,983	595	291,492	695	292,142	827	292,817	1082	293,318	1055	293,890	1157	294,666	1258
290,984	596	291,494	867	292,148	832	292,819	1082	293,319	1055	293,896	1145		
290,985	645	291,519	823	292,173	857	292,846	1082	293,322	1056	293,910	1147		
290,992	619	291,568	827	292,174	857	292,848	1056	293,343	1110	293,956	1180		
291,005	597	291,575	868	292,176	1214	292,864	937	293,344	1066	293,963	1110		
291,009	596	291,578	1181	292,187	843	292,871	944	293,358	1057	293,970	1151		

LIST OF JOURNALS ABSTRACTED, WITH ABBREVIATIONS USED, AND ADDRESSES OF PUBLISHERS AND PRICES.

Journal.	Abbreviation.	Address of Publisher and Price.*
Agricultural Bulletin of the Federated Malay States	Agric. Bull. F.M.S.	Dept. of Agriculture, Kuala Lumpur, F.M.S. 1s. 3d.
Agricultural Journal of India	Agric. J. India	W. Thacker and Co., 2, Creed Lane, London. 3s.
Agricultural Ledger	Agric. Ledger	Reporter on Economic Products to the Government of India, Calcutta.
Agricultural Research Institute, Pusa, Report and Bulletins.	Rep. (Bull.) Agric. Res. Inst., Pusa.	Supt. Govt. Printing, Calcutta. Price varies.
Allgemeine Zeitschrift für Bierbrauerei und Malzfabrikation	Allgem. Z. Bierbrau. u. Malzfabr.	Michaelerstrasse 25, Vienna XVIII/$_1$. Krone 12 per annum.
American Journal of Pharmacy	Amer. J. Pharm.	145, North Tenth Street, Philadelphia, Pa., U.S.A. 30 cents.
American Journal of Science	Amer. J. Sci.	New Haven, Conn., U.S.A. 50 cents.
Analyst	Analyst	Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 2, 4, 6, 8, Orange Street, London, S.W. 2s.
Annalen der Chemie	Annalen	C. F. Winter'sche Verlagshandlung, Leipzig, Germany. Per annum; M. 28.
Annales de Chimie Analytique	Ann. Chim. Analyt.	M. Crinon, 20, Boulevard Richard-Lenior, Paris, 1 fr.
Annales des Falsifications	Ann. Falsif.	56, Rue Madame, Paris, 6e. 2 fr.
Annali di Chimica Applicata	Annali Chim. Appl.	Via Panisperna N, 89*b*, Rome. Lire 34 per annum.
Annali della R. Stazione Chimico Agraria Sperimentale di Roma	Ann. R. Staz. Chim. Agrar. Sperim. Roma	R. Stazione Chimico-Agraria Sperimentale di Roma, Rome.
Apotheker-Zeitung	Apoth.-Zeit.	Levetzowstrasse 16b, Berlin, N.W. 87. 25 Pf.
Archiv der Pharmazie	Arch. Pharm.	Selbstverlag des Deutschen Apotheker-Vereins, Berlin, Germany. M. 12 per annum.
Atti della Reale Accademia dei Lincei, Roma	Atti R. Accad. dei Lincei, Roma	Tipografia della R. Accademia dei Lincei, Rome. Lire 10 per annum.
Berichte der Deutschen Chemischen Gesellschaft	Ber.	R. Friedländer und Sohn, Karlstrasse 11, Berlin, N.W. 6, Germany. M. 32 per annum.
Berichte der Deutschen Pharmazeutischen Gesellschaft	Ber.deuts.Pharm.Ges.	Verlag von Gebr. Bornträger, Berlin, W. 35, Schöneberger Ufer 12A, Germany. M. 20 per annum.
Berichte des Ohara Instituts für landwirtschaftliche Forschungen	Ber. Ohara Inst. landw. Forsch.	Verlag der Ohara Schiōnōkai, Kuraschiki, Provinz Okayama. 1 yen.
Biedermann's Zentralblatt für Agrikultur Chemie	Biedermann's Zentr.	O. Leiner, Königstrasse 26B, Leipzig, Germany. M. 22 per annum.
Bio-chemical Journal	Bio-chem. J.	Cambridge University Press, Fetter Lane, London, E.C. 7s.
Biochemische Zeitschrift	Biochem. Zeits.	Verlag von J. Springer, Berlin, W. 9, Linkstrasse 23/24. M. 14 per volume.
Board of Trade Journal	Bd. of Trade J.	Messrs. Wyman and Sons, Fetter Lane, London, E.C. 3d.
Brewers' Journal	Brewers' J.	F. W. Lyon, Eastcheap Buildings, Eastcheap, London, E.C, 2s.
British and Colonial Pharmacist	Brit. and Col. Pharm.	194-200, Bishopsgate, London, E.C. 1s.
Bulletin de l'Association Chimique de Sucre et de Distillerie	Bull.Assoc.Chim.Sucr.	156, Boulevard Magenta, Paris, 10*e*, France. 2 fr.
Bulletin of the Bureau of Agricultural Intelligence and of Plant Diseases	Bull. Bureau Agric. Intell.	International Institute of Agriculture, Rome. 2 fr.
Bulletin of the Bureau of Standards (U.S.A.)	Bull. Bureau of Standards (U.S.A.)	Government Printing Office, Washington, D.C. 25 cents.
Bulletin of the Forest Experiment Station, Meguro, Tokyo.	Bull. Forest Exp. Stat. Meguro.	Bureau of Forestry, Dept. of Agriculture and Commerce, Tokyo.
Bulletin of the School of Mines and Metallurgy, University of Missouri.	Bull. School Mines and Met., Univ. Missouri.	Director of Mining Experiment Station, Rolla, Mo., U.S.A.
Bulletin de la Société Chimique de Belgique	Bull. Soc. Chim. Belg.	M. J. Wauters, Palais du Midi (Galerie du Travail, 7), Brussels.
Bulletin de la Société Chimique de France	Bull. Soc. Chim.	Masson et Cie., 120, Boulevard Saint-Germain (6*e*), Paris. 38 fr. per annum.
Bulletin de la Société Française de Photographie	Bull. Soc. Franç. Phot.	51, Rue de Clichy, Paris, 9*e*. 1 fr. 50.
Bulletin de la Société Industrielle du Nord de la France	Bull. Soc. Ind. Nord	Rue de l'Hôpital Militaire 116, Lille, France.
Bulletin de la Société Industrielle de Mulhouse	Bull. Soc. Ind. Mulhouse	Berger-Levrault et Cie., 5, Rue des Beaux-Arts, Paris. 60 fr. per annum.
Bulletin de la Société d'Encouragement pour l'Industrie Nationale	Bull. Soc. d'Encour.	Secrétariat, Rue de Rennes 44, Paris, France. 36 fr. per annum.
Le Caoutchouc et le Gutta-Percha	Caoutchouc et Gutta-Percha	A. D. Cillard fils, 49, Rue des Vinaigriers, Paris, X. 26 fr. per annum.

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* The price for single copies is given where these are sold separately. In other cases, it is only possible to buy the Journals in question in complete volumes,

JOURNAL	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Chamber of Commerce Journal	Ch. of Comm. J.	Oxford Court, Cannon Street, London, E.C. 6d.
Chemical News	Chem. News	E. J. Davey, 16, Newcastle Street, Farringdon Street, London, E.C. 4d.
Chemical Trade Journal	Chem. Trade J.	Davis Bros., Danes Inn House, 265, Strand, London, W.C. 4d.
Chemiker-Zeitung	Chem.-Zeit.	Dr. v. Vietinghoff-Scheel, Cöthen, Anhalt, Germany. M. 28 per annum.
Chemische Industrie	Chem. Ind.	Weidmann'sche Buchhandlung, Zimmerstrasse 94, Berlin, S.W., Germany. M. 20 per annum.
Chemische Revue über die Fett- und Harz-Industrie	Chem. Rev. Fett-Ind.	Dr. L. Allen, Catherinenstrasse 25, Hamburg, Germany. M. 1.75.
Chemisches Zentralblatt	Chem. Zentr.	R. Friedländer und Sohn, Karlstrasse 11, Berlin, N.W. 6, Germany. M. 80 per annum.
Chemist and Druggist	Chem. and Drug.	42, Cannon Street, London, E.C. 6d.
Collegium	Collegium	K. Schorlemmer, Sebastian-Munster-Strasse 28, Worms am Rhein, Germany. 2s.
Collegium (London)	Collegium (London)	M. C. Lamb, 176, Tower Bridge Road, London, S.E. 2s.
Comptes-Rendus hebdomadaires des Séances de l'Académie des Sciences	Comptes rend.	Imprimerie Gauthier-Villars, Quai des Grands Augustins 55, Paris. 44 fr. per annum.
Comptes-Rendus des Travaux de Laboratoire de Carlsberg	Comptes-rend. Trav. Lab. Carlsberg	H. Hagerup, Copenhagen. Price varies.
Deutsche Zuckerindustrie	Deuts. Zuckerind.	Verlag der Gesellschaft, Die Deuts. Zuckerindustrie, Berlin. M. 24 per annum.
Elektrochemische Zeitschrift	Elektrochem. Zeits.	F. Siemenroth, Hafenplatz 9, Berlin, S.W. 11. M. 1.50.
Engineering	Engineering	C. R. Johnson, 35 and 36, Bedford Street, Strand, London, W.C. 8d.
Engineering and Mining Journal	Eng. and Min. J	McGraw Hill Publishing Co., 10th Avenue at 36th Street, New York City. 15 cents.
Färber-Zeitung	Färber-Zeit.	Julius Springer, Linkstrasse 23/24, Berlin, W. Germany. M. 18.40 per annum.
Ferrum	Ferrum	W. Knapp, Mühlweg 19, Halle on Saale, Germany. M. 22 per annum.
Feuerungstechnik	Feuerungstechnik	O. Spamer, Täubchenweg 26, Leipzig-R., Germany. M. 4.80 per annum.
Foreign Office Annual Series (Cons. Reports)	F. O. Ann. Series	Wyman and Sons, Fetter Lane, London, E.C. 1½d. to 6d.
Gas Journal	Gas J.	W. King, 11, Bolt Court, Fleet Street, London, E.C. 6d.
Gazzetta Chimica Italiana	Gazz. Chim. Ital.	La Direzione della "Gazzetta Chimica," Via Panisperna, 89, Rome. Lire 4.
Gerber	Gerber	VI/$_2$ Gumpendorferstrasse 89, Wien, Austria. Kr. 17.50 per annum.
Gummi-Zeitung	Gummi-Zeit.	Geschäftsstelle der "Gummi-Zeitung," Blücherstrasse 31, Berlin, S. 61, Germany. M. 16 per annum.
Imperial Institute Bulletin	Bull. Imp. Inst.	John Murray, Albemarle Street, London, W. 2s. 6d.
India Rubber Journal	India-rubber J.	Maclaren and Sons, 37 and 38, Shoe Lane, London, E.C. 3d.
International Sugar Journal	Int. Sugar J.	2, St. Dunstan's Hill, London, E.C. 1s.
Internationale Zeitschrift für Metallographie	Internat. Z. Metallog.	Gebr. Bornträger. Schöneberger Ufer 12a, Berlin, W. 35. M. 40 per annum.
Journal of Agricultural Research	J. Agric. Res.	U.S. Department of Agriculture, Washington, D.C., U.S.A. Price varies.
Journal of Agricultural Science	J. Agric. Sci.	University Press, Cambridge. 5s.
Journal of the American Chemical Society	J. Amer. Chem. Soc.	C. L. Parsons, Box 505, Washington, D.C., U.S.A. 60 cents.
Journal of the American Leather Chemists' Association	J. Amer. Leather Chem. Assoc.	American Leather Chemists' Assoc., Easton, Pa., U.S.A. 50 cents.
Journal of the Association of Official Agricultural Chemists	J. Assoc. Off. Agric. Chem.	Williams and Wilkins Co., Baltimore. U.S.A., and Cambridge University Press, Fetter Lane, London, E.C. $5 per annum.
Journal of Biological Chemistry	J. Biol. Chem.	2419-21, Greenmount Avenue, Baltimore, Md., U.S.A. $3.25 per vol.
Journal of the Board of Agriculture	J. Board Agric.	Board of Agriculture and Fisheries, Whitehall Place, London, S.W. 4d.
Journal of the Canadian Mining Institute	J. Canad. Min. Inst.	3 and 4, Windsor Hotel, Montreal, Canada.
Journal of the Chemical Society of London, Transactions	Chem. Soc. Trans.	Gurney and Jackson, 33, Paternoster Row, London E.C. Trans. 5s.
Journal of the Chemical, Metallurgical, and Mining Society of South Africa.	J. Chem. Met. Soc., S. Africa.	F. Rowland, Old Municipal Buildings, De Villiers Street, Johannesburg. 3s.

Journal.	Abbreviation.	Address of Publisher and Price.
Journal de Chimie Physique ..	J. Chim. Phys. ..	Gauthier-Villars, 55, Quai des Grands Augustins, Paris. 25 fr. per annum; the price of a single copy varies according to the size.
Journal of the College of Agriculture, Tokyo Imperial University, Japan	J. Coll. Agric., Tokyo	Director of the College of Agriculture, Tokyo Imperial University, Japan. Price varies.
Journal of the College of Engineering, University of Tokyo	J. Coll. Eng., Univ. Tokyo	The University, Tokyo.
Journal of the College of Science, Imperial University of Tokyo	J. Coll. Science, Tokyo	Director of the College of Science, Tokyo Imperial University, Japan. Price varies.
Journal of the Franklin Institute	J. Franklin Inst. ..	The Actuary, The Franklin Institute, Philadelphia, Pa., U.S.A. 50 cents.
Journal für Gasbeleuchtung und Wasserversorgung	J. Gasbeleucht. ..	R. Oldenbourg, Glückstrasse 8, München, Germany. M. 20 per annum.
Journal of Industrial and Engineering Chemistry	J. Ind. Eng. Chem. ..	C. L. Parsons, Box 505, Washington, D.C., U.S.A. 60 cents.
Journal of the Institute of Brewing	J. Inst. Brewing ..	Harrison and Sons, 45, Pall Mall, London, W. 4s.
Journal of the Institution of Mechanical Engineers	J. Inst. Mech. Eng. ..	Storey's Gate, Westminster, S.W.
Journal of the Institution of Petroleum Technologists	J. Inst. Petroleum Tech.	The Institution, 17, Gracechurch Street, London, E.C. 5s.
Journal of Physical Chemistry ..	J. Phys. Chem. ..	W. D. Bancroft, Ithaca, N.Y., U.S.A. $4 per annum.
Journal de Pharmacie et de Chimie	J. Pharm. Chim. ..	O. Doin et fils, Place de l'Odéon, Paris, 8. 17 fr. per annum.
Journal für praktische Chemie ..	J. prakt. Chem. ..	J. A. Barth, Dörrienstr. 16, Leipzig, Germany. M. 26.50 per annum.
Journal of the Royal Society of Arts	J. Soc. Arts	G. Bell and Sons, York House, Portugal Street, London, W.C. 6d.
Journal of the Russian Physical-chemical Society	J. Russ. phys.-chem. Soc.	Laboratoire de Chimie, Université Impériale, Petrograd, Russia. R. 1.50.
Journal of the Society of Dyers and Colourists	J. Soc. Dyers and Col.	Pearl Assurance Buildings, Market Street, Bradford, Yorks. 2s.
Journal of the Washington Academy of Sciences	J. Wash. Acad. Sci. ..	2419, Greenmount Avenue, Baltimore, Md., U.S.A. 25 cents; 50 c. for July, Aug., and Sept. numbers.
Kōgyō-Kwagaku-Zasshi (Journal of Chemical Industry, Japan)	Kōgyō-Kwagaku-Zasshi (J. Chem. Ind. Japan)	Kōgyō-Kwagaku-Kwai, Iidamachi, Kojimachi-ku, Tokyo. 5 yen. (10s. 3d.) per annum.
Kolloid-Zeitschrift	Kolloid-Zeits.	T. Steinkopff, Bismarckplatz 16, I., Dresden-A, 14, Germany. M. 3—4.
L'Industria Chimica	L'Ind. Chimica ..	Associazione Chimica Industriale, Via Roma 28 (Galleria Nazionale Scala A), Turin, Italy. Lira I.
Memoirs of the College of Science and Engineering, Kyoto Imperial University	Mem. Coll. Sci. and Eng. Kyoto Imp. Univ.	The University, Kyoto, Japan. Price varies.
Memoirs of the Department of Agriculture in India	Mem. Dept. Agric. India	W. Thacker and Co., 2, Creed Lane, London. Price varies.
Mémoriale des Poudres et Salpêtres	Mém. Poudres et Salpêtres	Gauthier-Villars, 55, Quai des Grands Augustins, Paris. $2.
Metall und Erz	Metall u. Erz	W. Knapp, Mühlweg 19, Halle on Saale, Germany. M. 28 per annum.
Metallurgical and Chemical Engineering	Met. and Chem. Eng.	McGraw Publishing Co., 239, West 39th Street, New York City, U.S.A. 25 cents.
Mittheilungen aus dem königlichen Materialprüfungsamt zu Gross-Lichterfelde West	Mitt. k. Materialpürf.	Julius Springer, Linkstrasse 23/24, Berlin, W. 9, Germany. M. 16 per annum.
Mittheilungen aus der Centralstelle für wissenschaftlich-technische Untersuchungen	Mitt. Centralst. Wiss.-techn. Unters.	Prof. Dr. W. Will, Neu-Babelsberg, bei Berlin, Germany.
Mittheilungen des k.k. Technischen Versuchsamtes	Mitt. k.k. Techn. Versuchsamtes	Verlag der k.k. Hof- und Staatsdruckerei, Wien, Austria.
Monatshefte für Chemie der kaiserlichen Akademie der Wissenschaften, Wien	Monatsh. Chem. ..	A. Hölder, Rothenthurmstrasse 25, Wien I, Austria. M. 16.50 per annum.
Moniteur Scientifique	Monit. Scient. ..	Dr. G. Quesneville, 12, rue de Buci, Faubourg St. Germain, Paris. 2 fr.
Oesterreichische Zeitschrift für Berg- und Hüttenwesen	Oesterr. Z. Berg- u. Hüttenw.	Kohlmarkt 20, Wien I, Austria. Kr. 28 per annum.
Oil, Paint, and Drug Reporter ..	Oil, Paint, and Drug Rep.	100, William Street, New York City, U.S.A. $5 per annum, U.S.A., $6 Canada, $7 other countries.
Paper Making	Paper Making ..	5, Ludgate Circus Buildings, E.C. 5s. per annum.
Papier-Fabrikant	Papierfabr.	Otto Elsner, Oranienstr. 140-142, Berlin, S. 42. 50 Pf.
Perfumery and Essential Oil Record	Perfumery and Essent. Oil Rec.	6, Serle Street, London, W.C. 1s.
Petroleum	Petroleum	Verlag für Fachliteratur, Motzstrasse 8, Berlin, W. 30. M. 1.50.

Journal.	Abbreviation.	Address of Publisher and Price.
Pharmaceutical Journal	Pharm. J.	150, Holborn, London, E.C. 6d.
Philippine Journal of Science	Philippine J. Sci.	Bureau of Science Manila, Philippine Islands. 50 cents.
Philosophical Magazine and Journal of Science	Phil. Mag.	Taylor and Francis, Red Lion Court, Fleet Street, London, E.C. 2s. 6d.
Photographic Journal	Phot. J.	Harrison and Sons, 45, Pall Mall, London, S.W. 1s.
Proceedings of the American Society of Civil Engineers	Proc. Amer. Soc. Civ. Eng.	220, West 57th Street, New York City, U.S.A. $8 per annum.
Proceedings of the Australasian Institute of Mining Engineers	Proc. Austral. Inst. Min. Eng.	57-59, Swanston Street, Melbourne, Victoria, Australia.
Proceedings of American Society for Testing Materials	Proc. Amer. Soc. Testing Materials	McGraw Hill Book Co., 239 W. 39th Street, New York. $ per annum
Proceedings of American Wood Preservers' Association	Proc. Amer. Wood Preservers' Assoc.	F. J. Angier, Mt. Royal Station, Baltimore, Md., U.S.A. $2.50 per annum.
Proceedings of British Foundrymen's Association	Proc. Brit. Foundrymeds' Assoc.	165, Strand, W.C.
Proceedings of the Engineers' Society of Western Pennsylvania	Proc. Eng. Soc. W. Pa.	2511, Oliver Building, Pittsburgh, Pa., U.S.A. 50 cents.
Proceedings of the Faraday Society	Proc. Faraday Soc.	The Secretary, 82, Victoria Street, London, S.W.
Proceedings of the Institution of Civil Engineers	Proc. Inst. Civ. Eng.	The Secretary, Great George Street, London, S.W.
Proceedings of the Institution of Mining and Metallurgy	Proc. Inst. Min. and Met.	1, Finsbury Circus, London, E.C. 21s. per annum.
Proceedings of the Royal Society	Roy. Soc. Proc.	Harrison and Sons, 45, St. Martin's Lane, London, W.C. Price varies.
Proceedings and Transactions of Nova Scotian Institute of Science	Proc. and Trans. Nova Scotian Inst. Sci.	Halifax, Nova Scotia. 50 cents.
Recueil des Travaux Chimiques de Pays-Bas	Rec. Trav. Chim. Pays-Bas	A. W. Sijthoff, Leiden, Holland. 6 fl. per volume.
Revue Générale des Matières Colorantes	Rev. Gén. Mat. Col.	L. Lefevre, 4, rue de Stockholm, Gare St. Lazare, Paris, France. 3 fr.
Revue de Métallurgie	Rev. Mét.	H. Dunot and E. Pinat, 49, Quai des Grands Augustins, Paris. 4 fr. 50.
School of Mines Quarterly	Sch. Mines Quart.	T. H. Harrington, Columbia University, New York. 50 cents.
Science Reports of Tohoku Imperial University	Sci. Reports, Tohoku Imp. Univ.	The Maruzen Co., Ltd., Sendai, Japan. Price varies.
Scientific American	Scient. Amer.	233, Broadway, New York City, U.S.A. 10 c.
Scientific Proceedings of the Royal Dublin Society	Scient. Proc. Roy. Dublin Soc.	Leinster House, Dublin. Price varies.
Silikat-Zeitschrift	Silikat-Zeits.	Verlag von Müller und Schmidt, Coburg. Germany. M. 12 per annum.
Sitzungsberichte der Königlich, Preussischen Akademie der Wissenschaften	Sitzungsber. Kgl. Preuss. Akad. Wiss.	Verlag der Königlichen Akademie der Wissenschaften, Berlin. M. 12 per annum.
Soil Science	Soil Sci.	Rutgers College, New Brunswick, N.J., U.S.A. 50 cents.
Sprechsaal	Sprechsaal	Verlag von Müller und Schmidt, Coburg, Germany. M. 14 per annum.
Stahl und Eisen	Stahl u. Eisen	A. Bagel, Breitestr. 27, Düsseldorf 74, Germany. M. 30 per annum.
Teknisk Tidskrift	Tekn. Tidsk.	Jakobsg. 19, Stockholm, 16, Sweden.
Tonindustrie-Zeitung	Tonind.-Zeit.	Dreysestrasse 4, Berlin, N.W. 21, Germany. M. 20 per annum.
Transactions of the American Ceramic Society	Trans. Amer. Ceram. Soc.	The Secretary, Columbus, Ohio, U.S.A. $5.50 per annum.
Transactions of the American Electrochemical Society	Trans. Amer. Electrochem. Soc.	Lehigh University, South Bethlehem, Pa., U.S.A $3 per vol.
Transactions of the American Foundrymen's Association	Trans. Amer. Foundrymen's Assoc.	R. Moldenke, Watchung, N.J., U.S.A.
Transactions of the American Institute of Metals	Trans. Amer. Inst. Metals	Buffalo, N.Y., U.S.A. $3 per annum.
Transactions of the American Institute of Chemical Engineers	Tr. Amer. Inst. Chem. Eng.	D. Van Nostrand Co., New York, and F. & N. Spon, Ltd., London.
Transactions of the English Ceramic Society	Trans. Engl. Ceram. Soc.	County Pottery Laboratory, Stoke-on-Trent, Staffordshire. 30s. per annum.
Transactions of the Institute of Metals	Trans. Inst. Metals	Institute of Metals, 36, Victoria Street, Westminster, London, S.W.
Transactions of the Iron and Steel Institute	Trans. Iron and Steel Inst.	28, Victoria Street, London, S.W.
Transactions of the North of England Institute of Mining and Metallurgy	Tr. N. Eng. Inst. Min. and Met.	Newcastle-on-Tyne.

Journal.	Abbreviation.	Address of Publisher and Price.
Tropenpflanzer	Tropenpflanzer	Pariser Platz, 7, Berlin, N.W , Germany. M. 15 per annum.
United States Bureau of Mines, Bulletins and Technical Papers	U.S. Bureau of Mines, Bull. & Tech. Papers	Bureau of Mines, Washington, D.C., U.S.A. Price varies.
United States Commerce Reports, Daily Consular and Trade Reports	U.S. Comm. Rept.	Superintendent of Documents, Washington, D.C., U.S.A. $2.50 per annum
United States Department of Agriculture Bulletins	Bull. U.S. Dept. Agric.	Department of Agriculture, Washington, D.C., U.S.A. Price varies.
Wasser und Gas	Wasser u. Gas	G. Stalling, Oldenburg i. Gr., Germany.
West Indian Bulletin	West Ind. Bull.	Imperial Dept. of Agriculture, Barbados, W.I.
Wochenblatt für Papierfabrikation	Wochenbl. Papierfabr.	Güntter-Staib in Bieberach a. d. Riss, Würtemberg, Germany. 50 Pf.
Wochenschrift für Brauerei	Woch. f. Brau.	P. Parey, Hedemannstrasse 10, Berlin, S.W., Germany. M. 40 per annum.
Zeitschrift der analytischen Chemie	Z. anal. Chem.	C. W. Kreidel's Verlag, Wiesbaden, Germany. M. 2.
Zeitschrift für angewandte Chemie	Z. angew. Chem.	Verlag von Otto Spamer, Nürnberger Strasse 48, Leipzig, Germany. M. 36 per annum.
Zeitschrift der anorganischen Chemie	Z. anorg. Chem.	Verlag von L. Voss, Leipzig, Germany. M. 12 per volume.
Zeitschrift des Vereins der deutschen Zucker-Industrie	Z. Ver. deut. Zuckerind.	Vereins-Direktorium, Kleiststrasse 32, Berlin, W. 62, Germany. M. 45 per annum.
Zeitschrift für das gesammte Brauwesen	Z. ges. Brauw.	R. Oldenbourg, Glückstrasse 8, München, Germany. M. 20 per annum.
Zeitschrift für das gesammte Schiess- und Sprengstoffwesen	Z. ges. Schiess- u. Sprengstoffw.	J. F. Lehmann, Paul Heysestrasse 26, München, Germany. M. 1.
Zeitschrift für Elektrochemie und angewandte physikalische Chemie	Z. Elektrochem.	W. Knapp, Mühlweg 19, Halle a. S., Germany. M.25 per annum.
Zeitschrift für Farben-Industrie	Z. Farben-Ind.	Verlag für Textil-Industrie, Kottbuser Ufer 39/40, Berlin, S.O. 26, Germany. M. 1.
Zeitschrift für öffentliche Chemie	Z. öffentl. Chem.	M. & H. Schaper, Hannover, Germany. 50 Pf.
Zeitschrift für physikalische Chemie	Z. physik. Chem.	W. Engelmann, Mittelstrasse 2, Leipzig, Germany. M. 76 per annum.
Zeitschrift für physiologische Chemie.	Z. physiol. Chem.	Verlag von K. J. Trübner, Strassburg, Germany. M. 12 per volume.
Zeitschrift für Spiritusindustrie	Z. Spiritusind.	P. Parey, Hedemannstrasse 10, Berlin, S.W., Germany. M. 30 per annum.
Zeitschrift für Untersuchung der Nahrungs- und Genussmittel	Z. Unters. Nahr. Genussm.	Julius Springer, Linkstrasse 23/24, Berlin, W. 9, Germany. M. 48 per annum.
Zeitschrift für Zuckerindustrie in Böhmen	Z. Zuckerind. Böhm.	Die Administration, Vodickova No. 704 (Palais Lucerna), Prag II Bohemia. M. 17.20 per annum.

LIST OF ERRATA, 1916.

No. of Journal.	Page.	Column.	Line from Top.	Line from Bottom.	Errata.
No. 1—Jan. 15	32	2	14	..	*For* 373 *read* 372.
,, ,,	35	2	30	..	*For* " with " *read* " without."
,, ,,	73	1	..	32	*For* " Kantsch " *read* " Kautzsch."
No. 2—Jan. 31	109	2	31	..	*For* " benzylsuphanilic " *read* " benzylsulphanilic."
,, ,,	127	1	..	22	*For* " acid-dye baths " *read* " acid dye-baths."
No. 3—Feb. 15	159	2	First	Table	*In first line, for* " 0·7 " *read* " 0·75."
,, ,,	170	1	..	28	*For* " alkaline-salt " *read* " alkaline-earth salt."
No. 5—Mar. 15	295	2	22	..	*For* " iley " *read* " Riley."
No. 6—Mar. 31	345	1	..	21	*For* " 1916 " read " 1915."
,, ,,	351	2	12	..	*For* " 86 " *read* " 36."
,, ,,	357	2	19	..	*For* " Mey " *read* " Hey."
No. 7—Apr. 15	428	2	31	..	*For* " J. Griswold " *read* " T. Griswold."
No. 8—Apr. 29	478	1	..	4	*For* " 100,906 " *read* " 100,096."
No. 9—May 15	499	2	..	9	*For* " intrinsic " *read* " extrinsic."
,, ,,	546	1	..	13	*For* " Hersman " *read* " Hershman."
No. 13—July 15	739	1	..	22	*For* " K. J. Seaman " *read* " H. J. Seaman."
No. 15—Aug. 15	867	2	15	..	*For* " pbosgene " *read* " phosgene."
Index	37	2	..	42	*For* " dimethylglyoxime " *read* " diphenylglyoxime "

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Journal of the Society of Chemical Industry.

No. 1, Vol. XXXV. JANUARY 15, 1916. No. 1, Vol. XXXV.

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ARMY RECRUITMENT.

Notice on Reserved Occupations.

The Royal Society has brought to the notice of the Society of Chemical Industry the scheduling by the Board of Trade of the following reserved occupations :—

Chemists : Analytical, consulting, and research chemists (not to be accepted for immediate enlistment or called up for service with the Colours without the consent of the Royal Society).

Chemical Laboratories : Head laboratory attendants.

In a supplementary list, the Committee on Reserved Occupations has included :—

In all industries : Works chemists.

Cement manufacture : Departmental managers, foremen, getters, or quarriers, burners or kilnmen, and millers.

A recent official announcement states that a mark is placed on the Army Register against the name of a man actually engaged in a reserved occupation. In the event, however, of any analytical, consulting, or research chemist being accepted for immediate enlistment or called up for service with the Colours, the chemist or his employer should at once point out to the Recruiting Officer that he belongs to a reserved occupation, and that the consent of the Royal Society is necessary. If there is reason to doubt whether the man is entitled to have a mark placed against his name in the Army Register, the Recruiting Officer may take steps to have the matter investigated by the Royal Society. (See also this Journal, 1915, pp. 1275, 1276.)

ENGLISH PATENTS.

Renumbering Specifications on Publication. Illus. Off. J., Jan. 12th, 1916.

In order to give the public the advantage of having abridgments of Specifications up to date while retaining their numerical sequence, Applications for Patents made subsequent to 1915 will be given new numbers when their Complete Specifications are accepted, or become open to public inspection before acceptance. The new numbers will start with No. 100,001 (without any indication of date), and will supersede the original Application numbers in all proceedings after acceptance of the Complete Specifications.

It is intended in future to issue abridgments of Specifications in the Illustrated Official Journal a few weeks later than that in which their acceptance or publication is advertised, so that they will be available for search purposes soon after the printed copies of the Specifications are on sale ; but, until the system is fully in force, they will only be issued when there are sufficient to make up a full sheet of sixteen pages.

The present series of abridgments will run concurrently with the new series in the Illustrated Official Journal until April, 1917, when it will be entirely superseded.

Applications for Patents.

For convenience of reference, the list of Applications for Patents in the Illustrated Official Journal will be arranged alphabetically under the names of the applicants and communicators, the latter being printed in Italic type. In the case of joint applicants or communicators, each name is given independently. The subject entry is an abridgment of the title only, and should not be regarded as an exhaustive subject-matter entry. The number after the subject entry is that of the Application, and should be used for correspondence purposes up to the date of acceptance of the Complete Specification. A new number will be given when the Complete Specification is accepted or becomes open to public inspection before acceptance ; in all proceedings after acceptance this new number only should be employed. The date following the Application number is that on which the Application was filed ; the date which the Patent will bear, if granted, will appear in a subsequent list of Complete Specifications accepted.

London Section.

Meeting held at Burlington House on Monday, December 6th, 1915.

MR. ARTHUR R. LING IN THE CHAIR.

The CHAIRMAN, in opening the meeting, referred to the loss the Society and the London Section had sustained by the death of Prof. Raphael Meldola and Prof. Vivian B. Lewes. Prof. Meldola, he said, was one of the Society's most illustrious past Presidents, and the loss of him to the country at the present time was a very serious one.

THE GRAPHICS OF BLENDING IN CHEMICAL INDUSTRIES.

BY PROF. F. G. DONNAN, F.R.S.

The object of the following paper is to indicate a general geometrical method for the solution of a certain class of problems occurring in technical chemistry. What is attempted is, in effect, an application of geometry to what may be called the "*Problem of Blending,*" using the latter word in its widest sense. The nature of this problem may be described as follows. In many industries the manufactured product is not a pure substance but essentially a mixture of substances, *e.g.*, soap, glass, pottery, varnish, lubricants, adhesives, etc., etc. Let us suppose that the product in question is manufactured from n constituents X, Y, Z . . . We shall assume that the proportions in which these constituents must be used in order to obtain a product of definite quality are found by experiment to be variable in a certain definite way, or variable within certain definite limits. Let the prices of X, Y, Z . . . per unit of weight be at any moment a, b, c . . . Then the problem to be solved is this : what are the cheapest proportions to employ ? As the market prices of the raw materials X, Y, Z . . . fluctuate, so will the solution of the problem vary. It is desirable therefore to have a rapid method of obtaining the solution, and for this purpose, as for so many other purposes of scientific and technical chemistry, graphical methods are the best. The author cannot pretend to offer to any particular industry a concrete solution adapted to its own special requirements. His object is solely to *hint* at a method which the technical chemists of any particular industry may perhaps be able to adapt and develop ; and generally to emphasise the power and utility of geometrical methods in the solution of the manifold problems of technical chemistry. In so far, however, as concrete illustrations are required, reference will be made to the industry of soap manufacture.

We must in the first place define in precise terms what is meant by the *quality* of the product. Clearly the quality is a function of the physical and chemical properties of the product. We shall further assume that the value, or selling-price, of the product is a definite function of its quality. Extraneous circumstances, *e.g.*, commercial and political changes, etc., may of coursalter this relationship, but it will be clear from what follows that due allowance can be made for such "catastrophic" changes. We shall therefore only deal with quality as determined by physical and chemical properties, and assume that quality determines value. Products of equal quality we shall call *isopoeic*, and curves corresponding to products of equal quality we shall call *isopoeic curves*, or, briefly, *isopoeics*. In the theory of blending these isopoeics play a fundamental rôle. Quality may be *simple* or *complex*. In the first case the quality is uniquely determined by a single physical or chemical property, or, more generally, by a single measurement. In the second case the quality depends on a number of physical and chemical properties, and requires for its experimental determination a number of measurements. In either case it is necessary to assign to every product a single number expressing its *total quality*. It is this total quality which determines the value or selling-price. Thus in determining the total quality of a product possessing complex quality, it is necessary to assign to each measurement of physical or chemical property a suitable numerical coefficient or "weight." The judicious assigning of these coefficients, so that the number expressing the total quality shall determine the value, is a very important matter. If correctly assigned, then the isopoeics, or curves of equal total quality, will also be curves of equal value. As an illustration of a product possessing complex quality we may take the case of soap. Its quality depends on such properties as detergent power,* "solubility" in cold water, "solubility" in hot water, alkalinity, hardness, colour, etc., etc. It is the business of the technical laboratory to measure these various properties, and from these measurements to assign to any sample a numerical value, expressing the total quality, and determining the value.

We come now to consider the solution of the main problem. To illustrate it we shall consider a product made from five constituents, two of which we shall suppose constant in price. As a concrete example, consider a hard soap, made from, say, pressed coconut oil, cottonseed oil, rosin, caustic soda, and water. Let us suppose for the purpose of illustration that the caustic soda and water remain constant in price, either because they are obtained or manufactured in the works considered, or because they are bought on long contract. The problem then reduces to this. What are, for any given current prices of pressed coconut oil, cottonseed oil, and rosin, the cheapest proportions to employ in order to obtain a soap of constant definite quality? Let us denote these three variable constituents by X, Y, Z (say X = coconut oil, Y = cottonseed oil, Z = rosin). It may be remarked in passing that the case of two variables requires no detailed consideration, since, owing to its simplicity, it offers no problem requiring geometrical treatment. The case where the number of variables is greater than three will be referred to later.

Let x, y, z denote the percentages of X, Y, Z respectively in the "charge," and let a, b, c denote the prices of X, Y, and Z per unit of weight (say, per ton). Then the price of a 100-ton charge is clearly equal to $ax + by + cz$. This 100-ton charge will yield a weight of product which will be a function of x, y, and z. In general this weight of product will be a linear function of x, y, and z with constant known coefficients (the coefficients being known from the mass-relationships of the various chemical reactions). We may denote it therefore by $lx + my + nz$, where l, m, and n are known constant coefficients. Calling P the price of a 100-ton charge of the (variable) constituents, and W the weight of product obtained therefrom, we have the equations :—

$$P = ax + by + cz$$
$$W = lx + my + nz$$

The cost, C, of the raw materials per ton of product is therefore given by

$$C = \frac{P}{W} = \frac{ax + by + cz}{lx + my + nz}$$

The composition of the product, and therefore its properties, *i.e.*, its quality, Q, is a function of x, y, z ; $Q = \phi(x, y, z)$.

We can now reduce the problem to a simple mathematical statement. Denoting by Q_1 the particular definite quality required, the problem reduces to determining the values of x, y, and z which satisfy the following three conditions :—

(1) $x + y + z = 100$.
(2) $Q_1 = \phi(x, y, z)$
(3) $\frac{ax + by + cz}{lx + my + nz}$ as small as possible.

It will be seen in what follows that this problem admits of a very simple geometrical solution. We shall pause here for a moment to consider the difference between what may be called *simple blending* and *complex blending*.

In simple blending (*i.e.*, simple admixture), $l = m = n = 1$. C therefore reduces to $\frac{ax + by + cz}{100}$ and hence condition (3) reduces to the condition that $ax + by + cz$ shall be as small as possible. Another case which, though not corresponding to simple admixture, reduces to the problem of simple blending is that where $l = m = n =$ say, q. In this case C reduces to $\frac{ax + by + cz}{100q}$. When, however, l, m, and n are sensibly different the problem is the general one of *complex* blending, where the final product is obtained from the charge of raw materials by chemical reactions and not merely by simple mixture.

Let us consider the solution of the problem of simple blending first. To represent graphically the composition of the charge we shall employ the ordinary triangular diagram so familiar to students of chemistry and metallurgy (see Fig. 1).

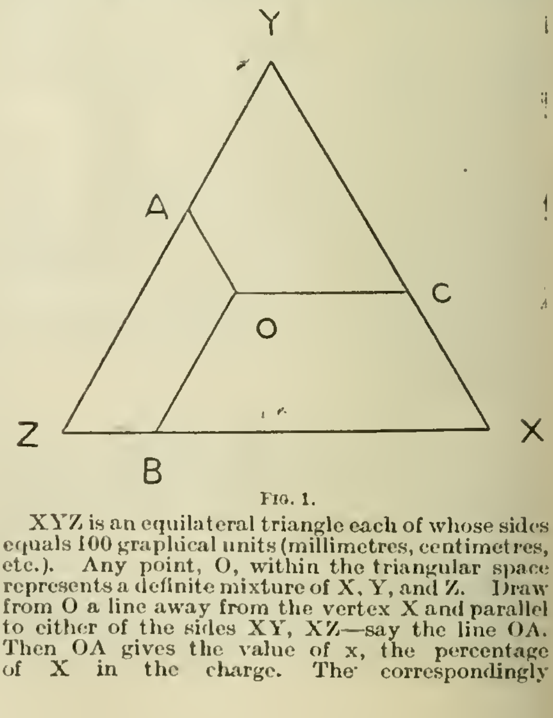

Fig. 1.

XYZ is an equilateral triangle each of whose sides equals 100 graphical units (millimetres, centimetres, etc.). Any point, O, within the triangular space represents a definite mixture of X, Y, and Z. Draw from O a line away from the vertex X and parallel to either of the sides XY, XZ—say the line OA. Then OA gives the value of x, the percentage of X in the charge. The correspondingly drawn lines OB, OC, give the values of y and z, the percentages of Y and Z respectively in the charge. $OA+OB+OC=100$, as follows at once from the construction.

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* Experimentally measurable in the laboratory by determinations of surface tension, and gold number.

Now imagine that from every point O we erect a perpendicular to the plane of the triangle, equal in length to the numerical magnitude of the quality Q of the corresponding product. The tops of all these perpendiculars will give the *quality surface* $Q=\phi\ (x, y, z)$. Imagine a plane drawn parallel to the plane of the triangle XYZ and at a height from it corresponding to some definite quality Q_1. This plane will cut the quality surface in a curve, and the projection of this curve on the plane of the triangle XYZ will give us the Q_1-isopoeic, that is to say, the points on this curve will correspond to all those charges which yield a product of the desired quality Q_1.

In order to draw a given isopoeic we do not require, of course, actually to construct the quality surface.

It will be the business of the technical laboratory to determine by careful measurement the qualities of the products corresponding to a number of different charges. From these data the various isopoeics can be immediately mapped on the triangular diagram. The system of isopoeics so obtained will then constitute a permanent guide-map, just as the contour lines on an ordinary map serve as a permanent guide to the traveller.

As a general rule the factory will manufacture only a limited number of qualities, so that the number of isopoeics required will in general be small.

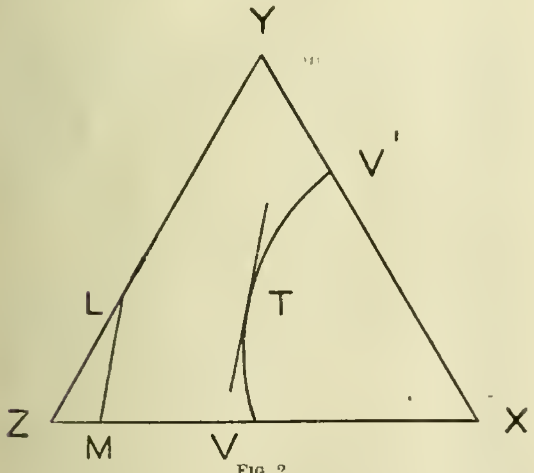

Fig. 2.

Let us suppose now (Fig. 2) that the curve VV′ represents the desired Q_1-isopoeic. What we seek is the point on this curve for which the value of P is as small as possible, where

$$P=ax+by+cz.$$

Now for varying values of the parameter P this equation represents a family of *parallel straight lines*. Since $x+y+z=100$, we can write the equation in the form $(a-c)x+(b-c)y=P-100\,c$, the co-ordinates x and y being measured in the usual way along the axes ZX, ZY respectively (Z being the origin). To fix our ideas, suppose that $a>b>c$, *i.e.*, Z the cheapest, X the dearest raw material. If y' and x' denote the intercepts on the axes ZY, ZX respectively at any one of the family of parallel straight lines, then clearly $\frac{y'}{x'}=\frac{a-c}{b-c}$. Measure off ZL proportional to $a-c$, ZM proportional to $b-c$. Then lines parallel to LM constitute the family of parallel straight lines in question. Draw a tangent to VV′ parallel to LM, touching VV′ at T. The composition corresponding to the point T is the desired solution in the present case. For it is clear (see Fig. 2) that as the parallel straight lines approach the vertex Z the value of P diminishes. In order to render this as clear as possible we have chosen as origin (Z) the vertex corresponding to the cheapest material, and as axis of x (ZX) the side of the triangle joining Z to the vertex (X) corresponding to the dearest material. It may happen, however, that the point where the tangent touches the isopoeic corresponds to a *maximum* value of P (which will be easily seen), or that the isopoeic admits of no tangent parallel to LM. In either case the cheapest mixture consists evidently of only *two* of the three (variable) constituents, and no geometrical solution is required. In this case it will be obvious that we can manufacture a product of the desired quality from the *two cheaper constituents.*

Let us proceed now to the case of complex blending. In this case $P=\frac{ax+by+cz}{lx+my+nz}$, and we seek the point on the given isopoeic for which P has the smallest value. We have

$$P=\frac{(a-c)x+(b-c)y+100\,c}{(l-m)x+(m-n)y+100n}$$

Consider the family of straight lines given by the equation

$$(a-c)x+(b-c)y+100c-P[(l-n)x+(m-n)y+100n]=0$$

where P is a variable parameter.

The above equation represents a family of straight lines passing through the point of intersection of the straight lines whose equations are :—

$$(a-c)x+(b-c)y+100c=0$$
$$(l-n)x+(m-n)y+100n=0$$

These straight lines can be immediately drawn as explained above and their point of intersection R found. From R draw a tangent to the given isopoeic, touching it at the point T (see Fig. 3).

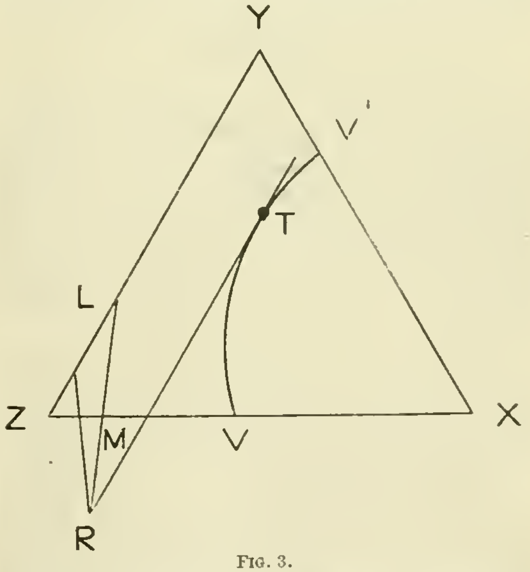

Fig. 3.

Then T is the point on the given isopoeic for which P possesses either a *minimum* or *maximum* value. In the former case the composition corresponding to T is the desired solution. In the latter case the optimum mixture is evidently a mixture of two constituents.*

This is also the case should the curve VV^1 not admit of a tangent from R. In both cases no problem requiring geometrical solution arises, for it will be immediately obvious that the cheapest mixture giving a product of the desired quality can be manufactured from two constituents only.

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* Unless the isopoeic is a closed curve contained inside the triangle and admitting of two tangents.

In order that the results obtained by this method should possess technical value, it is necessary to pay attention to the prices, a, b, c. These prices must include any additional cost required for refining, should this refining be carried out in the works. Thus the cost of palm oil, for example, must include the cost of bleaching should this be done in the works. Furthermore suitable deductions must be made for valuable by-products. Thus in soap manufacture one oil may yield per ton more glycerin than another (and in the case considered above the rosin yields no glycerin). The prices a, b, c used in the graphical solution must necessarily take account of such matters. But the technical laboratory will have determined the yield of glycerin per ton of each fat or oil employed, and the works will know how much glycerin on an average is actually obtained. The current price of glycerin will then at once provide the data required for correcting the prices a, b, c in the proper manner.

The fact that different fats will in general require different quantities of alkali for their saponification does not involve corrections in estimating the proper values for a, b, and c, for the alkali reappears in the product and this is taken account of by the expression $lx+my+nz$. It will be unnecessary to discuss this matter further, as it is neither the author's purpose nor within his competence to teach the soap manufacturer the science of his business. Enough has been said, however, to indicate the general character of the procedure required in assigning the proper values to the "prices" of the raw materials.

The case of complex blending where W is not a linear function of x, y, and z, presents no insuperable difficulty. Suppose in fact that we write quite generally, $W = f(x.\ y.\ z)$. Then

$$P = \frac{ax + by + cz}{f(x.y.z)}.$$

The work of the technical laboratory will determine the function $f(x.y.z)$. Now the equation $ax+by+cz—P.f(x,y.z)=0$ represents a family of curves passing through the point (R) of the intersection of the straight line $ax+by+cz=0$ and the curve $f(x.y.z)=0$. From what has been said this point R can be found by graphical construction, and by giving P a series of values we can plot a series of the curves $ax+by+cz—P.f(x.y,z)=0$. The values of P corresponding to a series of points on the given isopoeic can thus be determined*, whence the point on the isopoeic corresponding to the least value of P can be determined with sufficient accuracy.

The operation may appear laborious, though it is not so in reality. Once the form of the function $f(x,y,z)$ has been determined by experiment, the graphical solution can be obtained within an hour by any person familiar with the rudiments of geometry.

Greater practical difficulties occur, however, should we have to deal with *four* variable constituents. The isopoeic then becomes a *surface*, and the general solution requires the determination of the point of contact of a *tangent plane* with this surface. From a mathematical point of view there is of course no difficulty.† But the sufficient determination of any desired isopoeic surface would require very considerable labour in the laboratory, and would involve the construction of a solid model for the geometrical solution. There would be no insuperable difficulty in this, and indeed the construction of a solid model from given data is quite an easy matter. But the question would arise as to whether the value of the result justified the labour expended. The case of five variable constituents defies practical geometrical solution. Another difficulty of a different sort arises when the product must satisfy a *multiple quantitative specification*, that is to say, when the product must possess certain definite *measured* properties. We cannot then speak of "total quality," *i.e.*, we cannot assign to each product a single number expressing its total quality and determining its value. Suppose, for example, that the product must possess the definite values a and b corresponding to two properties (or measurements) A and B respectively. Plot on the triangular diagram the a-isopoeic and the b-isopoeic. If these be curves, and if they intersect in a point S, then S represents the unique solution of the problem *without regard to price*. If they do not intersect within the triangle, then it is impossible to satisfy the given specification with the given raw materials, and we must look for other ones. If, however, we have to deal with an isopoeic curve and an isopoeic *zone*, or two isopoeic zones, then the overlapping space satisfies the technical conditions, and the method described above will enable us to select the cheapest charge.

The object of the author in writing this paper will have been attained should he have succeeded in drawing the attention of technical chemists to the immense value of graphical methods in attacking the manifold complex questions which arise in scientific chemical manufacture. It must be clearly understood that the object of this paper is merely to *suggest*.

Discussion.

Professor ARMSTRONG said that chemists had been mainly concerned in extracting things from mixtures and not in making blends; therefore, the subject was one which did not appeal as much to them as it might do to the manufacturer. There were, no doubt, many cases in which, if the method could be made clear to the practical man, he would be only too glad to make use of it; but the difficulty, at the present moment, was that few could understand these somewhat abstruse ways of looking at such matters.

Mr. WALTER F. REID said that he knew of no industry in which the methods could be applied. They were unfortunately tied, in the first instance, by the quality of a product, and in the second instance they were bound by the qualities of the materials and not by their prices in most instances. Referring to the explosives industry, as an example, he said they could not substitute a cheaper material for one which was becoming dearer. He wished they could. Taking the glass industry as another instance, they were tied within very narrow limits with regard to the ingredients used, because if each ingredient were altered the quality of the product was altered. Again, in the cement industry, they were tied within narrow limits. It was not a question of being able to use a cheaper or dearer material. They were bound by such a commonplace thing as railway freight, for instance. There were many of those points that suggested themselves as being possible in an industry which theoretically would be one to which they could apply these formulæ in a clear and definite way. Suggestions of the kind Professor Donnan had brought forward made them think. He personally did not think the soap industry was one to which the formula could be applied, because there the product was so intimately bound up with the materials used. They had to use certain materials for a certain product. If one could find a method of utilising all oils in a commercial way perhaps the formulæ could be applied. He had no doubt that the soapmaker would be glad if, in a commercial way, certain oils could be used to get certain products; but as the public desired the goods to be of different qualities different materials had to be used on an industrial scale.

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* Or we can choose a series of points on the isopoeic, calculate the values of P for these, and on a separate plot determine the required point.

† We can employ the octahedral coordinates used by Löwenherz and by van't Hoff (cf. van't Hoff, *Ozeanische Salzablagerungen*).

Mr. YOUNG said that the lubricating oil industry was an industry to which the method could be applied. He was sure that cases must often occur in that large industry in which it would be very valuable; for instance, a company under contract to a large consumer to supply lubricating oil of a physical character within certain limits. One could imagine, for the sake of argument, that it should be a mixture of 50 % of fatty oil and 50 % of mineral oil and that it should have a stated character: then suddenly the war came and the supply of Russian lubricating oil was cut off, but other lubricating oil, such as American oil, could be bought. One could imagine also that within the limits of the specification two or perhaps three fatty oils might be used in the mixture. The dislocation of trade owing to the war, or the variations of prices, caused variations of prices of the three constituents, and in that case a problem such as Professor Donnan had suggested would at once arise. That was one instance where he thought it would be valuable. As Mr. Reid had said, the question of railway rates must come into consideration; that was one of the elements of the problem and essentially a difficulty.

Mr. REID said that his point with regard to railway freights was that at a Portland cement factory, the railway freights cut out all materials except those obtainable on the spot.

Dr. DUNKELSBÜHLER, referring to the paint industry, said that white paint might be made up from a number of materials. Of those, lead carbonate itself was the most expensive, and would give the maximum durability. Barium sulphate would give the most brilliant white, but it would not make a suitable paint with linseed oil. Calcium carbonate, finally, had the great attraction of being the cheapest of all. It was quite possible to make up a paint to suit the requirements of the customer; but he asked Professor Donnan how he would ascribe to the quality a numerical value. What would be the value of the durability, the whiteness, and the covering power, respectively?

Dr. R. SELIGMAN asked what happened if one was in the unfortunate position of being the manufacturer of a material which contained more than three constituents, say, for example, half a dozen. In that case was not the problem considerably more complicated?

Professor DONNAN, in reply, said that mathematics were now necessary in all exact industries and he hoped chemistry was an exact industry. It was not for him to point out the industries to which the method was applicable. He knew one very large industry to which it was applicable. He was unable to answer Dr. Dunkelsbühler's question as to the specification for white paint, since he was not in the paint trade. The lubricating oil industry was certainly a case where one had simple blending. One could probably apply graphical methods of this kind to any simple mixture. The paper applied equally to chemical reactions of all kinds—to complex as to simple reactions. With regard to the very pertinent question as to what would happen if there were more than three constituents, it was, of course, not possible in three-dimension space to apply the method.

THE TRANSPORT OF MATERIAL IN THE FORM OF DUST.

BY T. C. CLOUD.

The removal and transport of very fine material in a works or manufacturing concern are operations which are generally difficult to carry out economically; frequently they can only be performed at considerable personal inconvenience to the workpeople concerned. It will be sufficient to call attention to a few of the operations to which we are so inured as to look upon them as necessitated. Take, as an instance, the most common case—the cleaning and removal of the dust from the flues of a set of Lancashire boilers. After a certain period of use, each boiler in turn is put out and the flues are opened and left thus for a period of perhaps 24 hours. When the flues have become sufficiently cool, the men enter them with brushes and shovels and laboriously remove the accumulated dust, the work being rendered all the more troublesome from the very fine condition of the material and the extremely cramped space in which the work has to be performed, to say nothing of the heat still retained by the brickwork. When the dust has been deposited in a heap in the boiler house ready for removal, it is troublesome to handle, the slightest breeze sends it all over the place, and as it can only be damped with difficulty, the loading up for final removal adds further to the nuisance.

In some manufactures, there is also the production of impalpable powders in large quantity. The following is a mode of dealing with this fine powder. The material may be ground and the particles of requisite fineness removed from the grinding plant by a current of air so regulated in strength that only material of the finest possible size, in fact dust, is removed. This is blown into large chambers, where it is allowed to settle. From these settling chambers it is necessary to remove the accumulated dust at intervals and convey it to another part of the establishment where it is mixed with other material or otherwise treated.

There is also the case of chemical reactions resulting in the production of impalpable, precipitated substances which, when dried, have to be moved to the department where further operations are carried out. In these and all similar cases, the disagreeable nature of the labour involved will be recognised by those engaged in such manufactures.

I have not referred to the actual injury to the health of those engaged in the handling and moving of these substances in such fine state of division, because I shall deal more particularly with this class of material later on; it will be obvious that, in many of the industries, such materials in fine state of division may not only be disagreeable and troublesome to handle, but may be, and frequently are, of a distinctly poisonous character.

We will take, as an instance, a large smelting works treating argentiferous lead or lead copper ores, perhaps containing small amounts of arsenic and zinc. Such ores would be smelted in furnaces; in addition to the direct furnace products, they will give off very fine dust and also a smoke, which contains fume composed of various chemical compounds derived from the elements in the ores treated and their interaction, or as the result of heat and the chemical action of the furnace gases. The consequence of this is the production of flue deposit, which is collected in long flues built either underground or above ground to suit the local conditions. The fine dust thus collected has to be re-treated for the recovery of its metallic contents, and for this purpose must be removed from the flues and added direct to the smelting furnace, or be worked in a pugging machine with suitable cementing material and turned out in the form of briquettes, which are added to the charge of the smelting furnaces. In the case just referred to, the cleaning of the flues is exceedingly troublesome, especially if they are built underground, and involves considerable annoyance and discomfort to the men engaged. If the flues are built overhead and are suitably designed, the cleaning out is much facilitated, but the men engaged in drawing the dust off, transferring it to other departments and dumping it there, do not altogether escape its irritating and sometimes poisonous action on the system. In many cases the furnace gases, after passing through a series of flues and depositing therein the bulk of the suspended matter, is finally forced through bags with the object of removing the last traces of solid matter from the smoke.

In a case where the opportunity was afforded the author of making an entirely new departure in the moving of this class of material, the furnaces were producing a gas highly charged with arsenious oxide. This was, to a large extent, deposited in a complicated system of condensing chambers and flues, followed by filtration through bags in a bag house. The points at which it was necessary to remove the arsenious oxide from the bag house, flues, etc., were numerous, and it was also necessary to deliver all the material to the packing room where it could be packed in casks for marketing. After considering the existing methods for removal and transport of this material, none of which appeared suitable, experiments were made with a powerful vacuum-producing plant, such as has lately been placed on the market and was originally used for the removal of dust from carpets and household furniture. This class of plant has lately been successfully adapted to the cleaning of boiler flues and it appeared to the writer that such plant, with certain modifications, might be made suitable for the purpose in view. After some preliminary trials with a small plant, and also with one of double size, an installation was designed and erected of which the following is a description.

The vacuum pump, at normal speed (160 revs. per m.), has a displacement of 20,000 cb. ft. per hour and will produce a vacuum of 18 in. of mercury if all valves to the various branch mains are closed. In the packing house, the pipe main enters a cyclone separator in which the bulk of the arsenious oxide is deposited. Following this is another smaller separator. Finally the air is drawn through a shallow layer of water and then passes to the vacuum pump. The cyclone separator has a small storage capacity and the arsenical soot is automatically removed from this apparatus and discharged into the casks placed below. The smaller separator is furnished with baffle plates and collecting receptacle from which the deposit is only discharged at long intervals when the vacuum is off. The water separator is arranged so that a small continuous supply of water can be passed through it, or it may be charged and discharged intermittently.

The mains about the works are of ordinary gas pipe which need only be screwed together in the ordinary way. All bends and entering branches are of large radius and, for moving the material upwards, all vertical members are avoided and inclined pipes substituted. At numerous points about the works capped branches are arranged to which, on removal of the cap, suitable flexible hose can be attached ; either flexible metallic hose or reinforced rubber hose answers well. A suitable nozzle is fixed at the end of the hose, and on inserting this into the accumulated deposit, the latter is immediately sucked up and conveyed to the separating plant. This plant, having an air pump capacity of 20,000 cubic feet per hour, deals with one and a half to two tons of collected arsenious oxide per hour, and the farthest point from which a branch is situated is about 200 yards from the separator. The pump, in this instance, is electrically driven and absorbs at the rate of 12 to 14 H.P. The ease with which collecting hoppers, condensing chambers, flues, etc., are cleared out is remarkable. The men work entirely from the outside, the nozzle end of the flexible tube being pushed into the material, which disappears in a surprisingly rapid manner and, of course, without the production of the slightest amount of dust. All the annoyance to the men caused by the handling of this material is removed and respirators are superfluous.

It is easy to see how such a plant may be adapted for the removal and transport of such materials as are referred to in the first part of this paper, and many others will probably occur. The writer is convinced, after seeing what can be done in the case of a plant in operation, that a similar plant can be made to work successfully over greater distances and on larger quantities, and there appears no reason to doubt that the system can be satisfactorily applied to deal with any quantity of suitably fine material.

Discussion.

The Chairman having invited discussion—Prof. Hodgkinson thought that the method described was an extremely important advance in the technical treatment of a substance like arsenic.

Mr. Butterfield said that he supposed the discharge or exhaust from the vacuum pump was carried into a shaft, as, though the gas had passed through a water seal, in many cases it seemed to him that it must necessarily not be discharged into the air.

Mr. Walter F. Reid said that heather pollen had been collected in the North by means of a vacuum cleaner. Pollen was a very useful nitrogenous food, and all the young of bees were reared on it. Some pollens had a very nice flavour, and others had not. He had no doubt that some of them possessed medicinal properties, which might be of great use.

Mr. Young mentioned that the transport of dust by the means referred to in the paper had been used fairly largely for coal dust.

The Chairman said that it had also been used for malt dust.

Mr. Young asked whether the author had had any difficulty with the local authorities as to the gases discharged. Had any test been made to determine the amount of arsenic in these gases ?

Professor Donnan said that he had once had to deal with the question of the transport of dust. An enormous amount of powdery material had to be transported. It was very interesting to hear what Mr. Cloud had said as to the water separator, because that was where the difficulty came in. They had a number of cyclone separators, but they had been troubled with a very large volume of air leaving finally. He presumed that in the author's case the air leaving was not absolutely free from arsenical dust.

Mr. Cloud said that they had only used the water separator, and, as far as he could judge at present, the gas escaping from the pump was practically free from arsenic. He had not made any chemical analysis of the gas which escaped from the pump.

THE SAMPLING AND ANALYSIS OF BEESWAX.

BY M. S. SALAMON, B.SC.

Although the commercial analysis of beeswax is quite straightforward, yet in order that results of value may be obtained considerable care must be taken to ensure that the sample analysed shall truly represent the bulk ; the difference in results obtained by analysts is more often attributable to bad sampling than to anything else.

If the sample under investigation is a piece of refined beeswax, then all that is necessary is to take shavings from each corner and also from the centre of the block on both sides. This is most important, as a mixture of waxes has a tendency to settle out in layers on cooling.

The difficulty of obtaining a true sample is considerably increased when dealing with wharf samples. The average wharf sample usually consists of pieces drawn from only a small percentage of the bulk—usually 10% or 15%—and is made up very often of as many as thirty pieces of irregular size. Now the ideal method, providing the sample really represents the bulk, would be to melt the entire sample, but as a sample will often weigh as much as 30 lb. considerable time would be occupied and larger vessels than are usually found in the average analyst's laboratory would be required. To prepare the sample, therefore, it is best to take the shavings from each piece and melt these. An ordinary potato parer is a useful article for taking the shavings as it makes it possible to get pieces right out of the middle. Such articles as portions of paraffin candles, gravel, etc., have often been found in the centre of a piece of beeswax, the outward appearance of which left nothing to be desired. The preparation of a sample by means of shaving has the additional advantage over melting the whole sample, that it enables one to observe any pieces of the sample which are of suspicious character and which would be lost were the sample entirely melted. It is, in fact, often necessary to analyse these pieces separately in order to determine whether there is any adulterant present.

In a consignment of Chilian wax actually analysed the bulk consisted of 48 bags; 5 of these bags were broken open and were then sampled, about four pieces being taken out of each bag. The final wharf sample weighed about 24 lb. and consisted of twenty pieces of wax. During the preparation of the laboratory sample, three pieces were noticed which appeared to be by no means pure, and after having been sampled they were put aside for separate examination.

While the figures on the whole sample were quite normal, the figures on these three pieces indicated the presence in them of at least 25% of paraffin wax; since this represented only about 4% of the wharf sample it was scarcely detectable in the melted sample. When the whole 48 bags came to be sorted, it was found that 9 bags consisted almost entirely of this adulterated wax, and that pieces of it were present throughout nearly all the other bags.

When dealing with a wharf sample consisting of a lot of pieces of different appearance, it is often best to halve the parcel and prepare a sample from each half, analysing the two samples separately. In many cases the entire consignment is evenly adulterated, but far more often a consignment will consist partly of pure wax and partly of adulterated wax, and unless great care is taken the adulterated pieces may entirely escape notice.

The methods for the determination of the usual figures, such as acid value, ester value, etc., need no description, since they offer little difficulty, but unless the wax is very heavily adulterated, the information given by them is not sufficient to determine the purity of the wax, unless the actual source of the wax is known, and hence they should always be supplemented by qualitative tests, particularly directed to the presence or absence of paraffin wax, and if necessary a determination of hydrocarbons.

Take the case of a sample of beeswax having an acid value of 18 and an ester value of 71; had this been a sample of Chilian beeswax these figures would be quite normal, but the sample was one of Morocco wax, which usually has an ester value about 75; a search for paraffin wax indicated that about 10% was present.

In applying the Weinwurm test as a means of detecting the presence of paraffin wax, it is not sufficient merely to note whether the solution is clear or cloudy. Unless distinct flakes are observed, no conclusion should be come to without further tests. Certain hard waxes, such as Chilian and Egyptian, give a clear solution even when 5% of paraffin wax is present, while other waxes, such as Madagascar and Abyssinian, will give a slightly cloudy solution even when pure. It is therefore always best to prepare a further sample of wax to which 5% of paraffin wax has been added; if the original wax was adulterated

Origin of wax.		No. samples.	Acid value.	Ester value.	Ratio.	M.pt.	Clouding point.
						° C.	° C.
Abyssinian:	Average	42	19·8	74·5	3·8	63·5	60
	Minimum		18	72·2	3·6	62·5	59·5
	Maximum		21	77	4·1	64	60
Benguella:	Average	29	19	73	3·8	63	60
	Minimum		17·5	72·3	3·7	62·5	59
	Maximum		19·5	78·5	4·1	65	60
Chilian:	Average	11	18·5	72·3	3·9	64·5	60
	Minimum		17·3	70·6	3·8	64	60
	Maximum		18·5	74	4	65	61
Cuban		1	18	75	4·2	63·7	60
East African:	Average	57	18·5	75	4	63	60
	Minimum		17·3	70·6	3·7	63	60
	Maximum		20	77	4·1	64·5	61
Egyptian		8	19·3	72—76	3·8—4	63—64	59·5—61
Madagascar:	Average	40	18·5	75	4	64	60·5
	Minimum		17·3	72·8	3·6	63·5	60
	Maximum		20	78	4·5	65	61
Morocco:	Average	185	19	76	4	63·5	60
	Minimum		18	73·3	3·8	63	60
	Maximum		20·5	78	4·2	64·5	60·5
Mozambique:	Average	35	18·5	75	4	63·5	60
	Minimum		18	73	3·9	63·0	—
	Maximum		19	76·2	4·1	64·5	—
Portuguese:	Average	15	18·4	72	3·9	64	60
	Minimum		18	70·6	3·8	63	59·5
	Maximum		18·7	73·4	4	64	61
San Domingo:	Average	9	18·5	72	3·9	63·5	60
	Minimum		18	70·6	3·8	63	—
	Maximum		19	74	3·9	64	—
Sierra Leone:	Average	29	19	74	4	64	60·5
	Minimum		18·5	72·8	3·7	63	—
	Maximum		20	76	4	65	—
Spanish		2	18—18·5	74·5—75·5	4	64	60
Smyrna		2	19	74	3·9	64·5	60

with paraffin wax distinct flakes will then usually be seen in the Weinwurm solution obtained from this prepared sample. If these flakes are not observed it may be concluded that the original sample was free from paraffin wax providing the ester number was normal. In any case a clouding point test should always also be applied for confirmation (see this J., 1915, 34, 461).

It is necessary to emphasise the fact that the Weinwurm test is by no means reliable and is only useful when considered in conjunction with the other figures obtained in the course of the analysis. Experiments have been made with samples of beeswax to which 5% of paraffin wax has been added, and a clearer Weinwurm solution has been obtained from the adulterated sample than from the original sample which was free from paraffin wax.

The preceding table gives the characteristics of the various varieties of beeswax, showing the average, maximum, and minimum figures obtained in the course of the analysis of over five hundred commercial wharf samples of beeswax. The melting point determinations were carried out in capillary tubes closed at one end.

There appear to be two distinct types of Abyssinian beeswax. One is dark red in colour and has an average acid value of 20 and ester value 76, while the other is pale in colour and has an acid value of 18 and an ester value of 73.

Newcastle Section.

Meeting held at Bolbec Hall, on Wednesday, December 15th, 1915.

PROF. P. P. BEDSON IN THE CHAIR.

FUEL VALUES.

BY DR. J. H. PATERSON.

The financial value to the consumer of a fuel must be measured by the amount of heat which can be obtained from that fuel by the expenditure of a definite amount of money. This value is totally distinct from, and is not affected by the quantity of the available heat which is utilised in any given process. In this paper therefore no cognisance is taken of the methods and appliances used to obtain the most efficient utilisation of the heat generated, but only the amounts of heat actually available from the fuel used.

In dealing with fuels of different classes some difficulty has been met with in finding a common unit of value for their comparison, and it has been considered best, for the purposes of this paper, to make this unit the number of heat units (B.Th.U.) obtainable for one penny, after all the costs of handling the fuel and causing it to burn have been added to the price per ton. This number will be referred to hereafter as the Absolute Heat Value of the fuel in question.

As the cost of fuels varies very considerably in different parts of the country, the comparison of their values is impossible unless the prices of all the different classes considered are those ruling in the same locality. For the purpose of this paper, therefore, the prices given are an average of those ruling in the North East Coast industrial centres. As the present cost of fuels is in all cases abnormally high and in some cases (foundry coke and oil fuel) out of all proportion to the usual value, pre-war prices and values are shown in the most important cases as well as the present prices and values.

Coal.—It is very generally recognised that the less money one pays for coal the more incombustible matter (water and ash) it is liable to contain, but it is by no means so generally realised that the absolute heat value increases rapidly as the price decreases. The following table (Table I.), which is compiled from the average analyses of a few selected coals of types in common use, shows this clearly. In this table the calorific values shown are the net values, that is the calorimeter value as determined on the dried coal, less the amount of heat carried away as latent heat during combustion, by the steam produced. The price of the coal as quoted includes the cost of delivery into the works, this cost averaging about 2s. per ton.

TABLE I.

	Class of coal.	Price per ton.	Net cal. value. B.T.U.	Incomb. matter. %	B.T.U. for 1d.	A.H.V.
1	Best screened loco. coal	23/-	14,280	5·6	115,000	98,700
2	Screened steam coal	18/3	13,120	13·35	134,200	110,700
3	Screened steam coal	18/-	13,260	10·65	137,500	113,300
4	Smith's small coal	18/6	13,600	10·32	137,000	115,500
5	Unscreened steam coal	17/6	13,135	12·25	140,000	114,400
6	Washed small coal	15/-	12,780	12·50	153,500	126,100
7	Heap coal	8/-	10,040	20·3	222,000	136,200

In Fig. 1., the heat units per ton for a large number of coals have been plotted against the price per ton. As will be seen the resulting curve shows remarkable regularity. It is evident from it that,

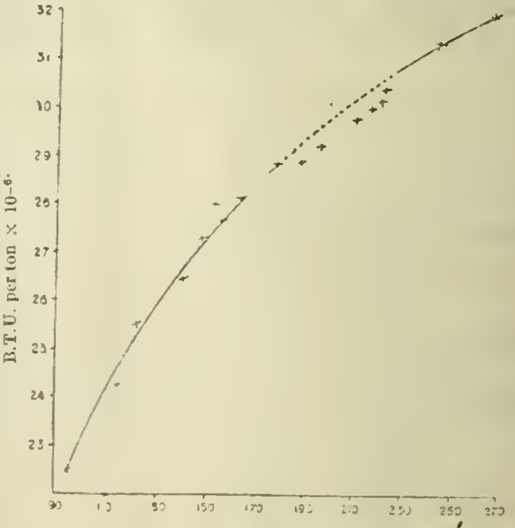

FIG. 1. Pence per ton, 1915.

for prices between 14s. 6d. and 18s. per ton, the heat value paid for falls away from the regular curve represented by the dotted line, or, in other words, if coals were sold on a regular calorific scale, instead of following the laws of supply and demand, we should expect to pay less than the present market value between these limits of price. The coals in this area of price include unscreened steam coals, washed slacks, and small nuts, all of which are among the most commonly used classes in large works.

Fig. 2. shows a similar curve constructed at the end of 1913 and reproduced from an article by the author in "The Shipbuilder" (Vol. x., No. 11). In this case the falling off in value occurs between the prices 8s. 9d. and 11s. 9d.

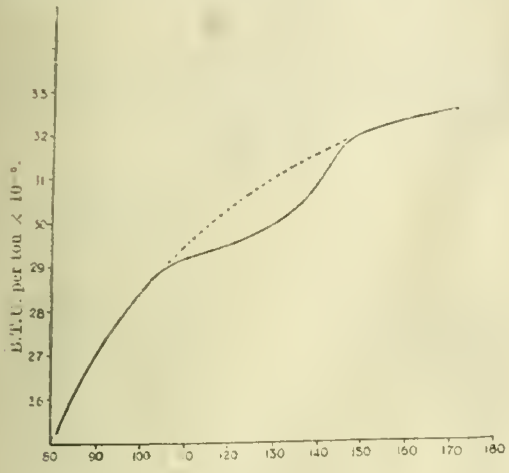

FIG. 2. Pence per ton, 1913.

Tables II. and III. show how the Absolute Heat Values of coals No. 2 and 7 in Table I. are arrived at. The figures given are those obtained when these coals are used to heat a frame-bending furnace and are very similar for a hand-fired boiler.

TABLE II.

Coal No. 2.

One ton coal has net cal. value of 29,344,000 B.T.U.

	Pence.
Coal at 18s. 3d.	219
Firing labour	36
Moving coals and clinker	8
Repairs to grates	2
	265

A.H.V.=110,700.

TABLE III.

Coal No. 7.

One ton coal has net cal. value of 22,489,000 B.T.U.

	Pence.
Coal at 8/–	96
Firing labour	38
Moving coal and clinker	20
Repairs to grates	4·5
Steam for blowing	6·5
	165·0

A H.V.=136,200.

Coke.—Coke of all classes requires a blast of air to keep it burning at a high temperature, so that in determining its absolute heat value the cost of this blast must be included. Foundry coke has recently reached so abnormal a price that its heat value as shown below is misinforming. Its value in 1913 as shown in Table VIII. gives a better idea as to its true relative position. Coke breeze (coke refuse from the gas works) is not always appreciated at its true value. This breeze when screened through a screen of ¼ inch mesh loses 40% by weight of fine dust, and leaves a residue of coke nuts which is an excellent fuel for many purposes. Previous to the war it paid to throw away the 40% of dust, but now that its price has risen it becomes worth while to briquette it and mix the briquettes with the screened breeze, the cost of briquetting being about 5s. per ton of screenings, including labour and tar binder, and also interest on capital. Tables IV., V., and VI. show how the absolute heat values of the foundry coke, screened breeze, and the mixture of screened breeze and briquettes are obtained. In Table V. the screenings from the breeze are assumed to be worthless and thrown away.

TABLE IV.

Foundry coke.

One ton coke has net cal. value of 30,350,000 B.T.U.

	Pence.
Coke at 32/–	384
Firing labour	36
Moving coke and clinker	9
Repairs to grates	2·5
Blowing	3·5
	435·

A.H.V.=70,000.

TABLE V.

Coke breeze (screened).

One ton breeze has net cal. value of 29,120,000 B.T.U.

	Pence.
Breeze at 10/–	120
Cost of screening	13
Moving coal and clinker	9
Firing labour	36
Repairs to grates	3
Blowing	4
	185

A.H.V.=157,400.

TABLE VI.

Coke breeze (briquetted).

One ton breeze has net cal. value of 29,120,000 B.T.U.

	Pence.
One ton breeze at 6/–	72
Briquetting 40%	24
Firing labour	36
Moving coal and clinker	9
Repairs to grates	3
Blowing	3
	147

A.H.V.=200,000.

Producer gas.—The absolute heat value of producer gas will depend mainly on the first cost of the coal and on the efficiency of the type of producer used. The results recorded below are obtained from a battery of water sealed producers of the Duff type, each producer being capable of gasifying 10 tons of coal per 24 hours. The coal used in them is the small coal No. 6 in Table I.

One cubic foot of the cold producer gas has a net calorific value of 170 B.T.U., and 65 cubic feet of cold gas is produced per lb. of coal or 145,600 cubic feet per ton. One ton of coal therefore gives cold gas equivalent to 24,750,000 B.T.U. When, however, the gas is used hot, as from the above producer, the sensible heat of the gas raises this quantity to 27,000,000 B.T.U. As the original heat value of the coal was 28,627,000 B.T.U. this shows a loss in the producer of 5% of the available heat. The absolute heat value is arrived at as shown in Table VII. It may be argued that a somewhat expensive coal has been chosen when calculating this absolute heat value, and that if a cheaper coal were burned in the producer the values shown would be greater. Experience shows, however, that this is not the case, as with the stationary type of producer there is a limit to the ash content of the coal, beyond which good results are impossible. As an example, in the same producers a small dusty coal was tried with the following results:—The cost of the coal was 11s. per ton, and its heat value 26,150,000 B.T.U. net per ton. The loss in the producer was 12%, and the heat value of cold gas per ton of coal 23,000,000 B.T.U. net. The cost of working the producer, supplying steam, and repairs to plant amounted to 112·5d. The absolute heat value of the cold gas was 98,500 and of the hot gas 108,500. The heat value is therefore 2% less than with the dearer coal, and the dissatisfaction among the firemen being taken into account, it will be seen that the cheap coal does not by any means produce cheap gas. Mechanical producers do away with the labour and other troubles enumerated above, but owing to their comparatively short life, increased first cost, and increased upkeep, their advantages are not very obvious, in this district at any rate.

TABLE VII.

Producer gas.

One ton coal produces gas with net cal. value of 24,750,000 B.T.U.

	Pence.
Coal at 15/-	180
Labour	37
Steam	13
Moving coal and clinker	8
Repair and upkeep	2
Int. on capital	6
	246

A.H.V. of cold gas = 100,600.
,, hot gas = 110,660 or 10% more.

Oil fuel.—Within the last 12 months the cost of fuel oil of moderately good grade has increased by nearly 100%. This therefore puts an always expensive fuel almost out of consideration. Good Texas oil of about 1,000 secs. viscosity has a net calorific value of about 17,300 B.T.U. per lb. or 38,750,000 B.T.U. per ton. This oil now costs 105s. per ton. Before it can be burned in a furnace, it must be first atomised either by compressed air or steam, or else blown through a special nozzle at high pressure into a forced draught furnace. The cost of vaporising oil by compressed air is 10s. per ton of oil, and by steam or by high pressure feed 6s. per ton.

The absolute heat value is therefore obtained as follows:—One ton of oil at 105s., 1260 pence; steam, 72; handling oil, 8; interest on capital, 1·5; total, 1341·5 pence. Thus the absolute heat value is 29,000.

Coal gas.—Ordinary town gas averages about 510 B.T.U. net per cubic foot. It may be obtained at about 1s. 7d. per 1000 cubic feet in most large centres. As there is no labour or upkeep of plant to consider, unless compressed air is used, the absolute heat value works out at 27,000.

Powdered coal.—Within recent years a method of burning coal by grinding it to a fine powder and blowing this powder into the combustion chamber by means of a stream of hot air, has received considerable attention. In the cement making industry its application has been highly satisfactory and its use has resulted in great economies. As applied to boiler and metal furnace firing it has, however, met with little success, owing partly to want of experience in its use and partly to the cost of grinding and handling the powdered coal. Its absolute heat value when determined for coal No. 6, Table I., is as follows:—Cost of coal, 180 pence; cost of grinding and blowing in the coal, 46; labour, 30; repairs to plant and renewals, 4·5; interest on capital, 6; total 266·5 pence. Hence the absolute heat value is 107,300.

Table No. VIII. shows the absolute heat values of all the fuels considered tabulated in their present order of magnitude. It should not be imagined that the figures will determine the most economical fuel to use in any given operation, as it is possible to utilise in some cases more of the available heat from one fuel than from another. Thus, by using producer gas for furnace heating it is possible to use efficient regenerators and thus recover a large proportion of the heat usually passed up the chimneys. As the saving in heat thus made possible is sometimes very great, the difference in the heat values of producer gas and small coal may be so far overcome as to make it economical to use the former. Again, while coal gas is shown to be highly uneconomical, it may be used for small operations with the utmost success, as the time and trouble saved in starting up, say, a tool hardening furnace heated by gas, more than counterbalances the increased cost of the fuel.

TABLE VIII.

Fuel.	Absolute heat value.	
	1915.	1913.
Coke breeze and briquettes	200,000	215,700
Coke breeze (screened)	157,400	232,900
Pit heap coal	136,000	140,000
Washed small coal	126,000	175,000
Screened steam coal	110,700	161,000
Producer gas (hot)	110,660	160,000
Coal powder	107,300	—
Foundry coke	70,000	140,600
Oil fuel	29,000	41,000
Town gas	27,000	30,000

New York Section.

Meeting held at Rumford Hall, Chemists' Building, on Friday, November 19th, 1915.

DR. W. M. GROSVENOR IN THE CHAIR.

THE CHEMISTRY OF AMORPHOUS SOLIDS.

BY WARREN K. LEWIS, PH.D.

During recent years a great deal of research has been carried on in the field of colloidal chemistry and the closely allied chemistry of amorphous bodies and plastics. A great mass of data and results has been accumulated, but this mass of facts is still largely unrelated, and the generalisations which would serve as a filing system for these facts have not been developed. It is proposed to submit certain generalisations in this field which it is believed are justified by the results of recent work. These propositions are not presented as ultimate in any sense because, in the first place, our knowledge is still too imperfect to justify such finality, and, in the second place, such finality is always disastrous to the progress of science. It is hoped that these generalisations will prove helpful, and will promote a discussion which will tend to perfect them and to lead to a deeper knowledge of the truth. In this attitude, certain theses are proposed as defendable general propositions.

Importance of amorphous solids.

Some solids possessing desirable mechanical properties, especially high tensile strength, high elastic limit, ductility, and plasticity, owe these properties to their amorphous condition.

Plasticity may be defined as that property of certain solids which enables them to be moulded, *i.e.*, to sustain permanent deformation after stress without rupture, and which causes free surfaces brought together to coalesce under pressure. Not only the properties of solids ordinarily connected with the word, but the capacity of metals to be wrought, spun, and welded below the melting point are due to their possession of plasticity.

It must not be assumed that all amorphous solids have desirable mechanical properties, for this is not the case.

Theses.

1. All, or nearly all, amorphous solids are composed of large molecular aggregates.

2. The molecular aggregates of most amorphous solids can be conceived as built up of a relatively small unit, V (or units, V′, V″, etc.) grouped together or associated by polymerisation, condensation, or otherwise, a large number of times, n, the result being represented as V_n (or V'_n, V''_n, etc.). Illustrations: Cellulose, $(C_6H_{10}O_5)_n$. Rubber, $(C_5H_8)_n$. Gelatin, condensation product of several amino acids.

3. Usually, in an amorphous solid, V_n, the value of n is not fixed, but the solid consists of molecular aggregates of varying size, due to a varying degree of association of the unit, V, *i.e.*, to varying values of n. No assumption is made regarding the mechanism of association of the units; it is probably chemical combination. While, from the nature of the assumption, n is necessarily an integer, it is probably in most cases not true that n can assume any integral value, but the various possible values of n will differ by relatively large whole numbers. This is due to the fact that in all probability the unit, V, first associates into small groups, further association being due to combination of these sub-groups (*e.g.*, starch, cellulose, etc.).

4. The characteristic properties of all amorphous solids are first, plasticity, and second, relative inertness, chemical and physical.

Plasticity is decreased, and chemical and physical inertness is increased (a) by any increase in the size of the molecular aggregate, V_n, and (b) by drop in temperature; and conversely, the swelling of amorphous solids in solvents is due to the distention of an insoluble and semi-permeable residue by the osmotic pressure of a dissolved portion.

The following explanation will make this statement clearer. If a solid composed of aggregates of varying size be treated with a solvent under such conditions that the larger aggregates do not dissolve, but the smaller do, the undissolved part serves as a semi-permeable membrane, through which the solvent can freely diffuse, but which is impermeable for the dissolved material, enclosing the solution of the soluble fraction. The osmotic pressure of this latter distends the mass, producing the swelling of amorphous solids in solvents. Ultimately this osmotic pressure may rupture the retaining wall, thereby disintegrating the aggregates, decreasing the average value of n in V_n, and thus render the whole "soluble." In general even the "soluble" fraction has a high molecular weight, and hence only a low osmotic pressure. Illustrations: gelatin in water; rubber in carbon bisulphide, etc.

It is not intended to deny the possibility of combination of a solvent with even the largest of the molecular aggregates involved, nor to assert that the solutions formed are not colloidal in character. It is probable that the molecular aggregates, both large and small, of all jellying or gel-forming amorphous solids combine with the solvent, probably by an association chemical in its nature.

In consequence of the influence of the size of aggregates upon plasticity and inertness, it is evident that solvents tend to increase plasticity, and to decrease chemical and physical resistivity.

6. Excessive mechanical manipulation of amorphous solids ruptures the molecular aggregates themselves, and consequently results in decrease in the size of the aggregates, producing increase in plasticity and decrease in inertness. Illustrations: manipulation of rubber; working of metals.

7. The utility of amorphous solids is due largely to their property of plasticity, *i.e.*, by virtue of their plasticity they can be formed at will. After moulding it is usually necessary to decrease plasticity to secure permanence of shape, hardness, and resistivity. This decrease in plasticity is always secured either by lowering temperature, or by increase in the size of the molecular aggregate.

Methods of manipulation of plastics.

The methods of manipulation of plastics can be grouped under seven heads; and such a grouping will be found helpful in keeping in mind the possibilities of manipulation in any given case, in comparing the treatment of different substances, and in emphasising the analogies between different types of plastics.

1. The required distortion is produced by mechanical stress; rigidity of the mass is such that further treatment is unnecessary. Illustrations: rolling, spinning, and working of the metals; cold-pressing of organic plastics, etc.

The behaviour of the metals cannot be explained on the basis of their plastic properties alone, for the simple reason that the metals do not consist solely of plastic or amorphous material. Rosenhain has shown that the amorphous material in the metals is merely a small amount of bonding substance between crystal grains, and the characteristics of the metal will therefore be dependent both upon the properties of the grains and of the amorphous bond between them. For example, in the cold working of the metals, *i.e.*, in distorting them beyond their elastic limit but not to the point of rupture, there is unquestionably destruction of the crystal structure, resulting first in decrease of the size of the crystals, second in partial conversion of the crystalline condition into the amorphous state, thus increasing the amount of bond between the crystal grains, and finally, in some cases at least, in the formation of new crystalline structure. There is also undoubtedly a certain amount of mechanical disintegration of the amorphous material already existing, which will result in increased plasticity of that material. On the other hand the total amount of amorphous material is still a small fraction of the whole mass. While the increase in plasticity will tend to result in increased ductility and softness, the decrease in strength of the amorphous bond will tend to cause readier rupture of the mass as a whole, and in some cases the one and in some the other of these factors may predominate. For example, in the rolling of zinc the increase in bonding material is apparently a more important factor than the decrease in strength of that material, and as a result rolled zinc is softer and more ductile than unrolled. On the other hand, in the case of copper the rigidity of the new crystal aggregate produced is the more important factor, so that, despite an increase in plasticity of the bond, the mass as a whole is harder rather than softer. In any application of the general properties of amorphous material to a study of the behaviour of metals under stress, the fact that the metal consists of a mass of crystal grains cemented together by only a small amount of amorphous bond must be kept constantly in mind, and the possibility of conflicting effects makes the problem a much more difficult one than that of a material amorphous throughout.

2. Plasticity is secured by rise in temperature; rigidity is restored by cooling. Illustrations: glass, bitumens, celluloid, and hot-pressing of organic plastics; hot working of metals.

The cause of the increase of plasticity of all amorphous bodies with rise in temperature is the decrease in their viscosity. The assumption that such bodies are super-cooled liquids, existing at temperatures so low that the viscosity is very great, seems the best interpretation of the facts. That the increase in plasticity may be due to dissociation of the molecular aggregates into smaller groups at higher temperatures seems very unlikely in those cases where the phenomena are practically reversible, unless decrease in viscosity itself be due to this effect; in cases such as the heating of rubber, where irreversible changes occur, disintegration of the aggregates undoubtedly takes place.

Only those plastics having very high softening points will be thoroughly rigid and stable at ordinary temperatures, because only at temperatures far below the softening point will the viscosity become sufficiently great. The really stable and therefore valuable organic plastics can, in consequence, not be manipulated by raising the temperature, since the required rise would be so great that decomposition would follow. The stable and important glasses are necessarily inorganic in structure.

3. The action of a solvent secures plasticity; its removal destroys plasticity. Illustrations: celluloid, artificial silk, sun-dried brick, etc.

4. After manipulation of a plastic, plasticity is destroyed by chemical conversion into a new and less plastic body.[*] Illustrations: ceramics, cement, plaster.

5. Plasticity is lessened by increase in the size of the molecular aggregate, produced by co-precipitation of two amorphous materials existing as colloidal solutions or gels of opposite sign.[†] Illustration: co-precipitation of hide substances and tannins as leather.

The leather industry furnishes many striking illustrations of the generalisations indicated above. Hides are usually treated as follows: first the rehydration of the skin if previously dried, almost always assisted by alkali; second, the removal of the hair, generally by the action of alkalis or alkali sulphides; and third, the precipitation of the hide substance by the action of colloidal solutions of so-called tanning agents, which act, however, only in an acid medium. Hide substance is a condensation product of a number of amino acids, the degree of association of these acids being unquestionably very great. On the other hand it is undoubtedly true that certain of the aggregates are much larger than others. It is probable that the cell wall is the more highly aggregated constituent, and that the contents of the cell, while in general similar in character, *i.e.*, consisting of condensation products of amino acids, are much smaller in size. Both components are capable of combination with water, *i.e.*, of hydration. The cell will form, however, only a gel, while the cell contents form a solution, colloidal in character on account of the large size of the molecular aggregates composing them. In its natural state hide substance is already hydrated. Upon drying, the moisture evaporates, plasticity decreases, and the hard and horny effect of dried hide is produced. The hide is capable of rehydration upon treatment with water, and the osmotic pressure of the solution of the cell contents serves to distend the mass and to produce the swelling observed upon soaking hides and skins. The cell contents, composed as they are of condensation products of amino acids, possess both free amino and carboxyl groups, and can therefore function either as an acid or a base, *i.e.*, are amphoteric in nature, the basic character being somewhat stronger. If treated with either an acid or a base of which the molecular weight is sufficiently small that diffusion through the cell wall is possible, a salt is formed: the amphoteric electrolyte within the cell is so weak that its dissociation is negligible, while on the other hand the salt formed is largely dissociated, as is true of all salts of this type; but nevertheless the ion formed from the cell contents—whether positive or negative, depending upon the use of acid or base—is too large to be able to diffuse through the cell wall. It therefore holds by electrostatic attraction its corresponding ion from the acid or base within the cell, thus doubling the molecular concentration in the cell, and also doubling the osmotic pressure. This increase in osmotic pressure increases both the rate and the extent of the distention of the skin, pulling the water necessary for the expansion of the cell contents through the cell walls themselves, and thereby greatly increases the rate of their hydration. For the rehydration of dried hides and skins dilute alkali is used to produce this effect, because its action is less violent than that of dilute acids and its use is therefore safer. On the other hand, co-precipitation of the tanning agents with the skin is impossible in alkaline solutions, and tannage must therefore take place in an acid medium. For the production of thick leather it is thus necessary to secure the preliminary swelling of the hide by the use of dilute acids, the action being, however, entirely analogous to the swelling in alkalis.

The agglomerates of amino-acids which compose the hide substance are easily capable of hydrolytic disintegration into smaller aggregates more plastic but also more soluble and mechanically weaker and unsatisfactory. This hydrolysis is promoted by certain ferments and especially by hydrogen ions.[*] On this account the use of acid for swelling is dangerous and is sure to result in weakening of the hide to a greater or less extent. The function of tannage is first to render the hide inert to this process of hydrolysis, and second to destroy its affinity for water so that osmotic swelling and disintegration will not occur. In order to do this the physical and chemical inertness of the materials is increased by increasing the size of the aggregate through co-precipitation of the hide substance with some sort of tanning agent, the solution of some colloid of opposite sign, such as the tannins, metallic hydroxides, aldehydic condensation products, etc. The increased resistance to the action of chemicals and solvents is characteristic not only of this particular process, but, as has been pointed out, is a general accompaniment of any increase in the size of the molecular aggregate.

Many of the phenomena of leather chemistry become clearer in the light of the generalisations which have been given. A single one must suffice at this point. It is a well-known fact that chrome leather upon drying loses its affinity for dyes. The probable explanation of this would seem to be that the first product of the tannage of leather by basic chromium sulphate is a co-precipitation of hydrated basic sulphate and hide substance. Upon drying, this precipitate loses its water of hydration, and is converted into a co-precipitate of dehydrated basic chromium sulphate and hide substance which is incapable of rehydration. This change is similar in character to the transformation taking place in the burning of ceramics, *i.e.*, the dehydration of kaolin and its transformation into a new amorphous body incapable of reversion.

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[*] Mellor holds that under the action of heat kaolin decomposes to form free alumina and silica, the water escaping; owing to the inertness of these bodies, recombination to form the original kaolin does not take place.

[†] The separate particles of all colloidal solutions and gels carry electrostatic charges either positive or negative in sign, depending both on the particular substances involved and on the conditions of formation and existence.

[*] It is possible that the disintegration by acids is entirely due to osmotic swelling.

6. In the complex, V_n, the size of the molecular aggregate is increased by increasing n. Illustrations: Bakelite, and all other condensation products.

7. In the complex, V_n, the size of the molecular aggregate is increased by increasing V. Illustrations: rubber, linoxylin, rubber substitutes (sulphurised oils), oxycellulose. In this case, a small change in the unit, V, produces a great change in plasticity and resistivity.

Rubber chemistry is one of the most fascinating fields for the application of the new ideas regarding colloids and amorphous bodies. Apparently isoprene is capable of polymerisation only to a limited extent. In other words, in the formula $(C_6H_5)_n$, n has a maximum value beyond which it cannot or does not go. This value of n is not sufficient to reduce plasticity to the necessary degree. The reason for assuming this is the fact that by no method of polymerisation alone have we yet been able to decrease the plasticity of ordinary rubber; in other words, it is assumed that in ordinary rubber the polymerisation has gone about as far as it is possible to carry it. On the other hand, it is always possible to decrease the value of n in the rubber complex. This can be done either by the action of heat; or by the action of solvents, in which case the smaller rubber aggregates unquestionably dissolve and, by their osmotic pressure against the retaining walls of the insoluble portion of the rubber, disrupt that portion and disintegrate it into smaller groups; or by mechanical manipulation. It is, however, possible to increase the size of the rubber aggregate by the introduction of sulphur into the isoprene unit, probably by direct addition at one of the double bonds. It has been suggested that the vulcanising action of sulphur is due primarily not to this introduction of sulphur into the rubber molecule, but to an accompanying catalytic action upon the polymerisation of rubber. This seems unlikely for two reasons, first, because it is difficult to explain our inability to find any other catalytic agent for this polymerisation except such as also combines chemically, and in the second place, because the known cases of chemical combination with the unit of an organic complex also produce, as in this case, marked changes in physical properties, very great in proportion to the amount of chemical action involved. One will recall the enormous increase in inertness of linseed oil corresponding to a relatively small addition of oxygen, the great decrease in strength and resistivity of cellulose upon the formation of oxycellulose, and the changes accompanying the addition of sulphur to oils in the production of rubber substitutes. It therefore seems more reasonable to assume at present that an increase in the size of the unit, V, of an aggregate is more important than a corresponding change in n.

By the introduction of a small amount of sulphur into the unit, V, of the aggregate, V_n, it is possible very greatly to decrease plasticity and to increase resistivity; and furthermore the extent of these changes can be controlled by the amount of sulphur combined. The product may be represented as $(VS_x)_n$, wherein x is small in comparison with the total amount of sulphur which the polyprene is capable of absorbing. If, however, the rubber has before vulcanisation been partially disintegrated, by heat, solvents, or manipulation, its formula is $V_{n'}$, where n′ is less than n. It is still possible to decrease plasticity and increase inertness to any desired degree by the introduction of sulphur, but to carry these changes to the same extent, a larger amount of sulphur must be combined, giving a product, $(VS_{x'})_{n'}$, where x′ is greater than x. While plasticity and resistivity may now be the same as before, the product is evidently a different one, and it is not surprising to find that rubber so treated has mechanical properties differing—less satisfactory, as it happens—from those of the original rubber vulcanised directly.

Again, it is possible to disintegrate the vulcanised aggregate, $(VS_x)_n$, by the action of solvents and heat, and, as is to be expected, it is possible to restore plasticity thereby. The product is devulcanised rubber, using the term to indicate only material to which plasticity has to a greater or less degree been restored. Since the capacity of the unit for the addition of sulphur has not been exhausted, it is possible once more to destroy plasticity by vulcanisation, but as in the previous case the product is by no means identical with the result of the vulcanisation of the original rubber, and it is therefore not surprising that such revulcanised rubber is mechanically different—again inferior—to the original article.

In conclusion, a few words regarding the relation between amorphous bodies and colloids are necessary. Apparently the removal of the solvent from any colloidal solution or gel leaves an amorphous body behind, but it does not follow that all amorphous bodies can be brought into colloidal solution, although this is frequently the case. While the relations between the two states of matter are not entirely clear, it is believed that any uncertainty in this respect will not affect the generalisations that have been made regarding amorphous solids.

RESEARCH MEN FROM THE MANUFACTURER'S VIEW-POINT.

BY C. F. BURGESS.

Research, invention, discovery, are words which possess a magic charm to those interested in progress, growth, and efficiency. The propaganda of research is being preached by universities and technical schools, by the press, by Government Bureaus, and by research men who, in offering their services for sale, point with justifiable pride to the savings which they have effected or the wealth they have created.

"Research pays" is a phrase which is coming to have a status comparable to the expression "It pays to advertise." Everywhere we see manufacturers who are recognising the value of research. Especially in these strenuous war times, under the motherhood of necessity, research work is receiving a great impetus. Courses in chemistry and chemical engineering are growing rapidly, and of the increasing number of students who enrol in them, many hope to be engaged eventually in industrial chemical research.

As the rosy side of chemical research is the one which has been displayed attractively to the public, it involves some temerity to discuss a phase of the subject which is less agreeable. It has been found by experience that not all advertising pays, and it is quite as true that research, as it is frequently conducted, is not always profitable. Many manufacturers who are indulging in it are not doing it properly, and many men who are fitting themselves as research workers are destined to be unsuccessful because they lack certain essential qualities.

An exceedingly interesting story could be told by the administrators of the large and notably successful industrial research laboratories, outlining the difficulties they have met and conquered in getting together the right kind of workers, in dealing with problems of jealousy, of adequate compensation, of co-operative effort, of co-ordination of the laboratory with other departments of the industry. Without having had such experience, I must confine myself to views based upon a long period spent in educational work, in consulting and engineering practice, in contact with numerous industrial research laboratories, and as administrator of a laboratory employing a moderate number of men in research work.

If records were available they would probably show that there have been more cases of disappointment than of success in the undertaking of research as an adjunct to an established business. Numerous instances are recalled where appropriations have been made by men who believed they were in sympathy with the research idea, while, as a matter of fact, they had no appreciation of what research really involves in the way of adequate support. A common method of procedure is to instal a chemical laboratory or research department and then forget it until the accounting department shows what is apparently an unwarranted expense without adequate return.

The manufacturer who thoroughly understands and believes in research will recognise that results may be attained slowly and that large investments may have to be made before any tangible assets are created, or before increased profits in operation can be effected.

Having installed a research laboratory, the mistake is commonly made to burden it with work of a strictly routine nature, such as control analyses, testing of materials in daily use, coal and fuel analyses, and the like. This kind of work has such a retarding influence on research that some manufacturers attempt a complete separation of the two kinds of laboratories. This has not become a common practice, however, and control and research work are commonly found in a state of confusion.

A serious blunder, and one not at all uncommon, is to allow the research department to become an adjunct to the sales department, especially when the commodity is competitive and sold largely through advertising methods. It is natural for a sales manager to muster all resources available to help him with his sales work, and therefore he goes to the research department for assistance in demonstrating by various kinds of tests and other methods, superiority, or alleged superiority, of the product. A notable instance is recalled where the *esprit de corps* of a research laboratory was demoralised because of the demands made upon it for devising tests and making comparisons of products. The employees learned from the published results that it was not real truth they were supposed to seek, but truth of the biassed kind which could be used in advertisements and sales arguments. The policy adopted by another laboratory of keeping entirely away from the sales department has some merit, though perhaps going too far to the other extreme.

The research laboratory cannot be a disconnected adjunct to a business and at the same time be a success. Its usefulness depends upon its being in touch with the financial management that it may determine how far expenditures can be made and what lines of work can be given the best support from a financial view point. It should be in relationship with the purchasing department in the study of raw materials, with the operating departments with a view to improving manufacturing methods, with the sales department that it may assist in imparting the right kind of information to the public, and with the legal department mainly on matters relating to patents. To establish such important and confidential relationship between a laboratory and an industry naturally involves having the right kind of laboratory administrator and the right kind of a force working under his direction, and if there is any one cause more pronounced than others in leading to disappointment in research, it is because of a lack of the right personnel.

Numerous other causes of disappointment might be named. An instance is recalled where after operation for some time it was found that no records of any value had been kept, even though the work and results were of an important nature. Although the importance of an adequate system of notes and reports is obvious, it is a feature often neglected.

There is no doubt that at the present time there are too few men being trained in the right way to supply the present and the coming demands for research workers. Educators have before them some large problems to solve if they would increase the effectiveness of their training. The difficulty which manufacturers have in getting the right men for research leads to the assertion that there is an insufficiency of trained men. The difficulties which chemically trained men have, on the other hand, of securing satisfactory employment in industrial research, leads to the oft-repeated assertion that American industries are not alive to the importance of research and that research men are not given a proper recognition. These divergent views come not so much through a lack of appreciation and knowledge of research by employers as through a lack of knowledge, experience, and ability, on the part of chemists who believe themselves qualified for research and development work. For this defect the colleges are in a large measure responsible.

As has been pointed out by Dr. Whitaker, the fact that mechanical engineers have played the important part they have in the development of chemical industries in this country, in spite of their limited training in chemistry, has been due largely to their engineering training, and there is no doubt that in the establishment of chemical engineering courses a marked step is being made in improving the methods for training men to assist in chemical research.

It is from our universities that the greater proportion of the intellectual raw material must be obtained for the building up of industrial research laboratories, and the first piece of research work a manufacturer must do when he makes up his mind to establish a research department, is to investigate carefully the kind of men who are available. It is true that there are other sources of supply, but they are of less importance. Suitable men may be picked from the operating force, others may be obtained from other research laboratories, and service can be secured from professional research men. But the main supply of raw material is that which is turned out by the colleges. That this material is raw and capable of refinement is shown by the records of research departments where many have been called but few have been chosen to play a part in the achievement of research successes. The quality of this material could be greatly improved if the teachers had a better understanding of the equipment desired and were more alert to the deficiencies in the men who are turned out with college degrees. There is no doubt that the producer and the user of intellectual raw material wish to co-operate, but the co-operation has not always been effective.

The average college graduate who secures employment in a research laboratory must be able to give up some of his illusions without losing his enthusiasm. He finds that he must work on a problem not of revolutionary importance and to him of apparently minor significance; that ninety per cent. or more of his work is of a routine nature requiring what appears to him to be mediocre ability; that others in the laboratory are working on more attractive problems; that he is required to work with equipment far less elaborate than that to which he became accustomed in his college laboratories. He may have poor library facilities, and uncomfortable working quarters. In this frame of mind he becomes discouraged and feels that there is little opportunity for advancement. In his university experience he became acquainted with the practice of studying a problem from the scientific point of view and working it out regardless of the cost of materials used, or the commercial value of the product produced, the next step being the preparation of a carefully worded report or thesis and finally its publication under the author's name. In the research laboratory he encounters a different mode of procedure, terminating not in publication with credit to the author, but in such secrecy that in some establishments the employees are discouraged from even talking chemistry to outsiders.

Reconciling himself to a lack of reward coming through publication, he begins to wonder whether he is receiving adequate compensation of a more tangible nature. Before presenting his claim for an advance in salary he endeavours to evaluate the work which he is doing for his employer. If his problem is to decrease the cost of an article he can easily figure to his own satisfaction how much the annual saving will be and how much should be his share. If the investigation is to improve the quality of a product his means of figuring are less tangible, but, nevertheless, he is inclined to figure. When a laboratory employee begins to estimate in dollars and cents the value of a discovery or development, he works himself into a state of mind which leads to trouble. He does not have the data from which to deduce actual values ; he is unable to determine in what degree the results are due to his own efforts and how much to the work of his associates, human nature makes him more generous to himself than to others, and he arrives at the conclusion that his salary is only a small percentage of that which he deserves. In this stage of the disease his efficiency and usefulness decline. One unfortunate feature of this malady is that it is contagious, and another is that there is no prescribed remedy for it. Illustrating by a specific example, one young man for whose college training and for whose appointment in a research laboratory I was partly responsible, worked for several months on the development of an improved product. As progress was made he began to withhold reports and data, and finally presented a demand for a large salary guaranteed for a period of years, together with a bonus of 10% on gross sales. In other words, he had lost his usefulness. While experiences of this kind may be met with occasionally, they are fortunately of somewhat rare occurrence.

One method of counteracting mental troubles of this kind, as well as of insuring a feeling of satisfaction on the part of the research worker, is a system of adequate compensation. This, however, is an exceedingly perplexing problem. To work out a profit-sharing plan for a research laboratory is far more difficult than to establish a profit-sharing plan for all the employees of a manufacturing establishment. There are very few investigations which can be isolated so concretely from associated investigations that the actual money value of one man's work can be determined. Even if it could be calculated, the payment of bonuses for work which happens to turn out commercially profitable involves great injustice to other research men to whom equally necessary but less directly profitable tasks may be assigned. I have attempted in various cases to work out some method of compensation based upon commercial results, including a percentage of savings effected over past practice, a percentage of profits, and by various other methods, but in all cases these plans led to misunderstanding and friction. Most manufacturers have an abhorrence of a payment of royalties on patents, and it is unusual to find one who will be content to set aside a certain percentage of profits over a period of years, as compensation for an improvement.

In addition to a selfish attitude on the part of the manufacturer, there are some very good reasons why he cannot figure out and set aside certain amounts to be paid for research work, and as soon as employees recognise this the relation between employer and employee becomes more satisfactory. The worker must recognise that there is a long step between a completed laboratory work and its development into a profitable commercial product or process. It is the usual thing that the commercialisation of a laboratory development requires a far greater outlay of money and effort after taking it from the laboratory than is necessary in the laboratory.

Based upon my own experience, in a variety of lines of work, I have formulated in my own mind the idea that in general the proportion of profit of a successful commercial commodity or process which had its inception in the research laboratory, which should be credited to the said laboratory, is of the order of 10%, the remainder to be credited to the manufacturing, the sales, the legal, and the other departments, which have worked out the numerous problems of putting the discovery into commercial use. An appreciation of the dependence of the success of research work upon the efforts of others not employed in the research department ought to be acquired by research men early in their career, and there is no doubt that a broader education of men while in college will do much towards bringing this about.

A striking example of neglect to recognise co-operative effort necessary to ensure success of research is a paper in November "Science Monthly" entitled "Cash Value of Research." In it Professor Robertson describes "the gift which Faraday presented the world in 1821" in terms of the value of electrical machinery manufactured each year, of the electric light and power stations worth $1,097,000,000, of telephones at $820,000,000, and of our potential water-powers which, capitalised on a 4% basis, gives a capital value of $75,000,000,000. Is the student properly informed when told by this same teacher that the research laboratory of the General Electric Company, under an investment of $100,000 per year has succeeded in bringing in $200,000,000 annually ? A few calculations of this kind would use up the entire country's wealth, and leave a little consolation in showing some of us why we cannot figure out cash values for our more modest research endeavours.

One of my students who has been notably successful in industrial research work told me that after having been employed for some months in the laboratory of an industrial plant, a certain recommendation was objected to by the management because it would involve too great an overhead expense. After trying to understand how the procedure would effect the travelling crane or other equipment overhead, he finally had revealed to him, by a friendly bookkeeper, what was meant by the term "overhead." The importance of business accounting is appreciated too little by our training schools, as a knowledge of accounting practice is one of the several things which is of use to a man who engages in industrial research. Likewise a knowledge of business practice, of labour problems, of sales methods, of patent practice, should be dealt with in college at least to the extent of arousing an interest in these matters.

In this paper no attempt is made to lay down any principles or methods which should be followed in the training of research men or in the management of research laboratories. This is a subject of magnitude and is well worth attention if there is to be a general increase in the number and efficiency of industrial research departments.

If some standardised system of accounting for research work could be evolved a distinct service would be rendered. Some industries hold the money devoted to investigative work as a running expense, not considering the information gained as a tangible asset. A method of accounting which appeals to the writer as being decidedly preferable is to carry a development account, on the debit side of which are placed all items of expense involved in the research and investigative work; on the credit side are placed the values created by the research department in the form of patents which may be transferred or sold, in royalties which may be received, or in pieces of finished work which are transferred from the laboratory to the production departments. An exercise of judgment is of course necessary in assigning values to these items. By a reasonable administration and accounting it can be demonstrated that research pays, and coupled with the campaign to create interest in and support for research work, there should be greater effort toward making it effective.

Systematic co-operation between the universities and industries is needed in the training of men, but equally important is the evolution of systems of administration of research work by the manufacturers.

SOME PRINCIPLES IN THE ADMINISTRATION OF INDUSTRIAL RESEARCH LABORATORIES.

BY RAYMOND F. BACON.[*]

A prominent director of research, Willis R. Whitney, has said.[†] "The organisation of industrial research involves arranging and maintaining a body of involute parts as an operative whole of highest efficiency. It is never perfectly accomplished, and the fact that improvement can always be made is an incentive for its discussion." Such consideration is especially propitious at this time. Our Society has an unprecedented responsibility to intervene actively in the promotion of the best interests of chemical industry.

The classification of administrative work.

Two general administrative schemes are in operation in the large research institutions of the United States. According to one of these, the administration is charged with both the research-executive and financial duties; in the other plan, the director of research is relieved of financial cares.

The work of the Carnegie Institution of Washington[‡] illustrates the first procedure. The activities of this Institution may be classified under the heads of a Division of Administration, a Division of Publications, Departments of Research, and a Division of Research Associates. The Division of Administration consists of persons charged with the executive, financial, and correspondence duties of the Institution.

The administrative scheme of the Rockefeller Institute for Medical Research[§] is ideal for large institutions engaged in specific fields of scientific research. The general administrative and financial conduct of the Institute, as distinguished from its strictly scientific activities, is delegated by the Governing Boards to the Manager. He is responsible to the Board of Trustees for the care of the grounds, buildings, and equipment of the scientific establishment. He is the treasurer of the Board of Scientific Directors, and is responsible to them and to the Budget Committee of the Corporation for the proper expenditure of the income, in accordance with the budget. As far as possible, he relieves the Director of the Laboratories and the other members of the scientific staff from administrative cares, and in general is expected to make and keep the entire plant an efficient instrument in their hands for the scientific purposes of the Institute. This plan is in operation in principle in some of our largest industrial research and testing laboratories.

Not infrequently the relations to a research institution sustained by the investigatory staff are so varied and so complex as to preclude summary specification. For instance, in the Division of Research Associates of the Carnegie Institution of Washington, each case presents conditions peculiar to itself. Invariably, increment in divisions tends towards an increasing complexity of administration.

The constant development in efficiency in manufacturing is largely the result of organisation that ensures the systematic use of every varied talent required; and occupying a very important place in such organisation is the fullest use of a research staff. Whitney[*] and Ferguson[†] have presented the results of their wide experience in charge of the research work of two of our largest corporations, and both emphasise plans of definite organisation which should be of interest to those in charge of the research departments of plants. In these departments as well as in research institutions, it is of primary importance, for effective effort, to "Get your principles right; the rest is a matter of detail."

It has been well said by a great leader of men, E. P. Ripley, that "the executive's chief business is to organise, deputise, and supervise." The need for executive ability is fundamental in all organised effort.[‡]

The Mellon Institute of Industrial Research.

A decade has now elapsed since my distinguished predecessor, the late Dr. Robert Kennedy Duncan, founded the system of practical co-operation between science and industry, now in operation at the Mellon Institute of Industrial Research of the University of Pittsburg. This system has been described at length in a number of places.[§] Suffice it to say here that a company, an association, or an individual may contribute a definite sum of money to the Mellon Institute for a period of one or more years. This money, with the exception of a small sum for the purchase, if necessary, of very special apparatus, is used by the Institute to pay the salary of the man or men who work on a particular problem, the solution of which is of interest to the donor. The Institute houses the research, furnishes it with all ordinary supplies and apparatus, affords library and consultative facilities, gives careful direction to the progress of the work, and offers an atmosphere sympathetic to research. The research is surrounded with the necessary secrecy, and any and all results obtained during the course of the Fellowship belong exclusively to the donor.

Thirty-two Fellowships are in operation at present, and the growth of the Mellon Institute has about reached the point where we shall be obliged to decline further industrial investigations for the present, since our laboratories are almost filled up to their capacity. It is gratifying to note that at the Thirty-fourth Annual Meeting of the Society of Chemical Industry, the President, Professor G. G. Henderson, referred to Dr. Duncan's scheme as "eminently practical," while Sir William Ramsay stated that he believed it to be an "admirable" one.* Certainly the results (see accompanying table) show that a valuable form of service to industry has been established.

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[*] Director of the Mellon Institute of Industrial Research of the University of Pittsburgh.

[†] Twentieth Anniversary of Clark University, September 17th, 1909.

[‡] "Scope and Organisation of the Carnegie Institution of Washington," 4th issue, 1915, p. 8.

[§] "History, Organisation, and Equipment of the Rockefeller Institute for Medical Research," New York, 1914, p. 21.

[*] *Loc. cit.*

[†] J. Ind. Eng. Chem., 1912, **4**, 905.

[‡] The individuality requirements of executives will not be considered herein. For a study of personal efficiency, see E. B. Gowin's "The Executive and His Control of Men," New York, 1915, pp. 3—95.

[§] See especially Duncan, this J., 1909, **28**, 684; Bacon and Hamor, J. Ind. Eng. Chem., 1915, **7**, 333 and 343; Hamor, Sci. Mon., 1915, **1**, 86; and Educational Pamphlets, No. 30, Board of Education, London, 1915.

Growth of the system of industrial research in operation at the Mellon Institute.

Academic year.	Number of Fellowships in operation.	Number of Fellows.	Amounts subscribed for the maintenance of Fellowships.
1911—1912	11	23	$39,700
1912—1913	16	30	53,500
1913—1914	15	29	59,100
1914—1915	24	42	74,350

Several of the Multiple Fellowships established at the Mellon Institute have been effectively at work since the foundation of that institution, while a large number of investigations utilising the services of one researcher—Individual Fellowships—have been promoted continuously for the past three years. Thus, although this must be regarded as a very short interval in the career of an institution whose history should be measured by centuries, it has been long enough to afford opportunities for the development of ideas and ideals concerning the conduct of industrial research. In addition to the necessarily limited number of investigations actually undertaken by the Mellon Institute, it has received proposals for research in nearly every field of applied science. If, under these circumstances, the Institute has not acquired something of the wisdom which is said to arise from experience, lack of abundance thereof cannot be properly assigned as a reason for so obvious a lapse. An adequate account of this extensive experience, which, while overloaded with the manifest and the impracticable, is yet rich in applicable instruction, cannot be attempted in an address of this nature. However, it may be useful to contemporaries to present certain practical results of an experience in the direction of industrial research, supplying such propositions as have been amply verified. Obviously, one is confronted with many difficulties in any attempt to discuss the requirements for running a research team, observing the psychology of newcomers, and eliminating those not destined for research. I shall, therefore, pay no especial attention to the factors involved in motivating an industrial research group.

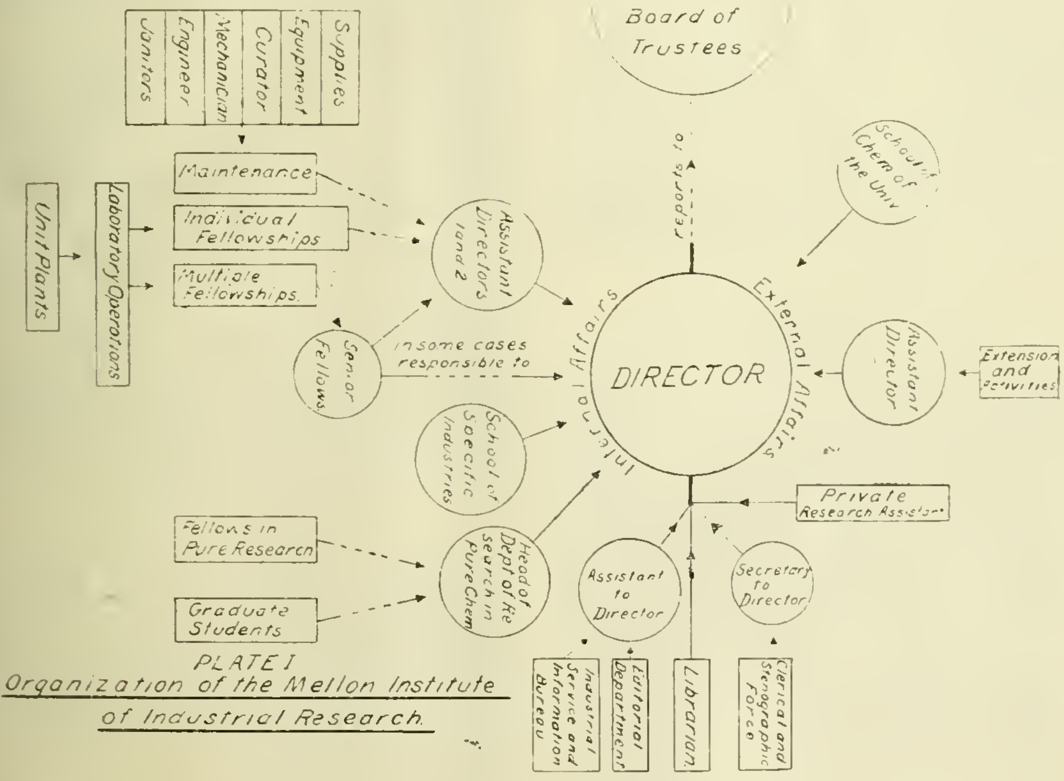

PLATE I
Organization of the Mellon Institute of Industrial Research.

METHOD IN RESEARCH ADMINISTRATION.

Personal organisation.

Since the policy which insures adequate guidance to a research organisation must be based upon facts, method in laboratory administration should provide for facilities for securing detailed information on a vast field, and for competent counsel from those who have a store of specialised knowledge. When the laboratory executive's work has passed the one-man stage, a division of labour comes about and it is here that he must see to it that he surrounds himself with men who are capable of effective effort—alert, original investigators of initiative and leadership.

An organised research administrative staff should not only result in effective division of labour, but also in efficient expenditure of executive energy, more effective plans, and general stabilisation. This can come about if there is a pervading organisation type of mind, which "is common to those drilled in systematic thinking and long immersed in the materials of their particular vocation. Such a mind sees details, but only as parts of a whole; reaches generalisations, but by the inductive route."[*]

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* This Journal, 1915, **34**, 751 and 753.

The activities of every research laboratory group themselves into certain general classes. Those of the Mellon Institute are expressed graphically in Plate 1. The basic requirement of organisation is the effective combination of work and men, and this systematic plan shows how we have carried out one combination.

It has been our aim to dovetail what is good in factory research methods with what is good in university methods into a scheme which gives results which are not obtainable by either method alone. For example, one very good thing in university practice is often neglect of the time factor, and what is often bad in industrial practice is the insistence upon immediate results, together with the more or less harassing atmosphere of factory intrigue, interference, and misjudgment.

The investigatory staff.

Just as an individual can exert only a very small influence except as a member of an organisation or institution, so a research institution never gains note or influence except through the attainments and achievements of its individual members. For example, the research department of a large industrial concern is great because it has investigators on its staff who possess great originality and ability and because its director is wise and far-sighted. It is generally conceded that the personal factor is always paramount in industrial research, and that, as in every other organisation, the control of men is the real problem in laboratory administration. This is why "executive ability consists in getting the right men in the right places and keeping them willingly at the top notch."

Conditions favourable to research.

A brief consideration of the conditions favourable to both pure and industrial research is pertinent in connection with any discussion of the personal organisation.

It is particularly adverse to progress to regard able investigators as abnormal men; for successful research demands neither any peculiar conformity nor any peculiar deformity of mind, but it requires, rather, peculiar normality and unusual industry and patience. It is little less inimical to expect productive work from those who are absorbingly preoccupied with other affairs than research; for fruitful scientific inquiry entails, in general, prolonged and arduous, if not exhausting, labour, for which all of the researcher's time is none too much (R. S. Woodward). It is only to be expected, therefore, that those most likely to produce important results in research are those who have qualified for the responsibilities thereof by the completion and publication of several worthy investigations, and who are at the same time able to devote the bulk of their energies thereto. The productive researchers in our universities are those who are devoting their whole time, or practically their whole time, to investigatory work.[†]

Research, and particularly industrial research, is increasingly effective in proportion as it is carefully planned and executed in accordance with definite progress. Then, too, notwithstanding the most diligent foresight, research is likely to expand more rapidly and hence to demand a more rapid increase of resources than many other realms of endeavour; the unexpected developments of research are frequently more important than its anticipated results, and new lines of investigation sometimes become more exigent than those carefully prearranged for pursuit. This has been the experience of every research institution.

Research should never be allowed to fall into the rut of prosaic routine. The personnel of the investigatory staff should be maintained at the very highest standard and all administrative plans should be carried out with enthusiasm and earnestness.

In the research laboratories of manufacturing plants the personal cooperation of the research staff with the members of other branches of the organisation always proves an important aid in maintaining interest in the work and is, in addition, mutually educating.[*] In particular, the research department should have an *esprit de corps* that keeps things moving and should lead the way so strikingly as to be apparent to all other departments of the corporation. In consequence, mediocrity should never be tolerated. It should be borne in mind, however, that the research man can only accomplish efficient work when he is free from restraint and petty annoyances.

The success which has attended our work at the Mellon Institute is to be attributed largely to the realisation for the Fellows of the fullest liberty compatible with order, the most thorough equality consistent with progress, and the completest fraternal spirit possible. The most important matter in connection with Industrial Fellowships is the spirit in which the research work is conducted. The introduction of the factory spirit into industrial research would be fatal and would be contrary to everything that the university stands for, to say nothing of the efficiency of the work.

The original spirit given to the Fellows by Dr. Duncan was expressed by him in these words: "To know, is to work and to do; and a new thing done is forever a rung in the ladder by which man climbs—necessary and good for all generations, until the summit is attained and the ladder can be cast aside." These ideals are kept before the Fellows and are cherished by us all.

Co-operation in research.

Co-operation is always contributory to success in a research laboratory, and, other conditions being equal, the valuable men are the ones who can and will co-operate with one another. As in business, men succeed only as they utilise the ideas and services of other men. It follows, therefore, that the strength of an investigatory staff, properly operated, should increase exponentially with its numbers, and that a fraternal spirit will play an important rôle in the productiveness of any research department.

At the Mellon Institute, every Fellow is expected to give undivided effort to his work, but the knowledge gained by one Fellow along one line is available to another investigator working along a similar line, *providing such co-operation violates no trust.*

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[*] Gowin's "The Executive and His Control of Men," p. 79, see also Blackford's "The Man, The Job, The Boss"; and Münsterberg's "Psychology and Industrial Efficiency."

[†] As a rule, the head professors of chemistry in the larger universities are not giving more than three to five hours of lectures during the week, the rest of their time being devoted to research, while a number of them have one or more private research assistants, besides the candidates for advanced degrees, doing research work.

[*] In several of our largest corporations, the plant superintendents make monthly reports to the research department, including all ideas of their own or of their assistants which may in any way warrant investigation. Then, too, the salesmen report regularly to the research department regarding the various ways in which the company's products are used and what substitutes are used for the company's products. Such plans stimulate closer thought and observation.

Qualifications for industrial research.

Research leading to the discovery of new ideas requires not only intellect and training, but also initiative or genius; it can come only from an individual who possesses unusual intuition and insight. It is only to be expected, therefore, that there is a scarcity of men gifted with the genius for industrial research, and that it requires much experience in selecting suitable men and in training them to the desirable degree of efficiency, after having determined the particular qualities required.

Important qualifications in industrial research are the following:—

Adequate training
Scientific acumen.[1] } Scholarship.
Active optimism.[2]
Intellectual honesty.
Unselfishness.[3] } Poise.
Tact.
Creative power.[4]
Exactitude.[5]
Intrepidity.[6]

Some directors of research place active optimism above scholarship, for they maintain that, without it, little that is novel will be accomplished except by accident. One is more likely to grant that knowledge may sometimes be a detriment to a researcher imbued merely with a need of solving new problems. However, the determinable nature of scholarship induces its primary consideration in this place. It is scarcely necessary to mention that in no other human endeavour do the personal traits protrude so much as in concerted research; but the successful administration of research always presupposes the utmost faith in human nature, and it frequently requires some time for a display of optimism, poise, or fair-play to become evident among qualified researchers, especially when they are engaged on separate problems.

The important requisites for industrial research are often unconsidered by manufacturers, who, in endeavouring to select a research chemist, are likely to regard every chemist as a qualified scientific scout. The supply of men capable of working at high efficiency as investigators, is well below the demand; and chemists having the requisites and spirit of the researcher are indeed difficult to find by ones experienced in the direction of research. All research professors know that the finding of a skilled private assistant—one who possesses not only originality, but also sound judgment and intellectual honesty—is not easy, because it frequently involves the gift of prophecy on the part of the searcher.* It has been truly said that the "seeds of great discoveries are constantly floating around us, but they only take root in minds well prepared to receive them."

On account of the extraordinary importance of new ideas, particular emphasis should always be laid upon finding and supporting brilliant researchers. Such individuals can best be found in the universities. The function of the university is to work with the beneficent idea of increasing the sum of human knowledge, and among its most valuable products are those who will work for the exercise of the investigative instinct and the pleasure of overcoming difficulties.

Dr. Duncan once said: "That 'good men' are scarce is, of course, a truism; but it is terribly apposite in these days. The modern manufacturer advisedly economises in everything but salaries, and the very considerable salaries paid to good men are ample evidence of their rarity. Now, the purlieus of adolescent 'good men' are the laboratories of the university. There it is that men are 'tried out,' and there it is, too, that men are known better than they know themselves."

I have been frequently consulted by manufacturers regarding the training of industrial research chemists. My opinion is that any specialisation in technology should be post-graduate work for those students who have received not only a thorough scientific training, but also courses of instruction in general industrial chemistry and in the design, erection, and equipment of industrial plants. The new home of the Mellon Institute affords ample accommodation for a graduate School of Specific Industries; and I predict that this idea of a suitable course of training for those who intend to devote themselves to technology, will eventually meet with the approval of educators as well as industrialists. In fact, this educational innovation, in operation only since the dedication of the permanent building of the Mellon Institute, has so favourably impressed certain manufacturers that they have made arrangements for training a number of young chemists to become experts in specific branches of technology.* It is clear that the plan of a graduate school of specific industries obviates the dangers incidental to early specialisation during the period of training, and that it thus overcomes one of the principal difficulties of the past. It can only result in a more satisfactory correlation of the work of the chemist and engineer in industry, and, by providing a sounder professional training, render the university of greater service to industry.

The matter of remuneration.

No matter how devoted one is to research, material considerations will enter. Generally speaking, three plans for remunerating men engaged in research are in operation in industrial laboratories. In one of these the researchers receive a straight salary; according to another, if the investigators succeed in a practical way, they receive, through a bonus, a substantial reward: and finally there is a system of remuneration based upon a combination of these two plans.

When the remuneration is by fixed salary, there is a tendency for research work to become perfunctory. On the other hand, with the bonus system, a criticism is that a researcher is likely to think how much he can get out of the work. It has been our experience at the Mellon Institute that a combination system increases the interest of the investigatory staff in the work which is to be done. A financially contented researcher will always think less about his rights and more about his duties. A satisfactory remuneration has much to do with the maintenance of hopeful pertinacity, while the incentive of a bonus exerts a pronounced influence on the development of a desirable poise among the men engaged in research.

Each Fellow of the Mellon Institute has the benefit of the institution's very excellent apparatus, chemical and library equipment—facilities which are so essential in modern research; and because of these opportunities and that of being able to pursue post-graduate work, it has been demonstrated that a higher type of young research chemist can be obtained by the Institute for a certain remuneration than can be generally secured by manufacturers.[*] Then, too, if the Fellows succeed in a practical way, they receive, in addition to their bonus, often the opportunity to become permanently connected with the company concerned in the agreement. It is the purpose of an Industrial Fellowship to afford a young man "every incentive to lay his hands on the vast body of correlated knowledge called Science and to make it subserve the practical needs of the human race."

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[1] Especially talent for observation and the gift of deducing sound conclusions from work. Such keenness is characteristic of "born chemists" and scientists in general.

[2] This includes hopeful pertinacity, enthusiasm, confidence, and self-reliance.

[3] Active optimism and co-operation among qualified researchers constitute the basis of success in systematic research. Researchers who are actively optimistic are invariably men of sympathy and hence loyalty.

[4] This consists largely of inspiration, ingenuity, and insight. A qualified researcher who possesses initiative is usually a creator.

[5] Sound judgment, thoroughness, and care; accuracy in experimentation and knowledge.

[6] This is of especial value during the industrial development of the results of research.

* See discussion in Science, n.s., 1915, **41**, 319.

* For a full explanation of the purpose of the School of Specific Industries of the University of Pittsburgh, see Bacon, J. Franklin Inst., November, 1914, 624; and J. Ind. Eng. Chem., 1915, **7**, No. 4, 346.

According to our experience, $1500 a year will obtain the services of a brilliant young graduate, splendidly equipped, in so far as his age and experience will allow. However, it requires at least $1800 to obtain the most desirable research quality—a man who has not only a comprehensive chemical training, but who has a reputation for successful research ability. He is not unlikely to be, say, 25 to 30 years of age and usually possesses his graduate degree, with high honours. While the young graduate of 23 may sometimes do just as well as the Ph.D. of 28, this cannot be predicted, and, naturally, the chances are in favour of the man of greater experience and training who is not too old.[†] The matter of salary remuneration is always left to decision after a full knowledge is had of the nature of the problems concerned. It may be noted here that no man is chosen for any Fellowship without a personal meeting and studying of the candidate by the administration and, as well, generally, by the donors, if such is deemed advisable.

Promotions.

In general, it may be said that no system of routine promotions is in operation in the important institutions and laboratories of industrial research; the work is generally so much specialised that appointments and promotions are considered in each case without reference to others. Good research men should not be spoiled by promotions to official positions in which their energies become dissipated in a mass of official detail instead of concentrated upon some problem for solution. Furthermore, the bid for popularity should never be permitted to carry a research man so far away from his work that no time at all remains for research.

Objective organisation.

Mention has been made of the Fellowships of the Mellon Institute, each of which is the subject of a definite agreement between the donor thereof—the individual, association, or company concerned—and the Institute. An Individual Fellowship utilises the services of one man, directly responsible to the administration; while a Multiple Fellowship has the intensive services of several men under the direction of a Senior Fellow, who, in turn, is directly responsible to and under the administration. The responsibility of the entire investigatory staff is shown in the graphic presentment of the organisation in Plate I.

The larger Multiple Fellowships are so well established and so distinctive in their several fields of inquiry that they are not uncommonly regarded as independent organisations, and several of them have, in fact, been mistaken for the Mellon Institute as a whole. These misapprehensions are the result of the existing favourable relations of the Fellowships to one another and to the Institute as a whole, which, when the donors so desire, secure to them a degree of autonomy which could hardly be surpassed under other conditions. The liberties of action, thus designedly and freely conceded in some cases, imply corresponding responsibilities, not only in Fellowship administration, but also in Fellowship exposition (reports, monographs, and papers). However, every Fellowship is a case of high trust, and knowledge concerning its progress and subject matter is always strictly withheld, in accordance with the terms of the agreement.[*] Unless the donor desires it to be otherwise, the only parties in possession of the knowledge of the work are, besides himself, the Director, the Assistant Director in charge, and the holder of the Fellowship concerned. Moreover, the utmost discretion is exercised in the business of obtaining information, etc., from the authorities in the various fields; for, wherever possible, the Mellon Institute secures, through proper connections, systematic prompt advices of all improvements in American and European practice that are of value to the donors of Fellowships.

In almost all researches, it is our custom to place the man chosen in the factory of the corporation concerned until he is in full possession of the actual status of the work in that corporation and the precise nature of the problem which he is expected to solve. He is made responsible for the investigation, but he consults right along with the administration and with other Fellows whose knowledge or skill may be helpful. Reports on progress made and difficulties encountered are submitted weekly from each Fellowship, and these are considered by the administration so that it can advise when necessary.

Bibliographic department.

It is now a usual practice in a number of our larger research laboratories to have one competent man, with assistants if necessary, in charge of bibliographic work which includes:

(1) Systematic abstracting from the principal foreign and American journals and patents on all subjects of interest. Copies of these abstracts go weekly to all who can use them, with instructions to study them carefully and immediately to advise the department of any subjects that seem to warrant investigation.

(2) Thorough abstracting from the literature in the case of new work undertaken, thus becoming familiar with all that has been published relating to the subject. Repetition of the work of others is thus saved, valuable suggestions received, and general knowledge of the subject enlarged.

(3) Systematic information is constantly and promptly obtained of all records of imports and exports and duties on all finished products and raw materials that interest the corporation in connection with its current business or as suggesting new articles of manufacture.

(4) Pamphlets describing machinery, structural material, etc., are often many years in advance of books upon identical subjects. A pamphlet library is therefore maintained in co-operation with the engineering department.

This plan is ideal wherever conditions permit, particularly in research departments of corporations; but it is lacking in effectiveness and is really impracticable in research institutions maintaining investigations in a large variety of fields.

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[*] For a discussion of this, see Bacon, Science, n.s., 1914, **40**, 880.

[†] In this connection, I beg to remind you that, excluding geniuses, men are so constituted mentally that while ample promise may be given at the age of, say, 30, full development is not usually attained before the age of 40, and in some cases even later. If, therefore, a research laboratory staff is recruited at, say, 23, and is developed under the influence of research requirements, there will obtain throughout the organisation an interchange of thought and outlook contributing to the highest degree of research development along the lines of individual temperament. Such an arrangement is ideal where possible.

[*] On the form of agreement used by the Mellon Institute, see J. Ind. Eng. Chem., 1915, 7, No. 4, 314.

The practice at the Mellon Institute is essentially as follows:—After consulting with the administration and, if necessary, the editorial department, regarding a course of procedure, each Fellow attends personally to all bibliographic work relating to the problem he has under investigation. In every case, the work itemised (1), (2), and (3) above is carried out by the men on the Fellowships; but pamphlets and trade catalogues* of interest to the Fellows are secured and filed by the librarian, who is responsible to the Director.

Equipment.

In its equipment the Mellon Institute is somewhat different from the usual research laboratory. As a new process is but barely started towards commercial reality when it has passed the test-tube stage, the Institute has been very well equipped with unit apparatus for conducting chemical operations on a large scale; and in a broad sense the equipment of the Institute may be said to include the factories of the corporations which are using its facilities. The usual history of a new process as worked out in the Institute is somewhat as follows. The researcher conceives and works out this process at first with the usual apparatus of the scientific laboratory and by the same methods which are used in research in pure science, all the conditions affecting the reaction involved being determined with even more care and accuracy than is often necessary in a purely scientific investigation. The next stage is to perform the same reactions, still on a very small scale, but in apparatus which is constructed of materials which are available for larger scale work. To this end, the Institute is well equipped with the usual standard large-scale apparatus for heating, distilling, drying, etc., and has, in addition, an excellent workshop with several trained mechanicians who build special small plants. After the difficulties of materials and of construction are solved, the next stage is either one of two things: (1) The equipment of the company's factory may be such as to permit a trial of the new process directly in the factory—and it has been found that American manufacturers are very willing to have such trials made when the previous work has been of such a character as to indicate a reasonable chance of success; (2) or, in case the process demands apparatus of a new type, which is not available in the factory, a unit plant is built. This plant is of such a size and is built in such a way that when it is running smoothly the manufacturer will feel justified in taking over its plan and spending such money as will be necessary to put in a very much larger unit or, it may be, several units.

The companies which were using the Institute during 1913—1914 spent approximately $55,000 in building small unit plants to develop the processes which were worked out in the laboratory. This did not include many processes which were adapted to the factory equipment already on hand. In no case was any of this money for plants provided for in the original foundation of the Fellowship, but in every case, after conference, the company felt that the progress of the work and the results obtained appeared promising enough to justify them in the expenditure of this money for further development. In the case of a number of these small plants in which processes have been developed, and where the processes have now gone into the commercial scale of operation, the plants are still available, being located in small, temporary buildings around the Institute; and such unit plants can often be adapted to the study of other new processes. The Institute is thus gradually acquiring what might be called a "large-scale equipment" that is undoubtedly unique in American laboratories.

General administrative and financial conduct.

Financial affairs. The financial affairs of the Mellon Institute are in charge of one of the assistant directors, who exercises general supervision over the endowment funds (general, permanent equipment, and library funds) and the Fellowship funds. The Fellowship funds cover expenditures for salaries of the investigators and the purchase of special apparatus. Individual booklets are kept for the accounts of each Fellowship. General, permanent equipment, and library charges are entered in separate ledgers. All payments are made by the treasurer of the Institute and the vouchers are retained by him.

Supplies. One assistant director exercises superintendence over the maintenance of supplies and equipment. The main store-room is in charge of a curator of supplies, directly responsible to this assistant director; and the sole duty of this curator is to tend the stock of chemicals and apparatus and to order materials required by the Fellows. Quotations on supplies are secured by the Fellows, who make all orders through the Office of the Institute. Orders are made on printed forms in duplicate; one form is sent to the company from which goods are to be ordered, while the duplicate is held in the Office and is bound permanently, in numerical order, in a loose-leaf system in charge of the curator of supplies.* The fund to which the order is to be charged, is indicated on each form. When an order is charged to a Fellowship fund, an additional carbon copy of the duplicate order is made by the Office and added to that Fellowship's booklet. All Fellowship booklets are balanced once a month, but at any time any Fellow may ascertain the exact status of his apparatus fund.

Reports. Weekly reports are received from each Industrial Fellowship in operation at the Mellon Institute. These weekly reports are filed chronologically, the reports of each Fellowship being put together according to a loose-leaf binding system; at the conclusion of every Fellowship, the reports, special and weekly, are bound permanently by the Mellon Institute Office. In the case of the Multiple Fellowships, it is the general custom for the Senior Fellow to incorporate the work of all the Fellows under his direction in his weekly report; that is, the Fellows report to him and he reports to the Institute. From time to time, special reports are made to the donors of Fellowships; these reports are filed in the same binder as the weekly reports, but are separate from them. At the conclusion of each Fellowship, a monograph of the work is prepared; with the consent of the donor, this may be published three years after the expiration of the Fellowship.

Correspondence filing system. Correspondence in the Mellon Institute divides itself naturally into five classes (see Plate II.); namely, Internal Relations Files (called Division II.), Fellows' Specific Information Files (called Division III.), Supplies Files, Applicant Files, and Extraneous Files (called Division I.).

Division II. These files include all correspondence with the donors of Fellowships and the Fellows' personal correspondence with the administrative officers of the Institute and with each other. This Division represents inside relations. The name and address of the founder of each Fellowship—firm or individual—are listed in the Institute's card-files "General Name Index" and "General Subject Index." For this Division there is also a separate information card-index.

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* At present, the catalogues of 475 different manufacturing firms are on file. For a description of the Mellon Institute library, see J. Ind. Eng. Chem., 1915, 7, 333.

* The Curator of supplies also keeps a record of all orders in an alphabetical card index. These cards give the order numbers, the dates of the orders, and the amounts of the expenditures.

Division III. These files include all incoming and outgoing correspondence written for the specific purpose of obtaining *special information* to forward the researches of the different Fellows. These letters are in most cases written and received by the Fellows themselves—sometimes, however, by the administration for the Fellows; in either case, the correspondence is filed in Division III. This Division represents Fellows' special outside relations. As a general rule, there is no card-indexing of Division III., as it is considered a private file, each Fellow having his own folders for his own research queries. Any letter, however, in Division III. may be card-indexed, if considered desirable, and the card filed in "General Name Index" or "General Subject Index."

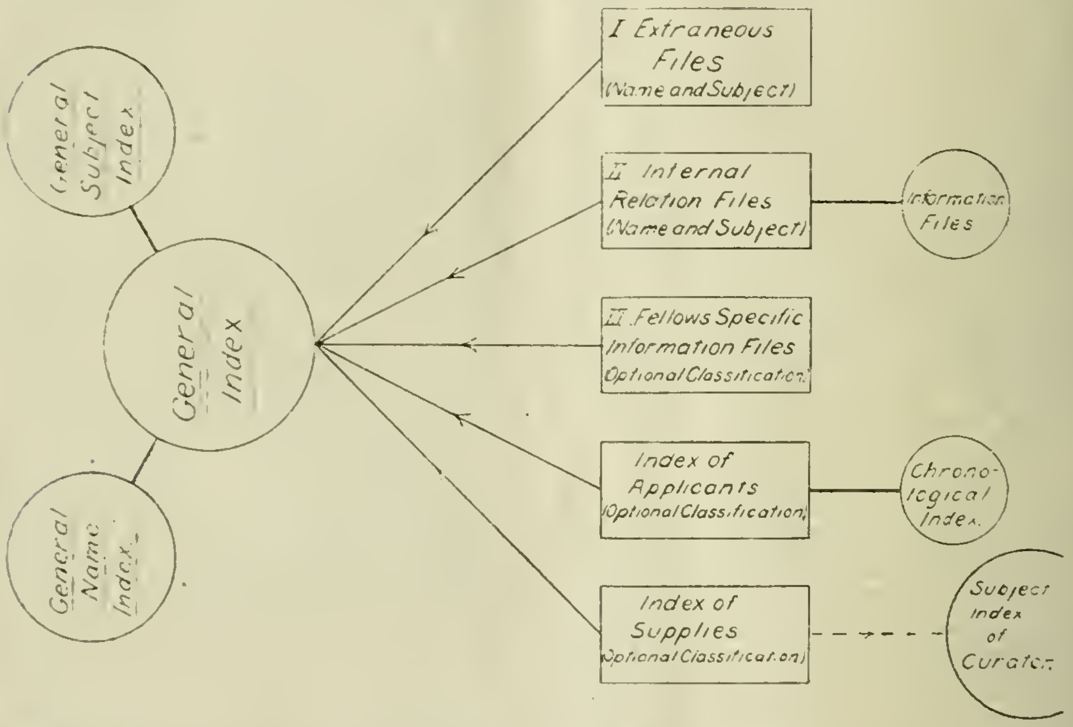
General Subject Index
General Index
General Name Index
I Extraneous Files (Name and Subject)
II Internal Relation Files (Name and Subject)
Information Files
III Fellows Specific Information Files Optional Classification
Index of Applicants (Optional Classification)
Chronological Index
Index of Supplies (Optional Classification)
Subject Index of Curator

PLATE II.
CORRESPONDENCE FILING SYSTEM OF THE MELLON INSTITUTE

Supplies files. These files include all incoming and outgoing correspondence dealing with the subject of supplies and apparatus for the Institute and for the various Fellowships. Address cards for the different firms are filed in the Institute's "General Name Index." The abstract of any letter properly belonging to this Division may be recorded in "General Subject Index" (see below), but this is done very rarely. The curator of supplies lists the apparatus purchased, separately.

Applicant files. These files include all incoming and outgoing correspondence with applicants for positions as fellows in the Institute, together with letters of recommendation from their professors, employers, etc. Any name, if desired, may be indexed in the Institute's "General Name Index" or "General Subject Index." For this Division there is kept a separate chronological card-index.

Division I. These files include all miscellaneous letters of general inquiry and information having nothing to do with the actual and practical furthering of the work of the Institute's Fellowships. These letters are usually addressed to the administrative officers of the Intsitute and concern any general subject. They come from all over the world—from chemists making new discoveries, cranks with strange plans, mining interests, etc., universities desirous of understanding the Robert Kennedy Duncan system, associations making appointments for addresses and visits, etc., newspapers requesting data for articles, individuals asking aid, etc. This correspondence is listed in the Institute's "General Name Index" and "General Subject Index." All letters of this division are card-indexed.

*General Card-Indexes.**

General Name Index. The General Name Index serves the purpose of listing alphabetically correspondents according to name and pointing out in which division the correspondence may be found. The contents of the divisions themselves are arranged alphabetically, with the exception of Division I., which is in numerical order. In this General Name Index are filed cards listing *all* letters in Division I., certain correspondence in Division II. and selected letters from Division III., Applicant Files, and Supplies Files, together with any name or address which it may be deemed desirable to remember, regardless of whether there is any correspondence in connection therewith—for instance, names of prominent scientists, noted men, etc.

General Subject Index. The General Subject Index serves the following purposes: (*a*) *As a letter finder.* The name of the writer of certain letters may be forgotten and only the general contents of the correspondence remembered. This card-index lists alphabetically, according to certain arbitrary rules, all such correspondence according to subject. It serves to recall names of correspondents; it does not point out where the correspondence may be found, but indicates, through brief extracts of the subject discussed, the *names* of the writers and is thus, when necessary, a guide to the General Name Index. (*b*) *As a fact recorder.* The contents of letters coming in from the world at large are generally of great interest and utility. Strange facts and useful references are daily brought to our notice by investigators and observers. These facts and references, coming in constantly, accumulate and might be forgotten. The General Subject Index, therefore, chronicles alphabetically the contents of letters which are worthy of note. Care is always taken in abstracting, as only general information is recorded, and never any inside Fellowship facts or details of processes. The subject cards, dated, are left intact in the files; they represent the facts as they were at the time the letters were written; and no alterations are made (changes of addresses, etc., which changes are made *only* on the cards of General Name Index). In this General Subject Index are filed cards listing: the facts abstracted from the correspondence of Division I., the manufacturing lines of firms represented in Division II., selected topics from Division III., exceptional subjects of letters from Applicant Files, and—but very rarely—notations from the Supplies Files. (*c*) *As massed information.* These subject cards also serve as suggestions in regard to the trend of the times, listing as they do movements from direct sources. In one day, perhaps, three different letters from three different parts of the country may be received, dealing with the same phase of the same subject; many curious coincidences occur. The cards serve thus as collective information of wide-spread origin.

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* See Plate II.

The General Subject Index is in charge of the Secretary to the Director and another of the secretarial staff. A short time devoted to it every day by both members serves to record such facts as are necessary and to index miscellaneous letters carefully.

The General Name Index is added to by the various members of the secretarial staff, one being in charge of letters dealing with supplies, another with applications for positions in the Institute, another with extraneous subjects, and others with the Fellows' special information correspondence. The Index being a simple guide to where letters are filed, the time devoted to it per day is negligible.

Special Card-Indexes.

Information. This card file contains all private information in regard to any Fellowship which is, or has been, in operation in the Mellon Institute. These facts are listed for quick reference. An alphabetical list and a numerical list of Fellowships are kept. All vital points in connection with the researches are recorded in the alphabetical list; for instance, the names of the donating companies, the Fellows chosen for the work, the amounts in money of the different Fellowships, the dates of the beginnings and endings of the various investigations, etc. A list of all Fellows, past and present, is kept ("once a Fellow, always a Fellow"), a list of monographs to be published, and a list of the years in which such monographs shall appear. This file is in charge of the Secretary to the Director and is strictly private.

Applicant. As the applicant letter-files themselves are alphabetically arranged, there is kept a chronological card-index for applicants which is for the purpose of recording, according to date of application, all names worthy of note, together with vital facts concerning them—degrees, scientific recommendations, etc. This file is taken care of by one of the secretarial force and requires but a few moments every day.

Supplies. This special card-file is in charge of the curator of supplies, who lists the pieces of apparatus purchased and any supplies worthy of record.

External affairs.

External affairs of importance in connection with an endowed institution of research are:—

(1) Promotion of the progress of science and stimulation of further investigation by making available to the workers in science complete and detailed accounts of what has already been done.

(2) Establishment of stable relations between the institution and other organisations, especially ones which are engaged in conducting or fostering research.

(3) Education of the public to the realisable functions of research.

(4) Imparting to the popular mind a wider recognition of the lines of demarcation which distinguish research from other worthy objects.

(5) The dissemination of dignified publicity material relating to the investigational activities of the institution, and to its capacities and facilities for research.

(6) Finally, in the case of institutions devoted to industrial research, the constant maintenance of a familiarity with the progress in technology and with the problems of manufacturing. The aim of every industrial operation is towards perfection, both in process and the necessary mechanical equipment, and every development in manufacturing creates new problems.[*] It follows, then, that the greater the number of researches in a given field, the greater is the progress in that field, and the greater becomes the number of new problems. The institution devoted to industrial research should be acquainted not only with those fields of industry which have been insufficiently investigated, but also with the problems which engage the attention of present-day industrialists.

It may be predicted that a number of independent organisations will enter the field of industrial research in the near future. For instance, the proposal has been made to establish State industrial research stations,[†] to be conducted along the same general administrative lines as the various Agricultural Experiment Stations, and some progress has, in fact, been made in this direction, for the University of Kansas has, in its Department of Chemistry, a Division of State Chemical Research. Then, too, the Royal Canadian Institute has lately inaugurated a Bureau of Scientific and Industrial Research, based upon the system in operation at the Mellon Institute, and the University of Sheffield and the Sir John Cass Technical Institute are contemplating a similar step in England.[‡] The experience of the industrial research institutions now in operation, which is certain to be drawn upon heavily in this movement, should be readily available, therefore, for use by their prospective allies. Their entrance into this field should be warmly welcomed. No greater good fortune could come to the Mellon Institute, for example, than a division of labours with a number of similarly well-founded establishments; and no greater good to society can arise than from a wider distribution of the duties and responsibilities of research.[*]

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[*] See Bacon, J. Ind. Eng. Chem., 1915, **7**, 535; and Bacon, Sci. Am. Suppl., November 20, 1915.

[†] One of the strongest arguments in favour of a State institution engaging in research for private individuals or corporations under a Fellowship system is this: work which is done for everyone and is immediately published freely is not likely to be taken up by individual concerns, since what is everybody's business is nobody's business, in manufacturing as elsewhere; and these concerns, as a general rule, will not see the significance of the possibilities of such general work in their own specific lines and do not know how to apply the results obtained to their own specific cases. In other words, almost any corporation's problems are somewhat specific to that particular corporation—the local conditions under which it operates and its general business policy—so that even after general principles are worked out and discoveries are made which are of value to the particular corporation, it is still necessary to work out the methods which will make these discoveries of commercial value to the particular corporation concerned. This, obviously, can only be done through some such system as that in operation at the Mellon Institute of Industrial Research, for, if a State institution does industrial research in general, it can not consistently apply the results to particular corporations.

[‡] The following are among the other institutions which are considering the establishment of Industrial Fellowships in accordance with the practical system in operation at the Mellon Institute: University of Washington, Georgia School of Technology, Massachusetts Agricultural College, and Sydney University (N.S.W., Australia). For an appreciation of the system of industrial research in operation at the Mellon Institute, see Humberstone, Quart. Rev., 1915, **224**, No. 445, 521. See also Mon. Rev. of Rev., November, 1915, 621.

"No wild enthusiast ever yet could rest,
Till half mankind were like himself possessed."

In keeping with this attitude of welcome towards prospective industrial research organisations, it is important to add that with them, as with educational institutions, no relations can be stable and helpful, but relations of reciprocity.[†] Co-operation is just as essential among research laboratories as it is among the members of a research team. The main object and the common endeavour of all research institutions should be to secure for competent investigators the most favourable opportunities for productive research. For scientific research in general and for industrial research in particular, the following lines are beautifully appropriate: "Words of friendly criticism may be as silver, but far better are golden words of encouragement."

Discussion.

Dr. A. M. Comey said that at the Du Pont Co. there had been a large research department for many years, but they had never been troubled in the least with the personal jealousies or antagonisms which had been mentioned. They found that it was essential entirely to separate research activity from routine laboratory work. Research workers with experience would take charge of an individual piece of research work and be made entirely responsible for its progress and success; new men were put under these as assistants until they were capable themselves of taking charge of other investigations. Each man was given repeated opportunities of consulting with the officers of the company particularly interested in the investigation, and thus had a direct means of seeing that his work was properly appreciated. It was practically impossible, and he believed it would be undesirable, to try to work such men on a routine or systematic basis. They came and went at their own pleasure, and all that was expected of them was results. It would be objectionable to ask such men to punch a time-clock.

The research workers of necessity came into very close contact with the factory practice before their investigations were completed. Their procedure was first to carry out the work as far as possible in small laboratory apparatus, and next in similar small apparatus, choosing the materials of probable construction in the factory; when they were satisfied that those materials would not interfere with the procedure of the reaction in the factory, they carried out the operation on a technical laboratory or small factory scale, at which point the research worker had the co-operation of the engineering staff and of the manufacturing men in whose department factory operations would fall. After that plan had been worked out, the research worker co-operated with the engineer and the factory man, in putting the process in operation in the factory.

In that way all research men got the benefit of the factory experiences applicable to their work, and occasionally a valuable factory man was developed from a research worker. There were temperamental differences between the successful investigator and the factory operator, and they believed that it was the exception rather than the rule when a man passed from one division of the work over into another.

With regard to the system of rewards, they firmly believed that a bonus system was desirable, but made no effort to calculate the amount of bonus on the basis of saving or value. Two classes of bonuses were given, one for the quality and character of the work done, *i.e.*, successful prosecution of the research, whether the results were of any commercial value to the company or not; the other purely dependent on the commercial success and adoption of the work. They paid their men sufficiently well for them to be satisfied and enthusiastic in their work without regard to the bonus, but they felt that the bonus was a necessary inducement for the quick completion and definite prosecution of research, and contented the man to turn the result of the work over to the company.

Dr. Colin G. Fink said that the value of an industrial research laboratory was very often largely dependent upon the rapidity and speed with which urgent problems could be solved. A number of the Edison lamp factories were directly dependent upon German potash. The factories looked to the research laboratory to find a substitute; they could not wait two, three, or more years for an elaborate investigation to be carried out, but wanted the answer within a week or a month. The factory must feel that it can look to the industrial research laboratory to render speedy assistance in emergencies.

The system of compensation of research chemists, outlined by Dr. Comey, seemed most admirable. It was well to emphasise that in 99 cases out of 100 a research man preferred full credit for actual results and services, to an increase in salary or a dozen bonuses and no credit at all.

Dr. J. B. F. Herreshoff spoke of the exhaustive researches involved in the work of the General Chemical Company at various times in its development, particularly in connection with the contact process for making sulphuric acid, in which case more than a thousand independent researches had been undertaken; each of these had been fully reported upon in detail, and the reports filed under lock and key in the records of the investigation department, where they could be consulted by anyone authorised to do so in connection with his work. There had been little difficulty experienced in the work of the company owing to friction or any jealousy among the research workers, and while the research work was largely independent of the analytical routine, nevertheless the routine analytical laboratory co-operated to some extent in aiding the research work.

Dr. A. S. Cushman said that industrial research might be endowed for public spirited and educational purposes; it might be supported by separate manufacturers to work out their own specific problems; it might be of a general commercial nature, or finally it might, like the work under his own direction, partake of something of the nature of all those lines at the same time. It was impossible to lay down rules for the most efficient conduct of such varying types of research work. He felt that sometimes in the effort to be systematic and efficient, individualism and genius were liable to be dwarfed. He deprecated the system of regular weekly reports, as he felt that the time and interest would be better spent in the work itself, postponing the literary and descriptive effort to such time as the results justified. He agreed that the men who were to be successful in prosecuting industrial research must possess, in addition to education and training, personality tempered by common sense. Above all, he believed that they must have the ability to get along well with the practical men with whom it was their special function to co-operate, and who were usually quick to classify a man as a live wire or dead timber. It was only by the closest co-operation between the office, the operating department, and the research department that useful progress could be made.

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[*] The national trait of desiring quick returns for a minimum expenditure of money has induced certain empirical work, which has gone under the garb of industrial research and is even now the predominant principle in many of the so-called research departments of our industrial plants. The system in operation at the Mellon Institute constitutes a tried method of combating pseudo-research in industry, for the cost factor is reduced to a minimum.

[†] There is one serious danger in connection with the establishment of Industrial Fellowships which is of much concern to the Mellon Institute and may therefore be mentioned here, and that is the danger that, in order to obtain fellowships, the heads of research departments will modify the conditions under which Industrial Fellowships are accepted at the Mellon Institute. This would be a very serious matter and might lead ultimately to the failure of the whole plan.

Nottingham Section.

Meeting held at University College, on Wednesday, November 24th, 1915.

DISCUSSION ON THE PROPOSED ESTABLISHMENT BY H.M. GOVERNMENT OF A CHEMICAL INTELLIGENCE DEPARTMENT AT THE BOARD OF TRADE.

In opening a discussion at Nottingham on this subject (see this Journal, 1915, 763, 1173), Dr. M. O. Forster said :—

My sole object in making this proposal is to turn the present misfortunes of our country to its future benefit, and I ask you to assist in this work by supporting a suggestion which should go far towards bringing at least one Government Department into closer association with the methods and potentialities of scientific procedure. The moment is particularly suitable for such an effort, because not only the military, but also the commercial demands of the country combine to emphasise the importance of the part which chemistry itself plays in the national economy ; at the same time the public, rudely shaken from their customary complacency by the shocks of war, now devote greater attention than ever before to schemes which are calculated to improve the general efficiency. The mind of the people resembles a newly sensitised film, and it is our duty so to focus opinion that a clear and moving picture may arise from its exposure to the new conditions. If only we possessed a chemical Charlie Chaplin to seize the public imagination, the task would be a comparatively easy one.

It is not my intention this evening to cover the old ground which is common to us all, and to advance the numerous explanations given during the past thirty years to account for the giant strides of Germany along the path of scientific progress, strides in comparison with which our own footsteps appear lame and faltering. The band of British ostriches who claim consolation in the past achievements of our country is rapidly diminishing, for the sand in which they love to bury their heads has been whirled into a storm which threatens to envelop their whole bodies. We are all alive to those achievements, we glory in them and honour their authors, but we cannot conceal from ourselves the fact that they could have been vastly multiplied in scope and splendour had our rulers taken the trouble to study the trend of cosmic development, and adapted the result of their investigations to practical politics. The best reply to the ostriches is to ask them to consider for a moment the dazzling position which the British Empire would have occupied in 1914 had there been brought systematically to its government that thorough practice of the scientific study of resources which characterises the procedure of our enemies. The Empire contains, or is capable of producing, practically everything that we need excepting potash ; the only other exception until recently was nitre, and the Imperial nitrogen is just as suitable as any other for oxidation to nitric acid. How long would Germany have remained dependent upon the United States for cotton had she possessed our climatic resources for so long a period ? To take another illustration, very much nearer home to us chemists : is it to be believed that Germany would have gone to the trouble and expense of establishing the commercial synthesis of indigo before doing what we scarcely attempted to do, namely, exhaust every scientific device for bringing indigo-cultivation to its optimum, and then standardising the pooled product ? In my belief, had this been done, a perfectly uniform natural indigo could have been produced at a cost so chilling to the marrows of Ludwigshafen that Baeyer's admirable investigations would have dwelt for ever in the text-books while the Badische's million jingled in the pockets of the shareholders. Does anybody here, who has had to calculate the cost of 23 tons, 11 cwt., 3 quarters, 25 lb. of material at £17 8s. 6d. per ton, imagine for a moment that a scientific-minded people would have tolerated the duodecimal " system " longer than was necessary to burn the elementary arithmetics, print new ones, and cast fresh weights ? Would a maritime people, suitably cultivated in a spirit of scientific inquiry and occupying unlimited seaboard, have neglected to utilise the vast stores of energy running to waste twice every twenty-four hours in the shape of tides, and is it not conceivable that one of the motives prompting Germany's desire for " a place in the sun," is a natural and proper anxiety to harness radiant solar energy ? To pursue for a moment longer this idea of a British Empire run on scientific lines, I say unhesitatingly that had our people embraced this principle simultaneously with Germany, namely, in 1871, had they even postponed its adoption for 10 or 20 years, the world-war would have remained in limbo, for Germany would never have dared to precipitate it in the face of such colossal risks. In this sense, British neglect of science is one of the contributory causes of the war.

The suggested scope of the Chemical Intelligence Department has been already published,[*] and I will therefore first refer very briefly to the more obvious consequences of its adoption, and then deal with some criticisms which have been directed towards it. The most immediate advantage arising from its establishment at the Board of Trade should follow from the missionary enterprise of its chemical staff. I am not among those who profess to hold Government officials in contempt. On the contrary, I have the highest admiration for their probity, their capacity, their urbanity, and their polite education ; but that education is one-sided, and has followed lines which run straight and strong from the abolition of the monasteries. Here is another grievous waste of material, namely, brains and character, for I fully and gladly recognise that the brains and character concentrated in Whitehall are of the highest order. If it served no other purpose than a matrimonial agency for uniting such splendid qualities with the resources of modern science, the Chemical Intelligence Department would more than justify itself. It is for this reason that I am unfavourable to the suggestion that the various chemical societies, subsidised for the purpose by the State, should themselves conduct this bureau, independently of government administrative assistance; since Whitehall has never gone to Chemistry in the past, I believe the best hope for the future lies in Chemistry going to Whitehall. Moreover, that is exactly what is happening now. War has constrained Whitehall to go into the highways and the hedges, and compel the chemists to come in; the wedding-feast should not be abandoned when peace is declared, but should rather be gladdened and compacted by the illuminations.

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[*] See this Journal, 1915, 763, 1173.

Dr. Forster then explained his scheme on the lines already published (*loc. cit.*), and proceeding, said:—

I will now deal with the objections to the scheme which have been brought forward in discussion or the press. The first of these takes the form of contending that it is not the business of the Government to organise chemical industry, which should be undertaken by the chemical manufacturers themselves. I quite agree, but would point out that I do not expect the Chemical Intelligence Department to organise chemical industry, but it would, in my belief, present a definite nucleus around which that organisation might take place. The need for some such nucleus is surely apparent from the fact that not only was the chemical industry unorganised before the war, but there are no conspicuous indications that the war has brought the desired reformation. Another critic inquires why chemical industry, as distinct from engineering and other industries, should be singled out for special treatment. The answer to that is two-fold. In the first place, the fundamental importance of chemistry has been overlooked by Governments in particular and the public in general, largely owing to the inexcusable confusion between chemistry and pharmacy; and secondly, because medicine, the law, the Church, and engineering in its various forms are already organised and trade-unionised, and do not therefore stand in the same need of consolidation and public recognition as chemistry. How does chemistry stand in the Houses of Commons and Lords compared with engineering, textile manufacture, shipping, railways, law, and the Church? I hardly hope that this question will answer the gentleman who, writing in the "Journal of Gas Lighting," November 9th, declares, "those of the chemical industry who think the Board of Trade should take the industry under its wing, and act as intelligence collectors and circulators for its benefit as much as for that of the 'national economy,' should explain why such preferential consideration should be showered on it, and not on other industries which are equally worthy, if not so opulent," because there lies throughout his article a vein of petulance and superficiality which leaves little hope of reconciliation to the proposal. The same gentleman accuses me of impracticability for suggesting the modest sum of £5000 per annum for upkeep of the Department. Of all possible objections to a new departure, the one most easily overcome is a complaint that insufficient money is demanded for the preliminary experiment, because the shortcoming is not inherent to the proposal itself, and can be rectified immediately the scheme is accepted on its merits, or justifies further outlay. The one piece of constructive criticism which has been adduced hitherto was voiced by Mr. Gordon Salamon on November 1st, supported by other members of the Society, and endorsed by the "Mechanical World" of November 12th in these words: "Difference of opinion exists as to the wisdom of creating a Government Department run by permanent officials. At the moment, probably, the stronger body of opinion is in favour of a joint committee appointed by the various societies dealing with the industry, something on the lines of the governing body of the National Physical Laboratory, which would have direct control over a permanent staff free from any influences of the class of administrator who is so essential to our Government Departments, but who nevertheless lacks the training for carrying through the scientific work of the nature contemplated." This criticism I welcome wholeheartedly, and believe that by the adoption of its principle in a somewhat modified form, the Chemical Intelligence Department might become a real galvanic force, stimulating the activities of the smaller manufacturers, linking them up with those of the larger, embracing the sympathetic co-operation of consultants and college chemists, and laying open to all that element of Government comprehension and support which must be forthcoming if the British chemical industry is to withstand successfully the onslaughts of its competitors in the years to come.

Professor F. S. Kipping cordially supported the scheme, which he considered an excellent one, and hoped that it would be put into effect without delay. His own position would illustrate what was possibly the position of a great many other men in the country at the present moment. Before the war he had been engaged in research work which was remote from anything of a commercial character. When war broke out and the importance of chemistry was brought more firmly before the country, it seemed to him—as no doubt it did to many others in a similar position—that they were rather wasting their time by devoting their energies to pure research work, and that they ought to give up those lines and try to do something useful in the ordinary sense of the word. Anyone who did that was immediately confronted by very great difficulties. He did not know what the demands of the country were: he had no idea what he ought to start research on, and if ideas struck him he was ignorant what had been done already. It seemed to him that an information bureau such as Dr. Forster suggested, whether carried out by a Government department or whether carried out on the lines of a committee or body of governors of the National Physical Laboratory, would be an exceedingly useful and an immediately practical thing. A circular had been sent out to all the Fellows of the Chemical Society, inviting suggestions as to researches which might be undertaken. It was not the province or in the power of the teaching chemist—the man engaged in pure scientific research—to make suggestions of that character. What was wanted in this country was to produce the things already on the market. They did not want to make new discoveries, but to compete with the enemy in goods and processes already on the market. Therefore attention must be paid to processes which were known to a certain extent and the details of which might be all-important, upon which details no doubt depended the success of manufacturing.

Mr. J. T. Wood asked what was the relation of the proposed scheme to that of the Board of Education for the organisation and development of scientific and industrial research? Would the two schemes overlap in any way? The Joint Committee of the Society of Chemical Industry, appointed to prepare a report on the co-operation of chemical manufacturers, also seemed to fit in with Dr. Forster's scheme. He hoped the matter would very soon be brought to a practical issue.

Mr. F. H. Carr said that the criticisms of the scheme to which Dr. Forster had referred, had dealt largely with the question of whether the proposed department should be a Government one, or whether it should be organised by the learned Societies. The Committees and Councils of these Societies were generally composed of amateurs and a few professional people who were exceedingly busy in their daily occupations, and, usually speaking, the amateur was most conspicuous on them. A scheme like this required the best possible commercial forces behind it, not amateur ones. Further, supposing that this Society were able to run it, the Council would need some official sanction to compel manufacturers to supply the necessary information. Unless they could do that, one of the greatest advantages of such a bureau would be lost. Those in the industry were naturally jealous of each other's efforts, and were anxious, if possible, to develop their own businesses, and in order to develop them they were anxious that their competitors should not develop too fast; consequently manufacturers were secretive. On the other hand the present time, while the market was practically unlimited, and not the end of the war, was the proper opportunity for co-operation. If they delayed too long, the manufacturers, having increased their plant greatly, would be feeling the pressure of German competition, and that would be a most inopportune moment for pressing the matter forward. At the present time his firm was attempting to make phthalic acid; they had not the dimmest notion whether half a dozen firms or one were trying to make it, or whether the weekly requirement was one ton or fifty tons. Working out such processes required a certain amount of time, and if the work was being duplicated by some other firm, one of the firms would be better employed working on another of the many chemicals which were required.

Mr. H. Droop Richmond said that the success of the scheme would depend very largely on the man who was chosen to be the head. The scheme itself was admirable. One point where it seemed to him it might fail was this. In England there was unfortunately a tendency to choose the wrong man, or not to choose the best man, but he thought there was a reasonable prospect, if this scheme were adopted, of actually getting the best man appointed. The best man, in his idea, would be the man who had a distinct personality—a charming personality—because he would have to persuade a great many people to do what they did not want to do. The English manufacturer was inclined to think too highly of his own manufactures, and to regard things as secret which were not actually so; the director of this bureau would have to persuade him to look at things in a broad light and to divulge a certain amount of information which in the past he had kept to himself. As to the position of the consultant under this scheme, he knew, in the first instance, practically nothing about what he was called in to advise upon. He only knew what the manufacturer did not know, and the consultant had first to find out what the manufacturer knew. He had then to apply a few chemical facts, and give back the information he abstracted from the manufacturer himself with the addition of these chemical facts. It seemed to him that the scheme will be of great assistance to the consultant, in that he would not have to go through the laborious process of abstracting the knowledge from the manufacturer, but would be able to get a very large amount of information from the Intelligence Department. It might be said that a chemical manufacturer could also get advice from the department, but he would not be able to get the special chemical knowledge that he wanted. In that way he thought it would improve the position of the consultant. To a certain extent it might go against the interest of the consultant in that there would be instances in which the manufacturer would be able to go to the Intelligence Department, but when once the chemical manufacturer was imbued with the scientific spirit, and was anxious to get scientific knowledge into his works, he would come to the chemist very much more than he used to do. In one works where a chemical department was established, the work of the consultant, contrary to expectation, had increased as the result of the establishment of the chemical department. That was because once a manufacturer realised the advantage that the aid of chemistry could give him he turned more and more to chemistry. Therefore the consultant need have no fear that the establishment of a scheme like this would go against his interests.

Dr. R. M. Caven said that we, as a nation, had failed in the past to recognise the extreme importance of chemistry. He thought that question arose when they considered what relation the new Department was to bear to the Government. If this new Department were to be, so to speak, usurped by the Government and by our national representatives at the present time, there was a fear that our awakening to the importance of chemistry would not last; for in the appointment of Committees for manufacturing dyes the men who knew most about the subject had been overlooked or put into the background, while officials, men of business and of political importance, had taken the lead. It seemed to him, therefore, that if the new Department was to be put under Government at all it was most important that full recognition of the profound importance of scientific chemistry should be secured from the outset, otherwise there was a danger that we should fall again into the old error. Then there was also the question of individualism. Research chemists had been individualists. They had chosen congenial subjects, pursued them intently and individually, and published their results without relation to others. Now it was being recognised that scientific problems should be co-ordinated, and men best qualified to carry them out should be asked to undertake them. At the present time we were losing much of our individualism in this country in consequence of the terrible conflict in which we are engaged. In view of this national exigency, this trade and scientific conflict with our enemies, was it not also necessary that scientific individualism should be limited or sacrificed? Should not we pursue a policy of mutual aid, not only in scientific research, but also in manufacture, so that as a nation we could get the most out of the forces we possess? He thought there was individualism amongst manufacturers in the same sense as amongst scientific chemists; and if scientific chemists were to sacrifice their individualism for the nation's good, the question arose how far manufacturers should also sacrifice theirs, how far the policy of co-ordination in regard to trade and manufactures should be pursued as it was now being pursued in the making of munitions. It seemed to him that this point should be considered in connection with the subject.

Mr. S. J. Pentecost said that, as chemists, they must not approach the subject from a selfish point of view. The matter of expense had been referred to, but it seemed to him that municipalities alone would save much more than the amount that had been mentioned as the result of such a scheme. He referred to those municipalities that perhaps worked gas plants and supplied water to various towns.

Mr. Smith thought that the conservatism of manufacturers and their fear of disclosing valuable information could very easily be overcome; manufacturers had already had experience of the loyalty of Government Inspectors to the profession in not giving away secrets.

Mr. Duncalfe said that the glue industry was being pushed forward very much in Germany. Until very recently indeed it had been worked almost entirely by rule of thumb methods in this country, in consequence of which the Germans had forged ahead and had become a very great power, supported as they were by the Government. There had been no information in this country in the way of intelligence, and it seemed to him that the suggested Intelligence Department would be a benefit and render a very great service. His own firm had had a desire to develop new processes in connection with the industry, and no information whatever with regard to those processes had been available in this country. Manufacturers had been extremely secretive and had worked very independently indeed. The consequence had been that his firm had had to obtain these processes from Germany. Whether they were the best of their kind he could not say—probably not, but they had had to obtain them such as they were from Germany, and to buy all the necessary plant from the same source. It seemed to him from the point of view of the manufacturer that there was practically an unlimited scope for trade if it was only properly organised to-day.

Dr. E. B. R. Prideaux understood that the idea was to pool the information of the country, as it were. From the point of view of productiveness that was all to the good, but the question was how did they stand with regard to other competing nations in reference to pooling information? Information got together was obviously open to the whole world. What had the German Government been doing in making scientific information available to all their manufacturers, and at the same time not throwing it open to the whole world?

Mr. Morton asked if, in case of all the scientific information being pooled, the necessary chemical work would be pooled also. If two or three big manufacturers were working on certain products the smaller manufacturers would not be able to compete at all in those particular branches, if the big manufacturers had all the information. It put the smaller manufacturers in such a position that without the extra capital and the extra business capacity the big manufacturers had at their disposal, and in the face of their having to get along with old plant that should have been scrapped years ago, the smaller manufacturers would simply have to devote themselves to other articles.

Professor Bulleid said that the problem of spending money on research was one which was always being encountered in engineering. He thought that the effect of this Bureau would be to stimulate the work of the consultant and not reduce it.

Mr. Collitt thought if the directorate of such a Bureau as suggested was to be appointed by the Government many people would have serious misgivings. With regard to Clause 3, Section A (collection of information, etc.), he thought it would be a good thing to make it "manufacturing plant" instead of "chemical manufacturing plant."

Dr. Forster, in reply, said that as no vital objections to the proposal had been brought forward, and criticism on the whole was favourable, he hoped the Section would pass a resolution requesting the Council to consider the scheme, and to take such steps to put it into execution as they think proper. The word "organise" appeared to have a dangerously hypnotic effect, because when uttered, it often left people exactly where they were before. He did not agree with the suggestion that the Intelligence Department should advise on questions of finance; that would involve the employment of a large number of legal gentlemen in actions for slander, which might obscure the usefulness of the scheme. With regard to the fear that pooling important information would render it accessible to the whole world, he did not anticipate that the bulk of the knowledge accumulated would be of such a confidential nature as to make this a serious difficulty, and it would in any case rest in the discretion of the Director to decide whether certain information should be withheld from the public. Whilst it would be obviously unreasonable to ask a manufacturer to give a list of his customers, or to say how much of his various products went to each, benefit might come to producers if an inquirer could be informed immediately as to what they produced, and the collection of such information, properly scheduled and indexed, would be one of the duties of the Department. His testimonial to Government officials was absolutely sincere; they represented a splendid body of men, and one of the few things we had to be grateful for in our particular form of government was that it was served, so far as the permanent officials and administration were concerned, by a body of men who were absolutely above suspicion and above reproach, the only complaint being that they had been brought up in such a way that they could not appreciate the possibilities of scientific procedure. The advantage of German practice lay in the fact that the whole attitude of the people towards scientific work was different. Any ordinarily well-educated German, who might not be a practising chemist, nevertheless had a general idea of the possibilities of chemical work. He would be able, for instance, to appreciate the importance of producing nitric acid from the atmosphere, whilst the corresponding Englishman's mind was a blank on the subject, because he had not the faintest idea what nitric acid was, and would hardly be certain that oil of vitriol was not a lubricant. On the question whether the Department would be inimical to chemists in consulting practice, it was encouraging to hear Mr. Richmond and Professor Bulleid express the belief that, on the contrary, it would be helpful to consultants: that was his own conviction also, for which he had already given his reasons. He agreed with Mr. Carr that the scheme should have the prestige of some Government Department behind it, otherwise the maximum amount of useful information would not be accumulated, and there would be diminished benefit accruing to Ministers and the State.

A resolution calling upon the Council of the Society to use its best endeavours to forward the adoption of Dr. Forster's scheme, was carried unanimously.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56, Rue Ferou, 8, Paris (3e); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Smoke, fume, and dust problems; Solution of —— by electrical precipitation. L. Bradley. Met. and Chem. Eng., 1915, 13, 911—914.

A general survey of the smoke, fume, and dust problem is given, dealing with a variety of industries, and showing that a considerable saving might be effected in many cases by extracting the values escaping at present into the atmosphere. A method of electrical precipitation is described, in which direct current discharges at high voltages (75,000 to 100,000 volts) are passed, between discharge and collecting electrodes, through the gases in iron pipes, the velocity of the gases being so regulated as to remove completely the suspended particles (see this J., 1911, 1037). Fractional precipitation may be obtained, when substances of varying volatility are contained in the gas, by treatment at varying temperatures. As examples of the value of the process, it is stated that at a sulphuric acid concentrating plant 2—3 tons of acid was being wasted daily as mist; and in another case, destruction of vegetation in a park near a works from which hydrochloric acid fumes were evolved, was entirely prevented by use of the process.—B. N.

Cumberland electrolytic process for preventing corrosion of all metals immersed in liquids. Cumberland. *See* X.

New hydro-electric power plants in Norway. See XI.

Patents.

Scale in steam boilers and the like; Process for preventing the formation of, and removing ——. G. G. Schlaepfer, Milan, Italy. Eng. Pat. 3489, Mar. 4, 1915.

To prevent the formation of, and to remove scale in steam boilers and the like, powdered porous carbon, such as animal or vegetable charcoal, coke, or lampblack, mixed with caustic soda or sodium carbonate solution, is added to the water. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 228 of 1866, 2925 of 1881, 11,195 of 1889, and 15,292 of 1903.)—W. F. F.

Filtering: Apparatus for use in —— or for separating solids from liquids. Brinjes and Goodwin, Ltd., London, and F. Titterton, Walthamstow. Eng. Pat. 22,481, Nov. 13, 1914.

A NUMBER of vertical filter elements covered with filter cloth are spaced apart in a tank having an open top and a hinged bottom. The material to be filtered is fed into the tank and fills the spaces between the filter elements. The clear liquid passes through the cloth into the interior of the elements and is discharged into a vacuum receiver or other tank. When sufficient cake has accumulated, the hinged bottom is lowered and the solid matter is loosened and discharged, either by bars or scrapers, which pass between the filter elements, or by compressed air or water forced into the filter elements.—W. H. C.

Soluble constituents: Apparatus for extracting —— from vegetable, animal, or mineral substances. H. Kaminski, Georgetown, S.C., and F. C. Niederhauser, jun., Paterson, N.J. U.S. Pat. 1,161,135, Nov. 23, 1915. Date of appl., Jan. 19, 1912.

A SOLVENT is evaporated in a tank and the vapour is passed through a condenser to a horizontal spraying pipe in a heated horizontal cylindrical chamber, containing the material to be treated and provided with a rotating helical mixer which feeds the material towards the axial discharge opening. The used solvent flows back to the tank by gravity.—W. F. F.

Liquefaction of gases by expansion without recuperation of external work; Process of ——. G. F. Jaubert. Fr. Pat. 475,255, Jan. 31, 1914.

THE gas to be liquefied is subjected, during its passage through the heat interchanger, and consequently when its properties are already far removed from those of a perfect gas, to a supercooling, effected by a difficultly condensable gas (preferably the same gas as is being liquefied), which is cooled by a portion of the return gas from the main apparatus.—W. H. C.

Separation of mixtures of gases liquefying at very different temperatures [e.g., hydrogen from water-gas]. L'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude). Fr. Pats. 475,297, Feb. 4, 1914, and 475,346, Feb. 10, 1914.

To obtain pure hydrogen by the partial liquefaction of water-gas, the greater part of the carbon monoxide is liquefied by the cold produced by the expansion of the liquefied carbon monoxide from a previous charge, and the last traces of carbon monoxide remaining with the hydrogen are liquefied either by the cold produced by the expansion of the whole or a portion of the separated compressed hydrogen, or by the evaporation of liquefied carbon monoxide containing dissolved hydrogen.—W. H. C.

Calcining kilns. J. A. Owen, Astrop. Eng. Pat. 2003, Feb. 8, 1915. Addition to Eng. Pat. 14,959, June 23, 1914 (this J., 1915, 212).

THE air-admission cone described in the principal patent is lengthened axially and divided into a number of compartments by horizontal plates. The compartments are supplied separately with air at different pressures. The division plates are made in two or more sections to facilitate removal.—W. F. F.

Precipitation, and precipitating apparatus. H. R. Conklin, Joplin, Mo. U.S. Pats. 1,160,849 and 1,160,850, Nov. 16, 1915. Dates of appl., Apr. 7 and June 26, 1915.

THE solution and a solid precipitant in small pieces are passed in opposite directions through an inclined spiral conduit, which is rotated about its axis. The precipitate is detached from the pieces of the precipitant by friction, and removed separately, the precipitant being returned and used again after separating very small particles.—W. H. C.

Leaching; Apparatus for methodical and continuous ——. Soc. Anon. d'Exploit. de Proc. Evaporatoires (Systeme Prache et Bouillon). Fr. Pat. 476,150, Apr. 7, 1914.

THE material and the leaching liquid are passed continuously, in opposite directions, through a cylindrical extractor, and at certain points of the circuit a portion of the partly saturated solution is withdrawn and concentrated in a tubular evaporator of the injector compressor type, and the concentrated liquid is returned to the extractor. The condensed water from the heating steam used in the evaporator is used instead of fresh water in the extractor.—W. H. C.

Treating liquids with gases and vapours. W. Feld. Fr. Pat. 475,387, May 19, 1914. (Extension of U.S. Pat. 1,110,914; this J., 1914, 999.)

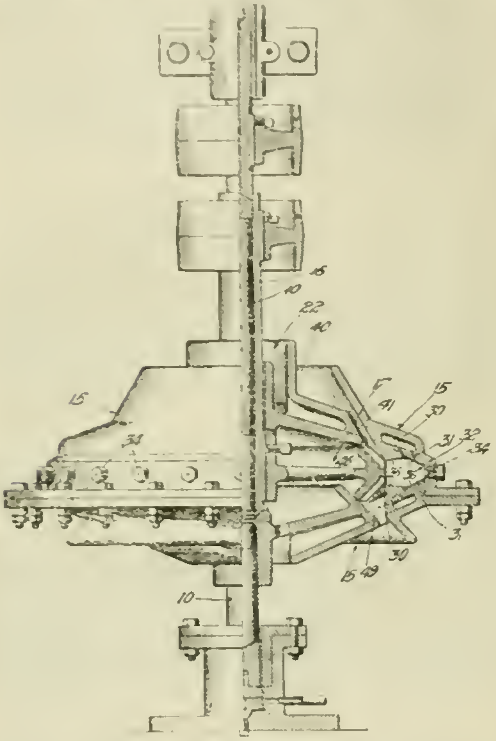
VARIOUS forms of agitators are claimed, which not only agitate the washing liquid and draw it upwards from the bottom of the vessel, but also aspirate the gas from the bell.—W. H. C.

Separator: Centrifugal ——. T. E. Brown, New York. U.S. Pat. 1,159,741, Nov. 9, 1915. Date of appl., Apr. 16, 1915.

A NUMBER of separating vessels, which are rotated about a common axis, have openings in their sides normally turned towards the axis. Each vessel is also mounted on an independent axis and can be rotated by fluid pressure so that the openings can be turned away from the common axis to allow the solid material to be discharged by centrifugal force.—W. H. C.

Separator; Centrifugal ——. J. McCallum, Hurley, New Mex., Assignor to W. W. Jourdin and A. W. Harris. U.S. Pat. 1,154,575, Sept. 21, 1915. Date of appl., Mar. 11, 1914.

An outer separating chamber, 15, and an inner agitating and scrubbing device, 17, are rotated respectively by the shaft, 10, and the sleeve, 16; the scrubbing device, 17, is rotated in the same direction as the outer chamber, 15, but at a higher speed. The material to be treated is fed into the hopper, 40, and passes down the channels, 41, to the annular separating chamber, 32. It passes over the upper face, 46, of the agitating device, which is provided with ribs, and the liquid portion passes over the lower face, 48, of the agitating device and is discharged through the opening, 49. The solids are thrown towards the outer part of the separating chamber by the centrifugal force and are discharged through the orifices, 34. The discharge of the separated solid matter is facilitated by a suitable liquid which is fed into the opening, 22, and is discharged into the separating chamber through the channels, 30 and 31.—W. H. C.



Fire-extinguishing liquid. J. W. Aylsworth, East Orange, N.J., Assignor to Pyrene Manufacturing Co. U.S. Pat. 1,154,161, Sept. 21, 1915. Date of appl., May 25, 1909.

Carbon tetrachloride is mixed with sodium tungstate and with a halogen derivative of benzene or naphthalene having a higher boiling point than carbon tetrachloride. When thrown on to burning material a blanket of heavy, non-poisonous gas is formed, which is a non-supporter of combustion and which smothers the fire, whilst the charred remains of the material become covered with a deposit which prevents their re-ignition.—W. H. C.

Catalyst. P. Sabatier and A. Mailhe. Fr. Pat. 475,367, Feb. 14, 1914.

A platinum, nickel, or other suitable metallic filament, rod, tube, or the like, heated to the requisite temperature by an electric current, is used as a catalyst. The metallic filament may be coated with any suitable oxide or other metallic compound.—W. H. C.

Separating gas mixtures; Method of ——. J. E. Lilienfeld, Leipzig, Germany. U.S. Pat. 1,163,423, Dec. 7, 1915. Date of appl., Oct. 13, 1911.

See Fr. Pat. 435,357 of 1911; this J., 1912, 385.

Fluids: Apparatus for the treatment of —— *with coagulants.* A. P. Strohmenger, Assignor to Ester and Co., Ltd., London. U.S. Pat. 1,161,750, Nov. 23, 1915. Date of appl., Sep. 30, 1914.

See Eng. Pat. 22,050 of 1913; this J., 1914, 373.

Regenerative furnaces [for gas retorts]. Eng. Pat. 9214. *See* IIa.

Machine for mixing concrete and other materials. Eng. Pat. 10,007. *See* IX.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Coking of —— *at low temperatures.* S. W. Parr and H. L. Olin. Bull. 70, Univ. of Illinois Eng. Experiment Station, May 31, 1915. 39 pages. (See also this J., 1913, 589.)

The experimental coking oven, holding about 100 lb. of coal, used in the investigation, consisted of a vertical steel cylinder, lined with asbestos and provided internally with another steel cylinder, inside which is a perforated truncated cone of light sheet-iron. The charge of crushed coal was fed into the inner conical chamber through a hopper and a large gate-valve. The products of distillation were withdrawn from the inner cylinder and collected. The oven was heated to between 400 and 500° C., by a ring-burner using gas and air blast. To prevent oxidation, superheated steam was passed through the oven during a test. It was observed that cokes of good density and hardness may be made by well mixing finely powdered semi-coke (about 68% fixed carbon referred to dry material) and raw coal in suitable proportions; highly bituminous coal from Vermilion County gave the best results when mixed with its own weight of coke dust, whereas smaller proportions of coke dust were preferable in the case of other types of coal with higher content of fixed carbon. The coke reduces the plasticity of the hot coal and allows the gases to escape freely without "blowing." The semi-coke produced at 400° to 500° C. from Vermilion County coal, without addition of coke dust, contains about 18% of volatile matter but no tar constituents. It is excellent for suction-gas producers and for household use. It is clean, burns without smoke or soot, and needs no special attention when burned in an open grate. The tar is fluid at ordinary temperature, and is black to rich brown in colour. It has a low viscosity, and a sp.gr. of 1·069. It yields about 18% of light oil distilling up to 210° C., and 28 to 30% of tar-acids, most of which distil between 210° and 325° C. About 10% of the total distillate from the crude tar is suitable for use in internal combustion engines. The crude tar contains 1·35% free carbon, no naphthalene, and yields about 30% of a hard pitch which is rather brittle and breaks with a bright fracture.
—A. B. S.

Critical points of several difficultly liquefiable gases: nitrogen, carbon monoxide, oxygen, methane. Cardoso. *See* VII.

Separation of hydrogen and methane. Catalysis of oxy-hydrogen mixtures. Activation of chlorate solutions by osmium. Hofmann and Schneider. *See* VII.

Effects of inhaling dusts applicable for stone-dusting in coal mines. Haldane. *See* XIXb.

Sensitiveness of petroleum asphalt to light. Gödrich. *See* XXI.

Patents.

Briquettes of anthracite, coke, lignite, [*wood-charcoal,*] *etc. Manufacture of smokeless* ——. A. Exbrayat. First Addition, dated Feb. 9, 1914, to Fr. Pat. 470,949, June 28, 1913 (this J., 1915, 215).

In the manufacture of the agglomerant according to the principal patent, the seaweed may be partly replaced by flour. Disintegration of the briquette by moisture is prevented by the addition of caustic lime and silicates of aluminium and calcium.—W. F. F.

Coke-ovens; Modification to permit by-product recovery from non-recovery horizontal —— with vertical flues. Soc. Franco-Belge de Fours à Coke. Fr. Pat. 475,154, Jan. 22, 1914.

Gas and air passages open into the top of each heating flue, and the hot combustion products pass downwards through the flues into the space below the ovens. In this way overheating of the crown of the coking chambers can be prevented merely by regulating the supplies of gas and air. The heating flues may be connected at their upper ends by a horizontal passage.—W. F. F.

Gas; Process and apparatus for the distillation of coal for the manufacture of ——. A. Pinet and A. Debout. Fr. Pat. 475,716, July 27, 1914.

Powdered coal contained in a hopper is fed by an oscillating cylindrical distributor, in a thin stream, into two conduits formed in the two upper inclined walls of a distillation chamber of diamond-shaped vertical section. The coal enters the chamber at opposite ends of a horizontal diameter and slides down the lower inclined walls to a quenching vessel below. The distillation chamber is heated by means of external flues. A suitable device is provided in the hopper to stop the oscillation of the feeding cylinder when the coal falls to a predetermined level. The quenching vessel may supply steam for the generation of water-gas. —W. F. F.

Carbonisation; Methods of ——. L. L. Summers. Fr. Pat. 476,127, Aug. 31, 1914.

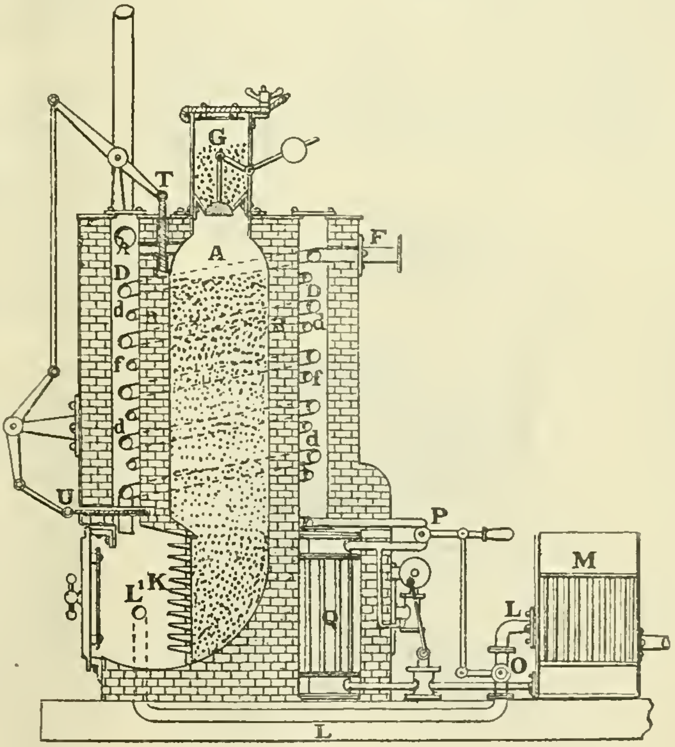
The materials to be carbonised are introduced into a closed retort heated externally, and, at a point near where the carbonaceous matter enters the retort, the temperature is raised sufficiently to render the materials plastic. The gases liberated during the carbonisation are made to pass over the surface of the raw materials as these enter the retort. The heating agent may be producer-gas, waste furnace-gases, or gas from a furnace specially built for the purpose. The method is specially adapted for the treatment of carbonaceous materials with a high percentage of volatile matter, and therefore difficult to carbonise by the ordinary methods.—J. B. C. K.

Carbonising furnaces. L. L. Summers. Fr. Pat. 476,128, Aug. 31, 1914.

The furnace comprises a horizontal closed retort divided into several chambers by light longitudinal partitions. The carbonaceous material is fed simultaneously into each of these chambers at one end, moved uniformly along the length of the retort, and discharged from the other end of the retort. The furnace is constructed with lateral gas passages in the partition walls and in the furnace roof. The feeding plate which regulates the supply of the carbonaceous material to the retort is constructed in sections—one section to each chamber—these different sections being held together by a cross head-plate outside the retort. The bricks used for the partitions of the furnace are moulded so as to leave a longitudinal gas-passage when set, and are provided with ribs and grooves which render the joints gas-tight. —J. B. C. K.

Water-gas; Apparatus for the production of ——. A. Choury. Fr. Pat. 475,407, July 16, 1914.

Air is forced by the pipe, F, heating coil, d, and space, L¹, through the grate, K, and the fuel in the chamber, A. The combustion products pass through the annular space, D, over the coil, d to the boiler, Q, and thence to the air. The valves T and U, are then closed and the valves, O and P, opened. Steam from the boiler passes through the superheating coil, f, to the chamber, A, and water-gas is withdrawn through the space, L¹, and pipe, L, to the water heater, M, which supplies the boiler, Q, and thence to a gasometer.—W. F. F.



Water-gas; Manufacture of —— *by using commercial oxygen.* R. P. Pictet. Fr. Pat. 475,528, July 21, 1914. Under Int. Conv., Oct. 27, 1913.

A mixture of pure or nearly pure oxygen and steam is admitted through a tube of refractory material into the centre of the charge of fuel in the generator, the mixture being in such proportions that the temperature is maintained at about 1600° C. Practically pure water-gas is drawn off and is scrubbed and stored in the usual way. The base of the generator is immersed in a water-seal, and openings are provided for the withdrawal of ashes.—W. F. F.

Regenerative furnaces [for gas retorts]. Drakes, Ltd., and W. A. Drake, Halifax. Eng. Pat. 9214. June 23, 1915.

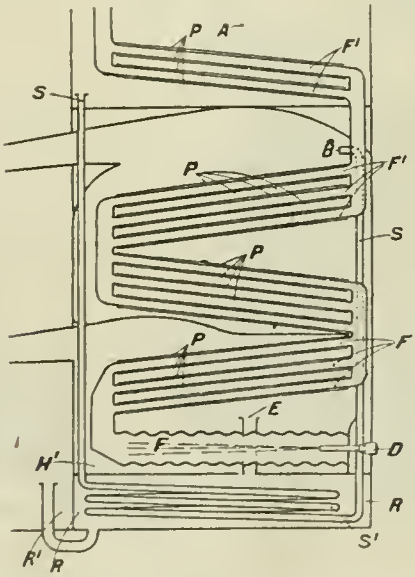
In the type of regenerative furnace for gas retorts in which the waste gases from the combustion chamber surrounding the retorts are conducted first downwards and then through horizontal tubular flues, the usual partitions in the vertical flues, which connect the outer walls to the tubes, are avoided by an arrangement of binding bricks projecting from the walls into the spaces between the tubes. The joints may be staggered to prevent leakage.—W. F. F.

Dissolved acetylene; Preparation of —— under reduced pressure. A. M. Haquette née Ferron. Fr. Pat. 475,197, Jan. 27, 1914.

The receptacles to be filled with dissolved acetylene are cooled so that the required amount of acetylene may be introduced at a lower pressure.—W. F. F.

Liquid hydrocarbons (petroleum); Electrically heated still for ——. T. Delort. Third Addition, dated Jan. 26, 1914, to Fr. Pat. 469,054, Feb. 8, 1913 (this J., 1914, 954; 1915, 20).

The liquid is first heated in the upper compartment, A, of the still while running through inclined troughs, P, containing heating conduits, F^1, for hot gases. The residue flows through a pipe, *s*, and a worm, s^1, in the compartment, R, which contains the residue from the compartment, H^1, from which it overflows by the pipe, E. The heated oil from the worm, s^1, flows from the pipe, B, over the zig-zag trough, P, which is similarly heated by hot gases from the combustion chamber, F. The temperature increases as the oil flows downwards. The hot residue after passing through the compartment, R, gives up its heat to the crude oil in the vessel, R^1. The apparatus may also be used for electrical heating.—W. F. F.



Light hydrocarbons and petroleum spirits and ethers; Manufacture of —— from heavy hydrocarbons obtained from refined petroleum, heavy petroleum oils, or analogous products obtained from shales, lignites, peat, or wood. P. Sabatier and A. Mailhe. Fr. Pat. 475,303, Feb. 4, 1914.

Crude petroleum, purified oils, or heavy hydrocarbons are passed over a network of wires heated electrically from 500° C. to a red heat, and the products condensed. The light oils obtained are converted into saturated hydrocarbons by hydrogenation in contact with finely divided nickel, cobalt, iron, or the like, heated to 200°—300° C. —W. F. F.

Petroleum; Process of treating crude ——. F. Seidenschnur, Charlottenburg, and J. Dehnst, Halensee, Assignors to Rütgerswerke Act.-Ges., Berlin. U.S. Pat. 1,162,729, Nov. 30, 1915. Date of appl., June 13, 1908.

See Fr. Pat. 389,860 of 1908; this J., 1908, 1012.

Petroleum of a high boiling point; Process of and apparatus for converting —— into petroleum of a lower boiling point. H. Wade, London. From Standard Oil Co. (Indiana), Whiting, Ind., U.S.A. Eng. Pat. 1226, Jan. 26, 1915.

See U.S. Pats. 1,129,034 and 1,132,163 of 1915 this J., 1915, 346, 415.

Manufacture of binding material for coatings, etc. [from coal tar or petroleum]. Fr. Pat. 476,362. *See* III.

Cyclic process for producing nascent hydrogen by means of esters. [Desulphurising petroleum.] Fr. Pat. 476,454. *See* VII.

Apparatus for the continuous direct rectification of wines, phlegms, and other volatile products, benzol, petroleum, etc. Fr. Pat. 475,969. *See* XVIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Arc; The electric —— in vapours and gases at reduced pressures. W. A. Darrah. Amer. Electrochem. Soc., and Illum. Eng. Soc., Joint Meeting, Nov. 11, 1915. Met. and Chem. Eng., 1915, 13, 915—918.

A special form of lamp was used in the experiments, the arc being produced in a chamber between tungsten electrodes partly surrounded by a refractory insulator. The upper movable electrode was fastened by a tungsten rod to an iron core, surrounded by a glass shell, and the current was conducted from the electrode to the upper seal by a flexible tungsten spiral. The deposit, collecting on the globe, was eliminated by arranging a draught tube around the upper electrode, with corrugations on the tube and condensing chamber to aid the deposition of the suspended matter. The lamp was exhausted and heated, and a liquid, volatile at a high temperature, introduced by a special contrivance to avoid the introduction of moisture. Experiments have been made with carbon, titanium, and silicon tetrachlorides, antimony, phosphorus, and aluminium trichlorides, stannic, arsenic, boron, cerium, calcium, and chromic chlorides, calcium iodide, titanium chlorobromide, bromine, iodine, and chlorine. These substances have been classified as (*a*) those giving high illumination but unstable arcs, (*b*) those giving low illumination and stable arcs at relatively low voltages, (*c*) catalysers, which assist recombination in the flame zone, thus minimising deposit. The arc has the general appearance of a thick, intensely-heated incandescent filament, slightly bent at the top. Very efficient five-ampère lamps, containing titanium bromochloride, have been constructed giving a white light, the compound being readily re-formed after dissociation.—B. N.

Coking of coal at low temperatures. Parr and Olin. *See* IIa.

PATENTS.

Vegetable charcoal decolorising agent and method of making it. C. Bonnard. Fr. Pat. 475,184, Jan. 23, 1914.

The charcoal is obtained by heating in a closed vessel an intimate mixture of wood sawdust and calcium carbonate or caustic lime, in the relative proportions of 4 : 1, to 400°—450° C. This heating may be carried out either in a crucible provided with a tightly fitting cover, or in a vertical retort in continuous operation, provided with means for protecting the products from oxidation, on their delivery at the lower end of the retort. For example, the calcined mixture may be allowed to fall into water, or into a vessel from which air is excluded, or which is filled with some inert gas. After the calcined mixture has been cooled, it is treated with dilute commercial hydrochloric acid in order to dissolve the lime, and is then washed and dried, when it is ready for use. Its bleaching power is only slightly less than that of animal charcoal. Peat or spent-tan may be employed in place of sawdust.—J. B. C. K.

Incandescent gas mantles; Apparatus for the manufacture of ——. J. L. Muller, Sannois, and J. Bonnet, Paris. Eng. Pat. 683, Jan. 15, 1915. Under Int. Conv., Jan. 31, 1914.

In the machine for making incandescence gas mantles which is described in Eng. Pat. 6556 of 1909 (this J., 1910, 340), displacement of the mantle-carrying rods due to wear is avoided by the substitution of a system of rigid members for the driving chains. A stop system to prevent a reverse movement during any of the operations is also provided.—W. F. F.

Arc-lamp electrode. E. J. Watzl, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,161,173, Nov. 23, 1915. Date of appl., Apr. 14, 1913.

The electrode contains the fused oxides of titanium, tungsten, and the rare earths in molecular proportions.—W. F. F.

Methods of carbonisation. Carbonising furnaces. Fr. Pats. 476,127 and 476,128. *See* IIa.

Manufacture of light hydrocarbons from heavy hydrocarbons obtained from refined petroleum, heavy petroleum oils, or analogous products obtained from shales, lignites, peat, or wood. Fr. Pat. 475,303. *See* IIa.

Production of liquid aromatic hydrocarbons from coal. Fr. Pat. 475,433. *See* III.

III.—TAR AND TAR PRODUCTS.

Phenylhydrazine, substituted phenylhydrazines, and p-nitrophenylhydrazones; Action of titanous chloride on ——. F. Robinson. J. Manchester School of Technol., 1915, 7, 105—108.

Phenylhydrazine and *p*-bromophenylhydrazine are not reduced by titanous chloride, whereas *p*-nitrophenylhydrazine is reduced quantitatively by this reagent to *p*-phenylenediamine and ammonia. By using standard titanous chloride in boiling solution, and titrating the excess with standard Crystal Scarlet, the *p*-nitro-compound and acetone-*p*-nitrophenylhydrazone may be estimated, but attempts to obtain a volumetric method for the estimation of acetone and formaldehyde by means of the *p*-nitrophenylhydrazones failed to give satisfactory results. The activating influence of the nitro-group may be due to the decomposition of *p*-nitrophenylhydrazine into nitrobenzene and *p*-nitraniline, which latter would eventually form *p*-phenylenediamine; these products were obtained by Hyde (Ber., 1900, **32**, 1816) by heating *p*-nitrophenylhydrazine with hydrochloric acid (1 : 1) in a sealed tube at 120°—130° C., but no support of this view has been obtained. The author was not successful in an attempt to establish a volumetric method for the estimation of sugars depending on the formation of the *p*-nitrophenylosazones.—F. W. A.

Alcohols, aldehydes, and ketones; Reduction of aromatic ——. A. Skita. Ber., 1915, **48**, 1685—1698.

The method described by Skita and Meyer (this J., 1913, 46), and recently confirmed by Skita (this J., 1915, 1271), has been applied to the hydrogenation of aromatic and heterocyclic substances in colloidal solution. The reduction of ketones and aldehydes to the corresponding alcohols may, in some cases, be effected with the addition of acetic acid to the gum arabic medium, but the platinum concentration must be increased; in certain cases the reduction can only be carried out in acetic acid solution. As recently shown (this J., 1915, 1271) benzaldehyde is reduced completely to toluene and hexahydrotoluene, and benzophenone to diphenylmethane and dodecahydrodiphenylmethane; attempts have now been made to prevent the reduction proceeding so far. The main product formed by the reduction of cinnamic aldehyde is hexahydrophenylpropyl alcohol (b.pt. 120°—121° C. at 15 mm.), only small amounts of the hydrocarbons, propyl- and hexahydropropylbenzene being obtained; the reaction has been shown to proceed first to the saturated aldehyde and then to the saturated alcohol before hydrogenation of the nucleus occurs. Similarly phenylacetaldehyde is reduced mainly to hexahydrophenylethyl alcohol (b.pt. 206°—209° C.); it reacts first as the acetate of its enolic form, *viz.*, as phenylvinyl acetate, the aliphatic double linkage being saturated, giving phenylethyl acetate, before the nucleus is hydrogenated. This result of acylation is not general in character; benzyl acetate and benzoate and benzaldehyde-diacetate give toluene on reduction, like benzyl alcohol and benzaldehyde; even benzyl ethyl ether is decomposed in this manner by the hydrogenation process, giving rise to toluene. Hexahydrobenzaldehyde was eventually produced by condensing benzaldehyde and aniline to benzalaniline, reducing with sodium and alcohol to benzylaniline and then by catalytic reduction to dodecahydrobenzylaniline; oxidation of this product by permanganate in acetone solution gave dodecahydrobenzalaniline, which decomposes rapidly in acid solution to hexahydrobenzaldehyde (b.pt. 160°—165° C.) and cyclohexylamine. Hexahydrobenzophenone was obtained in a similar manner. These catalytic reductions proceed more rapidly if a platinum compound is used in place of colloidal platinum; it is considered that addition compounds are formed when a sufficient concentration of platinum is attained, their formation being hastened by certain additions, notably acetic acid.
—F. W. A.

Manufacture of dyes, drugs, and chemicals in Japan. *See* IV.

Patents.

Aromatic hydrocarbons from coal; Production of liquid ——. E. Jolicard. Fr. Pat. 475,433, Feb. 17, 1914.

Coal is treated at 400° C. in a furnace, which is not heated externally, with nascent hydrogen, produced for example by introducing a mixture of superheated steam and air at 500° C.: carbon monoxide (producer gas, water gas) at 600° C. may be used in place of all or part of the air. A gaseous catalyst, such as chlorine or hydrochloric acid, may be introduced, or a solid catalyst, such as copper, nickel, etc., may be deposited on the coal.—F. W. A.

Coal tar; Process and apparatus for the treatment of —— by warm air. U. Ammann. Fr. Pat. 475,665, July 25, 1914.

To remove the ammoniacal liquor contained in crude coal tar, it is sprayed into the upper part of a tall cylinder, wherein it meets an ascending current of hot dry air.—F. W. A.

Binding material for coatings, etc.; Manufacture of —— [from coal tar or petroleum]. Soc. Anon. des Combustibles Industriels. Fr. Pat. 476,362, Apr. 18, 1914.

Coal tar or a petroleum product is heated to remove ammoniacal liquor and light oils, and distilled between 120° C. and 250° C. in the case of coal tar, or 120° and 300° C. in the case of petroleum products, in a rapid current of an inert gas. The distillate is freed from naphthalene by decantation, and incorporated with the undistilled residue. The heavy oil so obtained is thickened slowly by polymerisation by means of a current of oxidising gas, at a temperature below 250° C. for coal tar products or 300° C. for petroleum products. The products obtained by this treatment constitute excellent binding materials for coatings used in the metallurgical industry.—F. W. A.

Diaminodiphenylureatetrasulphonic acid; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 286,752, May 31, 1913.

By the action of phosgene on *p*-phenylenediaminedisulphonic acid in presence of a substance capable of combining with acid, a diaminodiphenylureatetrasulphonic acid is produced in which the sulphonic groups are in the *meta*-position with respect to the urea residue. Hence in the azo dyestuffs derived from this amino-acid the sulphonic groups will be in the *ortho*-position with respect to the azo group, a position in which they exert a favourable influence on the affinity of the dyestuffs for cotton and their fastness to light.—A. S.

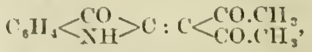
Manufacture of light hydrocarbons from heavy hydrocarbons obtained from refined petroleum, heavy petroleum oils, or analogous products obtained from shales, lignites, peat, or wood. Fr. Pat. 475,303. *See* IIa.

Apparatus for the continuous direct rectification of wines, phlegms, and other volatile products, benzol, petroleum, etc. Fr. Pat. 475,969. *See* XVIII.

IV.—COLOURING MATTERS AND DYES.

Indigoid colouring matters; Aromatic-open chain aliphatic ——. W. Herzog and A. Jolles. Ber., 1915, 48, 1574—1578.

Condensation of the anilides of *o*-diketones with β-diketones resulted in the formation of aromatic-aliphatic indigoid dyes of well defined crystalline character, considerably more soluble in organic solvents than Indigotin, and, although, like it, reducible with hydrosulphite, and reoxidised on the fibre, the colours produced were fugitive. From α-isatin anilide and acetylacetone, 2-indole-3-pentanone-indigo,



$$C_6H_4{<}\begin{matrix}CO\\NH\end{matrix}{>}C : C{<}\begin{matrix}CO.CH_3\\CO.CH_3\end{matrix},$$

was obtained as cinnabar-red needles, m.pt. 200° C. with slight decomposition and formation of yellowish-red vapours. 2-Indole-3-benzoylpropane-indigo, similarly obtained from benzoylacetone and α-isatin anilide, formed fiery red needles, m.pt. 180°—181° C., soluble in fuming sulphuric acid to a violet solution. From acetylacetone and thionaphthenequinone anilide, reddish-yellow needles of 2-thionaphthene-3-pentanone-indigo were obtained. They melt at 142°—143° C., and dissolve in hot fuming sulphuric acid giving a sulphonic acid soluble in water.—G. F. M.

Mono- and dis-azo compounds from phenols and phenolic ethers; Formation of ——. K. von Auwers and E. Borsche. Ber., 1915, 48, 1716—1730.

It has been shown by von Auwers and Michaelis (Ber., 1914, 47, 1275) that the coupling power of phenols and phenolic ethers generally increases with the number of alkyl groups present in the molecule, alkyl groups in *meta*-position exerting the greatest effect. These statements had only been proved for mono- and di-alkylated phenols, and the investigation has been extended to tri- and tetra-alkylated phenols. The coupling power was not much affected by the introduction of a third alkyl group, but was decreased by the introduction of an acetyl group, following the general rule for negative substituents. Tetra-substituted phenols couple with the same readiness as simpler phenols; the presence of two negative groups in *ortho*-position to the hydroxyl group in *o.o*-diaceto-*symm.-m*-xylenol did not prevent coupling. The rate of coupling of disubstituted phenolic ethers decreased somewhat on the introduction of a third alkyl group, and became practically *nil* on the introduction of an acetyl group, *e.g.* in the methyl ether of *o*-aceto-*symm.-m*-xylenol, the influence of this negative group apparently being greater in the phenolic ether than in the free phenol. The introduction of a fourth alkyl group into a phenolic ether decreases considerably the coupling power. The rule regarding the greater influence of alkyl groups in *meta*-position has been found to be general, and it is noted that *m*-toluidine, as opposed to its isomers and aniline, has a decided tendency to form aminoazo-derivatives instead of diazoamino-derivatives; from this behaviour it would be expected that of the three xylidines the symmetrical compound would have the greatest tendency to couple with diazo-compounds, but actually all three amines give mixtures containing practically the same amounts of aminoazo- and diazoamino-compounds.—F. W. A.

Dyes of the thiazine, oxazine, and azine series; Interaction between metallic copper and certain ——. J. R. Hannay. J. Soc. Dyers and Col., 1915, 31, 244—252.

The cause of damage to a copper pan used for dissolving printing colours has been investigated and found to be the solvent action of certain solutions of dyestuffs. The damage was first noticed in connection with the preparation of an 8 oz. standard of New Methylene Blue F (derived from monoethyl-*o*-toluidine) in 30% acetic acid. No appreciable loss in weight was noted on boiling about 39 grms. of copper with 200 c.c. of 30% acetic acid for 2 hrs., but on addition of 10 grms. of New Methylene Blue F (hydrochloride) and boiling for a further two hours, greenish crystals were formed, and a loss in weight of 0·57% of the copper was recorded. By using about 2 grms. of copper foil and boiling for 14 hrs., a loss in weight of practically 33% of the copper was found; the action almost ceased owing to a protective tarry film on the copper. On repeating the experiment with an aqueous solution of the dyestuff, a perceptible action on the copper was noted, but the rapidity of the action was greatly decreased, apparently owing to the fact that the protective film adhering to the copper assumed a tarry consistency immediately; after 16 hours, the loss in weight was about 13%. Methylene Blue D and DBB and also the zinc-free dyestuff (hydrochlorides) were found to give similar results of the same order. The crystals resulting from the reaction were repeatedly extracted with water, and found to have a solubility of about 1 : 1000 in the cold, and to contain 0·29%Cu; on addition of concentrated sulphuric acid, the crystals evolved hydrochloric acid, and on pouring the solution into water an indigo-coloured precipitate free from copper was obtained. On boiling copper with more dilute solutions of Methylene Blue, the intensity of the colour was much reduced, and a spot test of the solution on filter paper showed a gradual deepening in the colour, apparently indicating a reducing action similar to the action of zinc on Methylene Blue; treatment with zinc or copper produced a solution with a characteristic odour, but in the case of zinc no crystals separated and the solution oxidised more readily. A solution of Methylene White, obtained by the reduction of Methylene Blue by means of zinc in acetic acid solution, was found to be without action on copper; this is considered to discredit the formation of Methylene White as an intermediate stage in the reaction. The solution obtained from the interaction of Methylene Blue (zinc-free) and an excess of copper was evaporated to dryness and made up into a printing colour by solution in 80% acetic acid and addition of starch paste and tannic acid solution; a weak, dull greenish-blue shade resulted.

Similar results were obtained on boiling copper with the oxazine dyestuff Nile Blue A (sulphate), the azine dyestuffs Safranine FF (hydrochloride) and Methylene Violet RRA (hydrochloride), and with Acridine Orange NO. Rhodamine 6 G, Thioflavine T, and Brilliant Green did not appear to interact with copper in this manner.

It is considered possible that the presence of triad nitrogen plays some part in the activation of these dyestuffs towards copper, the dyestuffs being regarded as complex substituted ammonias which would tend to form cuprammonium compounds. The presence of copper in the portion of the dyestuffs which remains soluble does not materially improve their fastness to light.—F. W. A.

Manufacture of dyes, drugs, and chemicals in Japan. Board of Trade J., Dec. 30, 1915.

With reference to the proposal of the Japanese Government to grant subsidies for the manufacture of dyes and chemicals (see this J., 1915, 954), regulations in connection with the Government scheme have been published. In brief, these regulations are as follows :—

The Japanese Government will pay three subsidies: one, to a company specialising in the manufacture of dyestuffs, whose capital is at least 6,000,000 yen; the second, to a company manufacturing glycerin and carbolic acid, whose capital is at least 1,200,000 yen; and the third to a company manufacturing drugs, whose capital must be at least 500,000 yen. Anyone who desires to organise a subsidised company for the manufacture of dyestuffs and chemicals must apply to the Minister of Agriculture and Commerce for permission to establish the projected concern, but in the case of drugs permission should be sought from the Minister for Home Affairs. When part of the capital is paid up, the first general meeting of the shareholders completed, and the new company duly registered in the Courts, the promoters of the company are entitled to ask for a subsidy. The Government guarantees to each company a dividend of 8% per annum, making up any deficit. Each company must lay aside 5% of its net annual profits as a reserve fund. If its shares are issued at above par, the premium must be included in the reserve fund. A special reserve fund is also to be provided in order that the company may become self-supporting as soon as possible, and to this fund will go one-half of the excess net profits after the dividend of 8% per annum has been paid. The balance of the excess may be distributed amongst the shareholders, the maximum dividend from this source not exceeding 4% per annum; the residue will be included in the special reserve fund. The conduct of the subsidised companies will be under the strict surveillance of the Government.

The products provided for under this Law are as follows :—

Acetanilide, benzoic acid, carbolic acid, salicylic acid, antipyrin, bromine, chloral hydrate, chloroform, cresol, formalin, glycerin, guaiacol, caustic potash, potassium carbonate, creosote, alkaloids, and chemical compounds and derivatives of the foregoing. The by-products obtained from coal by dry distillation process, as follows :—Light oil and neutral oil, crude and refined benzol, toluol, xylol, carbolic acid, naphthalene, and anthracene.

Three companies are being organised with a view to obtaining Government subsidies under the above regulations. One company, engaged in the manufacture of glycerin, with a capital of 3,000,000 yen, intends to take over the business, etc., of an oil company at Osaka. The second company, manufacturing medicines and chemicals, intends to specialise in the manufacture of formalin and its derivatives, and in other carbon compounds. This company will have a capital of 500,000 yen, and will acquire the formalin works of an existing Japanese concern engaged in the production of acetic acid. The third company produces medicines and will have a capital of 1,000,000 yen. The Japanese Government has arranged to form a company for the manufacture of dyestuffs, with a capital of 8,000,000 yen. The first factory will be built in Tokio or Osaka, or in the north of Kiushiu (probably close to the Wakamatsu iron works, whence the necessary benzol will be obtained).

Note :—Yen = 2s. 0½d.

Dyestuff industry in the United States; Bill for the protection of the ——. [H.R. 703.]

A bill has been introduced into the House of Representatives with a view to the protection of the American dyestuff industry from foreign competition; the text is as follows :—

An Act to provide revenue for the government, and to establish and maintain the manufacture of dyestuffs.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

That on and after the day following the passage of this act, except as otherwise specially provided for in this act, there shall be levied, collected, and paid upon the articles named herein when imported from any foreign country into the United States or into any of its possessions, except the Philippine Islands and the Islands of Guam and Tuitila, the rates of duties which are herein prescribed, namely—

Dutiable list.

1. All products of coal, produced in commercial quantities through the destructive distillation

of coal or otherwise, such as benzol, toluol, xylol, cumol, naphthalene, methylnaphthalene, acenaphthene, flourene, anthracene, phenol, cresol, pyridine, quinoline, carbazole, and others, not specially provided for and not colours or dyes, 5 % *ad valorem*.

2. All the so-called "intermediates," made from the products referred to in paragraph 1, not colours or dyes, not specially provided for, 3¾ cents per pound and 15 % *ad valorem*.

3. All colours or dyes derived from coal, 7½ cents per pound and 30 % *ad valorem*.

Free list.

4. Acids:—Acetic or pyroligneous, arsenic or arsenious, chromic, fluoric, hydrochloric, nitric, phosphoric, prussic, silicic, sulphuric, and valerianic.

5. Coal tar, crude, pitch from coal-tar, wood or other tar, dead or creosote oil.

6. Indigo, natural.

Section 2. That paragraphs 20, 21, 22, and 23 of Schedule A of Section 1 of an act entitled "An Act to reduce tariff duties and to provide revenue for the government and for other purposes, approved 9·00 p.m., October 3, 1913," and paragraphs 387, 394, 452, and 514 of the "Free List of Section 1 of said act, and so much of any heretofore existing law or parts of law as may be inconsistent with this act, are hereby repealed.

Patents.

Vat dyes of the anthraquinone series and process of making same: A. L. Laska and E. J. Rath, Offenbach, Assignors to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,162,496, Nov. 30, 1915. Date of appl., Jan. 25, 1915.

See Eng. Pat. 610 of 1915; this J., 1915, 1084.

Wool dyestuffs; Brownish-yellow —— and process of making same. R. Schmidlin, Assignor to Farbw. vorm. Meister Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,162,109, Nov. 30, 1915. Date of appl., July 2, 1913.

See Ger. Pat. 265,197 of 1912; this J., 1913, 1101.

Standardisation of colours. Eng. Pat. 22,775. *See* VI.

Utilising the halogen hydracids, previously crystallised by cooling, as a source of iodine, chlorine, bromine, or fluorine, for the production of various organic and inorganic substances. Fr. Pat. 475,998. *See* VII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton; Tendering of —— by solutions of acids and salts. M. Fort and F. Pickles. J. Soc. Dyers and Col., 1915, **31**, 255—260.

Cotton yarn was heated for one hour at 100° C. under a reflux condenser with equivalent solutions of various acids, and the tensile strength and elongation were determined after washing and drying. The results showed that the loss of strength was directly proportional to the strength of the acids, as indicated by their relative conductivities or by their effect on the velocity of inversion of sucrose. With $N/1$ solutions of acids the percentage losses of strength amounted to:—100 for hydrochloric acid, 93·5 for sulphuric, 71 for oxalic, 10·9 for acetic acid, and 53 for sodium bisulphate: with $2N$-solutions the losses were: 72·7 for oxalic, 36·8 for phosphoric, 42 for chloroacetic, 31·4 for tartaric, 19·7 for formic, 17·1 for acetic acid, and 4·5 for water alone. The relatively high result recorded for chloroacetic acid is due to the formation of hydrochloric acid on heating with water. Somewhat similar relative results were obtained by a padding treatment followed by dry heating, but some variations from the normal rule were introduced by secondary factors. With $N/1$ solutions of salts at 100° C. no appreciable loss of strength was observed except with sodium bisulphate, although in certain cases (*e.g.*, in presence of magnesium chloride) the tensile elongation was slightly lowered. In padding experiments followed by heating at 100° C., sodium chloride and sulphate and magnesium sulphate, used alone, caused no tendering; zinc and magnesium chlorides each caused a loss of strength of over 20 %, but the addition of sodium chloride to these salts reduced the loss to 10 %. This is in accordance with the rule that the introduction of a salt of similar ion into a solution of an acid lowers the electrolytic dissociation of the acid and causes a corresponding reduction in its tendering action. The addition to a strong acid of salts of weaker acids in equimolecular proportions also results in a decreased tendering action, but the influence of the stronger acid cannot be wholly suppressed in this way, because it never completely displaces the weaker acid from its salt, but establishes an equilibrium. Conversely, the addition of a salt of a stronger acid to a solution of a weaker acid increases the tendering action of the weaker acid to an extent corresponding with the same equilibrium. Thus, a mixture of sodium chloride and sulphuric acid gave practically the same degree of tendering as one of sodium sulphate and hydrochloric acid. An apparent exception to this rule was recorded by Pilkington (this J., 1915, 831), who found that the tendering action of dibasic organic acids was diminished by the addition of sodium sulphate, but the authors show that in such cases the degree of electrolytic dissociation is decreased owing to the formation of acid salts of the dibasic organic acid, *e.g.*, with oxalic acid and sodium sulphate or chloride, sodium binoxalate is a main product and is formed in inverse ratio to the strength of the acid combined with the salt added.—J. F. B.

Paper; Determination of the permeability to air of ——. W. Herzberg. Mitt. k. Materialprüf., 1915, **33**, 142—144.

The apparatus used at the Materialprüfungsamt is designed to measure the flow of air through a sheet of paper under constant difference of pressure and at standard humidity. A disc of paper is clamped tightly between two metal flanges forming part of a funnel with a cylindrical upper portion. The funnel is fixed in the central orifice of a 3-necked Woulffe's bottle; one of the other necks carries a water-manometer and the third is connected with a "wet" gas-meter, provided with a special overflow to equalise the level of the liquid under the difference of pressure on the two sides of the meter. The meter is connected to a water suction pump, but in order to compensate for variations in the action of the latter, the suction is applied directly to a large bottle which communicates with a pressure regulator interposed between the bottle and the meter. This regulator consists of a second 3-necked Woulffe's bottle partly filled with water. Through the central orifice passes a glass tube open to the air, and the pressure is regulated by sliding this tube more or less deeply below the level of the water. On both sides of the regulating bottle the connecting tubes are fitted with branches carrying manometers. The determinations are made under a difference of pressure of 10 cm. of water, as indicated on the manometer attached to the first Woulffe's bottle, and the operative portion of the disc of paper has an area of 10 sq. cm. The readings of the meter are finally calculated in terms of litres per min. per 100 sq. cm. The area-weight and thickness of the paper are noted, but not included in the calculations.

Some typical results are quoted:—Thick blotting paper, 64·3; news paper, 2·9; tissue paper, 1·3; Normal 3a, (writing paper), 0·3; Normal 4b, 0·6; parchment papers, imitation parchment and pergamyn papers, 0·1. The last value may be taken as indicating a perfectly air-proof material for wrapping purposes where no difference of pressure exists.—J. F. B.

Paper from sugar-cane bagasse; Manufacture of —— in Cuba. J. Roy. Soc. Arts, 1915, **64**, 132.

The manufacture of paper from bagasse has been successfully carried out at a mill at Preston, Cuba, during the past year. At present only wrapping papers are made, but the manufacture of other grades of paper is to be undertaken shortly. The output is consumed locally. The bagasse is digested with live steam, then transferred to the beaters, where it is mixed with bleaching powder, and when sufficiently beaten is thinned with water before entering the paper machine.

Patents.

Animal fibres and fabrics; Combinations of salts for the treatment of ——. [*Wool-scouring.*] R. Vidal. First Addition, dated Feb. 25, 1914, to Fr. Pat. 473,183, Sept. 9, 1913 (this J., 1915, 545).

To the combinations of salts originally specified may be added phenols, cresols, naphthols, or dihydroxynaphthalenes, either directly or as the products of fusion of salts of the corresponding benzene- or naphthalene-sulphonic acids with excess of alkali. Instead of the alkali hydroxides, carbonates, or sulphides mentioned in the original specification, alkali aluminates may be employed. —J. F. B.

Silk; Process for degumming ——. Röhm und Haas. Fr. Pat. 475,343, Feb. 9, 1914.

Raw silk is digested for several hours at a temperature not exceeding 40° C. in solution of 0·05% of pancreatin and 0·1% of soap; it is then heated in water at 90°—100° C. for 20—30 minutes. Salts, especially alkaline salts, may be added to the pancreatin solution if necessary.—J. F. B.

Vegetable fibres for the textile and paper industries; Process of decorticating ——. Soc. Anon. des Brevets Peufaillit. Fr. Pat. 475,245, July 17, 1914.

Vegetable fibres are decorticated by digestion, at a high temperature, in open or closed vessels, with one or more of the chloro derivatives of ethylene or ethane in conjunction with water or soapy or oily emulsions.—J. F. B.

Horsehair; Product [from hide refuse] as a substitute for —— and method of manufacture. Pichard Frères. Fr. Pat. 475,793, Mar. 17, 1914.

Refuse of skins or hides, *e.g.*, rabbit skin clippings or tannery hide refuse, is cut up into shreds, washed, and steeped for 24 hours in warm water containing formaldehyde or salts such as copper sulphate or potassium bichromate, or alkalis, etc. The product is thus made elastic and non-putrescible and its deodorisation is completed by the addition of suitable aromatic substances.—J. F. B.

Cellulose [wood-pulp] for the manufacture of paper; Method of making innoxious the resin in ——. S. F. Lagermarck and W. Sverdrup. Bön. Eidsvold, Norway. U.S. Pat. 1,161,696, Nov. 23, 1915. Date of appl., Apr. 6, 1915.

About 8% of talc or other filling substance, such as kaolin, barium sulphate, etc., is added to the cellulose after it has been discharged from the boilers and washed in the hutches, but before it has been diluted for treatment in the separators, in order to deprive the finely distributed resin particles of their properties of adhesion.—J. F. B.

Cellulose fatty acid esters; Manufacture of ——. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 21,016, Oct. 15, 1914.

Cellulose may be acylated without dissolving the ester by treating it with the necessary acid anhydride below 20° C. in the presence of one or more catalysts, until a solid jelly is obtained, soluble in certain solvents but not in glacial acetic acid. The product yields more viscous solutions than the fatty acid esters of cellulose hitherto known. Mixed esters are produced if the cellulose is partly nitrated before esterification. *Example.*—A mixture of 200 parts of acetic anhydride, 200 parts of glacial acetic acid, and 1 to 2 parts of sulphuryl chloride, cooled below 10° C., is slowly added to 50 parts of cellulose (or feebly nitrated cellulose) and maintained below 20° C. until a solid, transparent mass has been formed. This gives a viscous solution with an equal weight of tetrachloroethane, and its solubility may be modified by diluting it in the cold with 450 parts of tetrachloroethane, neutralising the sulphuryl chloride by adding the required amount of a solution of crystallised sodium acetate in 60 parts of 70% acetic acid, and heating at 100° C. until the desired solubility is attained.—F. Sp.

Cellulose esters with more than twenty per cent. of combined fatty acid; Production of ——. Deutsche Gasglühlicht A.-G. (Auerges.), Berlin. Eng. Pat. 75, Jan. 2, 1915. Under Int. Conv., Jan. 3, 1914.

Cellulose esters are produced by the action of homologues of formic acid, in the presence of catalysts but without employing anhydrides, on hydracellulose (Schwalbe, "Chemie der Cellulose," 1911, pp. 160 *et seq.*), including all derivatives of cellulose which are subsequently hydrated, hydrated cellulose subsequently hydrolysed or oxidised, and also hydracellulose produced by the action of alkalis, aqueous acids, or salt solutions on cellulose, or by the separation of cellulose from solvents or esters. The hydracellulose is used preferably in a swollen condition, and suitable catalysts include sulphuric acid, sulphuryl chloride, hydrochloric acid, and the phosphoric acids, or mixtures of these. The degree of esterification attained depends on the catalyst employed and on the temperature. *Example.*—20 grms. of cellulose is kneaded to a dough with 70 grms. of 100% sulphuric acid, 10 grms. of glacial acetic acid, and 20 grms. of water at 0°—5° C. A mixture of 100 grms. of glacial acetic acid and 10 grms. of 100% sulphuric acid is slowly added, and the hydracellulose thus precipitated passes gradually into solution. After standing for 24 to 48 hours at 0° to 10° C., the product may be precipitated with water. It contains about 30% of acetic acid, and is soluble in formic acid, phenol, and lactic acid. —F. Sp.

Cellulose esters; Manufacture of ——. Soc. Chim. des Usines du Rhône, ancien. Gilliard, P. Monnet et Cartier, Paris. Eng. Pat. 8046, May 31, 1915. Under Int. Conv., June 12, 1914.

The process described in Eng. Pat. 13,696 of 1914 (see Fr. Pat. 477,399; this J., 1915, 488) is modified by the use of a small quantity of nitric acid in the preliminary treatment, so that esters containing nitrogen are produced. The percentage of nitrogen depends on the amount of nitric acid employed. *Example.*—10 parts of cellulose is treated with 60 parts of glacial acetic acid, 4 parts of acetic anhydride, 0·5 part of 100% sulphuric acid, and 0·5 part of nitric acid of approximately 100% strength. The nitroacetate obtained contains about 0·5% of nitrogen.—F. Sp.

Non-inflammable celluloid, plastic masses, and objects thereof; Process for the manufacture of ——. H. Dreyfus. Second Addition, dated Oct. 31, 1913 (under Int. Conv., Aug. 25, 1913), to Fr. Pat. 432.047, July 6, 1911 (this J., 1912, 24, 1027).

The trichloroethanes, particularly the isomer boiling at about 115° C., are solvents of cellulose esters, especially of cellulose acetate, and may be used as such, either alone or mixed with other chlorinated derivatives of acetylene, ethylene, or ethane, or with other solvents or camphor substitutes, to form lacquers, varnishes, films, celluloid, etc. By varying the constituents of the mixed solvents, any desired rate of evaporation may be obtained. Dyes, pigments, and any suitable filling materials may be added.—F. Sp.

Non-inflammable and inflammable celluloid and solutions of cellulose esters; Process for the manufacture of ——. H. Dreyfus. (A) Second Addition, dated Sept. 12, 1913, (B) Third Addition, Mar. 4, 1914, (C) Fourth Addition, June 30, 1914 (under Int. Conv., Nov. 5, 1913), and (D) Fifth Addition, June 30, 1914 (under Int. Conv., Nov. 5, 1913), to Fr. Pat. 432,264, July 15, 1911 (this J., 1912, 24; 1913, 652).

(A) Celluloid made from cellulose acetate and camphor, "mannol," or other derivatives of aromatic hydrocarbons, or triacetin, is slightly inflammable. Varying degrees of non-inflammability, extending to complete incombustibility, may be imparted by the use of tetrachloroethane, triphenyl phosphate, tricresyl phosphate, trinaphthyl phosphate, or chlorinated derivatives of acetylene, ethylene, or ethane. These may be used in conjunction with the following camphor substitutes: acetyldiphenylamine, formyldiphenylamine, and their homologues diacetyl and diformyl derivatives of aniline, toluidine, and naphthylamine, phenol or its homologues etherified with the halogen derivatives of acetylene, ethylene, or ethane, acetic acid esterified with the halogen derivatives of acetylene, ethylene, or ethane, chloro- and dichlorocamphor, bromocamphor. The liquid solvents may be methyl acetate, acetone, ethyl acetate and alcohol, acetone and alcohol, methyl acetate and alcohol, or tetrachloroethane with either methyl or ethyl alcohol. (B) The following substances may be used as solvents for cellulose esters, particularly cellulose acetate: Benzyl alcohol or its derivatives, purified by treatment with sodium bisulphite and containing neither aldehyde, acid, nor impurities chlorinated in the side chain, *e.g.*, benzyl chloride; other aromatic alcohols with similar properties, *e.g.*, diphenylcarbinol; pure *o*- and *p*-methylacetophenone, after treatment with sodium bisulphite; derivatives of acetophenone, benzophenone, *o*- and *p*-methylacetophenone, ditolylketone, or phenyltolylketone, having in the benzene nucleus hydroxyl groups etherified by alcohols or their derivatives, *e.g.*, methoxy- or ethoxy-acetophenone; derivatives of acetophenone or benzophenone chlorinated in the benzene nucleus; cyclohexanone, its homologues and derivatives, *e.g.*, methylcyclohexanone, dimethylcyclohexanone, cyclonaphthanone, or the corresponding alcohols; any of the previous compounds mixed with methyl or ethyl alcohol, or with acetone, methyl acetate, "special solvent," or with diluents, to form solutions of cellulose esters for varnishes, films, celluloid, etc. (C) Transparent cellulose acetate varnishes, which dry quickly and adhere to metals, are obtained by using a mixture of solvents boiling below 100° C. and a smaller quantity of solvents boiling above 100° C., according to the rate of evaporation desired. The addition of solvents of very high boiling point, *e.g.*, triacetin, glyceryl benzoate, or glycol benzoate, produces coatings with special properties. The other solvents claimed are methyl carbonate and propionate, the methyl and ethyl esters of glycollic, lactic, methyl- and ethyl-glycollic, methyl- and ethyl-lactic acids, ethylene and benzylidene diacetates, phenylacetate, the chloroethylene ester of acetic acid, and dihydrobenzoin. (D) In the manufacture of solutions of cellulose acetate, employing the solvents claimed in the principal patent and additions, or any other solvents, non-solvents, preferably immiscible with water, such as benzene, toluene, or xylene, may be used, provided that they have a lower boiling point than the solvent. The quantity of non-solvent must not be sufficient to cause precipitation at any point during evaporation, and the necessary amount of high-boiling solvent may be reduced by adding solvents of lower boiling point, such as acetone, methyl acetate, or ethyl acetate. The following additional solvents for cellulose acetate are mentioned: acetophenone, ethyl acetoacetate, methyl orthoformate, acetylcarbinol, diacetone-alcohol, acetylacetone, ethyl lævulate.—F. Sp.

Cellulose esters; Process for the manufacture of ——. H. Dreyfus. Fr. Pat. 475,160, Apr. 30, 1914. Under Int. Conv., Apr. 4, 1914.

By carefully controlling the temperature during the acetylation of cellulose, acetates insoluble in chloroform and in chloroform-alcohol may be produced. If sulphuric acid is used, the acetylating mixture is strongly cooled before adding the cellulose, and the reaction mixture is kept below 20°—25° C. Acetylation is stopped when the required solubility is obtained. With other catalysts, the necessary temperature conditions are different. Pure sodium bisulphate, and all other acid sulphates except those of the aromatic amines, if free from sulphuric acid, have no catalytic action even at 70° C. The bisulphates of the aromatic amines are of no use commercially, however, on account of the yellow colour that appears in the product. In the presence of free sulphuric acid, sodium and other bisulphates assist acetylation, and yield superior products to sulphuric acid alone. They are preferably prepared by adding to free sulphuric acid in the acetylating mixture rather less than its equivalent of anhydrous sodium acetate or sodium bicarbonate. The degree of cooling required during acetylation depends on the proportion of free sulphuric acid present, and if there is very little the mixture may require heating. The solubility of the products may be modified by applying the processes described in Fr. Pat. 432,046 (this J., 1912, 24). *Example.*—To 400 parts of glacial acetic acid, 300 parts of acetic anhydride, and 15—18 parts of concentrated sulphuric acid, is added 6·5—8 parts of anhydrous sodium carbonate; 100 parts of cellulose is introduced and the mixture is cooled by a stream of water. When the solution has become clear it is slightly warmed to finish the reaction, and the solubility of the product is modified as desired.—F. Sp.

Carbohydrate esters [pyroxylin]; Process of "colloiding" —— and product thereof. H. W. Matheson, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,161,063, Nov. 23, 1915. Date of appl., Nov. 4, 1913. Renewed Apr. 14, 1915.

A carbohydrate ester (pyroxylin) is made into a colloidal mixture with a benzoic acid ester of phenol (phenyl benzoate) or an ester of a homologue of phenol.—C. A. M.

Drying thread, band or tube-like formations of plastic substances; Apparatus for ——. C. Claessen, Berlin. Eng. Pat. 6104, Apr. 23, 1915.

Threads, films, or tubes produced by squirting plastic masses are suspended on arms carried on an endless chain driven by two or more rollers or wheels. The thread is fed from a distributing funnel which is rocked backwards and forwards above one arm and also moved sideways in the direction of the arm, so as to hang the thread in a regular manner on the arm. As soon as this arm has received a full load, the chain is automatically displaced so as to bring the next arm under the distributing funnel. The threads so suspended are dried by exposure to heat or a current of air, and are removed from each arm before the complete revolution of the chain brings it under the distributing funnel again.—F. Sp.

Paper: Method and machines for making ——. C. E. Pope, Holyoke, Mass., U.S.A. Eng. Pat. 9585, June 30, 1915. Under Int. Conv., May 26, 1915.

To transfer the wet web of paper, after leaving the couch-press, from the wire to the felt conveying it to the first wet-press, the web on the wire is cut in the usual way (*e.g.*, by a jet of water) so as to form a narrow end, which after passing the couch roll is projected upwards by a thin sheet of air directed against the wire tangentially to the surface of the lower couch roll, and is carried forward by its momentum on to the felt.—J. F. B.

Paper, cellulose, and other materials; Air drying apparatus for ——. L. A. Lyche, Vestfossen, Norway. Eng. Pat. 5855, Apr. 19, 1915. Under Int. Conv., Apr. 20, 1914.

The continuous web of material enters a chamber in which a zig-zag channel is constructed, *e.g.*, by two endless felts moving over driving rolls and guide rolls, and enclosed at the sides by the walls of the chamber. At every change of direction in its passage the web falls from one felt to the other, thus dividing the zig-zag channel into a number of separate compartments. Pipes for introducing dry air and exhausting the moist air, are so disposed in each compartment that the current follows the direction of the web at the same velocity. To prevent rapid drying at the edges the moist air may be passed up the edges of the felts.—J. F. B.

Cellulose acetates: Production of ——. Soc. pour l'Ind. Chim. à Bâle. Fr. Pat. 476,383, Oct. 26, 1914. Under Int. Conv., Nov. 10, 1913.

See Eng. Pat. 21,016 of 1914 ; preceding.

Seaweed; Manufacture of products [*alginates*] *from* ——. T. Ingham, Liverpool. U.S. Pat. 1,162,926, Dec. 7, 1915.

See Eng. Pat. 13,777 of 1913; this J., 1914, 689.

Treatment of various substances with hydrochloric acid gas. Fr. Pat. 476,630. *See* VII.

Process for rendering chromed colloids (*especially gelatin*) *insoluble, in the absence of light.* Fr. Pat. 475,152. *See* XV.

Process for the decomposition of soapy waters [*wool washings*]. Fr. Pat. 475,550. *See* XIXb.

Treatment of waste waters containing fats and soaps [*wool washings*]. Fr. Pat. 475,639. *See* XIXb.

Non-inflammable plastic materials. Fr. Pat. 475,351. *See* XXI.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Sulphide dyestuffs; Application of —— *to animal fibres and to union goods.* E. Lodge. J. Soc. Dyers and Col., 1915, 31, 252—255.

The methods which have been adopted in various attempts to dye animal fibres with sulphide dyestuffs are outlined ; their failure is attributed to the weak alkali, ammonia, which must of necessity be employed, not being sufficiently strong to keep the leuco-compound in solution. Vidal found that Vidal Black could be converted into a more soluble form (Vidal Black S) by treatment with a normal or acid alkali sulphite, and it is now pointed out that this also applies to the leuco-dyestuff. By addition of a normal sulphite to the dye-bath, a solution of sufficient concentration to produce any depth of shade, but at the same time of such feeble alkalinity as not to damage animal fibres, has been produced. The following is an outline of the general method : One part of the sulphide colour is boiled for 5—10 mins. with 2 parts of sodium sulphite and 10 parts of water ; 1 part of concentrated sodium sulphide is added and the mixture kept hot (but not boiled) until completely reduced ; the leuco solution is poured into the dye-bath, which is then heated to the required temperature, and two parts of neutralised ammonium sulphate or other ammonium compound added (to remove caustic alkali). The goods are kept under the dye-liquor as much as possible. In case only the cotton part of a union cloth is to be dyed, the goods should be worked in the cold or only lukewarm solution ; otherwise the bath is heated to 80° C., the heating stopped, and the goods worked for 10—15 minutes, squeezed out, entered directly into a cold bath, and worked until the cotton has acquired the correct intensity of shade. An alternative method is to boil the colour with sodium sulphite, pour the solution into a bath containing water at the correct temperature, and add sodium hydrosulphite, ammonium sulphate or ammonia being added to the dye-bath to correct for the alkalinity or acidity of the solid sulphide colour. An attempt to prepare an active dyeing solution by reduction with polysulphide failed until sodium sulphite was added to convert the polysulphide into ordinary sulphide, the excess sulphur giving thiosulphate : it would therefore appear that normal sodium sulphite is a rational ingredient to add to all forms of sulphide dye-vats, as sulphur, free or feebly combined, is a constant impurity in sulphide dyestuffs and will tend to form polysulphide, which is also liable to be present in commercial sodium sulphide. The sulphide colours dyed on wool or silk exhibit fuller and more bloomy shades than on cotton ; their resistance to scouring and milling is excellent ; they do not stain white wool, although some stain white cotton under milling, a defect which is remedied by after-chroming ; and most of the colours are very resistant to light, especially if after-chromed. The dyeings on silk are remarkable for their fastness to light, scouring, or milling, being faster than on wool or cotton.—F. W. A.

Dyeing of faded garments. C. M. Whittaker. J. Soc. Dyers and Col., 1916, 32, 4—9.

A faded garment may have been dyed with a fugitive colour, in which case the colour may easily be stripped and the garment again dyed, or the garment may have been dyed with fast colours and the fibre itself damaged by the sun and atmosphere combined, in which case the garment will probably have to be dyed black. Artificially faded wool, which has not been subject to actual wear and tear, does not give the same results as are obtained in practice. The affinity of flannel for basic colours increase on exposure ; the reverse side of the exposed flannel absorbs the colour in the usual manner. No rules can be stated for other classes of colours, *e.g.*, Chrysophenine gives lighter shades, Chlorazol Red A the same shade, whereas Chlorazol Deep Brown B and Chlorazol Green G dye the faded flannel much deeper shades, but these results vary according to the depth of shade attained. Although not capable of practical application, mordant colours dye faded garments best on chrome mordant, the same behaviour being noted for badly mixed wools. Level dyeings on faded and unfaded portions are obtained with Indigo extract XL, Fuchsine 6B, and Acid Magenta. Whereas in practice sulphocyanine dyestuffs have been found to be taken up more readily by the exposed portion, the reverse is found to be the case in dye-trials, whether the material is neutral or acid. An acid dye-bath is preferable in covering up faded portions to a union colour; unfortunately a strongly acid bath gives the best results so far as the depth of shade is concerned; boiling also favours the covering of faded portions, but is detrimental to the shape of the garments, and steam pockets may burst the seams. Indigo scarcely dyes faded flannel from a hydrosulphite vat, whereas Sulphur Black dyes the faded flannel deeper than the unfaded. Exposure of wool fibre is considered to result in a partial destruction of the amino-group. For this reason it is not probable that any treatment will result in obtaining the same dyeing properties for the faded and unfaded portions; attempts to utilise chlorination, sulphites, hydrosulphites, and oxidising agents have failed to lead to a satisfactory method. It therefore appears essential to experiment with each dyestuff before use, and to base garment dyeing entirely on practical experience.—F. W. A.

Interaction between metallic copper and certain dyes of the thiazine, oxazine, and azine series. Hannay. *See* IV.

Patents.

Metallic effects on fabrics; Process for obtaining ——. A. Baboin et Cie. Fr. Pat. 475,338, Feb. 4, 1914.

Open-mesh fabrics are immersed in suspensions of metallic powders in solutions of a colloid insoluble in water, for example in a mixture of 10 parts of acetylcellulose, 130 parts of tetrachloroethane, and 100 parts of bronze power. Other colloids may be used, such as other cellulose esters, gum resins, rubber, or rubber substitutes. The most suitable solvents are those immiscible with water, such as aromatic hydrocarbons, amyl and butyl alcohols and ethers, chloro-derivatives of acetylene, etc. The impregnated material is passed between two cylinders to remove the excess of material adhering to the fabric. The cylinders are prepared from substances unattacked by the solvent used; printing rollers of glycerin-gelatin are very suitable after hardening the surface by immersing in alcohol, which also dissolves the excess glycerin. Brighter effects, more similar to metallic filaments, are obtained than by the sprinkling process.—F. W. A.

Coloured effects obtained by mechanical means; Manufacture of fabrics showing after dyeing ——. A. E. Vergé. Fr. Pat. 475,794, Mar. 17, 1914.

Coloured effects are obtained by dyeing fabrics which have been submitted to suitable compression by an engraved surface, which may be heated.
—F. W. A.

"Running" of oils and oil colours on silk goods; Process for preventing the ——. G. Diesser, and Schweiz. Seidengazefabrik. Fr. Pat. 476,120, Apr. 4, 1914.

To prevent the "running" of oils and oil colours on silk gauze used for oil painting, it is saturated before treatment with the oil colour, with a solution of a drying or non-drying oil in a suitable solvent, *e.g.*, carbon tetrachloride.—F. W. A.

Fireproofing of tulle, muslin, and other finished goods: Process of ——. Comp. Française d' Injection pour la Conservation des Bois et Tissus. Fr. Pat. 476,061, Apr. 1, 1914.

To avoid the necessity of re-finishing goods after fireproofing, the neutral fireproofing solution is mixed with the finish. Suitable solutions are: (1) 125 grms. of ammonium phosphate, 7 grms. of boric acid, and 10 grms. of sodium tungstate per litre; and (2) 125 grms. of ammonium sulphate, 15 grms. of sodium borate, 5 grms. of boric acid, and 15 grms. of sodium tungstate per litre. The solution is added to the finish (gum, dextrin, starch, etc.) in the proportion of from 1 : 4 to 1 : 3.
—F. W. A.

Colours [pattern-books]; Standardisation of ——. R. C. Johnson and M. H. Myers, Leicester. Eng. Pat. 22,775, Nov. 19, 1914.

The colour scale comprises a master book of large patterns and a key book containing smaller patterns, several of the latter being bound on the same leaf or opening. The key patterns may be mounted on rotary discs contained in envelopes having a hole through which only one pattern can be seen at a time. The colours in both books are identified by corresponding names or numbers.
—J. F. B.

Bleaching process. R. Müller, Assignor to Luftbleiche G.m.b.H., Eilenburg, Germany. U.S. Pat. 1,163,438, Dec. 7, 1915. Date of appl., Mar. 14, 1910.

See Fr. Pat. 414,821 of 1910; this J., 1910, 1200.

Dyeing machine. W. Sehlbach, Barmen, Germany. U.S. Pat. 1,162,259, Nov. 30, 1915. Date of appl., June 10, 1913.

See Fr. Pat. 459,196 of 1913; this J., 1913, 1106.

Decoration of woven fabrics; Processes for the ——. H. Giesler, Brussels. Eng. Pat. 10,867, May 2, 1911. Under Int. Conv., Nov. 17, 1913.

See Ger. Pat. 282,351 of 1914; thisJ., 1915, 713.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid: Production of ——, *and a proposed new method of manufacture.* W. H. Waggaman. U.S. Dept. Agric., Bull. No. 283, Sept. 28, 1915. 39 pages.

In the United States in 1913, at least two million tons, or over 56% of the total output of sulphuric acid was consumed in the production of superphosphate; large quantities were also used for making ammonium sulphate and fertilisers of the "base goods" type. For the fertiliser industry, and for other industries where a pure acid is not essential, the lead-chamber process is still superior both as regards cost and efficiency. The complete admixture of the reacting gases, and the control of the temperature are essential to the success of this process. In the new process advocated, the admixture is effected by drawing the gases downwards through a spiral leaden flue. Sulphur dioxide, nitrogen oxides, air, and steam were passed through separate tubes into a large test-tube (200 c.c.), containing a little boiling water, and then drawn into a spiral leaden tube heated to 90° C. The acid formed in the spiral was collected at the base, and the residual gases were passed through bulbs containing concentrated nitric acid to absorb and oxidise any sulphur dioxide. When the supply of gases is properly adjusted, the yield of sulphuric acid is quantitative. The space occupied by the spiral for the oxidation of 1 lb. of sulphur in 24 hours is only 0·139 cub. ft., compared with 10 cub. ft. when a lead chamber is employed. By substituting glass for lead the yield was considerably smaller, and further experiments, performed without the use of nitrogen oxides, showed that the lead acted as a catalyst, and that lead or its oxide had a greater effect than lead sulphate; but nitrogen oxides were essential for complete oxidation. On a large scale the lead chambers and intermediate towers would be replaced by the spiral, but the Glover and Gay-Lussac towers would remain. The spiral would be cooled by air, or in hot weather by spraying water on its upper part, and the water thus warmed would be used to raise the temperature of the lower part where the reactions are less energetic. The large cooling surface and the continuous motion of the gases should diminish the corrosion of the leaden walls. A classified list and particulars of all American patents relating to the manufacture of sulphuric acid is appended.—E. H. T.

Potash from the seaweed of the Sargasso Sea. T. H. Norton. U.S. Cons. Rept. No. 276, Nov. 24, 1915.

Attention has been directed to the possibility of utilising the vast deposits of seaweed in the Sargasso Sea of the Central Atlantic. Enormous quantities are thrown upon the coasts of the Bahamas, and in one harbour the accumulation at times renders navigation almost impossible. The dried kelp obtained from this seaweed contains on an average about 9 % of potash, compared with 18·9 % in the kelp from the Pacific coast of California.

Boric acid; Influence of certain hydroxy-acids on the electric conductivity of ——. J. Böeseken. Rec. Trav. Chim. Pays-Bas, 1915, **35**, 211—224.

The author suggests that the antiseptic properties of boric acid may be attributed to the compounds of strong acidic character which it forms with the naturally occurring organic hydroxy-acids. This action of boric acid was demonstrated by the increased conductivity of α-hydroxyisobutyric, benzilic, diphenylhydroxyacetic, and diphenylenehydroxyacetic acids in presence of boric acid. The effect appears to depend on the carbonyl group closely associated with the hydroxyl group of the carboxyl on the one hand, and the α-hydroxyl group on the other, since no augmentation, and in some cases even a diminution of conductivity was observed with β-hydroxy acids and with α-glycols. The boro-α-hydroxyl complexes formed are comparable with the similar complex anions formed by α-hydroxy acids with metallic hydroxides, as for example in Fehling's solution, and the oxidising action of Fenton's reagent (hydrogen peroxide and a ferrous salt) is probably also attributable to the intermediate formation of iron complexes of the same nature.—G. F. M.

Alumina and aluminates. E. Martin. Monit. Scient., 1915, **5**, 225—232.

Aluminium hydroxides. The dense, granular hydroxide resulting from the auto-decomposition of alkali aluminates (Bayer's reaction) had the composition $Al_2O_3,3H_2O$ when dried in the air or at 100° C., and was non-hygroscopic. Dehydration commenced at 160° C., 1 mol. of water being expelled at 225° C. and 2 mols. at 235° C. From this point dehydration proceeded slowly and was completed only by heating to about 1000° C. The partly or completely dehydrated material re-absorbed 1 mol. of water on exposure, but lost the greater part or the whole of this in the desiccator or at 100° C. The composition of the gelatinous hydroxide obtained by precipitation with ammonia was variable; when dried at 80° C. the precipitate approximated to $Al_2O_3,2H_2O$ and absorbed water from the air with avidity. No definite hydroxide was produced at any stage on further heating, dehydration being gradual and continuous until completed at a red heat. *Alkaline-earth aluminates.* The only barium aluminate obtained by heating mixtures of alumina and barium carbonate below 1500° C. was Al_2O_3,BaO, the mixtures remaining unfused. From the solution obtained by extracting the product (molecular proportions) with water, a mixture of crystalline aluminates, less rich in barium was gradually deposited on standing; the composition $Al_2O_3.BaO$ was never quite attained in solution but was more nearly approached as the dilution increased. By the addition of alcohol to the fresh aqueous solution, a gelatinous precipitate, having the composition $5Al_2O_3,4BaO,4H_2O$ when dried in the desiccator, was obtained; and by concentrating the aqueous solution, filtering off the deposited aluminates, and allowing the filtrate to stand, needle-shaped crystals of $10Al_2O_3,11BaO,55H_2O$ were produced. The aluminate $Al_2O_3,3BaO$ was obtained by heating to fusion, in the electric arc, a mixture of alumina and barium carbonate in theoretical proportions; the melt was completely soluble in water, and by adding an excess of calcium chloride to the solution, a precipitate having the composition $(Al_2O_3,3CaO)_5,3CaCl_2$ was produced. The calcium aluminates Al_2O_3,CaO; $Al_2O_3.3CaO$; $2Al_2O_3,CaO$; $5Al_2O_3,6CaO$; and $10Al_2O_3,11CaO$ were obtained by heating the corresponding mixtures of alumina and calcium carbonate in the electric arc, and $Al_2O_3.2CaO$ by heating to 1450° C. The latter compound fused at 1400°—1450° C. and was slowly dissolved by water, but the theoretical composition was only maintained in very dilute solution. When finely powdered, this aluminate absorbed water and formed a crystalline product having the composition $Al_2O_3,2CaO,3H_2O$. *Double aluminates of alkali and alkaline-earth metals.* The preparation of these compounds, by heating mixtures of alumina (bauxite), alkaline-earth carbonates, and alkali sulphates or chlorides, is discussed mainly in connection with a process, patented by the author, for the production of pure alumina (see Eng. Pat. 9662 of 1915; following). *Sulpho-aluminates.* The compounds $Al_2O_3,2BaS$ and $2Al_2O_3.3BaS$ (and the corresponding calcium compounds) were obtained by heating, in closed crucibles, mixtures of alumina, barium (or calcium) sulphate, and carbon in theoretical proportions. These products were soluble in water, but the solutions decomposed rapidly with the production of the corresponding aluminates and hydrogen sulphide. *Silico-aluminates.* The compounds $2SiO_2,Al_2O_3,2CaO$ and $2SiO_2,Al_2O_3,CaO$ (and the corresponding barium compounds) were prepared by heating to about 1400° C. mixtures of silica, alumina, and calcium (or barium) carbonate in theoretical proportions. They were insoluble in water and formed no crystalline hydration products; no alumina was dissolved from them by solutions of alkali carbonates, but by treatment with dilute acids the alkaline earths were dissolved and insoluble, hydrated silica-alumina products formed. Constitutional formulæ are suggested for many of the compounds.—W. E. F. P.

Magnesium citrate in aqueous solution. F. Swart and C. Blomberg. J. Pharm. Chim., 1915, **12**, 387—391.

Magnesium citrate has the property of separating from its solution in water after several days as a white precipitate consisting of the normal salt. At first the precipitate is amorphous, but soon distinct crystals are formed of the compositio $Mg_3(C_6H_5O_7)_2.13H_2O$; their solubility is 1 % at 25° C. The deposition from solution is prevented by excess of citric acid, carbonic acid, or alkali citrates. Sterilisation of the solution by heat or by addition of formaldehyde does not prevent the deposition. These facts are explained by the ionisation of the normal salt into the two univalent ions $[Mg_2C_6H_5O_7]^+$ and $[MgC_6H_5O_7]^-$. This ionisation also explains the capacity of the solution to dissolve magnesia, the compound, $Mg_2(C_6H_5O_7)OH$, being formed. (See also Léger, this J., 1915, 574, 609.)—J. H. J.

Mineral sulphides and sulpho-salts; Decomposition of —— by thionyl chloride. H. B. North and C. B. Conover. Amer. J. Sci., 1915, **40**, 640—642. (Compare this J., 1915, 1206.)

MINERAL sulphides are in general decomposed by heating with thionyl chloride at 150°—175° C. in sealed tubes, with formation of metallic chlorides and oxides and chlorides of sulphur. Complex sulphides and sulpho-arsenides are likewise decomposed but in most cases more slowly. A few hours heating suffices for galena, pyrites, cinnabar, boulangerite, enargite, marcasite, orpiment, realgar, stibnite, tetrahedrite, and arsenopyrite, whilst pyrargyrite, proustite, and covellite are more resistant. Argentite, molybdenite, and cobaltite are unattacked by thionyl chloride.

—G. F. M.

Sodium nitrate. W. Montgomery and Co., Ltd., London, Dec. 31, 1915.

THE demand for refined nitrate for explosives purposes has grown rapidly, a demand not continued to this country but which has extended to the Governments of our Allies and also to America. Prices continued to advance, and oficinas which had closed down because of the unremunerative prices prevailing in the earlier days of the war, resumed operations. The result was a considerably increased production and a consequent check to the high prices obtaining in Chile. It is possible that the fall in prices was also due, in part, to the closing of the Panama Canal and the difficulty of obtaining freight. During the past six months prices have advanced continuously so far as nitrate in stock in Europe and afloat is concerned, but f.o.b. prices in Chile have fallen. No decrease is anticipated in Europe until a more plentiful supply is forthcoming. Consumption in the United Kingdom has probably been maintained during the past six months so far as agricultural quality is concerned, but the consumption of refined quality has increased very largely. Figures are hardly possible owing to the difficulty of obtaining accurate stock returns. Shipments to Europe for the past six months have been 651,000 tons against 386,000 tons. In America consumption for the same period has been 534,000 tons against 236,000 tons, but it is doubtful if any part of the increase was for agricultural purposes. Production has been making rapid strides and during December somewhat exceeded pre-war figures, at about 5,100,000 quintals. Stocks in Chile to-day amount to 17,000,000 quintals, against 23,500,000 last year.

Radium, uranium, and vanadium; Extraction of —— from carnotite. C. Parsons, R. B. Moore, S. C. Lind, and C. C. Schaefer. U.S. Bureau of Mines, Bull 104. (See also this J., 1914, 263; 1915, 77.)

THIS Bulletin gives the results of the co-operative work with the National Radium Institute and describes the methods of extracting radium from carnotite ore as carried out in the plant at Denver. The methods devised have proved highly successful. They depend essentially upon the fact that hot concentrated nitric acid has a high solubility coefficient for radium-barium sulphate. This enables the carnotite ores to be treated directly with hot nitric acid, removing the radium therefrom at a single operation. Briefly the method is as follows:—The carnotite, pulverised to 20-mesh, is treated in an earthenware leaching pot with 38% nitric acid, 500 lb. of ore being used to 121 lb. of 100% HNO_3. The acid is brought near to boiling by means of steam passed through a glass tube and the ore gradually stirred in. Heating is continued for 15 min., when the acid is filtered from the ore in a stoneware filter. This is followed by a second treatment in the same leaching pot with somewhat more dilute hot nitric acid, after which the whole is washed with hot water. Nearly all of the uranium, about 50% of the vanadium, and over 90% of the radium are carried into solution by this method and separated from the bulky residues, which are then discarded. The acid solution is nearly neutralised with sodium hydroxide, mixed with barium chloride and sulphuric acid in proper quantities, and kept in settling tanks with conical bottoms for three days to settle out the radium-barium sulphate. The supernatant liquid is then siphoned into an excess of boiling sodium carbonate solution to separate the uranium and vanadium from iron, aluminium, and calcium. The radium-barium sulphate left in the tank is run on to a stoneware filter, filtered, washed, and dried, the washings being also added to the sodium carbonate solution. The soluble sodium-uranyl carbonate and the sodium vanadate are filtered from the iron-calcium precipitate in filter presses and run into uranium-precipitation tanks. The sodium carbonate is then nearly neutralised with nitric acid, and sodium hydroxide added to precipitate completely the uranium as sodium uranate. The filtrate containing the vanadium is carefully neutralised with nitric acid, and ferrous sulphate added to precipitate vanadium as iron vanadate. Both the sodium uranate and the iron vanadate are separated from their solutions by means of filter-presses. The filtrate from the iron vanadate consists almost wholly of a solution of sodium nitrate containing a small amount of impurity. This filtrate is evaporated and the sodium nitrate recovered and used again for the manufacture of nitric acid. The radium-barium sulphate, without further treatment, is reduced in large graphite crucibles by charcoal, a very efficient conversion (90 to 95%) into barium-radium sulphide being obtained. The sulphides are dissolved in hydrochloric acid and the residue of unchanged sulphates re-treated. The chloride solutions are crystallised in silica-lined kettles, care being taken to keep the solutions acid with hydrochloric acid, as the separation of radium from barium is much more rapid under these conditions. The concentrated chlorides, containing from 4 to 10 mg. of radium per kilo., are taken to the laboratory, filtered from any insoluble impurities, and crystallised again in strong acid solution until the bulk has been reduced to a small volume, when they are converted into bromides. This is done after first neutralising with ammonia and precipitating with hydrogen sulphide to remove lead, which always accumulates and which is not precipitated by hydrochloric acid from strong barium chloride solutions. After removing the lead, the barium and radium are converted into carbonates by the addition of ammonium carbonate, washed, and dissolved in hydrobromic acid. From this point onwards crystallisation takes place in pure quartz dishes in solution strongly acid with hydrobromic acid. The fractional crystallisation of radium, from the original chlorides to the finished product, is neither tedious nor difficult, but takes place rapidly when acid solutions are used and proper apparatus is available which will withstand their action. The efficiency of the process is high. In connection with the radium plant a nitric acid plant has been erected which produces over 5000 lb. of nitric acid per day. Owing to the recovery of sodium nitrate, the cost of the nitric acid used has been very low, averaging, at the present cost for nitrate, slightly less than 2½c. per lb. To Sept. 1, 4774 mgms. of radium was produced in the form of sulphates and 1947·5 mgms. of element had been delivered in the form of bromide. Deliveries are continuing at the rate of 300 to 400 mgrms. per month.

Yttrium from the yttrium earths; Separation of ——. J. P. Bonardi and C. James. J. Amer. Chem. Soc., 1915, **37**, 2642—2645.

The most rapid method for separating yttrium from the yttrium earths is by fractional precipitation with potassium cobalticyanide. The cobalticyanides separate as a white granular precipitate on adding the solution of cobalticyanide slowly to a hot solution made by dissolving the oxides in hydrochloric acid, evaporating to dryness, and dissolving in water. Potassium cobalticyanide is added to the filtrate, and so on until four fractions are obtained, a fifth being formed by adding oxalic acid to the fourth filtrate. The precipitates are dissolved in sodium hydroxide, and precipitated with oxalic acid. Good results were also obtained by similar precipitations with ammonium sebacate, or potassium sulphite. Precipitations with azobenzenesulphonic acid effected no fractionation, as shown by atomic weight determinations, and this was also found to be the case with sodium phenoxyacetate and with sodium *m*-nitrobenzoate.
—W. G. C.

Adsorption compounds; Principle of the mobility of water in ——. A. V. Rakovski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1326—1329.

After filtration, ferric, chromium, and aluminium hydroxides contain about 90—95 % of water, most of which evaporates at constant rate under constant external conditions. As drying proceeds, these gels develop many cracks, which greatly increase the surface but do not affect the rapidity with which the water evaporates. This fact is explained by the very marked mobility of water in gels, which are adsorption compounds. In order to contrast this mobility with the far lower one of water in an ordinary solution, the author has exposed (1) moist potato starch and (2) aqueous sulphuric acid of vapour pressure 15 mm. at 19° C., in desiccators in which the pressure of aqueous vapour was maintained at 9, 11, 9, etc., mm. during successive periods of 24 hours, the temperature being 19° C. throughout. The course followed by the change in the water-content in each case is in agreement with the theoretical deductions of Duhem (J. Phys. Chem., 1900, **4**, 65). The numerical results are as follows :—

Day.	Vapour pressure.	Water content (%).			
		in starch.		in sulphuric acid.	
1	9	28·55	−4·79	65·56	−0·07
2	11	23·76		65·49	
3	9	19·52	+0·08	65·05	−0·04
4	11	19·64		65·01	
5	9	18·31	+0·71	64·58	−0·01
6	11	19·02		64·57	
7	9	18·02	+0·80	64·13	−0·01
8	11	18·82		64·12	
9	9			63·67	+0·03
10	11			63·70	
11	9			63·27	+0·04
12	11			63·31	

—T. H. P.

Critical points of several difficultly liquefiable gases: nitrogen, carbon monoxide, oxygen, methane. E. Cardoso. J. Chim. Phys., 1915, **13**, 312—350.

Using an improved form of cryostat, of which a detailed description is given, and recording temperatures by means of an isopentane thermometer standardised by means of melting ice (0° C.) and toluene (—94·5° C.), the critical temperatures and pressures of the above-mentioned gases were determined as follows: Nitrogen, —144·70° C., 33·65 atm.; carbon monoxide, —138·70° C., 34·60 atm.; oxygen, —118·00° C., 49·30 atm.; methane, —82·85° C., 45·60 atm., these results being subject to an experimental error of only ±0·10 of a degree or an atmosphere respectively. The critical density of methane was found by the use of the same apparatus to be 0·1623, and that of carbon monoxide 0·3110. The densities of co-existing phases of these two substances at temperatures somewhat lower than the critical point were determined, the curve plotted for the two phases, and the point at which the diameter, which from the experimental results was practically rectilinear, cut the curve, gave the above critical density values.—G. F. M.

Hydrogen and methane; Separation of ——*: catalysis of oxy-hydrogen mixtures. Activation of chlorate solutions by osmium. III.* K. A. Hofmann and O. Schneider. Ber., 1915, **48**, 1585—1593.

Absorption of hydrogen by chlorate solutions, although very slow in presence of osmium or other catalyst alone, is very greatly accelerated by employing a combination of catalysts, and the method is thereby rendered available for analytical determinations of hydrogen in presence of methane, which is not absorbed or oxidised under these conditions. A Hempel pipette is charged with a solution of 35 grms. of sodium chlorate, 5 grms. of sodium bicarbonate, 0·05 grm. of palladium chloride, and 0·02 grm. of osmium dioxide in 250 c.c. of water after the bulb has been packed as full as possible with platinised porous tubes or rods of earthenware. Hydrogen is absorbed at the rate of about 100 c.c. per hour, and the pipette once charged can be used for months. Catalyst poisons, such as gases containing sulphur or phosphorus, or ammonia, must be carefully excluded. Oxygen must be previously removed, otherwise the contraction in volume will represent hydrogen and a quantity of oxygen as well. The oxygen-hydrogen catalysis in absence of sodium chlorate is, however, unsuitable for analytical purposes, as only when the proportions are in the neighbourhood of 1 : 2 does the volume decrease correspond with theory. Carbon monoxide is very slowly oxidised in the pipette, but the contact surfaces are not thereby rendered inactive.
—G. F. M.

Solution of smoke, dust, and fume problems by electrical precipitation. Bradley. *See* I.

Carbides of aluminium, nickel, and copper. Briner and Senglet. *See* X.

New hydro-electric power plants in Norway. *See* XI.

Determination of lead in phosphate and alum baking powders. Seeker and Clayton. *See* XIXa.

Patents.

Hydrochloric acid gas; Treatment of various substances with ——. Soc. Ital. di Elettrochimica. Fr. Pat. 476,630, Dec. 1, 1914. Under Int. Conv., Oct. 30, 1914.

Hydrochloric acid is used in the gaseous state, instead of in concentrated aqueous solution, for the production of various chlorides, *e.g.*, ammonium barium, and potassium chlorides, and aniline hydrochloride. When the reaction between the base and the acid gas is carried out in the presence of water, a continuous precipitation of the pure crystalline chloride is obtained as soon as the water becomes saturated with the newly formed salt. The method may also be applied to the production of cellulose compounds, and avoids complicated operations.—J. B. C. K.

Cyanides; Electrical process for producing ——. J. E. Bucher, Providence, Rhode Island, U.S.A. Eng. Pat. 23,292, Nov. 30, 1914. Under Int. Conv., June 25, 1914.

In the production of cyanogen compounds from alkali or alkaline-earth compounds, carbon, and nitrogen, the materials are moulded into briquettes, 1 in. long by ¼ in. diam., which are heated to the required temperature in an electric resistance furnace made of magnesia brick and kieselguhr. Iron is incorporated with the briquettes in order that the reaction may take place at a more moderate temperature. Until highly heated the alkaline compounds act as insulators, but when hot the conductivity of the reaction mass increases enormously; to enable low voltages to be employed, therefore, a shallow charge is first heated, the amount being gradually increased, and the electrodes being drawn further apart, as the charge becomes hot. The briquettes may be preheated by the hot gases obtained in the treatment of a similar charge in a separate furnace. —W. G. C.

Aluminium nitride; Electric furnace for production of ——. Soc. Gén. des Nitrures. Fr. Pat. 475,908, Mar. 24, 1914.

The furnace described is an arc furnace, preferably of the three-phase type, with horizontal hollow electrodes. A mixture of carbon and alumina or other aluminous material, in a finely-pulverised state, is carried into the zone of the arc flame by the nitrogen, or gas containing nitrogen, required for the reaction. The gaseous products of combustion escape by an opening in the upper part of the furnace, but the denser portions of the solid matter, which remain suspended for a short time in the gas after its passage through the arc flame, fall to the floor of the furnace before the gases escape. The less dense particles of solid matter are carried away by the escaping gases and can be collected by a filter or by a condensing chamber through which the gases are led. The chief advantages of the furnace are, that the whole of the solid and gaseous matter passes through the arc-flame, and that the aluminous matter and nitrogen remain in contact at a high temperature, for a time sufficient to complete the reaction.—J. B. C. K.

Alumina; Manufacture of pure ——. E. Martin, Marseilles, France. Eng. Pat. 9662, July 2, 1915. Under Int. Conv., July 10, 1914.

Aluminous earths are ignited at about 1300° C. with calcium carbonate in sufficient quantity to saturate the alumina, and also the iron oxide and silica. A small proportion of an alkali salt, such as sodium sulphate, is added to lower the melting point of the material and increase the yield. The calcined mass of compound aluminates of calcium and alkali is washed in two stages with sodium carbonate solution at about 80° C. to yield soluble alkali aluminates free from silica. The alkali aluminate solution is submitted to carbonation or auto-precipitation by the Bayer process, and the liquid used to attack fresh material.—W. G. C.

Alumina; Process of making ——. L. G. Patrouilleau. Fr. Pat. 475,455, Feb. 25, 1914.

Aluminium carbide, as obtained in the electric furnace, is treated with soda or potash lye, whereby methane and acetylene are liberated and the aluminium goes into solution as alkali aluminate. The aluminate solution is filtered and then decomposed, *e.g.*, by adding a little solid alumina, pure alumina resulting. The alkaline liquor may be used again.—E. H. T.

Furnace; Electric arc —— for the oxidation of atmospheric nitrogen, with cooling of the resulting gases regulated according to their heat. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 476,633, Dec. 2, 1914. Under Int. Conv., Dec. 9, 1913.

Air is fed through a perforated wall to the electrode chamber, in which a disc-like arc is produced by a non-symmetrical magnetic field, and immediately above the arc is arranged a cooling vessel, or steam boiler, through which the gases are passed by means of tubes. The holes in the perforated wall, and the number and dimensions of the cooling tubes, are distributed according to the energy of the arc flame, and, in addition, cooling air is introduced through slits or tubes at the periphery of the flame.—B. N.

Carbides, carbo-nitrides, and nitrides; Process of making —— consecutively. G. Patrouilleau. Fr. Pat. 475,195, Jan. 27, 1914.

The oxy-compound of the metal is reduced with carbon in an electric resistance furnace, which is hermetically closed and evacuated as completely as possible. After removing the gaseous decomposition products, a current of nitrogen is passed through, thus converting the carbide into carbonitride (*e.g.*, cyanamide), or into a mixture of nitride and carbon.—E. H. T.

Calcium cyanamide and other nitrogen compounds; Manufacture of ——. N. C. Tommasi, and Usines Electriques de la Lonza. Fr. Pat. 476,294, Oct. 14, 1914. Under Int. Conv., Oct. 23, 1913.

Four periods may be distinguished in the ordinary process of nitrogen fixation by calcium carbide, namely—(1) the period of preliminary heating; (2) the principal reaction period; (3) the period of the end of the reaction; (4) the period of cooling. The efficiency of this method of nitrogen fixation depends largely upon the regulation of the temperature of the mass; and the heat which is generated in excess during the second period, may be utilised for heating or reheating the materials during the first and third periods of the process, respectively. In the method of operation described in the patent, which is applicable to furnaces of different types, the incoming gas is used as vehicle of heat transmission, for the purpose of utilising the heat evolved during the second period. —J. B. C. K.

Titanic acid [oxide]; Manufacture of ——. P. Gonnot. Fr. Pat. 475,642, Mar. 9, 1914.

Titanium oxide is precipitated in a pure state at the cathode when titanium tetrachloride solution is electrolysed. A carbon anode, a platinum cathode, and a voltage of 4—5 are recommended. The electrolysis is hastened by the addition of a little sodium or magnesium chloride.—E. H. T.

Crystallisation of salts; Means of promoting rapid ——, *particularly of sodium carbonate and sulphate.* G. Briois. Fr. Pat. 475,749, July 28, 1914.

The rapid crystallisation of a hot saturated solution is promoted by cooling and agitating simultaneously. The vessel is provided with a mechanical stirrer, and with a number of coiled tubes which are connected at both ends with external pipes in communication with a pump The crystallising liquor may be placed in the vessel and stirred while cold water circulates through the coils, or *vice versâ*.—E. H. T.

Salts; Process to prevent the hardening of —— during storage. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 476,151, Sept. 5, 1914.

The addition of a very small amount of silicious earth ("*farine fossile*") effectively prevents salts, like artificial nitrates, setting to a hard mass during storage. In some cases it is advantageous to heat the salt, to a temperature below its melting point, in a current of air or other gas, before adding the silicious earth.—E. H. T.

Amorphous silica; Manufacture of ——. P. Bertoye. Fr. Pat. 476,260, Oct. 3, 1914.

Pulverised quartz is converted into amorphous silica by heating it with caustic potash solution under pressure, and decomposing the alkali silicate solution with carbon dioxide or alkali bicarbonate. The precipitated gelatinous silica is filter-pressed, washed, ignited, ground, and sifted.—E. H. T.

Minerals; Method of dissolving ——, particularly applicable to the extraction of glucinum [beryllium] from beryl. H. Copaux. Fr. Pat. 476,465, July 18, 1914.

Powdered beryl (1 part) is heated with sodium fluosilicate (1·5 parts) to a moderate red heat for about 1 hour, and the product, which should not have been melted, is digested with water at above 100° C. in an autoclave for ½ hour. The liquid is then filtered and precipitated boiling with caustic soda; after drying at 110° C. the precipitate contains approximately 37% of beryllium, 4% of aluminium, 5% silica, 7% soda, 47% water, and a trace of manganese. The silica is precipitated by treatment with sulphuric acid, and beryllium sulphate is then crystallised from the filtered liquid. The method is applicable to other mineral silicates.—E. H. T.

Zirconium silicide, zirconium salts, and zirconium oxide; Manufacture of ——. P. Jost and P. Plöcker, Charlottenburg, Germany. Ger. Pat. 285,981, Feb. 1, 1914.

Zirconium silicide is prepared by heating a mixture of zirconium silicate and carbon to incandescence. Salts are prepared by decomposing the silicide with dilute mineral acids, and the oxide by ignition of the salts.—A. S.

Potassium sulphate; Process of producing ——. G. S. Morgan, Toledo, Ohio. U.S. Pat. 1,161,239, Nov. 23, 1915. Date of appl., June 7, 1915.

Alunite is roasted with calcium oxide at about 1200° to 1800° F. (650°—980° C.), to render the aluminium insoluble without the production of sulphur dioxide; the mass is leached and the liquid concentrated to recover the potassium sulphate.—B. N.

Dissolving salts, such as potassium chloride and the like; Process for continuously ——. J. Schnitzler, Bochum. Ger. Pat. 286,303, May 2, 1914.

The dissolving vessel consists of a horizontal cylinder fitted with a rotary agitator and conveyor. The salt is moved through the vessel in one direction and the solvent flows in the opposite direction, and the vessel is kept completely filled with the mixture of solid and liquid. The hot solvent is introduced through a pipe entering at the top of the vessel and stands under hydrostatic pressure. By means of a propeller placed immediately behind the inlet pipe, the hot liquid is prevented from flowing backwards, and the space between the propeller and the end where the solid residue is discharged forms a separate compartment to which cold solvent is supplied through a pipe entering at the bottom; the cold liquor also stands under hydrostatic pressure, and serves to wash the solid residue. The elevator into which the solid residue is discharged, is contained within a casing in which there is maintained a column of liquid of sufficient height to balance the hydrostatic pressure of the solution in the dissolving vessel. The solution of the salt flows out of the dissolving vessel at the opposite end into a trough. —A. S.

Sea-salt; Manufacture of ——. C. L. Achard and C. H. E. Wetzels. Fr. Pat. 475,485, Feb. 26, 1914.

The salt water is caused to evaporate at the surface of porous beds composed of a mixture of clay and fine sand, these beds being fed constantly from below, by means of a system of distributory or irrigation channels. The mixture of clay and sand favours the passage upwards of the salt solution by capillary action, while absorbing and giving up again a relatively large amount of the solar heat. A modification of the process consists in sweeping up the sand on the surface of the beds after it has become coated with salt, and by leaching this sand obtaining a concentrated brine which, on evaporation on special beds, yields a recrystallised salt.—J. B. C. K.

Aluminium sulphite; Process for the oxidation of —— to aluminium sulphate by means of air. C. A. Beringer, Charlottenburg, Germany. Ger. Pat. 286,366, Apr. 4, 1914. Addition to Ger. Pat. 269,794 (this J., 1914, 312).

An aluminous material which is attacked only slightly or not at all by sulphur dioxide at normal temperature and pressure, is treated with a mixture of sulphur dioxide and air under pressure and at an increased temperature in order to obtain aluminium sulphate.—A. S.

Perborates; Process for dehydrating ——. Deutsche Gold- und Silberscheideanstalt vorm. Roessler, Frankfort. Ger. Pat. 286,545, Apr. 23, 1914.

Perborates are dehydrated by heating with a liquid not capable of dissolving or decomposing them, preferably with a liquid, such as alcohol, which removes and dissolves the water of crystallisation. For example, if Tanatar's sodium perborate, $NaBO_3,4H_2O$, be heated for a short time with anhydrous or nearly anhydrous methyl or ethyl alcohol at 50°—70° C., the whole or the greater part of the water of crystallisation is removed.—A. S.

Rare earths; Manufacture of compounds of the ——. Gebr. Siemens und Co., Berlin-Lichtenberg. Ger. Pat. 286,573, Apr. 2, 1914. Addition to Ger. Pat. 284,889.

In the precipitation of rare earths as fluorides or phosphates by heating the solution with ground fluorspar or apatite and a small quantity of hydrochloric acid (see Eng. Pat. 8015 of 1914; this J., 1914, 830), the reaction velocity is greatly increased by heating to a temperature above the boiling point of the solution at atmospheric pressure. The higher temperature may be attained (1) by working under pressure or (2) by using a solution saturated at the reaction temperature, or a solid salt containing water of crystallisation heated to its melting point, or by a combination of both methods.—A. S.

Graphite; Chemical process of purification of natural ——. E. N. Lainé. First Addition, dated Jan. 14, 1914, to Fr. Pat. 464,642, Jan. 17, 1913 (this J., 1914, 550).

Mechanical devices, especially concentrating tables of the Dallemagne type, are employed to remove the lighter impurities and separate the graphite into grades of varying fineness, and the graded material is treated with hydrochloric acid (22° B., 1·18 sp.gr.) mixed with twice its weight of water, at 90° C., and washed, in vessels which are arranged in cascade. The washed material is dried in a hydro-extractor and with heated air, and is then intimately mixed with sodium carbonate (preferably the anhydrous Solvay product) and heated in crucibles for at least an hour, at about 1050° C. The product is treated with hot water, washed until free from sodium silicate, again treated with hydrochloric acid (1 acid to 6 water) at 80°—90° C., and finally washed with water and dried.—F. Sodn.

Iodine, chlorine, bromine, or fluorine, for the production of various organic and inorganic substances [without employing high temperatures and pressures]; Process for utilising the halogen hydracids, previously crystallised by cooling, as a source of ——. E. Fraquet. Fr. Pat. 475,998, Mar. 30, 1914.

A halogen hydracid is crystallised by cooling and allowed slowly to regain the ordinary temperature in contact with the material to be treated. Hydrogen iodide, for example, crystallised at —55° to —60° C., may be employed as a source of iodine in the preparation of organic iodo-compounds, such as tetra-iodofluorescein, or for effecting isomerisation, *e.g.*, of maleic esters to fumaric esters, or for polymerisation or condensation. The rise of temperature should occupy several hours.
—F. Sodn.

Nitrogen; Manufacture of chemically pure ——. Siemens und Halske A.-G., Siemensstadt, Germany. Ger. Pat. 286,514, Oct. 28, 1913.

Pure nitrogen is obtained by heating to a high temperature a mixture of tantalum powder and a nitrogen compound of an alkali metal. The tantalum absorbs any traces of oxygen and steam which may be present. Nitrogen compounds of alkali metals explode when heated alone.—A. S.

Hydrogen; Cyclic process for producing nascent —— *by means of esters.* [*Desulphurising petroleum.*] J. de la Fresnaye and P. Suchy. Fr. Pat. 476,154, Apr. 23, 1914.

An ester is saponified with water, in the presence of a metallic oxide or carbonate and a material to be treated with nascent hydrogen, to which may be added a reducing agent, such as trihydroxybenzene or gallic acid. For example, petroleum containing sulphur compounds is treated with ethyl acetate, lead oxide or carbonate, and a small proportion of trihydroxybenzene, the lead sulphide produced is filtered off, and ethyl acetate, which is continuously re-formed during the reaction, is recovered by fractionating the filtered product; the reaction is facilitated by adding ether to prevent emulsification.—F. Sodn.

Argon [from atmospheric air]; Process of eliminating or obtaining ——. Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Procédés G. Claude). Fr. Pat. 476,390, Apr. 21, 1914.

In the fractionation of atmospheric air, as described in Fr. Pat. 437,013 of 1911 (see Eng. Pat. 3326 of 1911; this J., 1912, 335), the mixture of nitrogen and oxygen containing most of the argon from the air treated, obtained by rectifying the liquid oxygen collecting in the column, is concentrated by partial liquefaction in an external reflux tubular system, cooled by liquid nitrogen from the column. Almost pure argon may be prepared from the residual gas, when containing as much as 20% of oxygen, by burning with a slight excess of hydrogen, and then liquefying and rectifying.
—F. Sodn.

Zeolites; Manufacture of ——. P. de Brünn, Düsseldorf, Germany. U.S. Pat. 1,161,200, Nov. 23, 1915. Date of appl., July 14, 1913.

See Addition of Sept. 27, 1913, to Fr. Pat. 455,391 of 1913; this J., 1914, 372.

Alumina: Manufacture of pure ——. E. Martin. Fr. Pat. 475,476, July 10, 1914.

See Eng. Pat. 9662 of 1915; preceding.

Alumina from clay and other alumina-bearing materials; Method for producing pure ——. M. Buchner, Heidelberg, Germany. U.S. Pat. 1,162,130, Nov. 30, 1915. Date of appl., June 27, 1914.

See Eng. Pat. 15,854 of 1914; this J., 1915, 871.

Potassium and sodium salts from kelp ashes: Process for the manufacture of ——. C. Klingbiel, Biebrich, Germany. U.S. Pat. 1,162,617, Nov. 30, 1915. Date of appl., Oct. 3, 1914.

See Ger. Pat. 277,109 of 1913; this J., 1915, 138.

Metallic amides, cyanamides, and cyanides; Manufacture of ——. E. A. Ashcroft, London. U.S. Pat. 1,163,498, Dec. 7, 1915. Date of appl., Apr. 14, 1910.

See Fr. Pat. 421,851 of 1910; this J., 1911, 422.

Ozone; Process of and apparatus for producing ——. J. Steynis, Bay Shore, N.Y. U.S. Pat. 1,162,415, Nov. 30, 1915. Date of appl., Jan. 29, 1913.

See Fr. Pat. 451,484 of 1912; this J., 1913, 611.

Preparation of tetra-cupric sulphate, and its use as fungicide. Fr. Pat. 476,512. *See* XIXb.

VIII.—GLASS; CERAMICS.

Stoneware glazes; Relation of frit to glaze in —— *and its connection with glaze defects.* H. Harkort. Z. angew. Chem., 1915, 28, 422—428.

The relation of the frit to the final compound glaze is specially important in glazes in which the acid components are low, and is connected with defects, such as cloudiness, matt patches, etc. Generally the defects are caused by too high a proportion of lime in glazes on the better classes of goods, fired at a glost temperature of Seger cone 01 to 6. The CaO should not exceed 0·4 of an equivalent for 2·5 equivalents of SiO_2, and must be reduced proportionally as the acid component is lowered, since the excess lime is not fritted and does not amalgamate with the glaze. Dulness often arises from volatilisation of boric anhydride from the glaze, and occurs especially when the glaze is exposed to the influence of sulphuric acid from the furnace gases. In glazes with less than 2·5 equivalents of SiO_2 and about 0·5 of an equivalent of CaO, this volatilisation causes the separation of matt patches, absorption of the glaze, and large burst blisters, but when the silica is increased and the lime diminished, the surface of the glaze only shows minute pricks. The presence of calcium carbonate is a protection against attack by sulphuric acid and so diminishes the risk of volatilisation of boric acid. Lead oxide promotes the absorption of lime, more effectually when present in the glaze than in the frit only, but exerts no influence on the volatilisation of boric acid. These results lead to the following conclusions. The content of lead oxide may be reduced and replaced by the cheaper calcium oxide, with a corresponding improvement of the health of the workers. The lead oxide introduced into the glaze should be fritted. By avoiding the use of sulphurous coal

and regulating the conditions of firing, certain of the defects can be remedied. The results also show how glazes of satisfactory colour can be obtained; the character of the glaze is often changed by the relatively large amounts of metallic oxides incorporated with the glaze.
—W. C. H.

Patent.

Glass; Manufacture of ——. H. T. E. Kirkpatrick. Brussels. Eng. Pat. 8673, June 11, 1915. Under Int. Conv., May 29, 1914.

In the manufacture of continuous glass sheets by the method of drawing from a mass of molten glass, the current of air to which the latter is subjected while being gathered, and during the formation and cooling of the sheet, is first directed downwards through the vertical drawing conduit and then upwards, by suction, through one or more adjacent flues into which the hot gases from the molten bath are also drawn, so that, by regulating the currents separately, the desired decrease in temperature from the molten mass to the formed sheet is effected. The central or drawing conduit is enlarged at its lower part to form an "adaptation chamber" for heating the air which is subsequently caused to play over the surface of the sheet prior to contact of the latter with the guiding devices; and the train of lifting or traction rollers is arranged over the drawing conduit, which is provided internally with guides so as to maintain the sheet in a strictly vertical plane. The application of the invention to a glass-melting furnace direct and to a heating chamber attached to a melting furnace is illustrated by a series of nine drawings.—W. E. F. P.

IX.—BUILDING MATERIALS.

Timbers: Strength tests of structural —— *treated by commercial wood-preserving processes.* H. S. Betts and J. A. Newlin. Bull. 286, U.S. Dept. Agric., Sept., 1915. 15 pages.

Beams of loblolly pine, longleaf pine, and Douglas fir, generally 14 ft. long and 8 by 16 in. in cross-section, were tested in the unseasoned and seasoned conditions, before and after treatment with creosote by the usual commercial processes of "boiling" and "steaming." In the tests, each beam was supported at the ends and a gradually increasing load applied at two points located one-third of the span from each support. The deflections corresponding to regular increments of load were recorded, and from these data the fibre stress at elastic limit, the modulus of rupture, the modulus of elasticity, and the longitudinal shear were calculated in each case. From the results obtained it is concluded that although creosote itself has no apparent weakening effect on timber, the latter is liable to considerable weakening by preservative processes. A process injurious to one timber may have little or no effect on the strength of another; so that, for comparative tests on different species, the preservative process employed should be the best adapted for all. The effect of a given treatment on any given species is liable to vary with the form, dimensions, and condition of the specimens treated.—W. E. F. P.

Patents.

Concrete and other materials: Machine for mixing ——. J. Southall, Worcester. Eng. Pat. 10,007, July 9, 1915.

An oblong vessel is mounted in a vertical position on a horizontal axle by means of which it can be rotated in either direction. It has an opening on each side for charging and discharging, and each opening is provided with an internal guard or deflector, by which leakage is prevented during rotation in one direction, and discharging facilitated during rotation in the opposite direction.
—W. E. F. P.

Portland cement; Process and apparatus for burning —— *in shaft kilns.* Amme Giesecke und Konegen A.-G. Fr. Pat. 475,253, Jan. 31, 1914.

Compressed air is supplied to a pipe which surrounds the outside of the kiln, and enters the kiln tangentially at different levels below the clinkering zone, through conduits connected with the pipe.
—W. C. H.

Clinker; Apparatus for cooling —— *in the manufacture of cement, and for like cooling purposes.* G. M. Park, Blackburn. Eng. Pat. 7415, May 18, 1915. Addition to Eng. Pat. 2661, Feb. 2, 1914 (this J., 1915, 284).

In the apparatus described in the principal patent, water from a spray pipe is passed through the hot clinker, which is retained upon a circumferential grid in a horizontal rotating drum to which the clinker is fed from a hopper. The hot water passes through an annular opening in the drum, provided with drip flanges, to a collecting trough beneath.—W. F. F.

Bricks; Manufacture of silico-alumino-calcareous ——. A. J. J. Dard. Fr. Pat. 475,328, Feb. 6, 1914.

Bricks similar to sand-lime bricks are made with argillaceous sand or with clay.—W. C. H.

"Portland lime" and its process of manufacture. M. J. Davidsen. Fr. Pat. 475,727, Mar. 13, 1914.

A hydraulic product, called "Portland lime," is made by burning argillaceous limestone to a temperature so high that the burnt material does not slake in the cold. The burnt material from the kiln is drawn off into receivers, the walls of which are heated to a temperature of 120° C. or higher, where it is slaked.—W. C. H.

Cellulose; Electrical treatment of ——. [*Wood preservation.*] A. L. C. Nodon. First Addition, dated Feb. 12, 1914, to Fr. Pat. 453,111, Mar. 26, 1912 (this J., 1913, 785).

In simplification of the original process the cement vat is replaced by a simple floor of planks and the preliminary steeping of the timber to be treated is dispensed with. Electrodes of galvanised iron matting, with damp coarse cloths on one or both sides, are placed at the bottom of the stack of timber and similar ones are built in at regular intervals in the height. The cloths are well sprinkled with water during the building, no salt solution being required. (See also this J., 1915, 284.)—J. F. B.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron and steel; Relative corrodibilities of ——. J. N. Friend. Faraday Soc., Dec. 8, 1915. [Advance proof.] 8 pages.

The factors determining the relative corrodibilities of iron and steel are considered, and the results summarised and discussed. According to this summary, iron and steel are practically equally resistant to corroding influences, but a wide divergence is shown between different irons and steels in individual cases. The author considers that since no one metal can be expected to offer equal resistance to all types of corroding media, investigation should be directed, in every case,

towards discovering the best variety of iron or steel for the particular purpose in view.
—W. E. F. P.

Iron and steel; Note on the corrosion of ——. S. Whyte. Faraday Soc., Dec. 8, 1915. [Advance proof.]

A mild-steel water-pipe, which had corroded rapidly in use, was found to differ from other pipes, which showed much less corrosion, only in the fact that the former appeared from microscopic examination to have been overheated to a greater extent than the latter. Tests on the electrolytic corrosion of steels in sodium chloride solution, showed that the corrosion product from overheated specimens was on the average about 20% more than from normalised specimens. The ferrite was first attacked, then a reversal took place, and the pearlite became relatively more attacked. On still further corrosion the free ferrite was again attacked relatively more than the pearlite, and much more so in the overheated specimens.—T. St.

Steel: Experiments on the influence of composition upon the corrosion of ——. L. Aitchison. Faraday Soc., May and Dec., 1915. [Advance proofs.] pp. 12 and 11.

The results are given of corrosion tests made on various steels in tap-water, in a 3% solution of sodium chloride (approximating sea-water), and in 1% and 10% solutions of sulphuric acid. Four series of steels were employed, containing (1) C 0·07—1·46%; (2) C 0·7—1·1% with varying proportions of either W (up to 26%), Cr (up to 24%), Co (up to 21%), or V (up to 13%); (3) C 0·11—1·30% with either W (about 3%), V (about 2%), Cr (about 2%), Ni (about 3%), or Mn (about 1%); (4) C 0·3—1·2% and Cu 0·5—5·0%. The results are tabulated and curves given showing the variation of corrosion or solubility with the different constituents for each series; micrographic evidence as regards the influence of composition on corrosion is considered in some detail. It is concluded that no steel is sufficiently homogeneous to resist corrosive attacks; that chemical homogeneity alone is insufficient to preclude corrosion, since the steel may contain twinned crystals or be in a state of thermal or mechanical strain; that non-homogeneity is not in itself productive of greater corrodibility; that non-corrodibility depends on some property of the solid solution (probably its solution pressure as reflected in its contact potential against the solution) existing as a consequence of the chemical composition only, coupled with the thermal and mechanical treatment; and that carbides in steel may act as deterrents to corrosion (being quite unattacked by the majority of reagents) but in most cases act as aids, by providing suitable cathodes to the anodic action of ferrite in solid solution.—W. E. F. P.

Steel; Volume changes during the hardening of ——. E. H. Schulz. Charlottenburg Technische Hochschule, Mitt. über Forschungsarbeiten, No. 161. Engineering, 1915, **100**, 596—597.

Working on small samples to obtain uniform structures, the author determined hydrostatically the specific gravities of steels of widely varying composition, after different heat treatments. It was found that the density of annealed steel decreased as the carbon percentage increased. The density was decreased by quenching, the more with higher percentages of carbon in the steel. To keep the volume changes small the quenching temperature should be low, for with rising quenching temperature the volume changes become much more noticeable. Above 800° or 900° C., however, the quenching temperature has little further effect. The author considers the best quenching temperature is a little above the pearlite-martensite transformation point. Tests made with wires 5 mm. in diameter showed in every case a lengthening on hardening. The lengthening increased with increasing carbon percentage and was roughly proportional to the length of the specimens. The author concludes from his experiments that on quenching, martensite needles are formed in the austenite, which is first compressed by them; but the decomposition of martensite begins at 100° C., and above 150° C. austenite becomes able to take up the compression stress, and is itself decomposed in the range, 250°—450° C., in which the martensitic decomposition is completed. On the other hand, rising temperature expands both the martensite and austenite, and as the expansion predominates in the interior, which is still in the annealed state, whilst contraction goes on in the cooled surface layers, hardness cracks are developed. It is not possible to relieve, by annealing, the stresses set up during hardening in specimens of large dimensions, because the complex groups of factors interact in various ways. Something, however, can be achieved by hardening at definite temperatures, which should be low in general, by avoiding eutectoid steels, which particularly incline to cracking, and by substituting special (nickel) steels for them. That eutectoid steels should be most liable to develop hardness cracks, the author ascribes to the circumstance that in them all the transformations take place at one temperature (about 700° C.), and not in several stages.—T. St.

Steel; Alumina in ——. G. F. Comstock. Met. and Chem. Eng., 1915, **13**, 891—895.

The microscopic study of unetched polished sections of steels to which different metallic oxides had been added, showed that alumina could be identified with certainty, and the presence of alumina, detected microscopically, in commercial steels, was confirmed by chemical analysis. The chief differences between inclusions of alumina and ordinary slag or silicates are:—(1), silicate inclusions generally take a fairly smooth polish, while alumina is very hard to polish without pitting; (2), silicate inclusions are always elongated in the direction of rolling or forging, while alumina particles are not; the groups of particles are elongated but not the particles themselves; (3), silicate inclusions are often of quite large size (as well as very small), while particles of alumina are always small, and do not seem to coalesce into larger bodies even when closely grouped together. Photomicrographs are given showing the characteristic appearance of alumina inclusions and the different appearances of other inclusions.
—T. St.

Swedish iron and steel production. Min. and Eng. World, Dec. 11, 1915.

According to official statistics of the Swedish iron trade for 1914, the production of iron ore in Sweden during that year was 5,966,039 tons. Pig iron production for 1914, as compared with 1913, was as follows:—Forge, 152,859 tons as against 186,090 tons; Bessemer, 111,830 tons as against 141,611 tons; basic, 335,216 tons as against 358,437 tons; spiegeleisen, etc., 5 tons as against 50 tons; foundry, 12,820 tons as against 14,250 tons; other qualities, 14,655 tons as against 15,891 tons; blast furnace castings, 12,333 tons as against 13,898 tons; total, 639,718 tons as against 730,257 tons. During 1914 there were 74 works producing puddled iron and ingot steel and castings, as against 77 in 1913. Of the total of 507,332 tons of steel (ingots and castings) produced in 1914, 300,104 tons was basic, as against 353,696 tons in a total of 590,887 tons during 1913

Steel; Direct production of —— from ore in Canada. U.S. Cons. Rept. No. 260, Nov. 5, 1915.

An electric smelter at Belleville, Ontario, is producing steel of all grades, including tool steel, direct from the ore. The heat of the waste gases of the smelter is utilised in a preheater. The plant has been working for about two months, and has been using ore containing 7·5% Ti. The company proposes to extend the plant to produce high-carbon tool steels and steel castings.

Corrosion of all metals immersed in liquids; The Cumberland electrolytic process for preventing ——. E. Cumberland. Faraday Soc., Dec. 8, 1915. [Advance proof.] 4 pages.

In the Cumberland process, a counter-electromotive force higher than that causing the corrosive action is introduced into the boiler, etc., the shell of the latter forming the cathode of a system, the anodes of which consist of pieces of iron inserted in the water and insulated from the shell. A continuous current is supplied, at small cost, by a dynamo of the electroplating type working at 10 volts, and the iron anodes are usually designed to last for 1½ or 2 years. The process is also effective in removing and preventing the formation of hard scale in boilers, etc., and may be applied with equal advantage to any apparatus in which metals are in contact with water or other corrosive liquid. The system has been used successfully for many years in large power plants and on steamships.
—W. E. F. P.

Brass; The corrosion of a solid solution: 70/30 ——. W. E. Gibbs. Faraday Soc., Dec. 8, 1915. [Advance proof.] 5 pages.

The corrosion of brass immersed in sea-water may be local or uniform; and it may be complete (both constituents dissolving at the same rate), selective (one constituent only dissolving), or irregular, the constituents dissolving at different rates. The most important factors influencing corrosion are discussed. The corrodibility of copper and of zinc is greater than that of their alloys, the alloy with 50 atoms % of each metal being least attacked. The rate of corrosion of 70/30 brass increases with the temperature from 15° to 50° C., beyond which it falls off very quickly. Up to 50° C., aeration of the sea-water increases the initial rate of corrosion; dilution decreases it, though the proportion of dissolved zinc increases rapidly. Moist zinc chloride at 70° C. produces rapid dezincification, with formation of zinc oxychloride. Hard-drawn brass corrodes less rapidly, but dezincifies more readily, than annealed brass. In contact with coke the rate of solution is increased fivefold, a non-adherent film of cuprous oxide being formed. The existence of compounds of copper and zinc, dissociating into a system of solid solutions at temperatures above 50° C., may possibly account for the phenomena of corrosion.—W. R. S.

Brass corrosion; The zinc-copper-couple hypothesis of ——. A. Philip. Faraday Soc., Dec. 8, 1915. [Advance proof.] 14 pages. (See also preceding abstract).

The theory is advanced that the corrosion of commercial brass may be due to the action of minute zinc-copper couples over its surface, and this assumption is shown to account for several facts regarding corrosion, which cannot be explained by assuming that the couples are composed of different phases of the zinc-copper alloy.—W. R. S.

Corrosion; Physical and mechanical factors in ——. C. H. Desch. Faraday Soc., Dec. 8, 1915. [Advance proof.] 6 pages. (See also this J., 1915, 258, 1015.)

According to the electrolytic theory, now generally accepted, the corrosion of metals is due to the formation of local electrolytic couples at the surface in contact with the solution or atmosphere. The heterogeneity of the metal, by which such local action becomes possible, may be either chemical or physical; and chemically pure metals may corrode rapidly by reason of local physical differences induced by mechanical means, such as "cold working" by which films of amorphous material are formed between the separate crystal grains. The results of experiments in which alloys of copper and zinc with other metals were corroded electrolytically in a solution of sodium chloride, the weights of the dissolved constituents determined, and the specimens periodically examined under the microscope during the tests, are discussed. The effects of small amounts of various metallic constituents, and of loose non-metallic particles in accelerating or retarding corrosion are also considered, and the opinion is expressed that methods of investigation in which the mechanical and physical factors are taken into account are capable of much greater precision than those in which these factors are ignored.—W. E. F. P.

Passivity of metals. N. A. Izgaryschev. J. Russ. Phys.-Chem. Soc., 1915, 47, 1337—1373.

Investigation of the polarisation of various electrodes in presence of methyl or ethyl alcohol gave the following results. Although chemical polarisation does not occur with cadmium, zinc, copper, etc., immersed in aqueous solutions of their salts, this phenomenon is exhibited to a marked degree on addition of an alcohol; in the case of nickel, however, the degree of polarisation is not only not increased by addition of methyl alcohol, but is even strongly diminished in 100% methyl alcohol. It is highly probable that one of the causes of the polarisation in such cases is the slowness with which the electrode processes take place. The course of ionisation in solution may be explained on the basis of two hypotheses, the first of which assumes that, in solutions of metallic salts which are not too dilute, complex ions are formed without the participation of the solvent. Thus, copper sulphate in water would ionise according to the scheme,

$$2CuSO_4 \rightleftarrows Cu^{\cdot\cdot} + [Cu(SO_4)_2]'' \text{ and }$$
$$2CuSO_4 \leftrightarrows (Cu_2SO_4)^{\cdot\cdot} + SO_4''.$$

The character of the processes at the electrodes would thus depend entirely on the velocities of formation and distribution of such complexes. This hypothesis is justified in its application to many of the phenomena of aqueous solutions, but is inapplicable to the explanation of the cases of polarisation now considered, since the participation of the solvent must be regarded as completely proved. The second hypothesis assumes the course followed by the electrode processes to be determined by the speeds of formation and of decomposition of solvate compounds in the formation of which either the alcohol and water together or the alcohol alone take part. The phenomena of passivity, that is, the polarisation of the electrodes on electrolysis, and the passivification of the equilibrium potentials of the same metals, are not in direct interdependence. It is found, indeed, that metals which are strongly polarised on electrolysis sometimes give active potentials. The latter are rendered passive principally owing to coupled oxidising processes, which cause the formation, on the surface of the electrodes, of a coating of oxide compounds, which probably include molecules of the solvent in their composition.—T. H. P.

Copper refining in Australia. Board of Trade J., Dec. 16, 1915.

The Federal Attorney-General, at the close of a meeting of the Metal Conference convened by him on 14th October, stated that arrangements had been definitely completed whereby the whole of the copper output of Australia suitable for electrolytic treatment could be dealt with in the Commonwealth. The problem the Conference had considered was how to make provision for refining copper by the electrolytic process or by the usual fire process. The policy of the Government had been to make provision for the treatment of copper ores so that they should leave Australia in the form of metallic copper, thus affording employment for capital and labour within the Commonwealth in the treatment of products which were formerly exported in crude form. The export of copper matte and blister copper would not in future be permitted unless it could be clearly shown that facilities for refining were insufficient. Only one further step remained to be taken, namely, the manufacture from metallic copper of all copper and brass goods consumed within the Commonwealth. Negotiations in regard to this were proceeding.

Copper; Influence of nickel on the mechanical properties of ——. W. Stahl. Metall u. Erz, 1915, **12**, 179. Chem.-Zeit., 1915, **39**, Rep., 372.

THE mechanical properties of refined copper may be improved by the addition of a few tenths per cent. of nickel. Refined copper has a tensile strength of 19 to 21 kilos., but copper containing a small quantity of nickel has a tensile strength of 22 to 23 kilos., an elongation of 39·5 to 46 %, and a reduction of area of 50·5 to 67 %.—T. ST.

Carbides of aluminium, nickel, and copper; Researches on the ——. E. Briner and R. Senglet. J. Chim. Phys., 1915, **13**, 351—375.

FROM a study of the formation and dissociation of the carbides the following conclusions are drawn. The reaction $Al_4C_3 \rightleftarrows 4Al + 3C$ is perfectly reversible; aluminium carbide is completely dissociated when heated to 540° C. in a vacuum, and converted into the corresponding oxides at the same temperature in air, if the time of heating is sufficiently prolonged. By heating mixtures of finely divided aluminium with excess of carbon to 750° and 900° C. for 1½—2 hrs., small quantities of the carbide were produced. Nickel carbide is formed and dissociated according to the equation $3Ni + C \rightleftarrows Ni_3C$, the temperatures most favourable to formation and dissociation being about 2100° and 1600° C. respectively; dissociation is relatively slow at 900° C. The forward reaction is endothermic when the nickel and carbon are in the solid state, and exothermic at temperatures sufficiently high for these elements to assume the gaseous or atomic condition. The formation (by an endothermic reaction between copper and carbon at a high temperature) of a carbide of copper which dissociated rapidly at 1600° C. and more slowly at lower temperatures, was indicated but not confirmed.—W. E. F. P.

Amalgams; Electrical transference in ——. G. N. Lewis, E. Q. Adams, and E. H. Lanman. J. Amer. Chem. Soc., 1915, **37**, 2656—2662.

THE authors find that an electric current passing through a dilute amalgam of sodium or potassium causes a transfer of the dissolved metal in the direction of the negative current, whereas, according to the theory of Kraus (J. Amer. Chem. Soc., 1908, **30**, 1323), it would be expected that the dissolved metal would be carried with the positive current, as is the case when a metal is dissolved in a non-metallic solvent, *e.g.*, sodium in liquid ammonia. The amalgam was prepared by the electrolysis of the hydroxide with a cathode of pure mercury, and was transferred to an evacuated glass receiver, which communicated with two glass tubes having platinum electrodes sealed in their lower ends. An electric current of 4 to 8 ampères was allowed to pass through the amalgam for several days so as to give about 1000 ampère-hours. The resulting amalgam in each glass tube was analysed by treating with excess of standardised hydrochloric acid, and titrating back with carbonate-free sodium hydroxide, using rosolic acid as indicator. It was found that the number of equivalents carried in the direction of the negative current per faraday is $2{\cdot}9 \times 10^{-6}$ in sodium amalgam of 3·24 atoms per cent. of sodium. In potassium amalgam of 2·16 atoms per cent. of potassium it is $3{\cdot}6 \times 10^{-6}$. This transfer to the negative pole is considered to be due to a diminution in the average mobility of the electrons, which is also the cause of the lowering of the conductivity of the mercury observed on addition of sodium or potassium. Potassium, at the same equivalent concentration, lowers the conductivity of mercury about twice as much as sodium, and, in agreement with this, potassium amalgams give twice as large a transference number as sodium amalgams at the same concentration.—W. G. C.

[*Metal*] *colloids; Electrical synthesis of* ——. H. T. Beans and H. E. Eastlack. J. Amer. Chem. Soc., 1915, **37**, 2667—2683.

IN order to investigate the hypothesis that electrical colloid synthesis consists of a thermo-mechanical dispersion, sols of platinum and gold were prepared, and the relative extent to which oxidation of the metal, *i.e.* formation of ion, takes place, was measured by the increase in conductivity. Water freshly distilled from alkaline permanganate was employed for the experiments, and collected in thoroughly steamed "non-sol" bottles. The conductivity cell and electrode adjustments were designed so that the colloid could be prepared in the cell itself, and thus pouring from one vessel to another was avoided. Conductivity measurements were taken after arcing had continued for about one minute in each case, and it was found that the average increase in conductivity was nearly eight times greater for platinum than for gold, the difference being due to a greater oxidation in the case of platinum. The platinum sols were always more stable than the gold, the latter precipitating in from two to twenty-four hours while the former remained unchanged for several weeks. The addition of electrolytes such as chloride, bromide, iodide, or hydroxide ions during preparation was found to have a marked stabilising effect upon gold sols, but this effect was not produced by dispersion of the gold in pure water and subsequent addition of the electrolyte. The stabilising effect was not observed on the addition of fluoride, nitrate, sulphate, or chlorate ions, and it seems to be closely related to the ability of the ion to form stable compounds with gold. The authors conclude that electrical colloid synthesis comprises not only a thermo-mechanical action, by which the metal is dispersed in a molten or vaporised state, but also the formation of a colloidal complex between the highly dispersed metal, at a high temperature produced by the arc, and certain ions present in the medium.—W. G. C.

Extraction of radium, uranium, and vanadium from carnotite. Parsons and others. *See* VII.

New hydro-electric power plants in Norway. See XI.

PATENTS.

Refined iron and refined steel from titaniferous iron ores; Direct production of ——. J. J. and W. A. Loke, The Hague, Holland. Eng. Pat. 5618, Apr. 14, 1915.

ORE containing about 94 % of titaniferous iron oxides, obtained, for example, by concentrating titaniferous iron sand, is melted (at 1600° C.) in an electric furnace of the resistance type and then "blown" with carbon monoxide or water-gas, by which the iron oxides are rapidly reduced and a heavy titaniferous slag (m.pt. 2400° C.) obtained. By continued blowing, the under surface of the slag is also reduced and sufficient titanium formed to refine the bath of metal below —W. E. F. P.

Cast iron; Process of dephosphorising —— in the Martin furnace. A. Pasquier. Fr. Pat. 475,702, Mar. 12, 1914.

The slag produced in the basic open-hearth steel furnace is removed as fast as it is formed to prevent reduction of the contained phosphates by the carbon in the molten metal.—W. E. F. P.

Metals or alloys [*e.g. special steels*]; *Production of* ——. E. Kardos, Chrome, N.J., U.S.A. Eng. Pat. 22,946, Nov. 23, 1914.

The finely divided ore, reducing agent, and flux are injected by means of gas into a closed reaction chamber in which the reduction and collection of the metal take place in one operation. The amount of blast injected is just sufficient to produce the required reducing gas on ignition of the mixture, and the process does not require the application of external heat. The waste gases may be utilised for industrial purposes or may be returned, in whole or in part, to the reaction chamber along with fresh material.—W. R. S.

Iron; Plating articles consisting wholly or chiefly of ——. W. E. Watkins, New York. Eng. Pat. 18,932, Aug. 21, 1914.

In a process for plating iron, etc., with a metal having a smaller affinity for oxygen, *e.g.* copper, the articles are uniformly coated with a paint composed of the oxide of the plating metal finely ground in a "viscous, neutral vehicle" (a mixture of American crude and fuel oils in equal parts) and heated to about the welding temperature of iron. By this means a continuous metallic coating in molecular union with the metal beneath is obtained, covered with a layer of magnetic oxide of iron, which may be removed by known means if required.—W. E. F. P.

Iron or other ores; Direct reduction of ——. C. A. M. Buckley, London, R. C. V. Whitfield, Redcar, and E. V. Clark, Lewes. Eng. Pat. 23,669, Dec. 7, 1914.

In a process for the direct reduction of iron or other ores, in which a regenerator is alternately heated by the combustion of producer gas and employed to preheat the producer gas for reduction, steam is supplied to the producer during the former period only and replaced by "top gas" from the reducing furnace during the latter period, so that the gas used for reduction is practically free from hydrogen. Alternatively, a system comprising two regenerators, two producers, and a recuperating stove may be employed in conjunction with a reducing furnace and operated so as to produce a similar result. —W. E. F. P.

Iron and steel sheets; Process of coating —— with lead and lead alloys. R. Hazeltine, Assignor to Wheeling Corrugating Co., Wheeling, W. Va. U.S. Pat. 1,161,475, Nov. 23, 1915. Date of appl., Feb. 9, 1914.

The sheets are passed through the coating bath and then between coating rolls composed of a non-ferrous metal capable of alloying with the coating in presence of a suitable flux, such as palm-oil, in which the rolls are submerged; the oil rests on the coating bath and the lower surface of the rolls is in contact with the coating alloy.—W. R. S.

Furnace; Metal melting ——. I. Hall, Birmingham. Eng. Pat. 1010, Jan. 21, 1915.

The furnace consists of a melting-pot the outlet of which is closed by a valve controlled by a spindle extending through the cover. The valve spindle compresses wire springs which take up any expansion or contraction due to variations in the temperature, and thus the valve when closed remains pressed upon its seating.—W. R. S.

Furnaces; Method of heating melting, re-heating, and other [*gas-fired*] ——. A. B. Chantraine. Fr. Pat. 475,649, July 25, 1914.

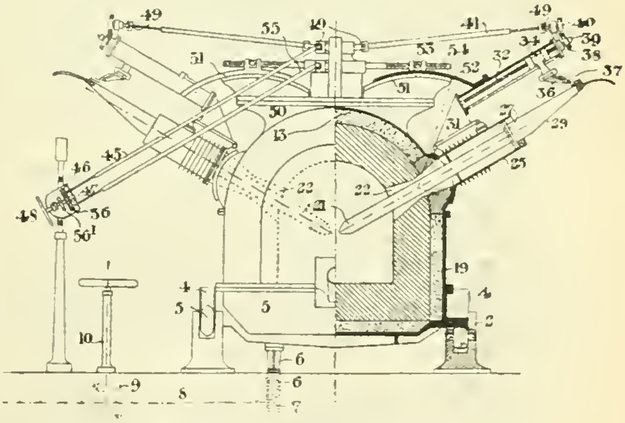
Preheated gaseous fuel is introduced through a large conduit at the upper part of the furnace, and preheated air for combustion, in the form of jets, from one or more series of apertures in the sides. Each series of apertures is supplied with air from a separately controlled chamber disposed in the furnace wall, for the purpose of regulating the temperature at different parts of the combustion chamber. It is stated that by this arrangement the combustible gas forms a protective envelope which prevents the walls of the furnace from being unduly affected by heat radiated from the hot furnace charge.—W. E. F. P.

Furnaces; Melting ——. L. Mélat. Fr. Pat. 475,974, Mar. 28, 1914.

The furnace is a combination of the combustion and the electrical resistance type, the heat derived from the solid, liquid, or gaseous fuel being supplemented by the heat of radiation from electrodes of graphite or other suitable material.—W. R. S.

Furnace for melting and refining metals; Tilting electric ——. F. Bassanese, Milan, Italy. Eng. Pat. 1173, Jan. 25, 1915.

The electrodes, 21, are arranged within conical apertures, 22, and are fed and tilted separately or simultaneously by means of holders, 29, sliding as pistons, 27, in air-cooled cylinders, 25, and oscillating over the apertures, 22. Each electrode holder is secured to a nut, 34, moving over a screw, 32, mounted on a bracket, 31, carried by the cylinder, 25, and the electrode is fed by actuating the screw, 32, by the hand wheel, 48, and clutch, 39, through the medium of bevel and spur gearing, 38, 40, 46, 47, telescopic shafts, 41, 45, and cardans, 49. The bracket, 31, is carried by an arc-shaped plate, 52, sliding over a similarly-shaped extension, 51, of a platform, 50, on the dome, 13, of the furnace, and is oscillated by a nut and screw, 53, 54, actuated from the hand wheel, 48, through the spur gearing, 56, 47, and a telescopic shaft, 55. Each electrode may be separately adjusted



by the surfaces, 36, 37, as to length and direction in relation to the feeding and tilting mechanism. A motor and relay (not shown) may be connected through the gear, 56^1, with the central controller for automatic adjustment when the hand adjustment is dispensed with. The melting chamber casing is formed from a tray, 5, resting on curved pieces, 4, and rollers, 2, 3, a dome, 13, carrying the mechanism and electrode cylinders, and side plates, 19, connected by screw bolts, and may be tilted by the mechanism, 6, 7, 8, 9 and 10.—B. N.

Porous metal, such as aluminium ; [Rendering impermeable] articles manufactured from a ——. M. Birkigt, Bois-Colombes, France. Eng. Pat. 3945, Mar. 12, 1915.

In a process for rendering impermeable the internal walls of vessels made of a porous metal, the vessel is filled with varnish, enamel, or the like under pressure, then emptied and " dried " in a stove, the process being repeated as often as necessary. —W. E. F. P.

Electrolytic deposition on all metals of aluminium, tin, nickel, copper, zinc, iron, steel, or alloys thereof ; Process for ——. P. Marino, London. Eng. Pat. 10,133, July 12, 1915.

A sheet of the metal or alloy to be deposited, is used as anode in an electrolyte composed of a concentrated solution of sodium pyrophosphate containing about 10% of phosphoric acid and 5—15% of sulphanilic acid. When the electrolyte is saturated the metal is deposited in the metallic state on the surface of the cathode.—W. G. C.

Electroplating apparatus. W. F. Koken and H. J. Richards, St. Louis, Mo. U.S. Pat 1,161,226, Nov. 23, 1915. Date of appl., Oct. 19, 1914.

The cathodes are supported by several ring-shaped carriers, disposed horizontally across a long tank containing the electrolyte and mounted on the lower ends of vertical shafts, which are provided with collars resting on a beam so that the latter supports the weight of the carriers. The cathode carriers are rotated by means of a horizontal shaft, provided with bevel wheels, mounted above the tank. A ring-shaped anode support, carrying several anodes, is mounted on a pedestal, and a frame of conducting metal is arranged to support a group of anodes within and outside the path of the cathodes on each carrier respectively.—B. N.

Welding metals ; Process of ——. S. W. Wohlrab, Maple Falls, Wash. U.S. Pat. 1,161,366, Nov. 23, 1915. Date of appl., Apr. 3, 1915.

Finely divided metal is fed under pressure of a non-oxidising gas through a carbon nozzle on to the surface to be welded ; an electric arc passes between the nozzle and the surface and fuses the particles of metal.—W. R. S.

Solder [for aluminium]. J. Cayocca, Sacramento, Cal. U.S. Pat. 1,161,612, Nov. 23, 1915. Date of appl., May 11, 1915.

The solder is composed of tin 12·8, lead 3·2, and aluminium 1 part.—W. R. S.

Tin ; Electrolytic refining of ——, applicable to any conducting material containing tin. G. Michaud and E. Delasson. Fourth Addition, dated July 28, 1914, to Fr. Pat. 435,936, Nov. 4, 1911 (this J., 1912, 395 ; 1913, 240 ; 1915, 182).

The tin ore is dissolved in a double-walled vessel, provided with a heater maintaining the liquid at about 40° C., and the solution flows to the electrolyser containing insoluble anodes furnished with diaphragms. The depleted electrolyte is run into a tank and returned by a pump to the solution vessel.—B. N.

Copper : Process for recovering —— from alloys [e.g., brass and bronze]. P. L. Hulin. Fr. Pat. 475,302, Feb. 4, 1914.

The molten alloy is blown with air in a converter to oxidise the zinc and tin, which are eliminated partly as fume and partly as skimmings. The excess heat generated by the oxidation of zinc and tin may be used to melt fresh quantities of alloy, added between the periods of blowing and skimming. The oxide fume is recovered in suitable condensing apparatus.—W. R. S.

Lead from antimony ores, etc. ; Process for eliminating ——. Schmitz, Mansion et Cie. Fr. Pat. 475,783, July 29, 1914. Under Int. Conv., July 29, 1913.

The finely divided oxidised or metallic material is heated to dull redness with a quantity of magnesium chloride corresponding to the lead content, or in a current of chlorine or hydrochloric acid gas, and the roasted product leached free from lead chloride ; or an excess of alkali chloride is added to the magnesium chloride and the temperature slowly raised till the mass is fused. After pouring and cooling it consists of two layers, the upper containing lead and alkali chloride, and the lower antimony.—W. R. S.

Zinc, copper, cadmium, cobalt, nickel, etc. ; Process for treating ores of ——. R. D. Lance. Fr. Pat. 476,304, Apr. 15, 1914.

The metals are converted into sulphates by heating the ore with sulphuric acid, the product is roasted at about 800° C. in presence of air and steam to decompose ferric sulphate, and the sulphates are removed by leaching and converted into chlorides by addition of calcium chloride. The chlorides may also be obtained direct by the action of moist hydrochloric acid gas or a mixture of pyrites and salt at 700°—900° C. The metals are precipitated from the chloride solution as hydroxides by adding calcium or calcium sodium oxychloride, with regeneration of calcium chloride. The oxychloride is prepared by treating quicklime with a boiling solution of calcium chloride or sodium chloride.—W. R. S.

Zinc and lead ; Process for the treatment of complex, manganiferous ores of ——. A. G. French. Fr. Pat. 476,346, Oct. 20, 1914.

In a cyclic process for treating zinc-lead-silver sulphide ores containing manganese, the ore is roasted at a low temperature (about 700° C.) until evolution of sulphur dioxide ceases, then mixed with 4 to 5% of sodium bisulphate (or sprayed with an equivalent amount of the salt in aqueous solution), and the mixture ground with water and leached. The solution, containing zinc, manganese, and sodium sulphates, is electrolysed between anodes of lead and cathodes of zinc foil, manganese dioxide being deposited on the former and pure zinc on the latter ; a current of 200—300 amp. per sq. m. of cathode surface is employed at $2\frac{1}{2}$—$4\frac{1}{2}$ volts. The manganese content of the electrolyte—by which the purity and physical condition of the zinc deposit is determined—may be increased, if necessary, by the addition of manganese sulphate, the latter being subsequently regenerated by treating the deposit of manganese dioxide with an aqueous solution of sulphur dioxide obtained from the furnace gases. The spent electrolyte is employed for leaching a further quantity of roasted ore, and the leached ore residue is dried and smelted for lead and silver.—W. E. F. P.

Iron-oxide castings; Process for manufacturing ——. L. Seherbel, Bussi, Assignor to Soc. Ital. di Elettrochimica, Rome. U.S. Pat. 1,163,167. Dec. 7, 1915 Date of appl., Aug. 1, 1914.

See Eng. Pat. 17,161 of 1914; this J., 1915, 910.

Alloy. C. R. Denton, Sheffield. U.S. Pat. 1,162,226, Nov. 30, 1915. Date of appl., July 13, 1915.

See Eng. Pat. 17,157 of 1914; this J., 1915, 35.

Copper constituents from cupriferous ores and their gangues; Process for extracting valuable ——. E. Erdös, Assignor to Azurit Co. Ltd. for Chemical Industry Koloszvár, Koloszvár, Austria-Hungary. U.S. Pat. 1,162,014, Nov. 30, 1915. Date of appl., Feb. 26, 1914.

See Eng. Pat. 4658 of 1914; this J., 1915, 875.

Sodium alloys: Electrolytic production of ——. E. A. Ashcroft, London. U.S. Pat. 1,161,585, Nov. 23, 1915. Date of appl., Nov. 22, 1913.

See Fr. Pat. 464,951 of 1913; this J., 1914, 489.

Manufacture of binding material for coatings, etc. [*from coal tar or petroleum*]. Fr. Pat. 476,362. *See* III.

Pigment [*blast-furnace flue-dust*]. U.S. Pat. 1,161,790. *See* XIII.

XI.—ELECTRO-CHEMISTRY.

New hydro-electric power plants in Norway. Engineering, 1915, 100, 673.

Several large industrial undertakings dependent on water-power are about to be started in Norway, and others are being extended. Amongst the former is a large aluminium manufactory, which has already secured all the shares in the French Société Anonyme des Bauxites du Var, from whence raw material will be obtained. The required power will be supplied by the Höyang Falls, in the Sogn district. Some 20,000 horse-power will be utilised at once, and a further 40,000 horse-power will be kept as a reserve. The capital required will be £700,000. The proposed factory is calculated to produce about 4000 tons of aluminium per annum, or 10% of the present European output. The French company controls extensive bauxite deposits in Southern France, and the Norwegian company has also secured the controlling right of very extensive bauxite deposits in the same district, and intends starting a factory for the production of aluminium oxide, which will then be sent to Norway for final treatment. The exploitation of the Bjölvevasdrag Falls is progressing, and a tunnel is being driven; the fall will be 870 m. (2855 ft.), the greatest fall utilised, it is stated, in Norway so far. When fully exploited the falls are calculated to yield 45,000 horse-power, but in the meantime only 20,000 horse-power will be made available, and this first stage should be complete in about two years' time. The energy will be applied to the manufacture of carbide, cyanamide, ammonia, sulphuric acid, and ammonium sulphate. A provisional power-station of 200 horse-power capacity has just been completed. The Arendals Waterfalls Company, which has built the Böllefos power-station, with a capacity of 20,000 horse-power, has since extended the station, so that it now has a capacity of 35,000 horse-power, and the capital is now being increased by £78,000. This company sells its power on contract, and from January 1, 1916, 35,000 horse-power will be available, representing an annual power rent of about £62,000, calculated to give a net profit of £16,700. A large mining undertaking is now being proceeded with in Ofoten, North Norway. This is the Björkaosen mines, Balangen, where working was almost completely stopped when the war broke out, but was resumed last summer. A number of diamond borings, of an aggregate of about 2000 metres, have been undertaken to ascertain the value of the ore (copper and sulphur), and the results are stated to be satisfactory. A provisional power-station will be built in the spring, the Börsvand Fall supplying the power, and the power-station proper, with power from the same fall, will be proceeded with in due course. The water for the separating works will have to pass through a tunnel 1400 metres long, and the quantity of ore to be treated is put at 200,000 tons annually. The new carbide factory near Bergen, which will receive the necessary energy from a power-station to be erected for the part exploitation of the Blaafold Falls, is an undertaking which has been under consideration for some time, and the concession for which is now being dealt with by the Department for Public Works. The Blaafold Falls have a capacity of over 100,000 horse-power, and the first exploitation will comprise some 15,000 to 20,000 horse-power. The "Blue River" has the largest catchment of all Norwegian rivers—viz., 138 litres per second per square kilometre (12·7 cub. ft. per square mile). Such a large catchment is only found elsewhere on the mountain slopes of Dalmatia, and the future industries fostered by the energy from the "Blue Falls" possess the chance of becoming some of the most important in Western Norway. The new carbide works will be situated at the Matre Firth, where a sufficiently large and flat area is available. The production is calculated at 20,000 tons per annum. Only Norwegian capital will be interested in the new company, whereas other carbide factories in Norway are principally controlled by foreigners. Another very large concern is the company for the manufacture of cyanamide and ammonium sulphate at Bjöloo, Hardanger. In the first instance, the Bjöloo Fall will be exploited to the extent of 30,000 horse-power, part of which must be looked upon in the light of a reserve. The installation is calculated to entail an expenditure of £335,000, or £11 per horse-power, all inclusive, which is a low figure, and the works, houses, working capital, etc., will absorb some £590,000.

Electrical transference in amalgams. Lewis and others. *See* X.

Patents.

Electrolytic cells. H. C. Jenkins, H. F. Pattinson, and R. Wellesley, London. Eng. Pat. 22,867, Nov. 21, 1914.

In an electrolytic cell of the "bell" type, ridges and depressions are made in the floor of the cell, so that the crest of each ridge comes under one of the bells containing the anodes. The depressions between the ridges form receptacles in which the electrolyte descends in more or less horizontal stratification from the open base of the bell to the cathode and thence to the outlet. The cathode consists of pairs of superimposed vertical plates, each pair of plates being arranged slightly farther apart than the pair beneath; a space is thus left between opposite plates in which the electrolyte can collect. A groove is provided along the lowest part of each depression, and the lowest pair of cathode plates is immediately above the groove; the grooves are connected with a draw-off device. —W. G. C.

Electrolytic apparatus. H. Monge. Fr. Pat. 475,382, Feb. 16, 1914.

A frame, which may be displaced on rollers face to face with the surface of the metal to be plated, is arranged to carry the anodes and conductors, bound respectively to the positive and negative poles. Flexible, articulated or hook contacts, resting on the surface to be plated, are supported by the conductors, which may be turned to raise the contacts from the cathode surface.—B. N.

Storage battery. J. O. Lathy, Assignor to Y. Hicks, San Antonio, Tex. U.S. Pat. 1,161,398, Nov. 23, 1915. Date of appl., Feb. 26, 1913.

The battery contains approximately 1 % of silver chloride in solution as part of the electrolyte.—B. N.

Furnace: Electric ——. A. Dow, Detroit, Mich. U.S. Pat. 1,161,634, Nov. 23, 1915. Date of appl., May 29, 1914.

A resistor bed, having an exposed surface, is arranged within a refractory casing, and an electric current is passed through it by means of terminals passing through opposite walls; several magnetic bars are arranged transversely to the path of the current, across the outside of the base of the casing, for deflecting the current towards the upper exposed surface of the resistor.—B. N.

Electrical process for producing cyanides. Eng. Pat. 23,292. *See* VII.

Electric arc furnace for the oxidation of atmospheric nitrogen. Fr. Pat. 476,633. *See* VII.

Electric furnace for production of aluminium nitride. Fr. Pat. 475,908. *See* VII.

Manufacture of titanic acid [*oxide*]. Fr. Pat. 475,612. *See* VII.

Electrical process for the ageing of wines, beers, and spirits, [*and rectification of perfumes*]. Addition to Fr. Pat. 459,111. *See* XVIII.

XII.—FATS; OILS; WAXES.

[*Determination of fat in*] *feeds and feeding stuffs.* Jones. *See* XIXa.

Patents.

Vegetable oils; Process of manufacturing ——. E. Klein, New York. U.S. Pat. 1,161,481, Nov. 23, 1915. Date of appl., Apr. 10, 1909.

Germs, seeds, soya beans, etc., are mechanically agitated and heated (100° to 150° C.) in a vessel containing a cooling coil or other cooling medium, and in the presence of a chemical agent consisting of approximately equal proportions of organic and inorganic acids, to absorb the disintegrated deleterious substances. The oil-bearing material is then separated from the acid medium and pressed to recover the oil.—C. A. M.

Colloidal soap; Manufacture of liquid ——. E. F. Rousseau. Third Addition, dated Mar. 14, 1914, to Fr. Pat. 472,587, Aug. 9, 1913 (this J., 1915, 560, 801, 1103).

Essential oils are dissolved in the neutral colloidal soap or in a mixture thereof with sugar to obtain an aromatic detergent dentifrice.—C. A. M.

Soft soap. R. Hague, A. Hulme, and J. K. Cheetham, Oldham. Eng. Pat. 3306, Mar. 2, 1915.

Soft soap with increased detergent power is obtained by mixing the following substances in approximately the proportions mentioned:—Common soft soap (96 parts by weight), fish oil (96), soda ash (5), ammonia solution (2), and oil of turpentine (1 part).—C. A. M.

Ammonium soaps; Process for the separation of —— from fatty acids and glycerin obtained in the hydrolysis of oils and fats by steam in the presence of small quantities of ammonia or ammonium soap, which act as catalysts. Process for the complete transformation of ammonium soaps into sodium or potassium soaps. P. A. Barbé, G. de Paoli, F. Garelli, and Soc. Ammonia Italiana. Fr. Pats. (a) 476,470 and (b) 476,471, Sep. 19, 1914. Under Int. Conv., Sep. 19, 1913.

(a) Oils or fats are hydrolysed in an autoclave by means of steam in the presence of a small quantity (0·4 to 0·7%) of ammonia or ammonium soap, which emulsifies the fat and acts as catalyst. The ammonium soap solution separates sharply from the fatty acids on the one hand, and from the glycerin water on the other. (b) Solutions of ammonium soaps are treated with solutions of sodium or potassium chloride to obtain sodium or potassium soaps. The resulting solution of ammonium chloride and excess of alkali chloride is concentrated and filtered from the deposit of alkali chloride, the filtrate cooled, and the ammonium chloride crystallised.—C. A. M.

Emulsion of tetrachloroethane and hydrocarbons; Process for the preparation of a stable aqueous ——. J. Filhol. Fr. Pat. 476,576, Apr. 27, 1914.

Tetrachloroethane is mixed with a hydrocarbon such as benzene, petrol, or petroleum spirit, in such proportion as to bring the specific gravity to 1, and the mixture is emulsified with 5 to 10 times its bulk of water, preferably containing some saponin. The emulsion is quite stable and can be used, either as made or diluted with water, for general cleaning purposes, having a solvent action on fats, resins, and waxes. Mixed with a bleaching agent it may be used for the simultaneous cleansing and bleaching of greasy fibres, etc.—B. V. S.

Cooling hot or molten fats and fatty emulsions and the like; Apparatus for ——. H. G. R. Naumann, Ubbergen, Assignor to Ant. Jurgens Vereen. Fabrieken, Oss, Holland. U.S. Pat. 1,163,439, Dec. 7, 1915. Date of appl., Feb. 24, 1915.

See Eng. Pat. 10,863 of 1914; this J., 1915, 144.

Process for the decomposition of soapy waters [*wool washings*]. Fr. Pat. 475,550. *See* XIXb.

Treatment of waste waters containing fats and soaps [*wool washings*]. Fr. Pat. 475,639. *See* XIXb.

Process for obtaining nitrogenous, biologically useful substances from cod-liver oil. Eng. Pat. 3075. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Patents.

Paints; Process of manufacturing ——. Les Fils Lévy-Finger. Fr. Pat. 476,061, Apr. 1, 1914.

An emulsion of a drying oil with *e.g.* an alkali silicate, is mixed with the pigment (zinc oxide) to obtain a durable exterior paint with good covering power.—C. A. M.

Pigment [*blast-furnace flue dust*]. F. Orth, Indiana Harbor, Ind. U.S. Pat. 1,161,790, Nov. 23, 1915. Date of appl., Mar. 18, 1912.

Blast-furnace flue dust of uniform colour and composition, as obtained after a run of several hours, is finely pulverised.—C. A. M.

Varnishes, lacquers, insulating waterproof coating preparations, protective preparations, paints, enamels and the like; Manufacture of ——. H. Terrisse, Geneva, Switzerland, and The Indestructible Paint Co., Ltd., London. Eng. Pat. 23.054, Nov. 25, 1914.

The stable, neutral compounds, obtained by heating "solubilised" fossil resins (this J., 1904, 552; 1908, 457) with glycerin or other high-boiling alcohols to about the boiling-point (see following abstract), are freely soluble in linseed oil, tung oil, turpentine, or white spirit, or in mixtures of these, or in other oils used in varnish-making, and such solutions, with or without the addition of other resins, form neutral varnishes, free from the objectionable properties of acid-resin varnishes. For example (1) 100 kilos. of Manila resin, esterified with glycerin, is melted and heated to 300° C.; 50 kilos. of linseed oil is added at 300° C., and the temperature is then raised to 310° C. until the product has the consistency of varnish. Driers are added, and the varnish is diluted with white spirit, turpentine, or the like. The varnish may be ground with an equal weight of zinc oxide to form a paint. (2) 100 kilos. of Congo copal, esterified with glycerin, is melted. 350 kilos. of linseed oil is added at 310° C., and this temperature is maintained until the desired consistency is obtained. Driers are added, and the varnish is diluted.—E. W. L.

Resins; Manufacture of useful products from ——. H. Terrisse, Geneva, Switzerland, and The Indestructible Paint Co., Ltd., London. Eng. Pat. 23,055, Nov. 25, 1914.

Fossil resins, (including Congo copal, Zanzibar and Madagascar anime, kauri, Benguela copal, pontianac, Manila and others) are "solubilised" (this J., 1904, 552; 1908, 457) by heating them, preferably under pressure in an autoclave at a suitable temperature (240°—360° C.), with or without the addition of naphthalene or phenol. The naphthalene or phenol is removed by distillation or otherwise, the acid value of the fused resin is determined, and an excess of high-boiling alcohol such as glycerin is added. The mixture is then heated until the uncombined alcohol is distilled off, the product consisting substantially of a true neutral resin acid ester, readily soluble in linseed oil. For example (1) 100 grms. of ground Zanzibar gum is heated with 350 grms. of naphthalene at 280° C. and 4 atmospheres for 4 hours, or until a test portion is soluble in linseed oil. The acid value is determined, and some excess above the calculated amount of glycerin is added. The mass is then heated in a still or open vessel at 280°—320° C. until a test on glass remains transparent on cooling. (2) 100 kilos. of Congo copal is fused by the open pot method; its acid value is then determined and the calculated amount of glycerin is added. 15 kilos. of copal oil, redistilled under reduced pressure to the state of a greenish-yellow viscous liquid, is added, and the mixture is heated in a still, or open vessel, to 280° C.; 5 to 6 kilos. of glycerin is then added, and heating continued until a test gives a clear bead.—E. W. L.

Resins; Process for the removal of —— *from woods, and especially from coniferous woods.* J. Frydmane. Fr. Pat. 476,330, Apr. 16, 1914.

Resin is removed by treating the wood with the fraction of the "white spirit" ("sangajol") obtained from petroleum from the Dutch Indies, which boils between 80° and 140° C. and is rich in saturated hydrocarbons. The dried wood is treated with the solvent in an autoclave, and the solvent is heated to boiling point and made to circulate over the wood. The solvent containing the dissolved material is fractionally distilled to recover the fraction of the sangajol, boiling between 80° and 140° C., and to obtain oil of turpentine, terpenes, and colophony, or commercial resin.—W. C. H.

White lead; Manufacture of ——. C. White and J. W. Patterson, London. U.S. Pat. 1,163,052, Dec. 7, 1915. Date of appl., Aug. 10, 1912.

See Eng. Pat. 9638 of 1912; this J., 1912, 998.

Manufacture of binding material for coatings, etc. [from coal tar or petroleum]. Fr. Pat. 476.362. *See* III.

Manufacture of non-inflammable celluloid, plastic masses, etc. Addition to Fr. Pat. 432,047. *See* V.

Manufacture of non-inflammable and inflammable celluloid and solutions of cellulose esters. Additions to Fr. Pat. 432,261. *See* V.

Standardisation of colours. Eng. Pat. 22,775. *See* VI.

[Rendering impermeable] articles made from a porous metal, such as aluminium. Eng. Pat. 3915. *See* X.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Caoutchoucs; Definition, classification, and evaluation of ——. *I. Two new constants.* I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1374—1401.

The elastic properties of caoutchoucs and their property of undergoing vulcanisation when treated with sulphur are associated not merely with natural caoutchouc, but with a more or less typical state of matter, to which the author gives the name of the "elastic" or "caoutchouc" state. This condition is exhibited only by amorphous compounds of high molecular weight and colloidal properties, and its degree of stability varies widely with substances of different composition and structure. To substances capable of existing in this elastic state the name "resinoids" is given. The elastic state of matter exists only over a definite interval of temperature; thus, below —20° C. natural caoutchouc loses its elastic properties and becomes leathery. To the temperature at which a substance is transformed into the elastic condition the name "temperature of elasticity" is given, and to the temperature at which the elastic properties are completely lost the name "fatal temperature." The former temperature is higher than the latter with all resinoids and both vary with the composition and structure of the caoutchouc and are affected by admixture of extraneous substances and by vulcanisation. All caoutchoucs obtained by direct heating of 2.3-dimethylerythrene at temperatures between 50° and 170° C., in presence or absence of a catalyst, exhibit one and the same temperature of elasticity. Depression or elevation of the temperature of elasticity of any given caoutchouc is accompanied by a corresponding change in the fatal temperature. A caoutchouc of which the temperature of elasticity, the fatal temperature, and the interval between these agree approximately with the corresponding constants for natural caoutchouc is termed a "normal" caoutchouc. "Simple resinoid" is the name given to a homogeneous caoutchouc-like substance, of which the principal part consists of one and the same compound. A "complex resinoid," on the other hand, is formed of a mixture of substances of different composition or structure, each of which separately may have nothing in common with caoutchouc. Harries has suggested that a caoutchouc be termed normal if the products yielded when its ozonide is decomposed by water are the same as those obtained from the ozonide of Para caoutchouc, but Steimmig (this J., 1914, 267) found that, unlike the ozonide of Para caoutchouc, the ozonides of all synthetic caoutchoucs yet obtained from isoprene give, when decomposed with water, acetonylacetone and succinic acid in addition to lævulinic aldehyde. Only caoutchoucs which are normal according to the author's definition and are also stable are of wide applicability in practice. Regenerated caoutchouc, prepared by treatment of old rubber with alkali, is a typical abnormal caoutchouc with a temperature of elasticity which lies above 100° C. and varies with the conditions of the regeneration and vulcanisation and with the state of the original waste rubber used. Up to the present time no means have been discovered for converting regenerated caoutchouc into normal caoutchouc. The following caoutchoucs are abnormal: those obtained by polymerisation of isoprene in presence of an alkali metal with or without barium peroxide, those obtained by isomerisation, and all the known polymerides of 2.3-dimethylethylerythrene. Normal caoutchoucs are: erythrene caoutchoucs, obtained either by the action of zinc dust on caouprene bromide or by the action of an alkali metal on erythrene; isoprene caoutchoucs obtained in small yield by direct heating of isoprene or by the action of an organic or inorganic peroxide, or by the action of a peroxide followed by that of an alkali metal; those obtained by the simultaneous action of barium peroxide and sodium on β-myrcene. The properties of an ideal caoutchouc are outlined.—T. H. P.

Caoutchoucs; Two new constants for——: Elasticity point and fatal temperature. I. I. Ostromyslenski and Mlle. I. M. Kelbasinskaja. J. Russ. Phys. Chem.-Soc., 1915, 47, 1401—1441. (See preceding abstract.)

The elasticity point is defined as the temperature at which the temperature curves of the different properties characterising the elastic condition of a caoutchouc cease to be analytical curves. This temperature and the fatal temperature represent characteristic constants for resinoids, and in particular for caoutchoucs, similar to the melting point of a crystalline solid or the boiling point of a liquid. These temperatures may be measured in colloidal solutions and, unlike viscosity, surface tension, etc., they do not change with lapse of time and do not depend on the nature of the solvent. The elasticity point and the fatal temperature of a solution of caoutchouc may be determined by means of either the viscosity, or the density, or the surface tension at different temperatures, all these methods giving perfectly identical results; an apparatus is described by means of which the viscosity and surface tension may be measured simultaneously. The presence of foreign substances and the nature of the solvent are not reflected in the elasticity point and the fatal temperature of caoutchouc solutions if the final condition of aggregation of the solvent and the concentration of the solution at the experimental temperature remain unchanged. These two temperatures serve to identify or differentiate caoutchoucs and furnish a basis for the more rational classification of caoutchoucs and caoutchouc-like compounds. There is evidence in support of the assumption that these temperatures represent, for colloids in general and not merely for caoutchoucs, the first constants which are invariable with reference to time. The paper contains a considerable mass of data relating to the physical constants of solutions of various caoutchoucs in different solvents.—T. H. P.

Synthetic caoutchoucs; Vulcanisation of——. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, 47, 1441—1453.

In order to convert chemically pure synthetic caoutchouc into a product equivalent to natural rubber, it is necessary: (1) to add to it substances which (*a*) protect it from decomposition during transport or exposure to the air, (*b*) accelerate the process of vulcanisation, (*c*) increase the physical stability, *i.e.*, the adherence of the vulcanised particles; (2) to confer on it the characteristic physical structure of the natural product and also give it more pronounced "nerve." Protection from decomposition may be effected by the presence of 1—0·5% of sulphur, nitrobenzene, 1.3.5-trinitrobenzene, nitrocyclohexane, etc., which have not the injurious action on the physical properties of the rubber subsequent to vulcanisation shown by tannins or aromatic amines. If oxidation begins, especially with dimethylerythrene-caoutchouc, it proceeds uninterruptedly, in spite of the presence of nitro-compounds, tannins, sulphur, or amines, but heating for 2—3 hours in a vacuum at 120°—130° C. converts the product showing incipient oxidation into one which will keep as well as the original caoutchouc. Vulcanisation is greatly accelerated by a mixture of an aliphatic primary or secondary amine with a metallic oxide such as that of lead, zinc, magnesium, barium, or calcium; tertiary amines, whether aliphatic or aromatic, are without effect. From 0·5 to 1% of piperidine piperidyldithiocarbaminate, together with 5% of magnesium oxide or lead oxide, diminishes the time required for vulcanisation to one-fortieth or lowers the temperature of vulcanisation to 50°—80° C.; in presence of 2—5% of the above piperidine compound, vulcanisation of either synthetic or natural caoutchouc is complete in a few seconds at 130° C. Similar effects are observed with diethylamine, propylenediamine, di-isoamylamine, di-isopropylamine, ethylamine, phenylethylamine, hexamethylenetetramine, etc. Very marked acceleration of the process of vulcanisation is also effected by glycerol or by the zinc salts of the esters formed by glycerol, menthol, isoamyl alcohol, or terpineol with xanthogenic acid. Mixtures of oxides with isopropyl alcohol or terpineol, menthol, geraniol, etc., also accelerate vulcanisation, but to a less extent. The resins which increase the mechanical stability of natural caoutchouc may be replaced, in the case of synthetic caoutchouc, by colophony, Canada balsam, gum dammar, high-boiling fractions of coal tar, etc. In the vulcanisation of normal erythrene-caoutchouc, 10—16% of admixed foreign substances are employed (see below), in addition to sulphur and metallic oxides, which are also used with natural caoutchouc. Allowing for the presence of 22% of useless methyl groups in natural caoutchouc and their absence from erythrene-caoutchouc, it is calculated that the latter may be treated with 32% of cheap, foreign substances and yet yield a product of equal value to natural caoutchouc. The characteristic reticular structure of natural caoutchouc, conditioned by the presence of protein compounds, exerts a favourable influence on its breaking strength. Experiments were, therefore, made on various artificial caoutchoucs, with the object of incorporating proteins with them. The proteins were mixed with the caoutchouc by rolling or were shaken, in finely-powdered condition, with a solution of the caoutchouc in isoprene, turpentine, or benzene; in no case was the breaking strength influenced by this treatment. When, however, a mixture of equal volumes of 10% solutions of natural and normal isoprene-caoutchoucs in benzene was shaken for some time at 70° C. and then allowed to stand for 24 hours, the product obtained after removal of the benzene in a current of steam exhibited the characteristic structure of natural caoutchouc and, after vulcanisation, a high breaking strength.

None of the methods yet published for the vulcanisation of synthetic caoutchouc gives products with the properties of vulcanised natural caoutchouc. This end may, however, be attained by immersing a homogeneous mixture of 100 parts of β-myrcene- or normal isoprene- or normal erythrene-caoutchouc with 2 parts of vaseline oil for 20—80 seconds in a 2·5% solution of sulphur chloride in carbon bisulphide.—T. H. P.

Vulcanisation of caoutchoucs : Mechanism of the process of ——. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47,** 1453—1461.

The author regards the process of vulcanisation as consisting of two fundamental phases : (1) a chemical reaction in which only a minute proportion of the caoutchouc participates, and (2) adsorption or swelling of the unchanged caoutchouc in the product of such chemical reaction.—T. H. P.

Hot vulcanisation of caoutchouc by nitro-compounds, without sulphur. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47,** 1462—1467.

Further investigation of this method of vulcanisation (*vide supra*) shows that natural Para caoutchouc is completely vulcanised by as little as 0·5% of trinitrobenzene, whereas 6% of sulphur would be required. Further, in the latter case, the unavoidable presence of free, uncombined sulphur lowers the technical value of many rubber wares. The use of different organic compounds for vulcanisation of caoutchouc allows of considerable variation in the physical properties, *e.g.*, flexibility, elasticity, etc., besides in the colour, smell, etc. Vulcanisation may be effected by mono-, di-, and tri-nitro-benzenes, -toluenes, etc., tri- and tetra-nitronaphthylamines, picramic acid, picryl chloride, artificial musk, nitrocyclohexane, nitro-dyestuffs, etc. Metallic oxides, which facilitate the vulcanisation of rubber by sulphur and enhance the value of the product obtained, exert a similar effect on vulcanisation by nitro-derivatives ; lead oxide is most valuable in this respect, and then follow, in order, oxides of zinc, calcium, magnesium, barium. On the other hand, mixtures of aliphatic amines with the above oxides, although they accelerate vulcanisation by sulphur or lower the temperature of the process to 10°—15° C., retard vulcanisation by nitro-compounds and lower the value of the corresponding product. Like sulphur and sulphur chloride, nitro-derivatives vulcanise, not only caoutchouc, but also various vegetable oils yielding products analogous to factis.—T. H. P.

Hot vulcanisation of caoutchouc by peroxides or peracids, without sulphur. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47,** 1467—1471.

Vulcanisation of caoutchouc by means of peroxides proceeds considerably more rapidly and at a lower temperature than under the agency of sulphur or nitro-compounds. A more detailed investigation of vulcanisation by benzoyl peroxide shows : (1) that metallic oxides which accelerate vulcanisation by sulphur or nitro-compounds are almost indifferent in this case ; in some instances they lower the velocity of the process and in most cases lead to increased oxidisability ; (2) that colophony and other resins diminish the value of the vulcanised product ; (3) that mixtures of amines and metallic oxides retard vulcanisation by this method and yield a product of less value ; (4) the influence of proteins on vulcanisation is the same, whether this is effected by means of sulphur, nitro-compound, or peroxide, the extensibility and the breaking strength being increased. In place of benzoyl peroxide, perbenzoic acid may be used and, probably, ozone, ozonides of caoutchouc or terpenes, oxides of nitrogen, certain metallic peroxides, hydrogen peroxide, etc., but barium peroxide does not seem to cause any trace of vulcanisation.—T. H. P.

New methods of preparing erythrene. Ostromyslenski. *See* XX.

Condensation of alcohols and aldehydes in presence of dehydrating agents. [*Formation of erythrene.*] Ostromyslenski. *See* XX.

Condensation of mixtures of acetaldehyde and alcohol to erythrene. Ostromyslenski and Kelbasinski. *See* XX.

New method of preparing piperylene. Ostromyslenski and Rabinovitsch. *See* XX.

Patents.

Rubber latex : Apparatus for coagulating ——. S. C. Davidson, Belfast. Eng. Pat. 22,489, Nov. 13, 1914.

Latex, contained in an oscillating, kidney-shaped cradle, is coagulated by adding to it, whilst in motion, a measured quantity of dilute acid from a tank above the cradle. The cradle is kept in motion until the coagulum separates from the serum, and the serum is then first discharged through a screen, by tilting the cradle over on one side, and the rubber by tilting it on the other side. The cradle may be hand- or power-driven.—E.W.L.

Rubber [*kneading*] *machinery.* S. C. Davidson, Belfast. Eng. Pats. 22,490, Nov. 13, 1914, 7168 of 1915, date of appl., Nov. 13, 1914, and 1420 and 1421, Jan. 28, 1915.

The apparatus described, which is designed mainly for the kneading of freshly coagulated rubber, consists of a number (3 or more) of rollers arranged so as to form a cavity within which the rubber mass can be worked. Another roller is movable into and out of the cavity to enable the mass to be introduced into the cavity, and to permit of pressure being exerted on the mass. All the rollers are driven in the same direction, and are adapted for steam-heating. The cavity is closed in at the ends of the rollers by end-plates. The rollers may be uniform in diameter or some may be larger than others.—E. W. L.

Plastic materials [*rubber*] ; *Process of manufacturing articles from* ——. R. B. Price, Mishawaka, Ind. U. S. Pats. (A) 1,152,834 and (B) 1,152,835, Sept. 7, 1915. Dates of appl., Dec. 30, 1911, and Jan. 9, 1912. (Cf. this J., 1915, 1062.)

(A) Plastic material, such as rubber, containing the necessary sulphur, is vulcanised by heating it to the requisite temperature, in a medium which is fluid at that temperature, and which possesses such an affinity for moisture as to prevent ingress of the latter to the material, and simultaneously the outer and inner portions of the article are subjected to different controlled pressures. The medium must have no deleterious effect upon the material at the vulcanising temperature ; its affinity for moisture should also tend to withdraw moisture from the material. A solution of calcium chloride is a suitable medium for this purpose, but other substances such as sulphur, solutions of barium nitrate, potassium acetate, calcium nitrate, potassium carbonate, caustic soda, caustic potash, glycerin, waxes, tars, and even fusible metal (Bi, 11 ; Pb, 8 ; Sn, 3—m.pt. 96° C.) may sometimes be used. (B) The fluid medium is subjected to a pressure greatly in excess of that produced by the expansion of the medium by heat at the temperature of vulcanisation. A pressure of 500 lb. gives good results in compacting the material, but pressures as high as 5000 lb. or more may be employed. —E. W. L.

Plastic and fabric articles: Process of treating combined ——. R. B. Price, Mishawaka, Ind. U.S. Pat. 1,152,836, Sept. 7, 1915. Date of appl., Jan. 9, 1912. (Cf. this J., 1915, 914.)

In plastic (rubber) articles containing embedded fabric, the fabric layer is subjected to the action of a fluid pressure, and during or subsequent to such action the exterior surface is subjected to a greater pressure, whereby the fluids in the fabric will be removed, the plastic material compacted, and the plastic material and fabric will be properly united.—E. W. L.

Plastic materials [rubber]: Process of treating [vulcanising] ——. R. B. Price, New York. U.S. Pat. 1,152,837, Sept. 7, 1915. Date of appl., Mar. 8, 1913.

The patent relates to the treatment of plastic material to cause it to set. As applied to the vulcanisation of rubber, the mixing is subjected to a preliminary warming, at or under atmospheric pressure, then to a pre-heating at a temperature above the vulcanising temperature and at a controlled pressure above, at, or below atmospheric pressure, and finally to the vulcanising operation. —E. W. L.

Colloidal substances [e.g., rubber]: Process of drying ——. G. B. Bradshaw, Brooklyn, N.Y. U.S. Pat. 1,161,603, Nov. 23, 1915. Date of appl., Sept. 11, 1909.

Rubber or other colloidal substance is heated to above 100° C., with or without pressure (100 lb. per sq. in.), and a partial vacuum then created or the pressure reduced so that volatile constituents escape readily and a porous spongy mass is left. —C. A. M.

Rubber-like substances from alcohols; Process for the production of ——. D. Spence and A. P. Clark, Akron, Ohio, Assignors to The B.F. Goodrich Co., New York. U.S. Pat. 1,161,904, Nov. 30, 1915. Date of appl., May 31, 1912.

See Fr. Pat. 448,520 of 1912 ; this J., 1913, 437.

Vulcanised-rubber waste; Apparatus for use in reclaiming ——. C. S. Heller, Barberton, Assignor to Moore Architectural and Engineering Co., Akron, Ohio. Reissue No. 14,027, Dec. 7, 1915, of U.S. Pat. 978,583, Dec. 13, 1910.

See this J., 1911, 99.

Non-inflammable plastic materials. Fr. Pat. 475,351. *See* XXI.

XV.—LEATHER ; BONE ; HORN ; GLUE.

Glues; Rotatory powers and adsorption of α- and β- ——. M. A. Rakuzin and E. M. Braudo. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1333—1336.

α-Glue (gelatin) was converted into β-glue (β-glutin) by Framm's method (Arch. ges. Physiol., 1897, **68**, 144). These two modifications are found to have virtually identical specific rotations and are both adsorbed positively and irreversibly by alumina. β-Glue is adsorbed negatively by gelatin. Both forms give the biuret reaction, but not Millon's, Adamkiewicz's, or the xanthoprotein reaction.—T. H. P.

Quebracho in Paraguay. Board of Trade J., Dec. 16, 1915.

With the exception of the output of a relatively small area (Puerto Max on the left bank of the River Paraguay), the whole of the quebracho logs and quebracho extract exported from the Republic is produced in the Paraguayan Chaco. With one exception all the factories are situated on the river. The output of three factories during 1914 was 9433 metric tons of extract. A fourth factory, whose output in 1914 is not given, is stated to have an average monthly output of 250 tons. The total exports of extract from Paraguay during the past three years have been as follows:—1912, 7298 metric tons; 1913, 11,721 metric tons; and 1914, 12,710 metric tons. There are a number of companies which own quebracho-bearing areas but do not manufacture the extract; their aggregate normal export of logs does not exceed a few thousand metric tons. In many areas forests are still untouched. The total exports of quebracho logs from Paraguay during the last three years have been as follows:—1912, 3689 metric tons; 1913, 12,970 metric tons; and 1914, 8117 metric tons.

Patents.

Tanning of butts or hides and apparatus therefor. E. Wilson, Bootle. Eng. Pat. 3184, Mar. 4, 1915.

Tanning is effected in a drum having a latticed periphery of sticks, to which the butts are attached. Within the drum equidistant poles extend between the end frames at any suitable distance from the axis. Butts mounted on the sticks are carried rearwards and over the poles and pass edgeways through the liquor in the vat in which the drum rotates.—F. C. T.

Leather tanned without unhairing; Manufacture of ——. L. Durand. Fr. Pat. 475,543, Mar. 2, 1914.

Leather is tanned in the usual way (except that unhairing is omitted), and the hair is rolled down after treating with a suitable agglutinating material such as caoutchouc, resin, gum, or gelatin (afterwards rendered insoluble). The hair may be bleached before or during the agglutination. Leather so treated acquires greater resistance to wear and moisture. Superimposed layers of leather may be caused to adhere by means of the agglutinant.—F. C. T.

Chromed colloids (especially gelatin); Process for rendering —— insoluble, in the absence of light. P. Lecroq. Fr. Pat. 475,152, Jan. 22, 1914.

Potassium bichromate is added to gelatin in solution, and chromic chromate produced by reducing the bichromate with tartaric acid, pyrogallol, or quinol. The gelatin is thereby rendered insoluble. The process can be applied to the manufacture of electrical insulators or for the production of impermeable paper, etc.—F.C.T.

Casein masses; Process for forming ——. F. Thomas, Schmölln, Germany. U.S. Pats. (a) 1,159,878 and (b) 1,159,879, Nov. 9, 1915. Dates of appl., Dec. 5 and 17, 1912.

(a) Streams of coloured solutions of alkali caseinate are allowed to fall vertically, in the form of drops, on to a common point in a coagulating solution containing an alkaline-earth salt, with or without formaldehyde. Spherical vari-coloured casein masses are formed. (b) Streams of solutions of alkali caseinate are allowed to fall in the form of drops, into cells open at their upper ends arranged within a coagulating liquid.—F. C.T.

Product as a substitute for horsehair [from hide refuse]. Fr. Pat. 475,793. *See* V.

XVI.—SOILS ; FERTILISERS.

Nitrogenous substances ; Biochemical decomposition of —— in soils. W. P. Kelley. Hawaii Agric. Expt. Stat., Bull. No. 39, Aug. 3, 1915, 25 pages.

The ammonification of the nitrogen contained in casein (12·4% N), dried blood (13·29%), soya bean cake meal (8·28%), cottonseed meal (5·1%), and linseed meal (5%), was investigated in the laboratory under varying conditions of aeration, etc. In the experiments, 100 grms. of soil or of silica sand was mixed with 1 grm. of fertiliser and 1 grm. of calcium carbonate, treated with a soil solution of constant strength and character, and then incubated at 28° C., the ammonia formed being estimated by distillation with excess of magnesia at intervals of 1—3 days for nine days. After 4 days the ammonia content diminished owing to evaporation and nitrification, therefore the rate of ammonification was determined only over 2 days. The nitrogen in casein was very rapidly ammonified both in sand and in a fresh heavy clay soil ; in the other fertilisers the reaction was far less rapid. The total yield of ammonia was greater in soil than in sand, and in the former the following percentages of nitrogen were ammonified in 9 days ; casein 50·2, dried blood 42·4, soya meal 40·9, cottonseed meal 27·1, and linseed meal 26%. In another series the fertilisers were added in amounts sufficient to furnish the same weight of nitrogen (132·9 mgrms.), and the moisture content was kept at 25%. The rates of ammonification were again similar ; cottonseed meal and soya bean cake meal were more rapidly decomposed than dried blood or linseed meal, but later, dried blood exceeded cottonseed meal. After nine days the percentages of nitrogen ammonified were, in the order named : 56·9, 49·3, 48·7, 32, and 34·6% respectively. With equal amounts of nitrogen, but under anaërobic conditions, ammonification was very slow : it was most rapid with casein, and only in this case did the amount of ammonia after 9 days approximate to the amounts found in the previous series. To make the conditions for bacterial action more nearly equal, the fertilisers were used in quantities to give equal weights of nitrogen, and corn starch was added to balance the inequalities in the amounts of non-nitrogenous materials. The yields of ammonia were much depressed in the early stages, casein gave much the highest yield after 2 days, and, except with cottonseed and linseed meals, the ammonia accumulated after 9 days showed a great reduction, probably because the ammonifying organisms utilised carbohydrate as a source of energy. When the amount of casein was increased, the total nitrogen recovered as ammonia also increased, but no appreciable increase was observed when the incubation period was extended beyond 4 days and an additional gram of casein was added every fourth day. The incomplete ammonification of the nitrogen in casein is not due to the toxic effect of decomposition products, but results from the resistance of a part (about 40%) of it to such change, and possibly also to some of it being assimilated by the bacteria. Casein is completely hydrolysed by bacterial action both in solution and in sand culture within 7 days ; in solution the hydrolysis proceeded more rapidly than the ammonification. The state of combination of the nitrogen is an important factor in determining its availability ; in most cases the basic diamino-acid nitrogen is converted more rapidly than that present as amide or monoamino-acid.—E. H. T.

Fertiliser ; Preparation of —— from municipal waste. J. W. Turrentine. U.S.A. Dept. Agric. Year Book. 1914, 295- 310.

Municipal waste is classified under the headings : ashes, rubbish, sewage, street sweepings, trade waste, dead animals, and garbage. Twenty-one samples of street sweepings contained an average of 0·41% nitrogen, and 13 samples gave : moisture 32·21%, ash 47·84%, organic matter 19·9%, phosphoric acid 0·4%, potash 0·21%. Their fertilising power is relatively low, transport costs are high, and they fetch 15c. to $2 (7½d.—8s.) a ton ; the agricultural value is diminished by the presence of oil from automobiles, of which as much as 2% may be present. Dead animals are disposed of by burying, cremating, and rendering. In "rendering," the skins and bones are removed, the carcases are cut up, heated in steam at a high temperature, pressed to remove water and grease, and finally dried and ground. The useful products are hides, bones, and tankage, and a dead horse when partitioned in this manner is worth $10 The tankage, which may contain as much as 8% of nitrogen and 10% of calcium phosphate, is a valuable fertiliser, of which 8500 tons per annum is at present produced, but the production could be greatly extended. Garbage (household, hotel, market, and slaughter-house waste) varies greatly in composition. Analyses gave an average of 7% rubbish, 71% water, 2% (usually 3%) grease, and 20% tankage. It is disposed of in various ways, of which incinerating and rendering are the most important, and rendering probably the most economical. In this process the garbage is dumped into a cement vault at the bottom of which is a steel conveyor which transports it to the top of the tank-house. It is then fed automatically into the tanks where it is subjected to live steam under 40 lb. pressure, admitted near the base. The tanks are provided with a false bottom of perforated steel upon which the solids collect, and when the "cooking" is finished, the steam is passed in at the top in order to force the liquid through the perforations. The solids are transported to a rotary hot-air dryer, where the moisture content is reduced to 7%, and thence to a large cylinder rotating on a horizontal axis where the grease is extracted with gasoline. The solvent adhering to the "tankage" is expelled with steam, and the material is either dried a second time and then ground, or ground without drying. The grease is recovered from the tank-water by skimming and from the solvent by distillation ; it fetches about 3·7 cents per lb. The tankage is a useful fertiliser, containing an average of 3·5% water, 3·43% ammonia, 5·46% calcium phosphate, and 1·31% potash : the price obtained is only about $6·50 (26s.) per ton wholesale, because the nitrogen is generally believed to be in an unavailable form, but there is no evidence that this is so and, moreover, the low price does not reflect the value of the material as a fertiliser base. The present output of garbage tankage is about 150,000 tons, from 1,200,000 tons of raw garbage ; it could be easily doubled.—E. H. T.

Patent.

Phosphate material and the like ; Method of drying and enriching ——. M. M. Haff and T. L. Willson, Ottawa. Assignors to Southern Investment Co. of Canada, Montreal. U.S. Pat. 1,161,173, Nov. 23, 1915. Date of appl., Oct. 19, 1912.

The material is placed in a closed vessel and treated under pressure with ammonia gas and air delivered above its surface.—W. R. S.

XVII.—SUGARS ; STARCHES ; GUMS.

Sugar beets ; Loss in tonnage of —— by drying. H. B. Shaw. U.S. Dept. Agric., Bull. No. 199, pp. 12, Apr. 7, 1915.

In an experiment in Utah, freshly pulled beets topped and left in the fields in open piles of 1—3 cwt., lost 4·7% of their weight, in the form of moisture, in 24 hours (mean temp., 43° F.), and in a similar experiment in Kansas an average loss of 6·48% per day for 4 days was observed (temp. limits 4°—67° F.). Open piles of about 5 cwt. of topped beets lost an average of 2·9% per day for 5 days (mean temperature 47° F.), whilst for similar piles protected by a covering of beet tops the average daily loss was only 0·9%. Large open piles of 11—28 tons lost 4·1% of their weight between Nov. 4 and Jan. 4 (mean temperature 36·7 F., and occasional showers). The loss of sucrose which topped beets undergo in the course of a few days, owing to inversion and decomposition, appears to be practically negligible. Where farmers are paid for the roots on a sliding scale approximately proportional to the sugar-content of the roots, determined at the time of delivery and weighing, any normal loss of weight of the roots between digging and delivery is reasonably well compensated for. When the factory is unable to accept immediate delivery of the roots and a farmer is required to store them for a considerable time, the inversion and decomposition of the sucrose becomes a factor of some importance; in Germany a farmer is allowed to add 1% to the sucrose-content of the roots at the time of delivery, for each month that he has stored them at the request of the factory. Where farmers are paid at a flat rate for the roots as weighed, all previous losses of weight represent pecuniary loss. Such losses can be reduced by piling the beets in fairly large heaps and covering them with the tops. This can be readily done if the following method of harvesting the roots, which the author considers the best, is adopted :—With a suitable beet plough or digger the beets are first torn from their root anchorage and lifted several inches in the soil, which is at the same time loosened. As soon as several rows have been dug, labourers pull the beets entirely out of the ground by hand, throwing those from 5, 7, or 9 rows into piles at convenient distances apart in the line of the centre row. Another squad of labourers immediately follows and tops the piled beets, throwing the tops to one side of the pile. When the roots cannot at once be carted away the piles may be covered with the tops.—J. H. L.

Canadian beet sugar industry. U.S. Comm. Rept., No. 259, Nov. 4, 1915.

Considerable activity prevailed in the Canadian sugar-beet industry during the year 1915. At present, the neighbourhood of Sarnia Ontario, is practically the only one where sugar beets are raised in Canada. There are two beet sugar factories, with a daily capacity of 1600 tons of beets. The increase of the import duty on sugar and the cessation of supplies from Europe have resulted in the construction of factories at Chatham and at Petrolea, which, when in full operation, will be capable of treating 1800 tons of beets daily. The climatic and soil conditions are favorable to the sugar beet industry, but the farmers are unwilling to plant large areas with beet, owing to the difficulty of obtaining the necessary labour.

Invertase ; Preparation of —— for the determination of sucrose. W. A. Davis. Intern. Sugar J., 1915, **17**, 522—523. (Hudson, this J., 1914, 802).

A very active and clear solution of invertase may be obtained in the following manner: Fresh pressed beer yeast is thoroughly washed with water on a Buchner funnel, and packed into a large wide-mouthed bottle; 30—50 c.c. of toluene is allowed to percolate through the mass, and after covering the mouth with a sheet of paper, the bottle is maintained at 25°—30° C. Autolysis takes place rapidly, and after a fortnight the liquid is filtered through a Buchner funnel. It is unnecessary to adopt Hudson's recommendation (*loc. cit.*) to purify the autolysed yeast with normal lead acetate followed by dialysis, since the method just described yields a preparation that is extremely stable, showing very little sign of deterioration after several years. Moreover, the addition of a large volume of water as advised by Hudson is considered to serve no useful purpose, and has the effect only of diminishing the activity of the preparation to about one-half the value it would otherwise have. As a preservative, toluene is preferable to chloroform, since the latter gives a less active product, and also has the disadvantage of reducing Fehling's solution. During autolysis maltase and zymase are destroyed, and the invertase solution prepared according to the author's method can safely be used in the presence of maltose without causing any change in this sugar, or in sucrose, other than simple inversion. On the contrary, when non-autolysed yeast is employed, both the enzymes mentioned may come into action in the presence of a substance such as toluene.—J. P. O.

Bagasse ; Simple method of determining sugar in ——. F. van Dixhoorn. Archief Suikerind. Nederl.-Indië, 1915, **23**, 1517—1520. Intern. Sugar J., 1915, **17**, 531—532.

Twenty grms. of bagasse is weighed into a counterpoised cylindrical copper vessel, holding about 700 c.c., and provided with a lid which can be closed hermetically; 250 c.c. of water is added, and after closing the vessel, it is heated in a boiling water-bath for 15 minutes, cooled, the lid removed, and the contents treated with 3 c.c. of lead acetate, filtered, and polarised.—J. P. O.

Melibiose ; Preparation of ——. C. S. Hudson and T. S. Harding. J. Amer. Chem. Soc., 1915, **37**, 2734—2736.

Five hundred grms. of pure raffinose is dissolved in water to make an approximately 10% solution, 10 grms. of bakers' yeast, a drop or two of glacial acetic acid, and about 1 grm. of malt combs (to serve as a nitrogenous yeast food) are added, and fermentation is allowed to proceed at the ordinary temperature. The optical rotation of the solution is observed at intervals; at first it falls rapidly to several degrees Ventzke below +47° (the calculated end-point), then rises gradually, and, after 36—48 hours, when fermentation has ceased, the reading will be within 0·2° V. of the calculated end-point. The solution is then treated with a slight excess of basic lead acetate, filtered through asbestos, excess of lead in the filtrate is removed by hydrogen sulphide, about 40 grms. of charcoal is added, the mixture again filtered, hydrogen sulphide is removed by a current of air, and the solution concentrated under reduced pressure to a syrup containing 20—25% of water. Alcohol (95%) is now added in quantity just insufficient to form a precipitate, a few crystals of pure melibiose are introduced (it is very difficult to induce spontaneous crystallisation), and, after 4 days, the solid crystalline mass is ground up with 75% alcohol, filtered, washed first with 75% alcohol, then with 95% alcohol, and dried in a desiccator. The yield is from 175 to 200 grms.—W. P. S.

Manufacture of paper from bagasse in Cuba. *See* V.

Mobility of water in adsorption compounds. Rakovski. *See* VII.

Oxidation of organic compounds by permanganate. Doroschevski and Pavlov. *See* XX.

Patents.

Soluble substances [sugar] contained in the cells of certain plants [beets]; Extraction of ——. M. Paquier, C. Théry, and E. Gallois. First Addition, dated Jan. 12, 1914, to Fr. Pat. 464,947, Jan. 25, 1913.

The process of extraction described in the principal patent (this J., 1914, 495) is carried out in a hermetically sealed box, provided with double walls heated by steam, and connected with a vacuum apparatus, the beet or other substance resting on a screen made of non-conducting material. After the desiccating treatment the friable product is pulverised, and the sugar extracted in the cold. Clarification and decolorisation of the extract may be effected by adding albumin and sodium, calcium, or zinc hydrosulphite, and heating to 80°—100° C., the liquid after subsiding being filtered.—J. P. O.

Defecation; Process of continuous —— at high temperature with filtration [in sugar manufacture]. J. V. Roussel. First Addition, dated Feb. 24, 1914, to Fr. Pat. 410,073, Mar. 5, 1909.

Excess steam coming from the lime-mixers in the process of continuous defecation already described (this J., 1910, 834) is used for heating two reheaters for the syrup coming from the multiple effect evaporator. Not only is an economy of heat effected in this way, but the formation of incrustations in the vacuum pans is avoided, the deposition of scale taking place in the reheaters, each of which may easily be cleaned without cessation of working.—J. P. O.

Sulphitation; Process of —— for the clarification and decolorisation of sugar juices. J. Weisberg. Second Addition, dated Jan. 27, 1914, to Fr. Pat. 455,936, June 5, 1912.

Syrup from the centrifugals, previous to being boiled for a second crop of sugar, is diluted to 28°—32° Brix, sulphited till the alkalinity to phenolphthalein is reduced to 0·1—0·3 grm. per litre, then mixed with a suitable quantity of second carbonatation scums resulting from the mode of operating described in the principal patent (this J., 1913, 955; 1914, 607), heated to 85°—95° C., and filtered. Syrup thus treated is lighter in colour, and gives a better quality of sugar, than that obtained by the customary procedure.—J. P. O.

Dextrin from starch; Manufacture of ——. Dextrin-Automat Ges. (Dextrin Automat, Ltd.), Vienna. Ger. Pat. 286,362, June 22, 1912.

Starch is swollen by heating, then mixed with powdered starch which has been treated with concentrated acid, and the mixture heated slowly in a steam-jacketed vessel to a temperature between 105° and 150° C. Dextrins of different characters may be obtained by regulating the temperature and rate of heating.—A. S.

XVIII.—FERMENTATION INDUSTRIES.

Hops; Soft resins in sulphured and unsulphured — in cold and in open storage. G. A. Russell. U.S. Dept. Agric., Bull. No. 282, pp. 19, Aug. 11, 1915.

Two lots of dried hops from the same field in Perkins, Cal., one of which had been sulphured on the kiln, were divided into smaller lots, baled in burlap, and kept, some in cold and some in open storage, for 1, 2, and 3 years. Both sulphuring and cold storage were found to retard changes in the physical characters of the hops, a combination of the two factors being more effective than either alone. At the end of three years, however, the cold-storage sulphured hops had lost all trace of hop flavour and developed a musty, straw-like odour; a slight stickiness could still be detected, but the hop cones had fallen apart to some extent and the lupulin was much discoloured. All the other samples had deteriorated to a greater extent. The moisture-content of the hops in cold storage increased from about 5—6% to 10—11% during the first year and then remained fairly constant, whilst that of the samples in open storage showed no general increase. The content of soft resins, which ranged from 11·2 to 12·3% in the dried hops before storage, fell to 7·43—11·46% during the first two years, and to 2·32—4·98% during the third year; the lower values refer to the unsulphured hops in open storage and the higher ones to the sulphured hops in cold storage. The total resins augmented slightly during the first two years and diminished considerably in the third year. The hard resins (5·3—6·4% in the original samples) approached a uniform value of about 10% after three years storage. Determinations of the acid-, saponification-, and iodine-values of the soft resins from year to year revealed no uniform progressive changes, but rather irregularities indicating marked changes in some of the components of the soft resins during the first 1—2 years. These changes appeared to be most pronounced in the unsulphured hops in cold storage, and least pronounced in the sulphured hops in open storage.—J. H. L.

Yeast nucleic acid; Crystalline hydrolytic products of high molecular weight from ——. S. J. Thannhauser and G. Dorfmüller. Z. physiol. Chem., 1915, **95**, 259—262.

Two acid products were obtained by hydrolysis of yeast nucleic acid with ammonia. The first was also obtained by hydrolysis with duodenal juice; it was lævorotatory ($[\alpha]_D = -19·6°$) and yielded a crystalline brucine salt, m.pt. 200°—205° C, $C_{32}H_{39}O_{23}N_{15}P_3.(C_{23}H_{26}O_4N_2)_6$. The brucine salt of the second product melted at 182°—183° C. —J. H. L.

Invertase; Effect of sodium chloride on the action of ——. H. A. Fales and J. M. Nelson. J. Amer. Chem. Soc., 1915, **37**, 2769—2786.

The concentration of hydrogen ions remains constant throughout the whole course of the inversion of sucrose by invertase. At the optimum of invertase action, the effect of sodium chloride seems to approach zero, but increases on either side of the optimum point. The use of "buffers" for regulating the concentration of hydrogen ions introduces a certain salt effect; the most satisfactory region for using "buffers" in invertase velocity measurements is in the neighbourhood of the optimum zone. In the region of enzyme activity, the hydrogen ion concentration must be measured and not calculated from the concentration of the acid used. The addition of sodium chloride to solutions of hydrochloric acid causes an increase in concentration of hydrogen ions as measured by the electromotive force method and by the hydrolysis of sucrose solutions. (See also Sörensen, this J., 1909, 950.) W. P. S.

Preparation of invertase for the determination of sucrose. Davis. *See* XVII.

Content of amylase in ripening horse beans. Blagoveschtschenski. *See* XIXa.

Patents.

Hops; Method of preserving ——. H. Wennersten, Assignor to J. W. and R. W. Hill, Chicago, Ill. U.S. Pat. 1,161,272, Nov. 23, 1915. Date of appl., May 24, 1913.

Comminuted hops are made into a thick paste by thoroughly mixing them with a viscous liquid, such as sugar syrup, below its boiling point, so that after cooling the closely packed particles are substantially cemented together and access of air to the interior of the mass is prevented. —J. H. L.

Fermentation: Process of continuous —— in alcohol manufacture. Soc. d'Exploit. des Procédés H. Boulard. Fr. Pat. 475,791, Mar. 17, 1914.

Saccharification of starchy material is effected by means of an active *Mucor*, for example, *M. Boulard* No. 5 (Fr. Pat. 461,601; this J., 1914, 197), and the wort is added continuously to a second vat, in which alcoholic fermentation is proceeding.—J. P. O.

Saccharification; Process of conversion of starchy materials for their —— in alcohol manufacture. Soc. d'Exploit. des Procédés H. Boulard. Fr. Pat. 475,792, Mar. 17, 1914.

Spent wash from a previous distillation is mixed with a small quantity of wort, inoculated with a suitable acidifying bacterium or yeast, and the acid liquid thus obtained is used in place of mineral acid or malt for the conversion of starchy materials in spirit manufacture.—J. P. O.

Wines, beers, and spirits: Electrical process for the ageing of —— [and rectification of perfumes]. C. Henry. First Addition, dated Mar. 16, 1914, to Fr. Pat. 459,141, Aug. 27, 1912 (this J., 1913, 1167).

In carrying out the process described in the principal patent, two pairs of electrodes, *e.g.*, in different casks of wine, are arranged in parallel in the circuit of an alternating current of 35,000—100,000 volts from a transformer. In each branch of the circuit is a gap between a point and a disc, the disc of one gap being connected to the same terminal of the transformer as the point of the other, so that as the current alternates it takes first one branch and then the other. Both directions of the current are thus utilised, but between any one pair of electrodes the direction remains the same, and spontaneous heating of the liquid under treatment is minimised.—J. H. L.

Yeast: Manufacture of pressed ——. A. J. C. Audouin. Fr. Pat. 475,487, Feb. 26, 1914, and First Addition thereto, dated May 19, 1914 (cp. following abstract).

One part of very finely ground rye is mashed with 4 parts of water for 1—2 hours at 30° C., and the mash is maintained at 58°—60° C. for 2 hours and afterwards heated to 66° C. and treated with a small quantity of ground barley malt (1—2% of the weight of rye) to complete saccharification. The cooled mash is fermented by "lactic acid yeast." In case of unsatisfactory saccharification of dextrins, a further small quantity (2—3%) of barley malt may be used. The addition to the principal patent provides for the partial replacement of rye by other amylaceous materials, such as rice, maize, or manioc, previously heated with water.—J. H. L.

Fermentable worts; Preparation of —— from amylaceous materials, particularly for the manufacture of gins and whiskies. A. C. J. Audouin. Fr. Pat. 475,758, Mar. 16, 1914, and First Addition thereto, dated May 19, 1914.

The diastase present in raw cereal grains is utilised for the saccharification of the starch. The grain, ground as finely as possible, is steeped in 3—4 parts of water at 30°—40° C. for 1—4 hours, and agitated mechanically or by injection of air. Formaldehyde, chloroform, or other antiseptic may be added to prevent infection. The mash is next suitably acidified, preferably with lactic acid and maintained for 1—2 hours at 58°—66° C. Nearly all the starch is thus saccharified, but to complete the process the mash, after being heated to 100° C. if necessary to gelatinise any residual starch and kill bacteria, is treated with a mash of ground barley malt corresponding to not more than 5% of the raw grain employed; or the sterilised mash is inoculated with a Mucor mould to complete saccharification. In working with grains rich in diastase (wheat, barley, rye) the mash may be allowed to stand after the steeping process (see above); the upper liquid is then drawn off and again mixed with the rest after the latter has been heated for 20 mins. under a pressure of 1 kilo. (per sq. cm.). In the case of grains (maize) containing only a small quantity of diastase, the steeped mash, after standing, may be drawn off in three fractions. The lowest stratum is suitably acidified and heated for 30—40 mins. under a pressure of 3 kilos., the intermediate stratum is heated without acid for 20 mins. under 1 kilo., and both are afterwards mixed with the aqueous fraction for saccharification. In the addition to the principal patent claim is made for the treatment of grains of low diastase-content (maize, rice) by heating them, whole or ground, for 1 hour with 2—3 parts of water under a pressure of 3 kilos., and then saccharifying them at 58°—60° C., by a diastatic extract of grains rich in diastase, such as barley or rye. Fermentable mashes are thus obtained without addition of malt or acid.—J. H. L.

[*Alcohol*:] *Apparatus for rectifying ——.* A. E. Vasseux. Fr. Pat. 475,250, July 17, 1914. Under Int. Conv., July 18, 1913.

In intermittently acting plant for the rectification of crude spirit from the previous distillation, the contents of the still are heated by automatic circulation through vertical steam-heated tubes outside the still. Liquid from the lower part of the still enters the bottom of the tubular heater, rises through the tubes, and returns to the upper part of the still. Owing to the rapid circulation of the liquid through the tubes, decomposition arising from contact with steam-heated surfaces is much less than in stills heated by internal steam coils. A tubular crown-piece situated below the bottom tube-plate of the heater, and having nozzles which project upwards into the tubes, enables a current of air or steam to be forced up the tubes to produce circulation in the early stages of the operation, before ebullition has commenced.—J. H. L.

Rectification of wines, phlegms, and other volatile products, benzol, petroleum, etc.; Apparatus for the continuous direct ——. E. Gazagne. Fr. Pat. 475,969, Mar. 28, 1914.

The following arrangement is designed to avoid the return of condensed liquid from head products into the wine (or other raw material), and consequent esterification. The wine flows down a column in the upper part of which the head products are expelled; in the lower part it is completely dealcoholised and the vapours from this part are led into the main rectifying column. The head products mentioned enter the bottom of a special column with an analyser above it (see Fr. Pats. 420,666 and 446,746, this J., 1911, 380; 1913, 156), and the liquids condensed in this column are led to a second one of somewhat similar construction, from which the condensed liquids pass into the main rectifying column. In the upper part of the main rectifying column, the plate from which the rectified alcohol is drawn off, and those just above it, are provided with steam pipes to raise the temperature of the liquid on them, or of the vapours between them, or of both, above that of the vapours ascending from below, so that the latter do not tend to condense on these plates, and the purity of the alcohol drawn off is consequently enhanced.—J. H. L.

XIXa.—FOODS.

Hydrogen peroxide in milk ; Persistence of ——. E. Hinks. Analyst. 1915. 40, 482—491.

Known quantities of hydrogen peroxide were added to various samples of milk and the amount remaining after stated intervals determined iodometrically and also tested for with the ortol, benzidine, and *p*-phenylenediamine reagents with the addition of fresh milk to ensure the presence of peroxydase. The peroxide is rapidly destroyed at first, the rate of destruction then diminishing, and if the amount of peroxide present is sufficient to withstand the first rapid destruction by the catalase present, the residual peroxide remains constant over long intervals. A sample of fresh milk to which 0·2 % of hydrogen peroxide was added contained more than 33 % of the added peroxide after one year, whilst the same amount of peroxide added to the same milk when three days old, was completely destroyed in an hour, owing to the increased amount of catalase present. Between 17° C. and 37° C. an increase in temperature lengthens the time during which the peroxide persists, but increases the amount destroyed in the first few minutes.—T. C.

Casein ; Conditions affecting the precipitation of ——. L. L. van Slyke and O. B. Winter. J. Assoc. Off. Agric. Chem., 1915, 1, 281—282.

The effects of the quantity of acid used, concentration of the acid, and temperature on the precipitation of casein from milk were investigated. In the case of milks containing less than 2% of casein, good results were obtained when 10 c.c. of the milk was treated with from 12 to 20 c.c. of $N/10$ acetic acid ; with milk containing more than 3% of casein, as much as 50 c.c. of $N/10$ acetic acid may be used. The precipitated casein was more flocculent and could be filtered more readily when the acid was diluted to 90 c.c. before it was added to the milk, than when the milk was diluted and then treated with the undiluted acid. Equally satisfactory results were obtained at all temperatures between 18° and 42° C.—W. P. S.

Glycerol in meat juices and extracts ; Determination of ——. F. C. Cook. J. Assoc. Off. Agric. Chem., 1915, 1, 279—281.

Two grms. of a solid, or 5 grms. of a liquid preparation is weighed into a small lead dish containing 20 grms. of ignited sand ; the dish is then transferred to a mortar containing several grms. of anhydrous sodium sulphate and some sand, and the whole is mixed. The sandy mixture and the lead dish are now placed in a Soxhlet apparatus, which has a piece of cotton-wool placed in the side tube to prevent the sand siphoning over, and extracted with dry acetone for 10 hours. The acetone solution is evaporated, the last traces of acetone removed under reduced pressure, the residue dissolved in water, a small quantity of silver nitrate is added, the solution diluted to 100 c.c., filtered, and the glycerol determined in an aliquot portion of the filtrate by the bichromate method. The results by this method have a tendency to be somewhat low, owing to the difficulty of extracting the last traces of glycerol.—W. P. S.

Feeds and feeding stuffs. [Determination of fat.] W. J. Jones. J. Assoc. Off. Agric. Chem., 1915, 1, 289—314.

In the determination of fat in feeding stuffs, extraction with petroleum spirit yields low results when the time of extraction is limited to 3 hours ; the figures obtained are from 0·1 to 1·53 % lower than those found by the official (American) method. If the extraction with petroleum spirit is continued for 9 hours, the quantity of fat found exceeds, in some cases, that obtained by the official method. The presence of moisture materially affects the amount of extract obtained with petroleum spirit : concordant results are not obtained for the same feeding stuff when the extractions are made with petroleum spirits from different crude petroleums, and the extracts must be dried for at least 3 hours to secure constant weights. The use of petroleum spirit for the determination of fat in feeding stuffs cannot, therefore, be recommended. Extraction with absolute ether, when the sample has not been dried, gives higher results than does the official method, and high results are also obtained by extraction with ether containing 3% of alcohol.
—W. P. S.

Feeding stuffs ; Determination of the amino acids of —— *by the van Slyke method.* H. S. Grindley and M. E. Slater. J. Amer. Chem. Soc., 1915, 37, 2762—2769.

Continuing their work on this subject (this J., 1915, 848), the authors have obtained the following results :—

	Nitrogen as—								
	Ammonia.	Humin.	Arginine.	Cystine.	Histidine.	Lysine.	Amino nitrogen in filtrate from bases.	Non-amino substances.	Total.
	%	%	%	%	%	%	%	%	%
Blood meal	5·85	3·95	9·16	0·69	8·53	9·73	56·57	4·42	98·80
Wheat	17·59	9·21	7·99	1·34	1·67	2·47	47·67	13·59	101·53
Rolled wheat	17·04	9·04	8·20	1·66	3·21	2·48	47·70	13·95	103·28
Barley	15·16	8·79	9·46	1·26	3·64	2·19	45·81	13·84	100·15
Oats	13·06	9·94	11·42	1·16	4·32	3·49	51·72	7·90	103·01
White soya beans	10·12	6·63	12·67	0·67	5·77	6·14	49·79	8·56	100·35

These results do not agree well with those recorded by Nollau (this J., 1915, 884), probably owing to differences in the details of procedure in the experiments ; the authors did not remove the fat from the substances previous to the determinations, and the hydrolysed solution was not filtered before removing the excess of hydrochloric acid or before determining the ammonia, total, and humin nitrogen. The high results for humin nitrogen are probably due, in part, to the presence of soluble carbohydrates during the hydrolysis of the proteins ; cellulose also mechanically prevents the complete hydrolysis of the proteins. These high results for humin nitrogen constitute a source of error in the direct application of the van Slyke method to feeding stuffs.—W. P. S.

Baking powders; Determination of lead in phosphate and alum ——. A. F. Seeker and H. D. Clayton. J. Assoc. Off. Agric. Chem., 1915, **1**, 264—266.

Twenty-five grms. of the baking powder is mixed with 25 c.c. of water and 25 c.c. of concentrated hydrochloric acid and the mixture heated on a water-bath until the starch is completely hydrolysed. A quantity of ammonium citrate corresponding with 25 grms. of citric acid is now added, the solution rendered slightly alkaline to litmus with ammonia (taking care to keep the solution cool), diluted to about 500 c.c., 10 c.c. of 10% hydrochloric acid is added, and the mixture saturated with hydrogen sulphide. After 18 hours the precipitate is collected, washed, and dissolved by pouring on the filter three 5 c.c. portions of boiling 10% hydrochloric acid followed by three 5 c.c. portions of boiling 25% nitric acid, the filter is washed with a small quantity of hot water, 2 c.c. of sulphuric acid is added to the solution and this is evaporated until fumes of sulphuric acid appear. The residue is cooled, diluted with 10 c.c. of water, 20 c.c. of alcohol is added, and the lead sulphate collected after 18 hours, washed with alcohol, treated with a few drops of ammonia, and dissolved in 10 c.c. of 50% ammonium acetate solution. The solution is acidified with acetic acid, heated nearly to boiling, an excess of potassium bichromate is added, the lead chromate collected after 18 hours, washed with cold water, dried, and weighed. The method yields from 86 to 100% of the lead actually present.—W. P. S.

Pepsin; Pekelharing's ——. W. E. Ringer. Z. physiol. Chem., 1915, **95**, 195—258.

Pepsin of high purity, exhaustively dialysed, and containing $0{\cdot}4\%$ or less of ash, was prepared from the gastric juice of a dog. By dialysis against dilute oxalic acid solution preparations free from chlorine were obtained; Pekelharing has shown that phosphorus is not an essential constituent of pepsin. When dissolved in hydrochloric acid of different concentrations and subjected to an electric field, the enzyme itself was invariably transported towards the anode and at the same time inactive protein matter travelled towards the cathode. A relatively large amount of albumoses in the solution interfered with the transportation, but amino-acids, though also positively charged, had no such effect. Pure pepsin is therefore negatively charged, and shows no iso-electric point: it combines with substances which it can decompose, and when so combined may appear to possess an iso-electric point. Measurements of potentials of hydrogen and chlorine electrodes in pepsin solutions containing hydrochloric acid, indicated that in presence of low concentrations of acid the enzyme binds more hydrogen than chlorine ions (3 : 1), but in $N/10$ solutions about equal numbers of both ions are bound. This behaviour is very similar to that of albumoses. The activity of pepsin in presence of different acids at various concentrations was determined by Grützner's method (see Geselschap, this J., 1915, 848). The stained and powdered fibrin was steeped in the acid liquid for half an hour before the pepsin was added, and the amount of fibrin dissolved by the enzyme was determined colorimetrically after 5 or 10 mins. The activity of the pepsin was found to depend on the condition of hydration (*Quellung*) of the fibrin, the concentration of hydrogen ions which produced the maximum swelling or hydration being also the optimum for peptic action. This optimum reaction was not identical in the case of different acids, but was affected by the nature of the anions. Sulphuric acid, owing to the hydrophile character of the sulphate ions, produced much less swelling of the fibrin than other acids; the peptic action was accordingly very weak and the optimum concentration of hydrogen ions was much lower than when hydrochloric or lactic acid was used. A study of the influence of salts confirmed the parallelism between activity of the enzyme and state of hydration of the substrate, and further confirmation was given by experiments in which the pepsin acted in a homogeneous medium (solutions of horse serum) and the degree of hydration of the substrate was estimated from the viscosity of the solutions.—J. H. L.

Amylase: Content of —— *in ripening horse beans.* A. Blagoveschtschenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1529—1532.

Examination of the seeds of *Vicia faba, L.*, var. *minor* at different stages of their maturation shows that the amount of amylase present changes approximately in the same way as the rate of accumulation of starch. This result is regarded as a proof of the synthesising action of the amylase in the ripening seeds, the apparent slight incompleteness of the parallelism between rate of synthesis and amount of enzyme being due to the loss of some of the starch from the assimilatory organs.—T. H. P.

Proteins; Optical and certain other properties of ——. M. A. Rakuzin. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1330.

The adsorption of the albumin of hens' eggs by alumina is an irreversible process.—T. H. P.

Biochemical decomposition of nitrogenous substances in soils. Kelley. *See* XVI.

Patents.

Bread; Process and substance for use in the manufacture of ——. Ward Baking Co., New York (Assignees of H. A. Kohman and T. M. Godfrey, Pittsburg, and C. Hoffman, New Rochelle, N.Y.). Eng. Pat. 1686, Feb. 2, 1915. Under Int. Conv., Apr. 21, 1914.

See U.S. Pats. 1,148,328 and 1,148,329 of 1915; this J., 1915, 918.

Vitamines; Art of obtaining ——. C. Funk, New York. Assignor to C. F. Boehringer und Söhne, Mannheim-Waldhof, Germany. U.S. Pat. 1,162,908, Dec. 7, 1915. Date of appl., Apr. 8, 1915.

See Eng. Pat. 3074 of 1915; this J., 1915, 1222.

XIXb.—WATER PURIFICATION; SANITATION.

Potable waters; Changes brought about in the chemical composition of —— *by treatment with hypochlorite: detection of such treatment.* C. O. Guillaumin and Vienne. J. Pharm. Chim., 1915, **12**, 377—387.

All waters to be used for drinking by the army in the field must be sterilised by treatment with hypochlorite, and it is of practical importance to know whether any particular water has been so treated. It was found that when very varying quantities of active chlorine were added to a water, there was always a small quantity left undestroyed at the end of a half hour, and usually also after two days. The absorption of chlorine increased with the amount added and with the time allowed to elapse before testing, becoming constant with a dose of 50 mgrms. per litre acting for 6 hrs. This constant is called the coefficient of absorption of chlorine. If this is determined for a water which has been already chlorinated, it is found that the coefficient diminishes with the quantity of chlorine previously introduced. In the absence of any excess of chlorine remaining in a water, a method of detecting whether the water has been chlorinated consists in testing for nitrite by the nitrosoindole reaction. If nitrite be present, the water cannot have been chlorinated or only incompletely. Hypochlorite treatment does not produce any nitrite. In the absence of nitrites, the chlorine absorption coefficient must be determined. This is done on 200 c.c. of the water which is treated with 10 c.c. of hypochlorite solution containing 1 grm. of active chlorine per litre. After standing over night, potassium iodide and acetic acid are added, and then excess of thiosulphate, and the excess determined by $N/100$ iodine. Any thiosulphate which may be present in the sample from previous treatment must be allowed for. Chlorination has an effect on the oxygen absorption of the water from permanganate in alkaline solution, this being always lowered if at least 0·9 mgrm. of chlorine has been added. The changes produced in the free and albuminoid ammonia are not sufficiently great to be relied on as an indication of previous treatment. If the oxygen absorption of the natural water is greater than that of the portion of it which is stated to have been treated, and the chlorine absorption also greater, then the water has been chlorinated effectively. If it be less or equal, then the water has not been treated, or treated ineffectively.—J. H. J.

Explosions in Mines Committee; Seventh Report of the ——. Effects of inhaling dusts applicable for stone-dusting in coal mines. J. S. Haldane. [Cd. 8122.] 22 pp. Price 2d. (See also this J., 1913, 476, 688, 1148; 1914, 1144.)

From practical experience in coal mines and from experiments on animals there is clear evidence that shale-dust, when inhaled, is not more injurious than coal-dust, so that shale-dust may be used quite safely for stone-dusting in coal mines. Flue dust, from the furnaces of the surface engines at collieries, has been used to reduce the inflammability of coal-dust, but it is objectionable to the workmen, and experiments on animals have shown that flue-dust, when inhaled, may produce ill effects. Besides shale-dust, powdered clay or chalk would probably be as effective in preventing explosions, and these substances are known to be practically harmless when inhaled, but they must be free from flint or grit. It is desirable from the point of view of health to reduce, as far as practicable, the inhalation of any kind of dust in mines; to effect this, the quantity of coal-dust produced should be reduced to a minimum, by occasional watering of the floor, or by the application of hygroscopic salts, such as calcium or magnesium chloride.—W. P. S.

Preparation of fertiliser from municipal waste. Turrentine. *See* XVI.

Patents.

Waters or other fluids: Purification of —— by filtration through porous walls. P. E. C. Michel. Fr. Pat. 475,445, July 20, 1914.

Two filter-candles with thin porous walls are clamped with their open ends together, and each is surrounded with a non-porous cover, making a water-tight joint at the junction of the filter candles, and leaving a space between the cover and the filter. The water to be filtered enters at the top of the space between the cover and the upper filter, passes through the wall of the filter into the interior space, and then through the wall of the lower filter into the surrounding space and so out by an exit at the bottom. A combination of more than one pair of filter candles may be used in one filter. The interior of the filters may be filled with carbon or other material —J. H. J.

Water: Apparatus for the distillation of ——. Soc. d'Exploit. de Proc. Evaporatoires Système Prache et Bouillon. Fr. Pat. 476,268, Apr. 11, 1914.

The water is heated to 97° C. in a preheater and then passed through a boiling chamber where it is heated to 100° C. by steam being bubbled into it, and is kept boiling until the bicarbonates of calcium and magnesium are decomposed. The boiled water passes, either directly or through a filter, into the distillation chamber proper, where it is heated by steam coils; the temperature of the water in the still being 101° C., it is concentrated without deposition of calcium sulphate, and means are provided for drawing off the concentrated solution as required. The steam from the still is used to bubble through the water in the boiling chamber, and afterwards is passed through coils in the preheater, where it is condensed and flows into the distilled water well. The apparatus may be used in multiple effect.—J. H. J.

Waste waters: Apparatus for the biological treatment of trade and domestic ——. J. Lévy. Fr. Pat. 475,427, Feb. 21, 1914.

The treatment is carried out in a closed septic tank and bacteria bed. The tank has a central partition which causes the waste water to flow down one side of the tank and return along the other, where it is taken off by an exit pipe, dipping below the surface and delivering into a charging box which supplies the bacteria bed. This bed has closed sides and contains a metal basket filled with filtering material, preferably blast-furnace slag mixed with scrap iron. The bed has a false bottom, below which air enters and travels up the bed as well as around the sides. The waste from the charging box is delivered on to the surface of the bed and leaves by a trapped pipe at the bottom. The rate of delivery on to the bed is regulated by a tap on the exit pipe from the tank.—J. H. J.

Soapy waters [wool washings]: Process for the decomposition of ——. Soc. d'Exploit. de Proc. Evaporatoires (Système Prache et Bouillon). Fr. Pat. 475,550, Mar. 3, 1914.

Soapy waters, and in particular wool washings, are treated directly with carbon dioxide, preferably under pressure, the mass being heated and continually agitated. This process of obtaining fatty acids and mineral salts may be worked continuously or intermittently. Reversal of the reaction is prevented by always having an excess of carbon dioxide present.—C. A. M.

Waste waters containing fats and soaps [wool washings]: Treatment of ——. Soc. d'Exploit. de Proc. Evaporatoires Système Prache et Bouillon. Fr. Pat. 475,639, Mar. 9, 1914.

The waste liquid is run into a concentrator where it is heated, to a temperature above the melting points of the fats, by steam at 103° C., coming for example from a compressor. The steam given off in concentration is passed to the compressor and used again. The concentrated liquid passes through a centrifuge, where the insoluble matter is separated and the fatty liquid passes to another centrifuge for the separation of the fat. The soapy liquid is sent to a mixer where it is decomposed by carbon dioxide under pressure and with the aid of heat (see preceding abstract), and the fatty acids recovered. The apparatus may be used in multiple effect.—J. H. J.

Tetra-cupric sulphate: Preparation of ——, and its use as fungicide. Soc. des Produits Agricoles Mouillants à l'Adhésol. Fr. Pat. 476,512, Apr. 24, 1914.

Tetra-cupric sulphate, $CuSO_4,3CuO$, of approximately 90—92% purity, is obtained as a bluish or bluish-green precipitate by adding a dilute solution of sodium carbonate, or similar alkali, very slowly to an excess of a weak solution of copper sulphate. For agricultural purposes, it may be used as a powder or paste, either alone or mixed with chalk, sulphur, etc.; it may also be mixed with a soluble copper salt, a serviceable mixture consisting of 9 parts of tetra-cupric sulphate and 1 part of normal cupric sulphate. —E. H. T.

Water: Means for softening ——. G. Buchner, Munich, Germany. U.S. Pat. 1,162,024, Nov. 30, 1915. Date of appl., Oct. 16, 1913.

See Eng. Pat. 22,617 of 1913; this J., 1914, 564.

Sewage or any other liquid: Apparatus for purifying ——. L. Linden, Brussels, Assignor to W. J. Stewart, Belfast. U.S. Pat. 1,162,621, Nov. 30, 1915. Date of appl., Jan. 30, 1914.

See Eng. Pat. 1266 of 1914; this J., 1914, 938.

Sewage: Treatment of ——. J. Orten-Böving, Assignor to The Sewage Syndicate, Ltd., London. U.S. Pat. 1,161,600, Nov. 23, 1915. Date of appl., Oct. 23, 1914.

See Eng. Pat. 25,056 of 1913; this J., 1914, 1169.

Disinfectant. P. Flemming, Hamburg, Germany. U.S. Pat. 1,162,152, Nov. 30, 1915. Date of appl., Jan 26, 1914.

See Fr. Pat. 467,636 of 1914; this J., 1914, 881.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

2-Phenylquinoline-4-carboxylic acid (atophan) and its oxidation products. R. Boehm and K. Bournot. Ber., 1915, **48**, 1570—1574.

Oxidation of 2-phenylquinoline-4-carboxylic acid (atophan) with hot alkaline permanganate furnished on the one hand, by rupture of the pyridine ring, carbonic and oxalic acids and benzenylaminophenol (μ-phenylbenzoxazole), and simultaneously, by oxidation of the benzene ring, α-phenylpyridine-α′.β′.γ-tricarboxylic acid, which forms coarse prismatic crystals, containing 1 mol. of water of crystallisation. At 183°—185° C. they lose carbon dioxide with formation of α-phenylpyridine-β′.γ-dicarboxylic acid. This substance was obtained in more satisfactory yield by boiling an acetic acid solution of the tricarboxylic acid. It crystallises in silky needles, m.pt. 248°—250° C., and forms a dimethyl ester of m.pt. 74° C.—G. F. M.

3.3′-Diamino-4.4′-dihydroxyarsenobenzene [salvarsan]: Compounds of —— with metallic salts. P. Ehrlich and P. Karrer. Ber., 1915, **48**, 1634—1644.

The tendency of organic arseno-compounds to form complex compounds with metallic salts has been investigated in the case of 3.3′-diamino-4.4′-dihydroxyarsenobenzene (salvarsan), and has been found to be so great that the addition of hydrosulphite to a mixture of aminophenolarsinic acid and copper chloride does not give rise to the formation of metallic copper, but of copper-salvarsan. The copper salt contains 1 or 2 mols. of copper chloride according to the amount added to the methyl alcohol solution of the salvarsan; it is an orange powder fairly soluble in water, more readily soluble in glycerin and glycol, and dissolves in caustic soda, the solution decomposing on warming. The silver salt is a yellowish brown powder, readily soluble in caustic soda; the hydrochloride is very soluble in water to a brownish red solution. The gold salt is precipitated by ether from the product resulting from the interaction of 2 mols. gold chloride and 1 mol. salvarsan; it is a brownish-yellow powder, very readily soluble in caustic soda and in alcohol; addition of further gold chloride causes precipitation of metallic gold, due to the oxidation of the arseno-compound to the arsinic acid, the complex-compound being destroyed and thus liberating gold chloride to take part in the oxidation. The mercury salt, obtained by using mercuric chloride, is a yellow powder, decomposed by water, more rapidly by caustic soda, with the formation of metallic mercury. The platinum and palladium salts are also described. The therapeutic properties of salvarsan are in many cases intensified by conversion into complex metallic salts; the copper salt containing 1 mol. of copper chloride is a very powerful bactericide. The silver and copper salts of arsenobenzene itself have also been prepared.—F. W. A.

m-Aminophenolarsinic acids and their reduction products. H. Bauer. Ber., 1915, **48**, 1579—1583.

The carbethoxy derivative of *m*-aminophenol was heated with syrupy arsenic acid on a water bath for a week, and the resulting 2-hydroxy-4-carbethoxyaminophenylarsinic acid isolated through its ammonium salt. It was a white crystalline substance, sparingly soluble in water, m.pt. 213° C. By hydrolysis with aqueous sodium hydroxide the corresponding 2-hydroxy-4-aminophenylarsinic acid was obtained, which after crystallisation from water melted at 173° C. On reduction with a mixture of stannous chloride (10 grms.), hydrochloric acid (10 c.c.), acetic acid (20 c.c.), and hydriodic acid (1 c.c.), it was converted into 2.2′-dihydroxy-4.4′-diaminoarsenobenzene, a yellow substance isomeric with, but therapeutically much less active than, salvarsan. 2-Hydroxy-4-carbethoxyaminophenylarsinic acid was also prepared synthetically from diazotised 3-nitro-6-aminophenol by treatment with sodium arsenite, and reduction of the 2-hydroxy-4-nitrophenylarsinic acid with iron and acetic acid —G. F. M.

Medicated drinks; Analysis of ——. [*Determination of salicylic acid, benzoic acid, and saccharin, etc.*] B. H. St. John. J. Assoc. Off. Agric. Chem., 1915, **1**, 343—345.

One hundred c.c. of the sample is acidified with sulphuric acid and shaken with several portions of 50 c.c. of a mixture of chloroform, 7, and alcohol, 3 parts; the chloroform solutions are drawn off and washed with concentrated sodium carbonate solution. If caffeine is present, the chloroform solution is then washed with water, filtered, evaporated, and the residue of caffeine weighed. The sodium carbonate solution will contain the salicylic and benzoic acids and the saccharin. The salicylic acid is determined by adding an excess of iodine, warming the mixture on a water-bath for one hour, collecting the rose-coloured precipitate, drying, and weighing it; the weight of the precipitate multiplied by 0·4657 gives the amount of sodium salicylate present. To separate the saccharin from the benzoic acid, the former is precipitated as its silver salt and the benzoic acid then removed by steam distillation, or the benzoic acid may be sublimed from the saccharin by heating the mixture of the two substances to constant weight. To determine phosphoric acid, it is recommended that this be precipitated directly from the beverage as ammonium magnesium phosphate; this precipitate is then dissolved in nitric acid, the phosphoric acid precipitated by the addition of molybdic acid reagent, and the yellow precipitate again converted into ammonium magnesium phosphate, which is collected, ignited, and weighed as magnesium pyrophosphate. The official (American) method for the determination of glycerol in wines is used for the determination of this substance in medicated beverages; the residue of glycerol obtained, however, may contain caffeine and other substances, and should be oxidised with permanganate and the amount of glycerol found from the quantity of oxalic acid thus produced.—W. P. S.

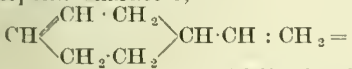
Thorn-apple (*Datura stramonium*) *: Odoriferous substances of the* ——. A. Sivolobov. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1561—1569.

The products obtained on distilling disintegrated branches of *Datura stramonium*, including leaves, flowers, twigs, and fruit cones, with water, consist principally of methyl and ethyl alcohols mixed with small proportions of trimethylcarbinol (?), aldehydes, ketones, and esters. The aldehydes comprise acetaldehyde and, probably, formaldehyde, propaldehyde, isobutaldehyde, and another of considerably higher boiling point. Acetone and another ketone of higher boiling point were found, and esters of acetic and formic acids. The small proportion of odoriferous substances found is explained by their volatility, which prevents any marked accumulation.—T. H. P.

Erythrene: New methods of preparing ——. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1472—1494. (Compare this J., 1914, 766.)

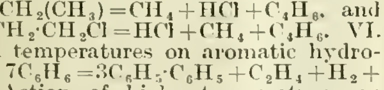
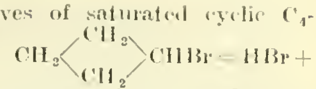
Erythrene may be obtained by the following 29 new reactions, some of which may be used also for the preparation of homologues of erythrene, such as isoprene, piperylene, etc.

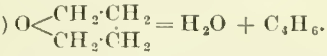
I. Depolymerisation of cyclic hydrocarbons of terpenic character,

(1) 

$$\mathrm{CH}\left\langle\begin{matrix}\mathrm{CH\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\right\rangle\mathrm{CH\cdot CH:CH_2} =$$

$$2\mathrm{CH_2:CH\cdot CH:CH_2};$$

in a similar way, cyclic dimethyldibutene (the dimeride of 2.3-dimethylerythrene) reacts with formation of 2.3-dimethylerythrene. II. Depolymerisation of open-chain hydrocarbons, accompanied by scission of either two mols. of hydrogen or a molecule of a saturated hydrocarbon, (2) C_8H_{16} (dibutylene) $= 2H_2 + 2CH_2:CH\cdot CH:CH_2$ (3) $C_{10}H_{20}$ (diamylene) $= 2CH_4 + 2C_4H_6$. These reactions are analogous to the known pyrogenic decomposition of natural myrcene, the di-isomeride of isoprene, (4) $CH_2:C(CH_3)\cdot CH_2\cdot CH_2\cdot CH:C(CH_3)\cdot CH:CH_2 = 2CH_2:C(CH_3)\cdot CH:CH_2$. III. Removal of RH, where R is an alkyl group, from saturated open-chain hydrocarbons, independently of their composition and structure, (5) $CH_3\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_3 = 2CH_4 + C_4H_6$, or, in general, $R\cdot C_4H_8R' = RH + R'H + C_4H_6$, R and R′ being alkyl groups. This reaction takes place in the pyrogenic decomposition of petroleum, dry distillation of coal, etc. IV. The removal of RH from an open-chain hydrocarbon containing one ethylenic linking in its molecule, for instance, (6) $C(CH_3)_2:CH\cdot CH_3 = CH_4 + C_4H_6$; this reaction may be regarded as an intermediate stage of reaction III. V. Removal of RH and hydrogen chloride from saturated, open-chain monochloroderivatives of the aliphatic series, for instance, (7) $C(CH_3)_2Cl\cdot CH_2(CH_3) = CH_4 + HCl + C_4H_6$, and (8) $CH(CH_3)_2\cdot CH_2\cdot CH_2Cl = HCl + CH_4 + C_4H_6$. VI. Action of high temperatures on aromatic hydrocarbons, (9) $7C_6H_6 = 3C_6H_5\cdot C_6H_5 + C_2H_4 + H_2 + C_4H_6$. VII. Action of high temperature on piperidine, (10) $2C_5H_{11}N = 2H_2 + 2C_4H_6 + N_2 + C_2H_6$, and $C_2H_6 = C_2H_4 + H_2$; the products include also hydrocyanic acid, pyridine, and resin. VIII. Removal of water from saturated cyclic C_4-alcohols, (11)  $\mathrm{CH_2}\left\langle\begin{matrix}\mathrm{CH_2}\\ \mathrm{CH_2}\end{matrix}\right\rangle\mathrm{CH\cdot OH} = H_2O + C_4H_6$. IX. Removal of hydrogen haloid from monohalogenated derivatives of saturated cyclic C_4-hydrocarbons. (12)  $\mathrm{CH_2}\left\langle\begin{matrix}\mathrm{CH_2}\\ \mathrm{CH_2}\end{matrix}\right\rangle\mathrm{CHBr} = HBr + C_4H_6$. X. Catalytic removal of $2H_2O$ from αγ-glycols, (13) $HO\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot OH = 2H_2O + C_4H_6$, and (14) $HO\cdot C(CH_3)_2\cdot CH_2\cdot CH_2\cdot OH = 2H_2O + CH_2:C(CH_3)\cdot CH:CH_2$. XI. Catalytic scission of water and an acid from esters of αγ-glycols, (15) $C_2H_3O\cdot O\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot OH = H_2O + C_2H_4O_2 + C_4H_6$, (16) $C_2H_3O\cdot O\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot O\cdot C_2H_3O = 2C_2H_4O_2 + C_4H_6$, (17) $HO\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot O\cdot CO\cdot CH_2\cdot CH(CH_3)\cdot OH = 2H_2O + CH(CH_3):CH\cdot CO_2H + C_4H_6$. XII. Catalytic removal of a molecule of acid from esters of γ-methylallyl alcohol, (18) $CH(CH_3):CH\cdot CH_2\cdot O\cdot C_2H_3O = C_2H_4O_2 + C_4H_6$, the γ-methylallyl acetate being obtained by the action of magnesium amalgam on aldol, $3HO\cdot CH(CH_3)\cdot CH_2\cdot CHO = 2H_2O + 2CH(CH_3):CH\cdot CH_2\cdot OC_2H_3O$. XIII. Catalytic removal of $2H_2O$ from hydroxy-ethers, (19) $HO\cdot CH(CH_3)\cdot O(C_2H_5) = 2H_2O + C_4H_6$. XIV. Catalytic scission of one mol. of hydrogen haloid and one mol. of water from chloro-ethers, (20) $CH(CH_3)Cl\cdot O(C_2H_5) = H_2O + HCl + C_4H_6$; the compound, $CH_2Cl\cdot CH_2\cdot O(C_2H_5)$, also gives erythrene under the same conditions. XV. Catalytic scission of one mol. of alcohol and one mol. of water from acetals, (21) $C_2H_5O\cdot CH(CH_3)\cdot O(C_2H_5) = H_2O + C_2H_5OH + C_4H_6$, and $C_2H_5OH = H_2O + C_2H_4$. XVI. Catalytic scission of one mol. of water and one mol. of acid from esters of hydroxyethyl ethyl ether. (22) $C_2H_3O\cdot O\cdot CH(CH_3)\cdot O(C_2H_5) = H_2O + C_2H_4O_2 + C_4H_6$. XVII. Catalytic removal of water from vinyl ethyl ether, (23) $CH_2:CH\cdot OC_2H_5 = H_2O + C_4H_6$. XVIII. Catalytic removal of water from tetrahydrofuran,

(24) 

$$\mathrm{O}\left\langle\begin{matrix}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\right. = H_2O + C_4H_6.$$

XIX. Condensation of different alcohols with various aldehydes, accompanied by liberation of $2H_2O$, (25) $CH_3\cdot CHO + C_2H_5\cdot OH = 2H_2O + C_4H_6$. (26) $CH_3\cdot CHO + CH(CH_3)_2\cdot OH = 2H_2O + CH(CH_3):CH\cdot CH:CH_2$. XX. Condensation of ethyl alcohol with dihalogenated ethanes, (27) $CH_2Br\cdot CH_2Br + C_2H_5\cdot OH = 2HBr + H_2O + C_4H_6$, (28) $CH(CH_3)Br_2 + C_2H_5\cdot OH = 2HBr + H_2O + C_4H_6$. XXI. Condensation of ethyl alcohol with vinyl bromide, (29) $CH_2:CHBr + C_2H_5\cdot OH = H_2O + HBr + C_4H_6$. A detailed discussion is given of the practical applicability of the different processes for converting ethyl alcohol into erythrene, acetic acid, etc., and of the uses to which the by-products may be put.—T. H. P.

Alcohols and aldehydes; Condensation of —— *in presence of dehydrating agents* [*formation of erythrene*]. *Mechanism of the process.* I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1494—1506.

It has been shown already that, in the presence of catalytic dehydrating agents such as red phosphorus, glacial phosphoric acid, sulphanilic acid, barium chloride, and, especially, alumina in the form of "*argilla pura*," acetaldehyde or paraldehyde condenses with alcohol yielding erythrene, $CH_3\cdot CHO + C_2H_5\cdot OH = 2H_2O + CH_2:CH\cdot CH:CH_2$. It is now shown that in this reaction the following intermediate compounds are formed: α-hydroxyethyl ethyl ether, βδ-dihydroxybutane, δ-hydroxy-Δβ-butylene, and methylallene, the various stages being represented by the following equations:

$$CH_3\cdot CHO + C_2H_5\cdot OH \rightleftarrows HO\cdot CH(CH_3)\cdot OC_2H_5;$$

$$CH_3\cdot CHO + C_2H_5\cdot OH + HO\cdot CH(CH_3)\cdot OC_2H_5 = 2HO\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot OH;$$

$$HO\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot HO = H_2O + CH(CH_3):CH\cdot CH_2\cdot OH;$$

$CH(CH_3):CH\cdot CH_2\cdot OH = H_2O + CH(CH_3):C:CH_2$, and the latter $= CH_2:CH\cdot CH:CH_2$.—T. H. P.

Erythrene; Condensation of mixtures of acetaldehyde and alcohol to——. I. I. Ostromyslenski and S. S. Kelbasinski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1509—1528.

A CONSIDERABLE number of experiments have been made to determine the effects of the different factors influencing the yield of erythrene obtained when the vapours of acetaldehyde and alcohol are heated together in presence of alumina. Precipitated alumina gives the best results but its action is due partly to the presence of various impurities, such as basic ammonium and aluminium salts, sulphates, etc. The form and degree of fineness of the alumina are of little influence, but as the reaction proceeds throughout the whole mass, and not merely at the surface of the alumina, the latter must be sufficiently porous and hygroscopic; nothing would be gained by precipitating the alumina on pumice, asbestos wool, etc. The catalyst very soon exhibits "fatigue," which is due to the formation of resinous and carbonaceous reaction products and may be remedied by heating to redness and subsequently treating the snow-white alumina thus obtained with water at the ordinary temperature; alumina thus regenerated gives results identical with those furnished originally. The best temperature for the reaction is 360—460° C., the mixed vapours being heated rapidly to this temperature and the products of the reaction quickly removed from the region of high temperature. The nature and thickness of the material of the tube containing the alumina exert marked influence on the yield of erythrene, this being to some extent determined by the thermal conductivity. The length of the layer of alumina taking part in the reaction determines the velocity of the process. The diameter of the tube cannot be increased beyond a certain point, unless metal wires or gauze are introduced into the tube to render the temperature virtually uniform throughout. On an industrial scale, an apparatus comprising a system of tubes of relatively small diameter could be employed. Mixtures containing 1, 1·5, or 2 parts of alcohol to 1 part of acetaldehyde give approximately identical yields of erythrene, 100 parts by weight of such mixture giving up to 25 parts of crude product and 16—18 parts of pure erythrene. This result may be due partly to lowering of the partial pressures of the reacting substances by the excess of alcohol; it is, however, possible that some proportion of the excess of alcohol is converted into acetaldehyde and hydrogen, since the latter is actually found among the gaseous products; the preliminary formation of acetal according to the equation, $2C_2H_5.OH + CH_3.CHO = C_2H_5O.CH(CH_3).OC_2H_5 + H_2O$, is also possible, it having been shown that this acetal gives good yields of erythrene under the conditions employed. As the reaction, $C_2H_5.OH + CH_3.CHO = 2H_2O + CH_2{:}CH.CH{:}CH_2$, is accompanied by increase in the volume of vapour, it should be favoured by diminished pressure; this is actually found to be the case.—T. H. P.

Piperylene; New method of preparing——. I. I. Ostromyslenski and P. N. Rabinovitsch. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1507—1509.

IN presence of alumina at about 400° C., propyl or isopropyl alcohol condenses with acetaldehyde with formation of piperylene, thus,

$$CH(CH_3)_2.OH + CH_3.CHO = HO.CH(CH_3){\cdot}CH_2.CH(CH_3).OH = 2H_2O + CH(CH_3){:}CH.CH{:}CH_2;$$

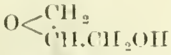
no trace of isoprene is formed. This method is recommended as the cheapest and simplest.
—T. H. P.

Oxidation of organic compounds; Certain conditions of—— by permanganate. A. G. Doroschevski and G. S. Pavlov. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1313—1326.

INVESTIGATIONS have been made on the coupled oxidation of organic compounds by permanganate and ferrous salt or other inductor (compare this J., 1915, 903, 1115). Both mannitol and glycerol are readily oxidised by permanganate in presence of a ferrous salt, increase of the proportion of the latter being accompanied by diminution of the induction factor; ferric salts appear to be without influence on the oxidation. Similar results are obtained with dextrose, lævulose, and sucrose. The induction factor in the case of lævulose is greater than with dextrose, and the ratio increases with increase in the quantities of the two sugars. Thus, lævulose is more easily oxidised than dextrose, and a solution of the mixed sugars having virtually no optical rotation (+0·04°) was found to be decidedly dextrorotatory (+0·26°) after the oxidation had proceeded for some time, in spite of the dilution which takes place. Preliminary hydrolysis facilitates the oxidation of sucrose, this fact being probably of importance in the animal organism, in which such hydrolysis always occurs; the oxidation of invert sugar represents the summation of the oxidations of dextrose and lævulose. Thus, not only the higher alcohols but also keto- and aldehydo-alcohols are capable of oxidation by permanganate in conjunction with a ferrous salt; in general, however, the introduction into the alcohol molecule of a new chemical function lowers its capacity for coupled oxidation, and conversion of an alcohol into the corresponding acid may result in complete loss of such capacity. The action of oxalic acid or stannous chloride as inductor was also investigated in certain cases of oxidation by permanganate. The presence of stannous chloride induces the oxidation of mannitol, glycerol, formic acid, etc., and, also to some extent, that of acetic and succinic acids, which are not oxidised in presence of ferrous sulphate. It is possible that, with each organic compound, there exists a most active inductor for any given oxidising agent. As regards the influence of manganous sulphate, it is known that in other cases this salt acts sometimes as a positive and sometimes as a negative catalyst. The latter function is clearly revealed in the oxidation of alcohols by permanganate and ferrous sulphate, this being either retarded or completely inhibited by the protecting action of manganous sulphate. This action appears to have a bearing on the character of the curves expressing the connection between the induction factor (as ordinates) and the quantity of acceptor in the instances mentioned above. The fact that these curves tend to become parallel to the axis of abscissæ may, indeed, depend largely on the fact that a continually diminishing amount of permanganate is used to oxidise the acceptor owing to the protecting influence of the manganous sulphate, which accumulates in the solution as the ferrous sulphate is oxidised. Further, when stannous chloride is employed as inductor, stannic chloride is found to exert a protecting influence. Thus, in so far as the reactions investigated by the authors are concerned, the secondary products exert a protecting action, the result being somewhat similar to the principle which states that change in the constitution of a system is accompanied by processes resisting further change. The protecting action of manganous salts may explain the fact that alcohols, sugars, formic acid, and many other compounds are easily and completely oxidised by permanganate in an alkaline medium but do not undergo oxidation in an acid medium, no manganous compounds being formed in solution in the former case.—T. H. P.

Glycerol α-monochlorhydrin; Mechanism of the action of trisodium phosphate on——. O. Bailly. Comptes rend., 1915, **161**, 677—680.

ACCORDING to King and Pyman (this J., 1914, 665), trisodium phosphate reacts directly with α-monochlorhydrin in cold aqueous solution to form sodium chloride and sodium α-glycerophosphate. An experimental study of the mechanism of this reaction has shown that it takes place in two phases: the substances first react to form sodium chloride, disodium phosphate, and glycide alcohol,



$$O<\begin{matrix}CH_2\\CH.CH_2OH,\end{matrix}$$

and then the two last-named interact to produce the α-glycerophosphate. The latter is mainly produced by this double reaction.—E. H. T.

Higher alcohols, water, and salts; Equilibria in the systems ——. G. B. Frankforter and S. Temple. J. Amer. Chem. Soc., 1915, **37**, 2697—2716. (See also this J., 1914, 711.)

INVESTIGATION of the seven systems: normal propyl alcohol, sodium carbonate, water; isopropyl alcohol, potassium carbonate, water; isopropyl alcohol, potassium fluoride, water; allyl alcohol, potassium fluoride, water; allyl alcohol, potassium carbonate, water; allyl alcohol, sodium carbonate, water; and allyl alcohol, sodium chloride, water, showed that potassium fluoride was the most satisfactory of the dehydrating agents employed, especially when the object was the determination of the water content of the alcohol. The end-point could be determined readily with widely varying composition of the solvent, the separation took place in two liquid phases only, and the salt combined with a large amount of water to form its lowest hydrate. Potassium carbonate worked satisfactorily with all the alcohols studied. Curves have been worked out for the determination of the water content of allyl alcohol and of isopropyl alcohol by the method described by Frankforter and Frary (this J., 1912, 894) for ethyl and normal propyl alcohols. The salting-out efficiency of a salt appears to be a function of its solubility in the water and in the alcohol, of the amount of water with which it combines to form its lowest hydrate, and of the power of the alcohol to replace the water of hydration.—W. P. S.

Alkyl phosphates; Simple and mixed ——. W. A. Drushel. Amer. J. Sci., 1915, **40**, 643—648.

SIMPLE alkyl phosphates were prepared by the action of phosphorus oxychloride on the corresponding dry sodium alkoxides in presence of ether. The trimethyl and triethyl esters boiled without decomposition under atmospheric pressure at 197° and 215° C., respectively, whilst the tripropyl and tri-isobutyl esters can be distilled *in vacuo* unchanged, contrary to statements in the literature. They boil at 131° and 152° C. respectively at 15 mm. pressure. At ordinary temperatures they are scarcely hydrolysed by $N/10$ hydrochloric acid, but barium hydroxide rapidly removes one alkyl group, and from the resulting dialkyl hydrogen phosphate mixed esters were prepared by the silver salt method. When these mixed esters were similarly hydrolysed with barium hydroxide, one of the different alkyl groups was not removed to the exclusion of the other, as stated by Lossen and Köhler (Ann. Chem.Pharm., 1891, **262**, 209) but esters of both types, $HRR'PO_4$ and HR_2PO_4 were present in the product, the first type, apparently, from the analytical results, largely in excess. Statements that the last two alkyl groups in the phosphoric esters could not be removed with barium hydroxide were shown to be erroneous, nevertheless hydrolysis took place with much greater difficulty than was the case with the first alkyl group removed.
—G. F. M.

Tincture of aconite; Comparison of the chemical and physiological assay methods for ——. C. C. Haskell and H. W. Zirkle. Amer. J. Pharm., 1915, **87**, 537—540.

FOUR samples of tincture of aconite from various sources showed little variation in composition when assayed by the U.S.P. method, but great variation in toxicity when tested upon guinea pigs and cats by the lethal dose method. The U.S.P. method is therefore considered of no value for determining the physiological value of tincture of aconite.—T. C.

Pepsin in gastric juice; Modification of Rose's method for the determination of ——. M. H. Givens. Amer. J. Pharm., 1915, **87**, 541—549.

A SERIOUS error is introduced in Rose's method of determining pepsin in gastric juice, by the previous neutralisation of the juice, as the temporary alkaline reaction at the point of contact of the added alkali is sufficient to inhibit or destroy the action of pepsin. The following modification is therefore proposed: 1 c.c. of a filtered 0·25% solution of pea globulin in 10% sodium chloride solution, followed by 1 c.c. of a 0·6% hydrochloric acid solution, is measured into each of seven small test tubes, which are then allowed to stand for about 5 minutes to develop the maximum turbidity. 0·9, 0·8, 0·7, 0·6, and 0·2 c.c. of distilled water is then added to the first five tubes respectively. 2 c.c. of the gastric juice previously strained through cheesecloth is diluted to 25 c.c., 0·1, 0·2, 0·3, 0·5, 0·8 and 1·0 c.c. of the diluted juice is rapidly added to the first six tubes respectively, and 1 c.c. of the boiled diluted juice is added to the seventh tube. The measurements in each case are made with an Ostwald pipette graduated in 0·01 c.c. All the tubes are then immersed for 15 minutes in a water-bath at 50°—52° C., and at the end of this period the tube is selected which is clear and which contains the least amount of gastric juice. The peptic activity is calculated as the number of c.c. of 0·25% globulin solution digested by 1 c.c. of undiluted gastric juice. If the free acidity of the gastric juice be high the latter is made more dilute, whilst greater accuracy is obtained by increasing the number of tubes, although seven is sufficient for ordinary purposes.—T. C.

Formic acid as a reagent in essential oil analysis. W. H. Simmons. Analyst, 1915, **40**, 491—494.

THE results obtained by boiling 2 vols. of 100% formic acid with 1 vol. of various essential oils or their alcoholic constituents for 1 hour, as also the corresponding acetylation values are tabulated, together with similar results obtained by using less formic acid and also 85% formic acid. These results show that terpineol is almost completely decomposed by formylation, geraniol and linalool yield appreciable quantities of esters, and santalol is only very partially decomposed, whilst citronellol, menthol, and the borneol in rosemary oil may be approximately estimated by formylation.—T. C.

Action of titanous chloride on phenylhydrazine, substituted phenylhydrazines, and p-nitrophenylhydrazones. Robinson. *See* III.

Manufacture of dyes, drugs, and chemicals in Japan. *See* IV.

Magnesium citrate in aqueous solution. Swart and Blomberg. *See* VII.

PATENTS.

Urea; Manufacture of ——. J. Y. Johnson, London. From Badische Anilin u. Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 24,012, Dec. 14, 1914.

THE formation of urea from ammonium carbamate

is accelerated by the addition of one or more catalysts, which may be neutral, acid, basic, or saline, *e.g.*, water (set free from ammonium carbonate), charcoal, sugar, gum, thio-urea, urea itself, oxides and salts of metals, particularly light metals (alkalis and alkaline-earths), and various acids, either free or in the form of ammonium salts. *Example.*—Ammonium carbamate (from solid carbon dioxide and liquid ammonia) is mixed with 10 % to 20 % of neutral ammonium carbonate and heated in a closed vessel to 135°—140° C. Urea is formed more quickly than from ammonium carbamate alone, and more completely than from ammonium carbonate alone. (See also Eng. Pat. 24,117 of 1914; this J., 1915, 924.)
—F. Sp.

Arseno-phosphorus derivatives; Preparation of ——. A. Mouneyrat, Paris. Eng. Pat. 9234, Feb. 25, 1915.

New arsenophosphorus compounds which are only slightly toxic and have marked spirillicidal and trypanosomicidal properties, are prepared by the action of phosphorus oxychloride on *p*-hydroxy-*m*-aminophenylarsinic acid in presence of an aqueous solution of caustic soda, and subsequent reduction of the product by sodium hydrosulphite. *Example.*—27 c.c. of phosphorus oxychloride is added to a cooled and well-stirred mixture of 23·3 grms. of *p*-hydroxy-*m*-aminophenylarsinic acid dissolved in 300 c.c. of water, 90 c.c. of caustic soda of 36° B. (sp.gr. 1·332), and 350 c.c. of 90 % alcohol. The liquor is neutralised with 18 c.c. of caustic soda of 36° B., poured into a mixture of 1800 c.c. of water, 100 grms. of magnesium chloride, and 500 grms. of sodium hydrosulphite, and then heated for four hours at 50° C. The precipitate which forms is filtered off and dried *in vacuo* over sulphuric acid. It is a yellow powder, soluble in dilute sodium carbonate and in hydrochloric acid. The alkaline solutions reduce Fehling's solution and Nessler's and Tollens' reagents. Compounds of different composition are obtained by varying the proportions of the original reagents.—F. Sp.

o-Sulphamidobenzoyl-p-phenetidine; Process for the production of ——. Chem. Fabr. vorm. Sandoz, Basle, Switzerland. Eng. Pat. 9511, June 29, 1915. Under Int. Conv., July 4, 1914.

A mixture of *p*-phenetidine with *o*-benzoic acid sulphimide, or with the ethyl or methyl ester of *o*-sulphamino-benzoic acid, is heated for some hours at 120° C. out of contact with air; it is then boiled with water, treated with sodium carbonate to slight alkalinity, and the resulting crystalline powder filtered, washed, and purified. The compound thus obtained is non-poisonous, has antipyretic and hypnotic effects on the animal organism, and is comparatively easily saponified by dilute alkalis but not by dilute acids.—B. V. S.

Nitrogenous, biologically useful substances from cod-liver oil; Process for obtaining ——. C. F. Boehringer und Soehne, Mannheim-Waldhof, Germany. Eng. Pat. 3075, Feb. 25, 1915. Under Int. Conv., Mar. 24, 1914.

Cod-liver oil is extracted with ligroin or dilute acidified alcohol, and the extract separated and hydrolysed by dilute acid; the hydrolysis may precede the extraction. The hydrolysed extract is purified by precipitation as phosphotungstate, washing with acetone, treatment with lead acetate, and evaporation of the aqueous solution *in vacuo*. The product is useful in diseases known as avitaminoses, produced by imperfect nutrition.
—B. V. S.

Lipoid blood-coagulating substance; Manufacture of a ——. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 11,215, Aug. 3, 1915.

A highly efficient blood-coagulant is obtained by evaporating at a low temperature most of the alcohol from an alcoholic blood extract, adding water to the residue, extracting the resulting emulsion with a chlorinated hydrocarbon, precipitating with acetone, extracting the precipitate with ether, and evaporating the ethereal extract *in vacuo*. *Example.*—40 litres of "magnesium blood" or "oxalate blood" and 120 litres of alcohol are boiled and stirred for 5 hours under a reflux condenser. The alcoholic extract is filtered at 70° C., the insoluble residue boiled again with 40 litres of alcohol for 5 hours, the mixture filtered at 70° C., and the residue pressed. Most of the alcohol is distilled off from the combined filtrates under high vacuum. 10 litres of water is added, and the distillation continued until 16—20 litres of emulsion remains. This is extracted for 10 minutes with 5 litres of chloroform and again with 3 litres of chloroform. Acetone is added to the combined extract, and the precipitate obtained is separated, washed with acetone, and extracted with ether. The ether extract is evaporated to dryness *in vacuo*. The product is a clear brown to yellowish-white lipoid substance, which keeps well and is a more active blood-coagulant than any substance hitherto known. It contains carbon, hydrogen, phosphorus, and traces of iron. It is very soluble in benzene and carbon tetrachloride, soluble in chloroform, ether, toluene, and carbon bisulphide, partly soluble in alcohol with a yellow colour, and insoluble in acetone.—F. Sp.

Papaverine and its derivatives; Process for preparation of condensation products of —— *with aldehydes or substances capable of producing aldehydes.* Soc. pour l'Ind. Chim. à Bâle. Fr. Pat. 475,654, July 25, 1914. Under Int. Conv., Aug. 6, 1913.

Dihydropapaverine and tetrahydropapaverine condense with aldehydes, with the formation of tetra-cyclic bases similar in constitution to some of the natural alkaloids. The substitution products of the hydropapaverines as well as the phenolic bases formed by saponification of one or more methoxy groups, behave similarly. In most cases it is preferable to use the acetal instead of the aldehyde and saponify it by a weak mineral acid. Details are given of the preparation of methylene- and ethylidene-tetrahydropapaverine, and of the hydrochloride of the amino-ethylidene-tetrahydro-compound.—B. V. S.

Acetylene; Process for accelerating and assisting the fixation of —— *in chemical reactions requiring the presence of a catalyst.* G. Boiteau. Fr. Pat. 475,853, Mar. 20, 1914.

If the catalyst is formed in the presence of the substance which is to combine with acetylene, the reaction takes place more quickly, more completely, and with less tendency to form tarry matters. For example, in the formation of ethylidene diacetate from acetic acid and acetylene the catalyst, mercury sulphate, instead of being added as such, is formed by first dissolving the oxide in the acetic acid and then adding the necessary quantity of sulphuric acid.—B. V. S.

Ethyl acetate; Preparation of —— *from acetaldehyde.* Consortium für Elektrochem. Ind. Ger. Pat. 286,812, Jan. 31, 1914. Addition to Ger. Pat. 277,111.

In the preparation of ethyl acetate from acetaldehyde by the action of aluminium alkyl oxide in presence of a halogen compound, preferably aluminium chloride (see Eng. Pat. 26,825 of 1913;

this J., 1914, 666), the aluminium chloride is added during the preparation of the alkyl oxide from aluminium and alcohol, and the resulting halogen-containing aluminium alkyl oxide is used in the form of a solution in ethyl acetate.—A. S.

Formaldehyde from methane ; Preparation of ——. Verein f. Chem. Ind. in Mainz, Frankfort, Germany. Ger. Pat. 286,731, Aug. 10, 1913.

A mixture of methane with a large excess of air or oxygen is heated to 150°—220° C. in presence of a metal or a metal couple. For example, a mixture of 3 parts of methane and 100 parts of moist air is passed over copper or silver, or both, at 150°—200° C. A portion of the methane is converted into formaldehyde ; this is removed by treating the gaseous mixture with water, and the residual gas, after addition of a further quantity of oxygen to make up for that consumed, is again passed over the heated metal.—A. S.

Nitrated aminobenzolarsinic acid ; Art of preparing ——. L. Ach, Mannheim, and A. Rothmann and H. Hatzig, Heidelberg, Assignors to Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. U.S. Pat. 1,163,496, Dec. 7, 1915. Date of appl., Dec. 30, 1913.

See Eng. Pat. 29,546 of 1913 ; this J., 1914, 806.

Cod-liver oil ; Art of preparing nitrogenous products from ——. C. Funk, New York, Assignor to C. F. Boehringer und Söhne, Mannheim-Waldhof, Germany. U.S. Pat. 1,162,907, Dec. 7, 1915. Date of appl., Apr. 8, 1915.

See Eng. Pat. 3075 of 1915 ; preceding.

Hydrogenation of unsaturated substances. R. Lessing, London. U.S. Pat. 1,162,623, Nov. 30, 1915. Date of appl., July 31, 1913.

See Eng. Pat. 18,998 of 1912 ; this J., 1913, 917.

Silver glycocholate ; Compound of —— readily soluble in water. K. Kautsch, Assignor to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,161,866, Nov. 30, 1915. Date of appl., Jan. 29, 1915.

See Ger. Pat. 284,998 of 1914 ; this J., 1915, 1166.

Utilising the halogen hydracids, previously crystallised by cooling, as source of iodine, chlorine, bromine, or fluorine, for the production of various organic and inorganic substances. Fr. Pat. 475,998. *See* VII.

Electrical process for the ageing of wines, beers, and spirits, [and rectification of perfumes]. Addition to Fr. Pat. 459,141. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Petroleum asphalt ; Sensitiveness of —— to light. P. Gödrich. Chem.-Zeit., 1915, 39, 832.

Residues from the distillation of crude Galician petroleum were dissolved in benzol, and the solutions (8 %) filtered from the carbon and poured over zinc plates, which, after evaporation of the solvent, were covered with a glass negative and exposed to light. It was found that certain residues, both brown and black, were sensitive to light, and when developed in Neustadt oil of turpentine gave distinct though not very permanent images. This sensitiveness to light was not found with pitches containing paraffin wax. These could be exposed to light for several hours without being altered. Soft and semi-solid residues also gave no image after exposure to light. By treatment with sulphur chloride, up to 12 % of sulphur could be introduced into the residues, but the products, unlike natural asphalts enriched with sulphur, had completely lost their sensitiveness to light by the treatment. (See also this J., 1915, 1273.)—C. A. M.

PATENTS.

Photographic processes, including a process of producing kinematographic photographs in colour. C. K. Mills, London. From Kinemacolor Co. of America, New York, U.S.A. Eng. Pat. 3666, Mar. 8, 1915.

Two negatives are taken, through a red and a green screen respectively ; in a cinematograph film the screens are used alternately. A positive taken from the "red" negative is toned in the usual way with an acid solution of ferric chloride and potassium ferricyanide ; a positive image of the "green" negative is then super-imposed in register, toned with a vanadium toning bath (vanadium chloride, potassium ferricyanide, and oxalic acid, 0·2 % of each) to a light yellow tone and then stained with a basic dye such as Rhodamine, Azine Red, Acridine Red, or Safranine, the image acting as mordant. The resulting colour is complementary to the blue-green colour of the ferrocyanide. The second positive may be printed on the same sensitive film as the first one if the developer is destroyed and the toning and washing operations carried out in darkness without fixation ; or the film, after fixing, etc., may be recoated for the second image. The blue-green tone of the first image is destroyed in the subsequent development but is restored in the vanadium-ferricyanide bath.—B. V. S.

Screen films of adjacent polychrome elements for colour photography, and their method of manufacture. L. Dufay. Second Addition, dated Mar. 20, 1914, to Fr. Pat. 442,881, June 30, 1911 (this J., 1912, 1008 ; see also this J., 1913, 451).

One side of the transparent film is marked in any desired pattern in relief. The hollows are filled in with a material of the colour of one of the elements of the screen and impermeable to the solvents to be used subsequently. The rest of the film is coloured with an alcoholic solution of the second colour element. A part of the surface is now protected with a coating of greasy matter in any desired design, and the film treated with an alcoholic solution of a third colour. The greasy matter is cleaned off and the whole film coated with protective varnish before applying the sensitive emulsion.—B. V. S.

Plastic materials [cinematograph films] : Non-inflammable ——. Comp. Gén. des Etablissements Pathé Frères. Fr. Pat. 475,351, Feb. 11, 1914.

Cinematograph films of cellulose acetate are made impermeable to water and atmospheric influences by adding to the solution from which they are made polymers of isoprene, or homologous or analogous substances of high boiling point, which are formed at a certain stage in the manufacture of synthetic rubber, and which are soluble in acetone or methyl acetate. Polymerisation of the hydrocarbons appears to continue after the film is made, and may be assisted by known methods. Other materials may be incorporated with the hydrocarbons in order to produce the desired plasticity, and the process may be applied to the manufacture of celluloid substitutes with a basis of nitrocellulose, cellulose formate, acetate, butyrate, benzoate, etc. —F. Sp.

Photographic prints in colours ; Process for obtaining. G. Schweitzer. Fr. Pat. 476,213, Apr. 9, 1914.

The process depends on the use of dyes which are destroyed by oxidising agents, which in their turn may be destroyed either by photo-chemical action or by the action of the metallic deposit of a silver or other similar print. Several examples are given of the application of the process. (1) A film coated with a layer of a light-sensitive oxidising agent such as manganese lactate or oxalate, is exposed under a negative and then placed in a suitable dye-solution; the film is coloured only in those parts where the oxidiser has been destroyed by the action of the light. (2) A negative, after conversion of the silver image to chromate and thorough washing, is dyed and then treated with a weak mineral acid; the regenerated chromic acid destroys the dye and a coloured positive results. (3) A coloured film sensitised with potassium ferrocyanide or potassium bichromate is exposed under a negative and then subjected in the former case to dilute gaseous ammonia, in the latter case to dilute gaseous hydrochloric acid; or after sensitising with manganese bichromate, exposing under a positive, and thorough washing, the film is treated with ½% hydrochloric or sulphuric acid. (4) A coloured silver positive is treated with an acid solution of potassium bichromate or permanganate; the silver is attacked in preference to the dye and a coloured positive results by stopping the action when the silver image has been dissolved. Carmine, Orchil, Bordeaux Red, Poirrier Orange, Tartrazine, Safranine, Curcumin, Quercetin, Aniline Green, China Green, Methylene Blue, Indigo Carmine, Indigo, Methyl Violet, and Gentian Violet are mentioned as suitable dyes. The method can be adapted for tricolour prints. —B. V. S.

Screen for colour photography and general photographic purposes. J. Rheinberg, London. U.S. Pat. 1,161,731, Nov. 23, 1915. Date of appl., Mar. 16, 1915.

See Eng. Pat. 9929 of 1914; this J., 1915, 637.

XXII. EXPLOSIVES; MATCHES.

Seventh report of Explosions in Coal Mines Committee. Effects of inhaling dusts applicable for stone-dusting in coal mines. Haldane. *See* XIXb.

Patents.

Smokeless powder; Process for transformation of collodion into ——. J. Delpech. Fr. Pat. 475,299, Feb. 4, 1914.

Collodion, formed by dissolving highly nitrated cellulose in an excess of solvent, is led into troughs arranged one above another in closed vessels, and the solvent is slowly distilled off. The distillation may be accelerated by passing through the apparatus a current of gas, preferably free from oxygen to avoid the formation of explosive mixtures. The gas is passed through condensers to recover the solvent, and led back to the distillation apparatus. The sheets of collodion finally obtained, which should contain 20% to 40% of solvent, are cut roughly to the required shape and compressed in suitable moulds.—F. Sp.

Process of "colloiding" carbohydrate esters [pyroxylin]. U.S. Pat. 1,161,063. *See* V.

XXIII.—ANALYSIS.

Dissociation constants of weak bases; Determination of the —— and their titration by the conductivity method. C. de Rohden. J. Chim. Phys., 1915, 13, 261—301.

A new method of determining the dissociation constants of weak bases by means of the hydrolysis of their salts is based upon conductivity measurements of dilute aqueous solutions of the base to which gradually increasing quantities of acid are added. A conductivity curve is thus obtained in which the sharp change in direction, exhibited in the case of a non-hydrolised salt, is smoothed out into a curved line in the neighbourhood of the neutralisation point. From this curve, by drawing a tangent at the point of origin, the asymptote, and a line parallel to this through the axis, the ratio $\frac{K}{K_b}$ is deduced from the lengths of the portions of the ordinates intercepted by these lines. (K = dissociation constant of water multiplied by its molecular concentration, and K_b = dissociation constant of the base.) Where the degree of hydrolysis exceeds 10% certain corrections have to be applied, which are discussed at considerable length in the paper.—G. F. M.

Action of titanous chloride on phenylhydrazine, substituted phenylhydrazines, and p-nitrophenylhydrazones. Robinson. *See* III.

Separation of hydrogen and methane. Catalysis of oxy-hydrogen mixtures. Activation of chlorate solutions by osmium. Hofmann and Schneider. *See* VII.

Preparation of invertase for the determination of sucrose. Davis. *See* XVII.

Simple method of determining sugar in bagasse. Van Dixhoorn. *See* XVII.

[Determination of fat in] feeds and feeding stuffs. Jones. *See* XIXa.

Determination of lead in phosphate and alum baking powders. Seeker and Clayton. *See* XIXa.

Determination of glycerol in meat juices and extracts. Cook. *See* XIXa.

Changes brought about in the chemical composition of potable waters by treatment with hypochlorite: detection of such treatment. Guillaumin and Vienne. *See* XIXb.

Equilibria in the systems, higher alcohols, water, salts. Frankforter and Temple. *See* XX.

Comparison of the results secured by the use of chemical and physiological assay methods for tincture of aconite. Haskell and Zirkle. *See* XX.

Analysis of medicated drinks. [Determination of salicylic acid, benzoic acid, saccharin, etc.] St. John. *See* XX.

Formic acid as a reagent in essential oil analysis. Simmons. *See* XX.

Modification of Rose's method for the determination of pepsin in gastric juice. Givens. *See* XX.

Trade Report.

Prohibited exports.

By virtue of an Order in Council dated Dec. 20th, 1915, the exportation of haematite pig iron and of iron and steel smelting scrap is prohibited to all destinations, and the exportation of sodium bichromate and of colchicum and its preparations is prohibited to all destinations abroad other than British Possessions and Protectorates.

France: Prohibited exports.

A French Presidential Decree, dated the 7th December, prohibits, as from the 14th December, the exportation and re-exportation (after warehousing, transit, transhipment, and under the "temporary admission" régime) from France of the articles enumerated in the subjoined list. In some cases the new prohibitions embrace general categories of articles, some of the goods belonging to which were already on the "prohibited" list (*e.g.*, the headings for "Vegetable alkaloids" and "Resins"). In virtue of a Decree of the French Minister of Finance, dated the 10th December, those goods marked with an asterisk in the subjoined list, covered by the prohibition established by the above-mentioned Presidential Decree, may be exported or re-exported from France, without special authorisation, when consigned to the United Kingdom, the British Dominions, Colonies, and Protectorates, Belgium, Japan, Montenegro, Russia, Serbia, or American countries:—*Accumulators and accumulator plates. *Acetylcellulose. Acetate or pyrolignite of lime, and medicinal acetates. *Other acetates. *Hydrobromic acid. *Stearic acid. *Tartaric acid. Potassium tartrate. *Other alkali tartrates. *Aconite (preparations and alkaloids). Vegetable alkaloids—Those specified in the Decrees of 21st December, 1914, and 4th February, 1915. *Other. Aluminium, pure or alloyed, in all forms and oxides—*Manufactures of aluminium and oxides. Other. *Alums. *Antifriction metal. *Belladonna and its preparations and alkaloids. *Bichromate of soda. *Cantharides and preparations thereof. *Rubber, manufactures of. Rubber, vulcanised sheets of. *Carob beans. *Cellulose. *Ceresine. *Tallow candles. Chloramide and preparations with a chloral basis. Chlorine, liquefied. *Chlorides of tin, of magnesium, of zinc. *Chromium in all forms. *Cement. *Cobalt in all forms. *Coca and its preparations. *Copper, pure or alloyed, in all forms. Cyanides, ferricyanides, and ferrocyanides of potassium and of sodium. *Electrodes, electric batteries and their elements. *Manures, chemical. *Ergot of rye. *Tin, pure or alloyed, in all forms. *Eucaine (hydrochlor.). Gases, asphyxiating—products for the manufacture of. *Gentian and its preparations. Gums of all kinds—Gum-lac. *Other. Tar, vegetable, and vegetable tar oil—*Wood tar and wood tar oil. Other. *Indigo, natural. *Ipecacuanha root. *Henbane and its preparations. *Manganese (metal) in all forms. *Residue (*marc*) of olives. Lubricating materials—With basis of mineral oil. *Other. *Slow matches. Medicaments—Those specifically prohibited to be exported. *Others. *Mercury (compounds and preparations of). Molybdenum (metal and ore). *Molybdenum (salts of). *Mica, worked. *Novocaine. *Nickel, pure or alloyed, in all forms. *Nux vomica and its alkaloids or preparations. *Articles for dressing wounds. *Paraldehyde. *Peptone. Peroxides, metallic—Sodium peroxide. *Other. Platinum (metal, ore, and salts). Chemical products for pharmaceutical use—Those specifically prohibited to be exported. *Other. *Protargol. Resins—Pine and fir resins. *Other. *Saccharin and products related thereto. *Sodium salicylate. Methyl salicylate. *Salvarsan and neo-salvarsan (hydrochlorate of dioxydiaminoarsenobenzol). *Santonin and its preparations. *Soap. *Salts of copper, chromium, tin, and mercury. *Selenium. *Serums. *Silicon. *Sodium hyposulphite. *Sulphate of soda. *Sulphate of zinc. Tartar. Dyes derived from coal tar. *Thymol and its preparations. Titanium (metal and ore). Titanium (salts). *Peat. *Trional. Oilcakes and other products used for cattle feeding. Tungsten ore (wolfram). *Tungsten (metal) in all forms. *Urea and its compounds. *Urotropin (hexamethylenetetramine) and its preparations. *Vaccines. Vanadium (metal and ore). *Vanadium salts. *Veronal (diethylbarbituric acid) and veronal sodium. Zinc (metal, pure or alloyed) in all forms—*Zinc, manufactures of. Other.

Switzerland: Prohibited exports.

A Decree of the Swiss Federal Council, dated the 11th December, prohibits the exportation of the following articles from Switzerland, as from the same date:—Chrome oxide and hydrated chrome oxide, even in aqueous paste; residues of chrome from the manufacture of chemical products; colouring materials and colours ground in oil or merely mixed with oil; hydrosulphite, hydrosulphite-formaldehyde of soda; paper-making materials, fibrous (wood-pulp, wood sawdust, cellulose, etc.); paper for printing newspapers (containing wood) of only one colour, weighing from 45 to 55 grammes per square metre; packing papers of all kinds, including pasteboards weighing up to 400 grammes inclusive per square metre, corrugated paper, tarred paper, "patent packing," etc.; pasteboard, grey; straw and wood pasteboard, leather-board, etc.; roofing cardboard (asphalted or bituminous cardboard); silver nitrate (lunar caustic), fused in bars, in crystals, or put up in the shape of pencils.

Contraband of war. Declaration by Austria-Hungary.

The "London Gazette" of 21st December notifies that lists of absolute and conditional contraband of war were communicated by the Austro-Hungarian Government to the United States Embassy in Vienna on the 12th November. The lists contained the following:—

Absolute contraband.—Gunpowder and explosives of all kinds. Ingredients of explosives, viz., nitric acid, sulphuric acid, glycerin, acetone, calcium acetate, sulphur, potassium nitrate, the fractions of the distillation products of coal tar between benzol and cresol inclusive, methylaniline, ammonium perchlorate, sodium perchlorate, sodium chlorate, barium chlorate, ammonium nitrate, cyanamide, potassium chlorate, calcium nitrate, mercury; toluol and the compounds of toluol extracted from tar, petroleum, or in any other manner. Ammonia and its simple and compound salts; liquid ammonia, carbamide, aniline and its compounds. Ferro alloys, including ferro-tungsten, ferro-molybdenum, ferro-manganese, ferro-vanadium, ferro-chrome. The following metals: tungsten, molybdenum, vanadium, nickel, selenium, cobalt, hæmatite pig-iron, manganese. The following ores: wolframite, scheelite, molybdenite, nickel ore, chrome ore, hæmatite iron ore, manganese ore, zinc ore, lead ore, bauxite, cryolite. Aluminium, alumina and salts of aluminium. Antimony, together with its sulphides and oxides. Copper, unwrought and part wrought, copper wire. Lead, pig, sheet, or pipe. Iron pyrites. Tin, chloride of tin, tin ore. Copper iodide. Rubber of all kinds and goods made of rubber. Resinous products, camphor, and turpentine. Mineral oils, raw and refined, and other fuel used for engines. Castor oil. Paraffin wax. Lubricants. Coal and coke.

Conditional contraband.—Foodstuffs. Forage and feeding stuffs for animals of all kinds. Gold and silver, in coin or bullion; paper money. Fuel, other than coal, coke, and mineral oils. Linseed oil. Tanning material of all kinds, including the extracts used in tanning.

Books Received.

Historical Introduction to Chemistry. By T. M. Lowry, F.R.S. Macmillan and Co., Ltd., London. xv.+581 pages. 7½ × 5 in. Price 8s. 6d.

Of the making of books, which are, in some measure, historical introductions to chemistry, there would seem to be no end. The chemical treatises and manuals published in the first half of the nineteenth century are rich in historical notes, and the student of to-day is indebted to the writers of that time for much valuable historical information.

Of late years chemical history is less popular than formerly. Few chemists, particularly industrial chemists, have leisure to spend in historical study, and they are apt to confine themselves to established facts and modern theories. Possibly the study of history might help them—even with modern problems—but its advantages are not obvious, and life is short.

Dr. Lowry's very carefully arranged "Historical Introduction to Chemistry" should appeal to the busy chemist of to-day who feels at all interested in the story of his science. The book does not pretend to be a formal history, neither does it aim at giving biographical details concerning the chemists of other days. The classification is of subjects rather than authors; for example Chapter I. deals with "Raw materials and primitive manufactures" and Chapter II. with "The acids," while other chapters have such headings as "The study of gases," "The decomposition of the alkalies," "Molecular architecture," etc. A valuable feature in the book is the reproduction of illustrations of apparatus used by some of the early workers, and no less valuable are the details of classical experiments. As a prominent example we may refer to pp. 390–1, on which reference is made to the method of analysis of organic substances, worked out by Gay-Lussac and Thénard in 1810. An illustration of the apparatus used is given in Fig. 49 (p. 391), with an enlarged section of the ice-cup for keeping cool the metal connection, and the process is thus described:—"The substance was mixed with a known weight of potassium chlorate, made into pellets and burnt by dropping into a hot tube (Fig. 49). The gases produced by burning the pellets (oxygen, carbonic anhydride, and nitrogen, if present), were collected and analysed. From the volume of carbonic anhydride the weight of *carbon* in the substance could be calculated; a similar calculation gave the weight of *nitrogen*. Blank experiments showed what volume of oxygen was set free by igniting the chlorate alone. In several cases the deficiency of oxygen was exactly equal to that due to the formation of carbonic anhydride; any part of the weight of the substance not accounted for after adding together the carbon and nitrogen, together with other easily recognised elements, such as chlorine, phosphorus and the metals, was regarded as *water*. A greater or less deficiency of oxygen indicated the presence of an excess of *hydrogen* or *oxygen*, above the proportions required to produce water." Such was the early method of Gay-Lussac and Thénard: and there are many chemists to-day who have scarcely heard of it. Eighty years ago, however, a manual of chemistry (Brande, 1836) told the student all about it, and pointed out the objections to the use of potassium chlorate, and also explained how Gay-Lussac had improved and simplified the process by substituting copper oxide. The subject was also treated at some length in Dr. Henry's "Elements of Experimental Chemistry" (1826), vol. II., ch. X. This fact might be used as an illustration of the opening remarks of this review.

Dr. Lowry gives copious references to the sources of the information contained in his work, and closes each chapter with a useful "Summary and Supplement." He appears to have made a careful study of his subject, and a judicious selection from the wealth of material which he had at hand. To most workers in chemistry the book will be useful and interesting, and to the few who rank themselves as students of chemical history, it may be a very useful index and guide. To these latter the "Biographical Index"—which might with advantage have been extended—will be specially attractive. E. V. E.

National Physical Laboratory. Collected Researches. Vol. XII. 1915. Harrison and Sons, St. Martin's Lane, London, W.C. 173 pages, 12 × 9⅝ in. Price 12s.

This volume contains eleven papers by different members of the staff, which have been reprinted from the Journals of learned Societies. It includes papers on "The estimation of high temperatures by the method of colour identity," by C. C. Paterson and B. P. Dudding (this J., 1915, 819); "A new reagent for etching mild steel," by W. Rosenhain and J. L. Haughton (this J., 1914, 551); and "Note on a specimen of ancient iron from Ceylon," by W. Rosenhain.

Peat, Lignite, and Coal. By B. F. Haanel. Canada Department of Mines, Mines Branch, Report No. 299. xvi. + 261 pages, 9¾ × 5½ in.*

This report deals chiefly with the value of peat, lignite, and coal as fuels for the production of power in the by-product recovery producer. The author describes a number of European plants where peat is in use for the production of power, with by-product recovery, and other by-product recovery plants using coal. The economic aspects of the subject are fully considered, and the author expresses the opinion that by-product recovery producer-gas plant can be profitably worked to produce power or fuel gas—and in some cases to manufacture ammonium sulphate alone—at certain of the Canadian peat bogs, and in the Western Provinces at certain of the lignite deposits. The process could also be profitably applied to the Canadian bituminous coals, provided that the gas could be disposed of.

Investigation of the Peat Bogs and Peat Industry of Canada, 1911—1912. By A. v. Anrep. Canada Department of Mines, Mines Branch, Report No. 266. 47 pages, 9¾ × 5½ in.*

This report contains a detailed description of nine peat bogs in the Province of Quebec, and a preliminary report on some bogs in Ontario. Eleven maps and 35 photographs and drawings are included.

Year-Book of Pharmacy and Transactions of the British Pharmaceutical Conference. 1915. J. and A. Churchill, 7, Great Marlborough Street, London. 480 pages. 8½ × 5½ in. Price 10s.

This volume contains abstracts of papers relating to pharmacy, materia medica, and chemistry contributed to British and foreign journals from July 1, 1914, to June 30, 1915, and also the Transactions of the British Pharmaceutical Conference held in London on July 14, 1915. The abstracts are edited by J. O. Braithwaite and the Transactions by R. R. Bennett, whilst T. Stephenson is responsible for the section on new remedies.

Gypsum in Canada. By L. H. Cole. Canada Dept. of Mines, Mines Branch, Report No. 245. x. + 206 pages, 9¾ × 5½ in.*

This report contains a full account of the occurrence, exploitation, and technology of gypsum, and is illustrated by 57 plates and drawings and 6 maps.

Notes on the Clay Deposits near McMurray, Alberta. By S. C. Ells. Canada Dept. of Mines, Mines Branch. Report No. 336. 15 pages, 9¾ × 5½ in.*

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* Any of the reports of the Canada Government Departments for which no prices are mentioned, can be obtained free by application to the Department concerned at Ottawa

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Official Notice.

DISPOSAL OF NITRE CAKE.

A notice appeared in the Journal of November 30th last, p. 1121, giving suggestions for the disposal and utilisation of nitre cake which had been laid before the Special Joint Committee of the Chemical Society and Society of Chemical Industry. Since that date two suggestions have been received as follows:—

Dr. C. Budde, Hendon Paper Works, Sunderland. Use of nitre cake instead of sulphuric acid in treating paper makers' black liquor for recovery of carbon dioxide, acetic acid, furfural, and ammonia, with eventual reduction of sulphate to sulphide.

Jas. W. Fielden, 7, High Street, Middleton, Lancashire. Use of solution of nitre cake to replace sulphuric acid in the souring stages in bleaching textiles, or in certain dyeing operations with acid dyes.

See also page 109 of this issue of the Journal.

Canadian Section.

Meeting held at Toronto, on Friday, December 10th, 1915.

PROF. J. W. BAIN IN THE CHAIR.

A RAPID METHOD OF CONVERTING SCRAP PLATINUM INTO CHLOROPLATINIC ACID.

BY J. BISHOP TINGLE AND ALFRED TINGLE.

The conversion of scrap platinum into chloroplatinic acid, by dissolving it in *aqua regia*, even when the metal is clipped into quite small fragments, is a long process and wastes a disproportionate amount of acid.

By alloying the platinum with a suitable base metal, the time necessary for converting it into chloroplatinic acid can be shortened, so that a preparation normally occupying several days can be completed in three hours. We prefer to use zinc as base metal, since it fuses and alloys readily, and is more easily separated from platinum in the later stages of the operation than are most other metals.

The scrap platinum is fused with fifteen times its weight of zinc under a layer of borax or other flux to prevent oxidation of the zinc. The mass is kept fused for about ten minutes; the temperature is then raised till the zinc begins to boil and its vapour to burn above the layer of flux. When small quantities are being treated this operation may be carried out in an old porcelain crucible over a Bunsen burner.

The crucible is then cooled, the flux roughly separated, and the metallic mass dropped into dilute commercial hydrochloric acid. The zinc dissolves very rapidly, leaving a finely divided black powder which can be washed sufficiently by decantation. This powder has much the appearance of platinum black, but generally contains zinc. On treatment with a little *aqua regia* it dissolves almost instantly. The resulting solution, which contains a little zinc, is evaporated to dryness and then redissolved in warm, very dilute hydrochloric acid.

The solution may then be treated with pure zinc, preferably in the form of sheet or rod, the precipitate of platinum washed with pure dilute hydrochloric acid until the washings are free from zinc (as shown by the ammonium sulphide test), and the residue dissolved in *aqua regia* as described below; or hydrogen sulphide may be passed into the warm solution of platinum chloride, precipitating platinum sulphide. This sulphide is filtered, washed, and ignited on the filter.

The metallic platinum is re-dissolved in *aqua regia* (solution taking place very rapidly), the solution evaporated almost to dryness, the residue dissolved in hydrochloric acid, and the solution evaporated; the residue is dissolved in water and the solution of chloroplatinic acid is filtered and brought to the strength desired.

Instead of precipitating the platinum by hydrogen sulphide, ammonium chloride may be employed. This obviates the necessity of evaporating to expel nitric acid, but we find that hydrogen sulphide gives more complete precipitation when niceties of manipulation are not being observed.

THE DETECTION OF NITRATES IN THE PRESENCE OF ORGANIC MATTER.

BY ALFRED TINGLE.

When the present author proposed (this Journal, 1915, **34**, 393) the use of sulphonated salicylic acid as a qualitative test for nitrates, he was not aware that Paride Torti (Boll. Chim. Farm., 1914, **53**, 400) had suggested the use of nitric acid as a test for salicylates. The characteristic colour change which takes place when nitrosalicylic acid is neutralised by an alkali is employed by both authors as a part of their tests. It occurred to Torti only, however, to extract the nitrosalicylic acid from the reaction products by the use of ether, and to him also belongs the sole credit of pointing out that when this ethereal solution is shaken with a 1% aqueous solution of ferric chloride, the latter assumes a blood-red colour.

Torti's observations suggested to the author that his own test for nitrates might be so extended as to apply to organic nitrates or nitrates mixed with organic matter. Experiment has confirmed this suggestion. As originally described (*loc. cit.*) the test could be used only for inorganic mixtures. A reagent for nitrates which is moderately sensitive, easily applied, and equally applicable in the presence or absence of organic matter, is likely to be useful.

The method of applying this test now proposed, elaborated in accordance with Torti's suggestive remarks, may be best gathered from the two examples which follow. The reagent consists of 3 grms. of salicylic acid dissolved in 100 c.c. of concentrated sulphuric acid. The exact proportions of this solution may be varied widely without affecting the result. Formerly the author used 2 grms. of salicylic acid in 30 c.c. of sulphuric acid.

A blank test showed that this reagent, after being warmed, contains no unchanged (*i.e.*, unsulphonated) salicylic acid. When, in the absence of nitrates, an ethereal extract is made, the extract gives no colour with ferric chloride solution. Consequently it is not necessary to avoid the use of an excess of the reagent when it is desired to confirm the colour reaction given by alkalis, and to obtain also that given by ferric chloride with nitrosalicylic acid.

A 0·1 % solution of potassium nitrate was saturated with cane sugar at the temperature of the laboratory. To 2 c.c. of the resulting syrup an equal volume of the reagent was added. The mixture was gently warmed till it evolved copious sulphurous fumes, the charred mass was boiled with 10 c.c. of water, and the resulting solution was poured off, cooled, and extracted with its own volume of ether. One half of the ethereal extract was shaken with a little aqueous ammonia, which at once assumed the expected orange colour. The other half was shaken with 2 c.c. of a 1 % aqueous solution of ferric chloride: the aqueous layer slowly became red, as described by Torti.

The same quantity of this same solution of potassium nitrate and sugar, when tested with sulphuric acid and copper turnings according to the familiar method, gave no indication that any nitrate was present.

In another experiment, a strip of ordinary photographic film, measuring 8 mm. × 100 mm., was clipped into fragments and placed in a test tube, 5 c.c. of the reagent was added, and the tube was cautiously warmed to start the reaction, which then proceeded with violence; heat was again applied, and the acid solution was thoroughly boiled. When cool it was poured into 25 c.c. of water, and the black solution extracted with its own volume of ether, to which a little alcohol was added to break up any emulsion. The ethereal extract so obtained gave quite distinct colour reactions with ferric chloride and with ammonia, as described above, thus indicating that the film contained a cellulose nitrate.

Edinburgh Section.

Meeting held at Edinburgh, on Wednesday, December 15th, 1915.

PROF. JAMES WALKER IN THE CHAIR.

SOME CAUSES OF DAMAGE IN THE BLEACHING OF LINEN AND COTTON TEXTILES.

BY J. F. BRIGGS.

The examination of bleached linen and cotton textiles for the purpose of tracing the origin of damages resulting from improper treatment at the hands of the bleacher, comprises relatively few and simple qualitative tests, but requires a fairly intimate knowledge of the technology of the bleaching process and the general properties of cellulose. To enumerate all the various causes of damage which have occurred in one's experience would not be to the point and an attempt must be made at some sort of classification.

The first thing to be noted is whether the damage to the fabric is purely local or more or less general, and this is an important factor in arriving at deductions as to its probable cause; next, whether the cloth has been laundried or otherwise operated on by the customer since leaving the bleach works, as this may in many cases shift the responsibility from the shoulders of the bleacher. Damage to the fabric may either be purely mechanical or of chemical origin. Mechanical damages produced in the bleach works rarely come up for report by the analyst, presumably because they are readily recognised in the overlooking of the cloth before it leaves the works. The only mechanical damage of this order, which has to be differentiated from a chemical damage, is the picking of small holes in the fabric by some jagged portion of the bleach works machinery. The mechanical origin of such holes is established by the fact that the cut threads are otherwise intact and their ends, though slightly frayed, can be smoothed out so as to reconstitute to some extent the original cloth. The frayed threads are perfectly strong and the usual chemical tests give negative results. Cases of alleged chemical damage may occasionally be traced to mechanical causes entirely beyond the control of the bleacher. For instance, the yarns of the warp and weft may not be suitably adapted to one another, as when, for the sake of cheapness, a very loosely spun weft is combined with a warp containing stripes of hard-twisted 2-ply yarn. Under the friction of use the hard warp may disintegrate the loosely twisted weft, and the unexpectedly short life of the latter may be wrongly attributed to the yarn-bleacher.

Damage due to chemical causes may be either evident or latent. Undoubtedly what I have called latent chemical damage is nothing but an extremely mild form of the more obvious type, but not readily recognisable as tendering by the crude means at our disposal for determining the tensile strength of textiles. The direct loss of strength in such cases is within the range of error, but the cellulose has been chemically strained and is sensitive to the attack of alkalis, suffering abnormal losses of strength and weight in subsequent laundry treatments and coming to a premature end. Nevertheless, not every cloth which breaks down after a few visits to the laundry is debitable to the bleacher: in fact great caution must be exercised in laying the blame on the bleacher, without some direct proof, if the cloth has been laundried or otherwise treated. The modern laundry freely uses the same chemicals as the bleacher and is generally far less instructed in their proper use.

Damages due to chemical causes may be classified according to the three main operations of the bleaching process, *i.e.*, boiling, liquoring, and souring.

(1) *Boiling.* Chemical damage produced in the boiler is never latent, so far as we know. Any degree of overboiling, within the range of practical conditions, is accompanied by a corresponding loss of weight and the remaining fibre apparently retains its normal strength for its weight. A distinction must be drawn between losses of weight by the removal of matters extraneous to the cellulose, and those produced by hydrolysis of the fibre cellulose itself. The latter losses are small during the early stages of purification, but their effects are cumulative and more marked when the cellulose approaches purity.

Accidental damages produced in the boiling are of the local type and fairly obvious. The commonest is caused by exposure of a portion of the goods above the surface of the boiling liquid. This type is supposed to be produced mainly or solely in the lime boil, but it may occur equally in the alkali boils. Bleachers are thoroughly alive to the danger, and avoid it by placing weights on the top of the cloth packed in the kier, but are sometimes tempted to put in too much cloth for the amount of lye in the charge. This type of damage is characterised by a total absence of specific chemical reactions, and its diagnosis depends largely on negative evidence. Nevertheless the nature and extent of the tendering leave little room for doubt. Kier damage occurs in the form of patches, several inches across, of tender but not absolutely disintegrated cloth, merging gradually into sound strong material. I have no satisfactory explanation of the chemical process of this kind of tendering. By some it is attributed to the concentrated action of the boiling alkali through the drying up of the exposed portions; by others to the oxidising action of the air in the steam; there is, however, no evidence ot the formation of oxycellulose.

Another type of tendering in the kier is caused by the crystallisation of calcium carbonate in the fibre, a mechanical damage due to chemical causes. The cellulose shows no chemical alteration but the microscopic structure is profoundly affected. When a deposit of lime is formed locally in the cloth, *e.g.*, by the drying of exposed portions in the lime boiler, calcium carbonate may be formed inside the fibre in contact with the sodium carbonate of the alkali boil. Cloth showing such lime stains may be quite tender; the linen fibres when examined microscopically will then show a very large number of "kinks" or bursts, resembling somewhat the "nodes" of bamboo. Another type of damage which becomes evident in the boiling process, although not caused by it, is occasionally found in the case of fabrics woven from "creamed" linen yarns which have suffered from "overliquoring" at the hands of the yarn bleacher. In the process of "creaming," the yarn bleacher aims at removing only a portion of the cementing matters or "gum" from the fibres by a relatively light boil, then "creaming" the yarn with a strong dose of bleach liquor. It is possible thus to do a considerable amount of chemical damage without it becoming apparent, owing to the support afforded by the residual gums. But when these gums are entirely eliminated by boiling the woven fabric previous to bleaching the cloth, their support is withdrawn and the fibre may break down. Such a trouble due to faulty yarn would hardly ever happen simultaneously in both warp and weft, and the localisation of the tendering in one direction or the other is an indication of the cause of the damage.

(2) *Damages by bleach liquor.* This is the most frequent source of tendering encountered in the bleach works. It may be general, widely localised, or confined to small patches or lines. The qualitative tests available for the detection of oxycellulose in these cases are: (1) visible reduction on boiling with Fehling's solution diluted with an equal volume of water; (2) formation of a golden-yellow extract on boiling with 5% caustic soda, the liquid subsequently turning brownish-yellow; (3) increased affinity for basic dyestuffs, *e.g.*, Methylene Blue. Of these the first two may be made quantitative (1) by determining the amount of reduced cuprous oxide; (2) by determining the loss of weight on boiling with caustic soda under standard conditions. Neither of these tests serves to differentiate oxycellulose formed by overbleaching from hydrocellulose produced by the action of acids. The Methylene Blue test is more specific but often fails in mild cases of overbleaching, through lack of sensitiveness. In cases where the overbleaching is general the Methylene Blue test is often inapplicable for want of a contrast for comparison.

The above tests, although extremely useful, all require some care in their interpretation. For instance, they can only be applied directly to fully purified cellulose; the non-cellulose residues of the fibres after treatment with bleach liquor respond to the tests very much in the same way as oxycellulose. In fact the effective process of hypochlorite bleaching is not, or at any rate should not be, the whitening of colouring matters, but consists in converting the non-cellulose matters into oxidised forms comparable with oxycellulose in that they are characterised by free carbonyl groups. The whitening effect of the bleach liquor is for the major part merely incidental and is only really necessary for say the last 10% of the total work of oxidation. The true function of the hypochlorite is to prepare derivatives which are soluble in boiling alkali, and it is the alkali which in effect performs the real work of purification. Thus we may have both in linen and cotton goods, particularly the latter, samples which show the oxycellulose reactions but which are quite undamaged by overbleaching; such goods might be described as fully bleached but not fully purified. Another consideration also limits the validity of the oxycellulose tests, namely that if the fabric has suffered chemical damage through overliquoring in an early stage of the bleaching process, the aldehydic groups on which the evidence depends may have been eliminated in the later stages. This elimination, however, is not necessarily complete, and in suggesting whether the fault is of remote or recent origin, the analyst should base his opinion on the relation between the intensity of the reactions and the degree of tenderness of the fabric.

The trouble of general tendering through overliquoring is usually due to a miscalculation of the relative activities of the earlier and later bleach liquors. Owing to the "protective" action of the non-cellulose matters it is not only permissible, but even desirable, to employ a comparatively active liquor in the first "chemick" while the goods are still "greedy"; tendering of the cellulose at this stage is seldom to be feared. On the other hand, if the goods are too carefully nursed in the early stages they are apt to show residues of "sprit" at the later stages when the fibre is mainly clear and denuded of protective impurities. This may induce the bleacher to strengthen up his later liquors, with some danger of general tendering of the cloth. The activity of a bleach liquor depends not only on its chlorine strength and temperature but also on its acidity. For this reason the bleacher does not use a freshly prepared liquor but depends for satisfactory results on old liquors made up to strength by the addition of a strong stock solution. By systematic working, a sort of automatic control of acidity is thus established, with calcium bicarbonate in solution in presence of excess of calcium carbonate as a sediment. A ripe hypochlorite liquor is acid to phenolphthalein and basic to methyl orange; in this condition it tends to form not only oxidised but also chlorinated derivatives with the unsaturated impurities, which are very readily disintegrated and dissolved by boiling alkalis. The specific effect of such active liquors in conjunction with alkali scalds is very valuable for breaking down and eliminating impurities, but in the final "chemick" where the object is to clear up the colour of a purified cellulose, it is safer and more satisfactory to employ a more basic bath prepared with fresh bleach liquor.

Local damages due to bleach liquor sometimes occur in small patches through accidental splashes of strong liquor; these are very easily diagnosed by the oxycellulose reactions, particularly the Methylene Blue test. Similarly, local patches of larger size may be produced by the floating of the cloth on the surface of the steeps owing to enclosure of air. The projections form centres of concentration of hypochlorite by evaporation and of acidification by the carbon dioxide in the air. Lastly, we have the sharply localised tendering effect caused by the action of metallic impurities through contamination by dirty lubricating oils; the formation of oxycellulose due to their action on hypochlorite liquor has been frequently described in this Journal (White, 1903, 132; Higgins, 1911, 188, 1296; Briggs, 1911, 397). In such cases the oxycellulose can be clearly characterised by the reduction of Fehling's solution and the Methylene Blue dyeing test. If the cloth has been finished out of bleach liquor, copper oxide can generally be detected directly, but if it has received a final sour, copper can only be detected after treatment with chlorine. Black grains of metal can generally be observed embedded among the fibres on microscopical examination.

I have also encountered in practice a damage of similar origin in the sodium peroxide bleaching process, in which the goods are treated for about an hour in a weak solution of sodium peroxide at 75°–80° C. In this instance the destruction of the cellulose is so profound that in the great majority of cases there is no residue either of oxycellulose or of metallic contamination left to afford evidence of the cause of damage. The trouble appears in the form of holes cut cleanly out from the sound normal cloth; only rarely is a narrow fringe of oxycellulose discernible on the extreme edge of the hole and still more rarely can a minute trace of copper be detected. The damage, however, is very easily reproduced by digesting strips of cloth in sodium peroxide after spotting with various metallic preparations. I have obtained complete destruction of the cellulose by spots of dirty lubricating oil, brass filings suspended in clean oil, aqueous solution of copper sulphate, ferric chloride and ink spots.

Damage by acids. Practically the only source of acid damage is imperfect washing out of the final sour. If a trace of free acid be left in the goods after washing, it becomes concentrated during the process of drying on the heated cylinders and causes tendering, more or less serious, according to the severity of the conditions. A degree of acidity which is sufficient to cause appreciable damage during the drying out of the goods is distinctly discernible before drying by a weak solution of methyl orange, and every batch of goods should be so tested before passing to the finishing department. As the souring is the last chemical process, tendered samples which come up for examination under this heading will generally still show the presence of free acid. On the other hand, if the cloth has been laundried before the damage was observed it is more difficult to locate the fault with certainty. Hydrocellulose produced by the action of acids shows the same reactions with Fehling's solution and boiling caustic soda as oxycellulose produced by overliquoring, but it does not show the Methylene Blue test. The value of this negative distinction, however, is limited to cases of local tendering, since the dyeing test is not available in cases of general tendering.

Damage by acid may be of the so-called "latent" type, *i.e.*, the tendering may be so slight that it is overlooked in the inspection of the finished cloth, and only becomes apparent after one or two alkaline treatments in the laundry.

Under specially severe conditions of dry heating, a degree of acidity insufficient to be detected by Methyl Orange may cause tendering of the cloth. For a discussion of this point a recent paper by Lester (this J., 1915, 931) may be consulted. It is generally conceded that litmus tincture is not a very suitable indicator for use in this connection. Personally I have found the potassium iodide-iodate and starch reagent very useful. This is made up with distilled water and adjusted for neutrality by the addition of a drop or two of $N/10$ acid until the liquid shows a slight blue colour; it is then boiled until it again becomes permanently colourless. The indications of this test have a roughly quantitative significance, depending on the time required to develop a bluish stain. This appears at once in presence of an objectionable amount of free acid; if no signs of a stain are visible within 5 mins. the cloth may be regarded as safely neutral.

Lester (*loc. cit.*) points out that hot-ironing before laundrying is the most severe treatment which a cloth can receive in presence of free acid, and he recommends a test based on this treatment. Certain substances which show little or no acidity at the ordinary temperature develop acid when heated. For instance, Cross, Bevan, and Briggs (this J., 1908, 260) described this effect in the case of chloramine derivatives of protein residues which they found in a cotton cloth used in connection with heated calender bowls. Certain salts occasionally used in finishes undergo similar decomposition on heating, *e.g.*, the chlorides of calcium, magnesium, and zinc. I may cite, in conclusion, a case which I had to investigate of a cloth which had received a transfer for embroidery by the local application of a hot iron. The cloth was badly broken down and yet perfectly neutral to indicators. On passing a hot iron over a stain of methyl orange on the cloth a very transient pink coloration was observed, turning yellow again rapidly as it cooled. Analysis revealed an appreciable amount of calcium chloride in the finish.

DISCUSSION.

In reply to questions by the Chairman and Messrs. Porritt and Smith,

Mr. BRIGGS said that the lime boil was supposed to be much more effective than the soda boil with certain fabrics, especially with coloured ones. Soda alone was never used with linen, though it frequently was with cotton; the results, however, were not so good. For a real cotton bleach the initial lime boil was the most effective treatment. When used in treating dyed goods, it had no effect on the cellulose itself in subsequent bleaching; it liberated oxygen from hypochlorite and sodium peroxide and was converted into oxide. To ensure good circulation in the kier it was necessary for the material to be properly packed. Bad circulation was one of the weak points of the cloth bleacher, and the Scottish linen bleacher was very conservative as regarded the modern types of kier.

CRUM'S AND MARSHALL'S TESTS FOR MANGANESE.

BY LEONARD DOBBIN, PH.D.

(Abstract.)

Crum's test. In 1845, Walter Crum (Annalen, **55**, 219) described as a delicate test for manganese the reaction in which lead peroxide is heated with dilute nitric acid and the liquid to be tested for manganese is added to the mixture. When manganese is present, the liquid exhibits a purple-red colour which Crum attributed to permanganic acid.

This reaction is attributed to Crum by Wolcott Gibbs (Amer. J. Sci., 1852, [2], **14**, 205, 207), by Braun (Z. analyt. Chem., 1868, **7**, 342), by Chatard (Amer. J. Sci., 1871, [3], **1**, 419), and by others, but in Treadwell's "Qualitative Analysis" it is referred to as Volhard's, and by Leclerc (Comptes rend., 1872, **75**, 1210) and by Vogel (Ber., 1875, **8**, 1534) it is attributed to Hoppe-Seyler. The original paper of Volhard (Annalen, 1879, **198**, 357) gives full credit to Crum, as also does that of Hoppe-Seyler (J. prakt. Chem., 1863, **90**, 303).

The association of Hoppe-Seyler's name with the reaction is due to Fresenius, who, though not actually crediting Hoppe-Seyler with having discovered the reaction, employs phraseology which appears to leave no doubt on the point (Z. analyt. Chem., 1872, **11**, 308; "Quantitative Analysis," 10th English Ed., 1887, p. 122).

Marshall's test. In 1901, Hugh Marshall pointed out (Chem. News, **82**, 76) that the most delicate test for manganese in solution depended on its conversion into permanganate, and refers to Crum's method of effecting the oxidation, adding that the test would be greatly improved by the use of a colourless and soluble oxidising agent. In an

earlier paper (this J., 1897, **16**, 399) he had stated that persulphates cause precipitation of peroxides when added to solutions of certain metallic salts, and that in the case of manganous salts the oxidation can be carried beyond the stage of peroxide by digestion on the water-bath for some time, when a pink solution of permanganic acid or alkali permanganate is slowly formed. In the 1901 paper he mentions that a trace of a silver salt greatly accelerates the oxidising action of persulphate solutions, and suggests the suitability of the method for converting manganous salts into permanganate. He found that minute quantities of manganese could be detected by warming the solution with persulphate in presence of sulphuric or nitric acid, with the addition of a drop of dilute silver nitrate solution. The delicacy of the test was such that 0·001 mgrm. could be detected when the total volume of liquid was about 0·5 c.c. He also stated that the reaction could be used for quantitative work.

Although Holland (Chem. News, 1907, **96**, 3) correctly attributes the reaction to Marshall, many other writers[*] have given the credit to Walters, who, however, only described certain details as to the application of Marshall's test as a quantitative method (Chem. News, 1901, **84**, 239).

Liverpool Section.

Meeting held at Liverpool, on Wednesday, November 24th, 1915.

MR. JOHN GRAY IN THE CHAIR.

ON THE EXPERIMENTAL TECHNICS OF CALORIMETRIC MEASUREMENTS AT HIGH TEMPERATURES.

BY DR. SETSURO TAMARU, R.H., R.G., TOKIO.

The thermochemical data at present available, though fairly well worked out thanks to the elaborate measurements of Thomsen and Berthelot, leave much to be desired in point of accuracy and of exhaustiveness, the results of experiments at high temperatures especially being very meagre, so that although the progress and refinement of the experimental technics achieved in recent years is very notable, we have still mostly to rely on the figures of the old determinations at ordinary temperatures. In the formation of water from hydrogen and oxygen in a calorimeter, we start from hydrogen and oxygen at the ordinary temperature and finish with water, also at the ordinary temperature; *i.e.*, although the reaction of formation of water from hydrogen and oxygen does not take place at ordinary temperature, the value thus obtained is without doubt that corresponding to the reaction at ordinary temperatures. The process actually involves three steps: first the gas is heated by an igniting agent in a calorimeter to a high temperature T, absorbing thereby the heat amount $c_m t$ (c_m=mean heat capacity of the gas mixture, t = temperature rise); next the reaction proceeds at this high temperature, evolving an amount of heat Q_t corresponding to the heat of formation at the temperature, T; finally the water formed is cooled to the temperature of the calorimeter, evolving at the same time the heat amount $c'_m t$ (c'_m = mean heat capacity of water between t and ordinary temperature).

$$\begin{tikzcd}
\text{High temperature T:} & \tfrac{1}{2}(2H_2+O_2) \arrow[r, "Q_t"] & (H_2O) \arrow[d, "c'_m t"] \\
\text{Ordinary temperature:} & \tfrac{1}{2}(2H_2+O_2) \arrow[u, "-c_m t"'] \arrow[r, "Q_0"] & (H_2O)
\end{tikzcd}$$

The total algebraic sum Q_0 of heat evolution effected in these three steps is measured, although the value of each term is not known separately.

$$Q_0 = Q_t + c'_m t - c_m t$$

As the specific heats of substances change their values in general with the temperature, we can write

$$c_p = a + b t + c t^2 + \ldots\ldots$$
$$c'_p = a' + b' t + c' t^2 + \ldots\ldots$$

(where c_p and c'_p are the true specific heats of reacting substances and the reaction product respectively under constant pressure at a temperature t; a, b, a', b', etc., are constants) and therefore we have

$$Q_t = Q_0 + c_m t - c'_m t = Q_0 + \int_0^t (a + bt + ct^2 + \ldots)\,dt - \int_0^t (a' + b't + c't^2 + \ldots)\,dt$$

If we know exactly the value of a, b, a', b', etc., or, in other words, if we know the specific heats of the reacting substances and of the reaction products at all temperatures, we can calculate the heat of formation at any temperature, provided the value at one temperature is known.

Taking ammonia for example, $\tfrac{1}{2}(N_2+3H_2) \rightarrow NH_3$, we know that for $N_2 : c_p = 6{\cdot}88 + 0{\cdot}00082t$[†] and for $H_2 : c_p = 6{\cdot}68 + 0{\cdot}00082t$[†], so that for $\tfrac{1}{2}(N_2+3H_2) : c_p = 13{\cdot}47 + 0{\cdot}00164t$, and for $NH_3 : c'_p = 8{\cdot}62 + 0{\cdot}0035t + 5{\cdot}1 \times 10^{-6}t^2$,[‡] and Q_0 (the heat of formation of NH_3 at 0° C) = 10,950,[*]

$$\text{therefore } Q_t = 10{\cdot}950 + \int_0^t (13{\cdot}47 + 0{\cdot}00164t)\,dt - \int_0^t (8{\cdot}62 + 0{\cdot}0035t + 5{\cdot}1 \times 10^{-6}t^2)\,dt$$

or after integration, $Q_t = 10{,}950 + 4{\cdot}85t - 0{\cdot}00093t^2 - 1{\cdot}7 \times 10^{-6}t^3$.

This value can be obtained graphically in a simpler and clearer way as follows:—

If we plot the specific heats of the reacting substances and the reaction products at different temperatures (compare Fig. 1), the difference of the heat of formation at two temperatures, t_1 and t_2, namely,

$$Q_2 - Q_1 = \int_{t_1}^{t_2} c_p\,dt - \int_{t_1}^{t_2} c'_p\,dt$$

is represented by the area intercepted by two ordinates, t_1 and t_2, and by two specific heat curves, so that the increase of heat of formation can be readily found simply by measuring this area, as is shown in Fig. 1. (In Fig. 1 the results have been calculated every 200° C. by counting the number of squares and adding 10,950, each square representing 200 grm.-cals.)

In this way the heat of reaction at any high temperature can be calculated from that at ordinary temperature, provided we have accurate knowledge of the specific heats of all the substances concerned at all temperatures. Unfortunately our knowledge of specific heats at high temperatures is exceedingly limited, and it is not possible to carry out the calculation. It is advisable, therefore, to work out an experimental method by which the heat of reaction at high temperatures may be determined directly.

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[*] Hillebrand, "Analysis of silicate and carbonate rocks," 1910, 117; Mellor, "Quantitative Inorganic Analysis," vol. i., 1913, p. 382; Williams, Chem. News, 1909, **99**, 288; Boyle, J. Ind. Eng. Chem., 1912, **4**, 203; Stehman, J. Amer. Chem. Soc., 1902, **24**, 1201; Schmidt, *ibid.*, 1910, **32**, 965.

[†] Pier and Bjerrum: Zeits. Elektrochem., 1909, **15**, 536; 1912, **18**, 101.

[‡] Haber and Tamaru: Zeits. Elektrochem., 1915, **21**, 228.

[*] Thomsen found 11,880 and Berthelot 12,200 (both at room temperature) instead of 10,950. A much lower figure is obtained by the method of direct decomposition of ammonia carried out by the author, compared with that obtained by the indirect method of Thomsen and Berthelot. *Cf.* Tamaru and Oeholm: Zeits. Elektrochem., 1915, **21**, 206.

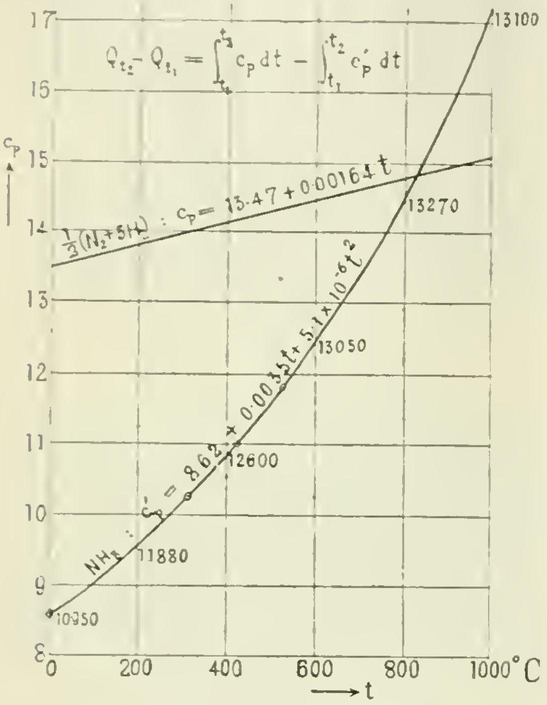

FIG. 1.

Calorimetry at high temperatures is incomparably more difficult than at ordinary temperatures, firstly, because of the difficulty of getting an effective thermostat at such temperatures—say at red heat; secondly, because of the difficulty of measuring the temperature accurately; and thirdly because of the higher heat conductivity of materials under such conditions. As I had the opportunity to examine this problem during a study of the chemical equilibrium of ammonia synthesis and accessory thermochemical and thermodynamical problems, and as the experimental methods employed differ greatly from practice at ordinary temperatures, and moreover in view of the fact that the same apparatus can be used not only for the measurement of heat of reaction, but also for the measurement of specific heat[†] at high temperatures by a small alteration, I will discuss it more or less fully.

Description of apparatus. The principle resorted to was that of constant flow calorimeter. Fig. 2 shows the construction of a calorimeter. Ammonia gas enters at the top of the preheater, which consists of a silver tube containing silver filings and is provided with a heating coil outside. The gas passes through the silver filings and leaves the preheater at a temperature which is measured by thermocouple, t_1, attached to the bottom of the preheater, and enters the decomposer through a thin platinum capillary. The decomposer consists of a silver crucible containing silver filings and a small silver tube. The latter—the decomposer proper—contains a catalyst,[*] C, and is provided outside with a heating coil which consists of a long, thin platinum wire imbedded in kaolin and asbestos (h is the wire connection of the coil). The ammonia, on entering the decomposer, is decomposed into nitrogen and hydrogen and cools the decomposer, as the decomposition of ammonia is accompanied by heat absorption. An amount of heat is, however, supplied electrically by the heating coil surrounding the catalyst to compensate the fall of temperature. The decomposed gas passes again through silver filings and leaves the latter at a temperature which is recorded by thermocouple, t_2, finally leaving the apparatus by way of a thin porcelain tube, p. The whole apparatus is put in a wide porcelain tube and the latter is placed in turn in a thermostat—a thick block of copper heated in an electric furnace to a uniform temperature recorded by the thermocouple t_3 (W represents a water cooling coil). The silver filings in the preheater and in the crucible are used to measure the temperature of the gas. To trace a temperature change of a gas quickly is very much more difficult than in the case of a solid or a liquid, but this can be effected according to the method of Wiedemann by using silver or copper filings.

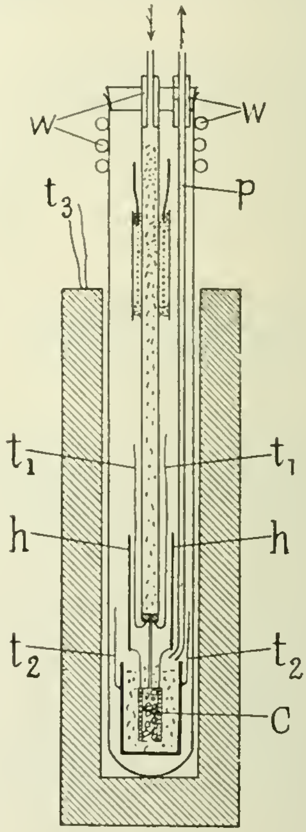

FIG. 2.

The arrangement of the complete apparatus is seen from Fig. 3. At the top right hand end is a steel cylinder containing liquid ammonia—synthetic ammonia, manufactured by the Badische Anilin und Soda Fabrik from atmospheric nitrogen and hydrogen by the Haber process and therefore exceedingly pure, containing no trace of aromatic hydrocarbons or other tarry matter—the pressure of the ammonia being reduced by means of a Le Rossignol valve. The ammonia enters an automatic pressure regulator, A, which will be described later on, then a drying tube, K, containing solid caustic potash, a differential manometer, D_1, and the calorimeter, C, which is kept in a thermostat with flowing water, so that the measurement is not affected by the change of room temperature. The decomposed gas together with the undecomposed part of the ammonia enters a Peligot tube, P, containing sulphuric acid (which is cooled by running water) for the purpose of removing the undecomposed ammonia. The mixture of nitrogen and hydrogen, free from ammonia, passes another differential manometer, D_2, a rotameter, R, and finally reaches a gas meter, G. A constant current of ammonia is passed through the system and so much electric current supplied to the heating coils of the copper thermostat, the preheater, and the decomposer, that all three are kept at the same temperature. Thus the ammonia enters the decomposer at a selected temperature and leaves it at the same temperature after decomposition. The amount of energy supplied to the decomposer in order to compensate the heat loss by the decomposition, gives the heat of formation at that temperature for that amount of ammonia decomposed in the decomposer. This is apparently only admissible when there is neither heat gain from nor heat loss to the surroundings on the part of the decomposer. The temperature inequality of the decomposer with the surroundings will naturally cause a certain heat inflow or outflow, which can, however, be accurately measured by passing an inert gas through the system.

[†] Haber and Tamaru (*loc. cit.*).

[*] The most effective catalysts for ammonia synthesis are uranium, its carbide and nitride, osmium, iron, molybdenum, and tungsten. They have been carefully studied by Haber and his co-workers.

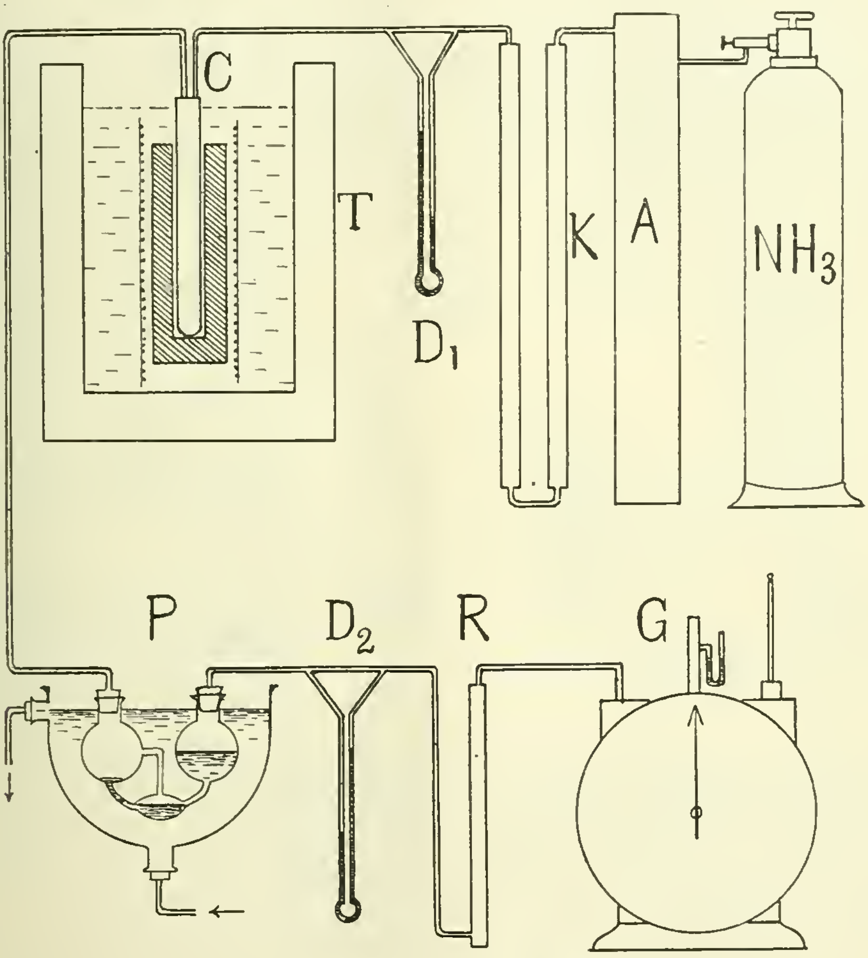

FIG. 3.

Measurement of temperature. As the accuracy of the results depends on the accuracy of the measurements of temperature, of energy, and of gas volume, these have to be carried out with sufficient precautions. Owing to the lack of aftereffect, Le Chatelier's thermocouple was preferred to others, one junction being kept as usual in contact with the body of which the temperature was to be measured, while the other junction was kept at 0° C. The thermo-electric power can be measured by a millivoltmeter or by a compensation method, the temperatures thus found being different from each other. They may be called uncompensated temperature and compensated temperature. The uncompensated temperature is read usually by means of a millivoltmeter with high resistance, sometimes directly graduated in a temperature scale and called a pyrometer. It is impossible to get an accurate temperature record by means of a pyrometer, since the instrument cannot be calibrated, for a pyrometer is nothing more than an ammeter with high resistance (300—450 ohms usually) and the resistance of the thermocouple is mostly so large and so changeable (according to the temperature to which it is exposed and according to the length of the thermocouple heated in the furnace), that it may make an error of many degrees. A simple calculation makes this clear. Calculated from the specific electric conductivity of platinum, a thermocouple 0·3 mm. thick has a resistance of about 3 ohms for arms 1 metre long. Since the temperature coefficient of electric resistance of platinum is as large as the expansion coefficient of gas, we would expect the resistance to double below 300° C., treble at 550° C., quadruple at 800° C., and so on. If we insert the thermocouple deeply enough into the furnace to prevent the cooling of the junction by the heat conduction of the metallic wire composing the thermocouple, the additional resistance amounts sometimes to 4—6 ohms, which means an error of 7°—10° C. at 700° C. The ordinary pyrometer is usually so graduated that it reads true temperatures when the thermocouple has no resistance. Even when the pyrometer and the thermocouple are standardised and calibrated beforehand at the fixed points of the thermometric scale (see below), this error can only be partially eliminated, for even at the fixed temperature, the temperature readings will coincide only when the temperature distribution along the thermocouple is such that the electric resistance of the thermocouple remains constant.

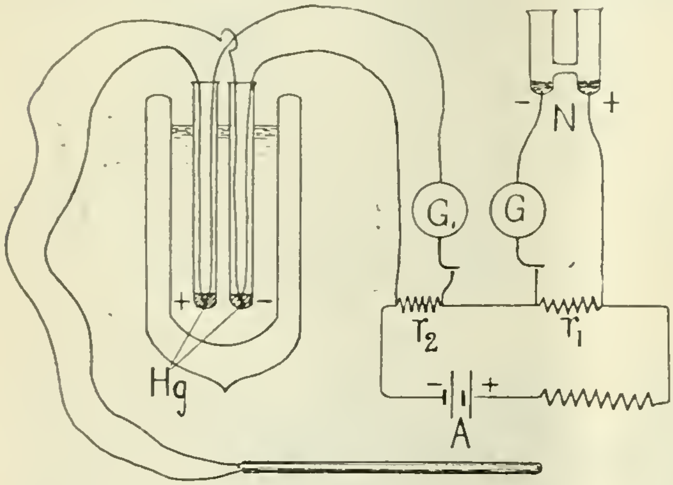

Fig. 4.

Another source of error in the uncompensated method is the temperature change of the junction caused by the thermo-electric current itself. This error is, however, less serious than the former.

Both the sources of error mentioned above can be avoided by the compensation method—a method of measurement of thermo-electric power without flow of current. A circuit containing two accurately standardised resistances, r_1 and r_2, and auxiliary cells, A (Fig. 4), has two shunts in r_1 and r_2, the one containing a normal cadmium cell, N, and a galvanometer, G, the other containing a thermocouple and a galvanometer, G_1. The resistances, r_1 and r_2, are so regulated that there is no flow of electric current in either shunt. Then we have

$$e = 1{\cdot}0184 \times \frac{r_2}{r_1}.$$

Fig. 4 shows the arrangement used in the calibration of the thermocouple. The cold junctions are put in a few drops of mercury contained in test tubes, which latter are immersed in ice. For the insulation of the arms of the thermocouple a thin porcelain capillary of about 1 mm. outer diameter has proved very useful. As electric resistances can be standardised to an accuracy of hundredths or even thousandths of a per cent., this method enables us to estimate the thermo-electric power most accurately.

There is, however, another source of serious error due to cooling of the junction by the heat conduction of the thermocouple itself. This source of error can be avoided by soldering the junction to a piece of metal of large heat capacity or by inserting the thermocouple deeply enough into the furnace.

Another source of error is the incomplete homogeneity of the metal of the thermocouple. As every heterogeneous point of the wire acts as a junction, we have a series of junctions at different temperatures. This can be easily tested, however, by heating the wire along its length. The thermocouple used was quite satisfactory in this respect.

Another source of error is from the foreign electric charge of the junction. As we have to measure one-millionth of a volt, which corresponds to 0·1° C. in temperature, the junction should have no appreciable electric charge from the surroundings. If an electric furnace is used to produce high temperature, the junction gets necessarily a certain potential, as there is no sufficiently good insulator at red heat—hard glass, fused silica ware, asbestos, etc., which are good insulators at ordinary temperatures, conduct more than sufficient electricity at high temperatures to destroy the measurement. This can be avoided either by connecting the junction with earth, or by isolating carefully the system of measuring apparatus from the earth. In our case both methods were used at the same time.

The calibration of the thermocouple by the compensation method is made usually at the boiling point of sulphur 444·6°+0·09(P—760), at the melting point of antimony, 630·6° C., of gold, 1063·9° C., or of nickel, 1458° C.

Considerable care is necessary if results are to be reproducible to an accuracy of 0·1° in temperature. For instance, by changing the quantity of antimony and taking cooling curves each time, it is found that at least 100 grms. of antimony must be present to assure the above accuracy.

Changing the position of the junction in the metal and again taking cooling curves every time, it was found that the position of the junction can cause a great deal of error. A porcelain test tube of 2 cm. diameter, filled with antimony, gives at the bottom as much as 20—30 microvolts lower. This is apparently due to the notably poor heat conductivity of antimony.

Another precaution is necessary with regard to the ice-pot. As water has a maximum density at 4° C., the half-molten ice in the pot does not keep the junction in mercury at 0° C. Should it be at 1° C., it gives rise to an error 0·7°—0·8° C. at 500° C. and about 0·5° C. at 800°—1000° C. Even when the ice-pot is nearly full of ice, the galvanometer reading changes when the ice in the pot is stirred. The temperature reading can of course only be true when there is no change in the galvanometer reading by moving the ice.

Taking all these precautions, the thermo-electric power is measured at these fixed temperatures. The question arises as to how the intermediate temperature is to be computed. Since the thermo-electric power is a function of high order of temperature, the temperature cannot possibly be interpolated linearly. The thermocouples used were all bought from Heræus. This firm prepares a mass of alloy at one time, and sends a sample, of the thermocouples made from it to the German Standards Bureau for calibration. Heræus sends this calibration table to the customer together with the thermocouple, so that a calibration table is available, though not for our particular sample. The correction, *i.e.*, the difference between the value found experimentally and that calculated from the table, can be brought to the intermediate temperature by assuming that $\left(\frac{d^2e}{dt^2}\right)_t$, *i.e.*, the second differential quotient of thermo-electric power after temperature, is constant for all samples of Le Chatelier thermocouples at any temperature. This assumption is justified, for, although the equation giving thermo-electric power as a function of temperature is different according to different authors and with different samples, it gives practically the same value for $\frac{d^2e}{dt^2}$, and therefore can surely be used for making a small correction for intermediate temperatures.

The measurement of energy. The amount of energy supplied to cover the heat absorbed by the reaction can be measured by means of an ammeter and a voltmeter. So long as the temperature is not high it seems preferable to measure the potential between the terminals of a heating coil made of manganin wire by the compensation method,[*] Energy $= 0{\cdot}2389\ E^2/R\ \frac{\text{Cal.}}{\text{Sec.}}$. E and R can be easily measured and standardised as accurately as 0·01 %. At high temperatures where platinum wire has to be used as the heating coil, the accuracy is much reduced. As the resistance of the coil changes greatly with the temperature, an ammeter and a voltmeter must be used. Using a precision ammeter and a precision voltmeter with 150 scale divisions, a mirrored scale, and a thin needle, 0·1 can be read exactly and 0·05 approximately. Arranging the shunt in such a way that the instrument is always read in the vicinity of 130—150 scale division, the accuracy of reading of each instrument is ± 0·03 %, so that the uncertainty of energy caused by the reading is ± 0·06 %. This accuracy is, however, much diminished by the error of standardisation, for neither an ammeter nor a voltmeter is free from after-effect. Even excluding the error arising from the zero point change, the indication changes with time. Moreover the reading of these instruments changes according to the position in which they are placed, very often as much as 0·1 scale division or more, apparently due to the disturbance by the earth magnetism. For the same reason the reading is changed appreciably if other electric or magnetic instruments are in the vicinity. If an ammeter and a voltmeter be read in juxtaposition, both readings are appreciably wrong. In one case, for instance, when a voltmeter and an ammeter were placed 25 cm. apart, an error amounting to 0·2 scale division in each instrument was observed. The above remarks show the necessity of standardising the instruments in the same position and in the same way as they are used in the actual measurements.

The measurement of constant gas flow. As the principle of our measurement is that of the constant flow calorimeter, it is necessary to get a constant gas flow through the calorimeter. As the ordinary arrangement for pressure regulation is not sensitive enough, we constructed for this purpose a special automatic pressure regulator which was exceedingly effective and satisfactory. It gave a constant pressure of a 1—1½ metre column of water (or other liquid according to the condition prevailing) with a change within ± 0·7 mm. in the regulated pressure, or ± 0·05 %, while the primary pressure was changing more than 100 %. The principle of regulation is just the same as that of an automatically regulating valve for compressed gas in a steel cylinder. Fig. 5 gives a sketch of the device. The gas enters a metal case (left-hand figure) through an orifice, O, and leaves by the exit below. The increase of pressure in the metal case pushes the membrane, M, outwards. The membrane, M, is connected with a metal arm, A, by a hinge, H, of special construction, which acts in such a way that the outward motion of the membrane moves the arm in the opposite direction, so that the orifice is partially closed, and the gas supply is reduced, and *vice versa*. By using the sensitive floating equilibrium [*] instead of a short metal arm, the sensitiveness of an automatic pressure regulator can be improved. The right hand sketch (Fig. 5) shows how this is arranged. In a metal cylinder, C, containing a liquid, there is a floating body, B, an inverted metal cylinder, connected with the stem of the valve, V, by means of levers, L M, which have their fulcrums at F, so that the up and down motion on the part of the floating body causes the motion of the valve in the opposite direction. The action of regulation is therefore similar to the former. The adjustment for different pressures is effected in the former by changing the distance between the valve and the orifice by means of an adjusting screw, and in the latter by adjusting weights put on the floating cylinder.

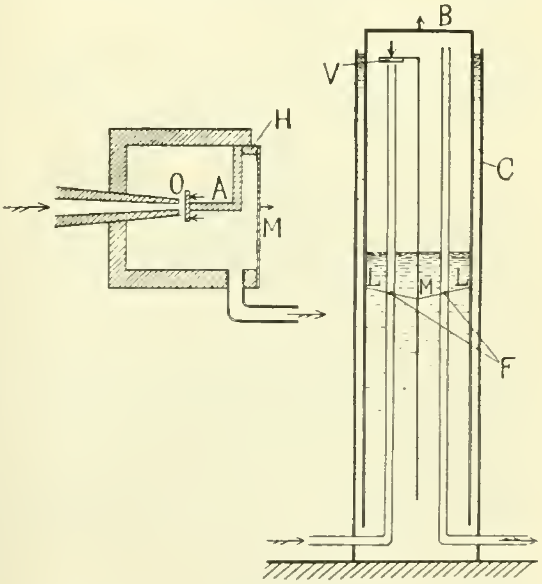

FIG. 5.

The measurement of a gas flow can be made by a calibrated differential manometer, by a rotameter, or by a gas meter. The accuracy of all these instruments is very limited. A reliable result can only be obtained by a careful standardisation of a better kind of gas meter. The "Experimenting gas meter" of Elster, which I used, had four gas chambers revolving in water or other liquid. The needle did not run with a constant speed, even when the gas flow was maintained constant, so that the error was very serious if the readings of the needle were taken directly. We could, however, reduce the error greatly by standardising the complete turn of the needle and taking the volume of all four chambers of the gas meter as unit. This was done by taking a glass bulb, B (Fig. 6), the contents of which corresponded just to one complete turn of the gas meter needle; the volume had been previously accurately standardised by weighing. At first the cocks. H_1 and H_3, were closed, a volume of air was sucked through water in F into the bulb, B, by means of a levelling vessel, L. When the water level reached the cock. H_5, the latter was closed and H_3 was opened, so that the contents of B were now at the atmospheric pressure. Next H_2 was closed, the contents of B were driven through the gas meter, and the reading of the latter was taken after tapping it lightly. Again closing H_1 and repeating the same process 20 to 30 times, each time tapping the gas meter lightly before the reading was taken, we could see how large the discrepancy of the successive standardisation was.* The temperature of water in F, in L, and in the gas meter must of course be kept the same. The gas meter used was provided with a thermometer, T, a manometer, M, and a level. The following figures, obtained in one case, will show the magnitude of the discrepancy of the successive standardisations. The gas meter was kept undisturbed between two successive standardisations.

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[*] This method allows an accurate measurement of specific heat of salt solutions, etc., also the thermodynamic calibration of a thermometer by means of Richards' adiabatic calorimeter.

[*] The floating equilibrium is exceedingly sensitive. A minute change of specific gravity of a salt solution caused by a temperature change of 0·001° C.—a change of a few units in the 7th decimal—is enough to change the upward motion of a float into a downward motion, as Richards and Shipley observed. Richards proposes to standardise a thermometer by this means with 0·001° C. accuracy. *Cf.* Richards and Shipley, J. Amer. Chem, Soc., 1914, **36**, 1.

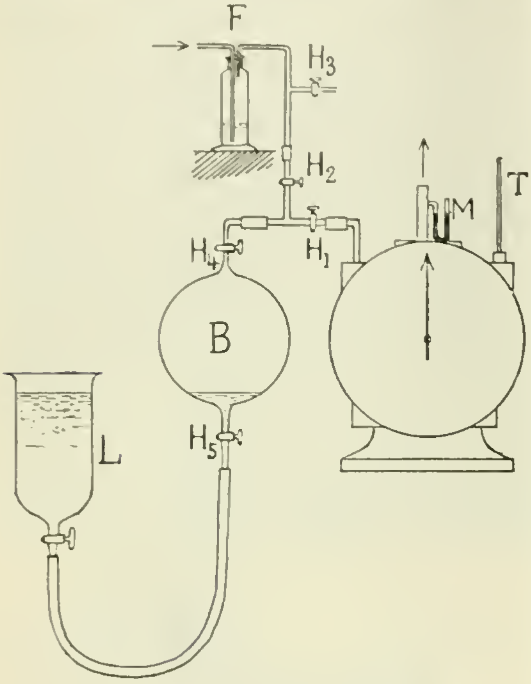

Fig. 6.

—0·2 % +0·3 % +0·2 %—0·9 % +0·2 % +0·7 %
± 0·0 %—0·6 % +0·3 % +0·5 %—0·7 % +0·1 %

It will be seen from the above figures that the discrepancy mostly cancels at the second or third reading. This is without doubt due to the sticking of the needle. The results of standardisation and the discrepancy of successive standardisations were not altered when the speed of the gas was varied over a considerable range. We have, therefore, good reason for thinking that the comparatively large uncertainty of one standardisation will be reduced to a tenth or perhaps to a fiftieth if we take 50 to 100 uninterrupted complete turns successively for the standardisation. The differential manometer and the rotameter, though less sensitive, proved to be convenient as a means of seeing instantaneously whether or not the gas current is kept constant.

The sensibility of the calorimeter. If we define—t_d as temperature of the decomposer, t_w as that of the wall, t_p as that of the preheater, v as the volume of gas passing through the calorimeter in c.c. per second, and E as the electric heat supply to the decomposer per second, we have, so long as we are working with an inert gas or a mixture of N_2+3H_2.

heat loss to the copper thermostat $=(t_d-t_w)a$
heat loss to the preheater $=(t_d-t_p)b$
heat consumption by the passing gas $=(t_d-t_p)cv$

where a and b correspond to heat conductivity, c to specific heat of the gas. Therefore—

$$E=(t_d-t_w)a+(t_d-t_p)(b+cv).$$

Owing to the complicated conditions prevailing around the decomposer it is not possible to get an accurate value for a, b, or c by simple calculation from known data of absolute heat conductivity or specific heat. We can, however, determine them experimentally by observing different sets of values of t_d, t_w, t_p, v, and E. It was found at 659° C. that $a=0{\cdot}11$, $b=2{\cdot}3\times10^{-3}$, and $c=3{\cdot}56\times10^{-4}$ for the mixture (N_2+3H_2). In the case of decomposition of ammonia a and b will retain the same value, but c will be about 1½ times as large, so that the amount of energy, which is not used for the decomposition of ammonia, or in other words, the energy correction ΔE will be

$$\Delta E=(t_d-t_w)\,a+(t_d-t_p)\,(b+c'\,v)$$

where $a=0{\cdot}11$, $b=2{\cdot}3\times10^{-3}$, $c'=5{\cdot}34\times10^{-4}$, and therefore we have $Q_t=\frac{E-\Delta E}{v}\times 44{,}824$.

Sources of errors in the measurement. There are many sources of possible error. Firstly the thermal state of the decomposer is different when ammonia, instead of the mixture, N_2+3H_3, passes through it. As the decomposition of ammonia absorbs a large amount of heat, the decomposed gas is necessarily much colder at the moment when it leaves the catalyst than before, and therefore the lower part of the silver crucible is lower in temperature than the upper half. The direct measurement with two pairs of thermocouples, one at the upper end and the other at the lower end of the crucible, showed about 0·4° C. difference between them, when ammonia was being decomposed at maximum rate. This constitutes a source of error amounting to 2/3% in the heat of formation. In the actual experiment the thermocouple was soldered at about two-thirds of the height of the crucible and therefore the result found was about 0·5% too low.

The greatest difficulty connected with the measurement was, however, the correction for that part of ammonia which is decomposed at other places than in the decomposer, or, in other words, not at the expense of the measured energy supplied to the decomposer. We know, thanks to the extensive researches of Haber and his co-workers, that different substances have different grades of catalysing power in the synthesis of ammonia. As the catalyst is merely an accelerating agent of the reaction from a non-equilibrium state toward an equilibrium, we would expect that they would accelerate the decomposition of ammonia also in different degree, as the equilibrium at 660° C. is reached only when more than 99·9% ammonia is decomposed. Although silver, platinum, and porcelain, with which the ammonia comes in contact in our measurements, are the poorest catalysts in this particular reaction, they act, together with the unavoidable trace of dust, to decompose ammonia to a certain extent. This happens first within the preheater, which comes in contact with 100% NH_3. The remaining decomposition takes place after the gas has left the decomposer, *i.e.*, in the hollow space confined by the porcelain vessel, which comes in contact with gas already mostly decomposed, but still containing some quantity of undecomposed ammonia. We have to find the amount of the correction. Now, if we cut the platinum capillary which connects the preheater and the decomposer, take off the decomposer entirely, pass ammonia through the apparatus just as in the main experiment, and measure the amount of ammonia decomposed, this amount will be larger than the correction wanted, as the hollow space confined by the porcelain vessel will now come in contact with practically 100% NH_3 instead of mostly decomposed gas—say 60% decomposed, as in the case in the main experiment—and as the 100% NH_3 is decomposed more easily and to a greater extent than ammonia which is already 60% decomposed, as we know well from the laws of chemical kinetics. If we make a mixture of a composition corresponding to 60% decomposed and 40% undecomposed ammonia, and pass this mixture through the system instead of ammonia and measure the amount of ammonia which is decomposed anew by the apparatus, then this amount is apparently smaller than the correction wanted, for, although we find the decomposition in the hollow space correctly the decomposition within the preheater will be this time too small, as it comes now in contact with 40% NH_3 instead of 100% NH_3, as is the case in the main experiment. Thus, although we do not know the exact magnitude of the correction wanted, we know that it must lie between the two limit values thus obtained. By using the limit values as the correction, we get the limit values of the heat of formation of ammonia. The nearer the limit values of the heat of formation approach each other, the smaller the uncertainty arising from this source will be. The results obtained will be seen from the following table :—

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* B should not be filled through the gas meter. If a gas be sent once in the reversed direction through a gas meter, the next meter reading is no longer trustworthy.

TABLE I.

Experimental data obtained in the determination of the heat of formation of ammonia at 659° C.

No.	NH_3—Vol. sent in (reduced) c.c. per sec.	(N_2+3H_2)—Vol. produced (reduced) c.c. per sec.			Energy supplied grm.-cals. per sec.	Heat of formation of ammonia grm. cals. per mol.			
		With decomposer from NH_3.	Without decomposer.			I. Lower limit.	Upper limit.	II. Lower limit.	Mean of the last two.
			from NH_3	from $NH_3+3H_2+N_2$.					
1	12·7	16·32	0·680	0·183	4·641	12,750	13,310	12,900	13,110
2	12·7	15·96	0·680	0·183	4·499	12,670	13,200	12,820	13,010
3	20·9	18·59	0·778	0·460	5·252	12,670	13,230	13,000	13,120
4	13·9	12·51	0·696	0·306	3·504	12,560	13,300	12,880	13,090
5	4·3	5·703	0·575	0·063	1·592	12,500	13,910	12,630	13,270
6	4·3	5·727	0·575	0·059	1·578	12,340	13,720	12,480	13,100
7	4·3	5·472	0·575	0·064	1·506	12,350	13,800	12,490	13,140

The first lower limit in the last columns of the table is obtained when no correction due to the decomposition elsewhere is made, the second lower limit when the correction obtained by the further decomposition in the mixture $NH_3+N_2+3H_2$ is made, while the upper limit is that when the correction obtained by the decomposition of ammonia in the absence of the decomposer is made. The mean of the two corrected limit values gives 13,100 grm. cals. per mol. It is, however, likely that this figure is about 0·5% too low owing to the fact that the thermocouple for the decomposer has been fixed at about two-thirds of the height of the silver crucible instead of at the middle, as already stated. We obtain thus for the heat of formation of ammonia 13,160 grm.-cals. per mol. at 659° C.

In exactly the same way other series of measurements were carried out at lower temperatures. The results were :—12,860 grm.-cals. per mol. at 554° C., 12,700 grm.-cals. at 503° C., and 12,670 grm.-cals. at 466° C. The latter figures are, however, less accurate owing to the smaller quantity of decomposed gas, and accordingly the smaller amount of supplied energy.

The result found experimentally can be checked by calculation from other physical constants. That it can be calculated from specific heats of the substances concerned is already fully shown at the beginning of this paper. There is, however, another consideration which allows us even to reach those inaccessible figures at higher temperatures, at which the measurement of the heat of formation or the specific heat of ammonia becomes impossible owing to its great instability. The heat of formation is, as is well known, closely related to equilibrium constant, the relation being usually expressed by the van't Hoff's equation of reaction isochore,

$$\frac{d \ln K_C}{dT} = -\frac{Q}{RT^2}$$

$$\text{where } K_C = \frac{C_{NH_3}}{C_{N_2}^{\frac{1}{2}} \; C_{H_2}^{\frac{3}{2}}}$$

in the case of the reaction $\frac{1}{2}N_2+\frac{3}{2}H_2 \rightleftarrows NH_3$, where C_{NH_3}, C_{N_2}, C_{H_2}, represent the molar concentrations of NH_3, N_2, and H_2 respectively in the mixture of the equilibrium state. If we allow the reaction to proceed under constant pressure, as happens in our actual measurements, instead of at constant volume, we have

$$\frac{d \ln K_P}{dT} = \frac{Q'}{RT^2}$$

$$\text{where } K_P = \frac{p_{NH_3}}{p_{N_2}^{\frac{1}{2}} \; p_{H_2}^{\frac{3}{2}}}, \quad Q' = Q + RT, \; (p_{NH_3}, p_{N_2}, p_H)$$

representing the partial pressure of the components at an equilibrium state). If Q' is approximately constant between 600°—1000° C., we can integrate the equation, namely,

$$\ln K_P = \frac{Q'}{RT} + \text{constant} :$$

$$\text{or } \log K_P = \frac{Q'}{4{\cdot}571\,T} + C.$$

The most careful investigation of the maximum yield of ammonia from nitrogen and hydrogen, in other words, that of the equilibrium constant, carried out by Dr. Ponnaz and the author,* shows very clearly that the equation—

$$\log \frac{p_{NH_3}}{p_{N_2}^{\frac{1}{2}}\ p_{H_2}^{\frac{3}{2}}} = \frac{13200}{4{\cdot}571T} - 6{\cdot}314.$$

expresses the experimental results almost exactly, as will be seen from the following table :

TABLE II.

Temperature.	$10^4 \times K_p$.	
° C.	found.	calc.
561	21·3	21·3
631	11·4	11·5
914	1·99	1·99
952	1·68	1·67

We see that $Q' = 13{,}200$ grm.-cals. per mol., $C = 6{\cdot}134$, express almost exactly the experimental result, or in other words, the heat of formation between 560° C. and 1000° C. is nearly constant. The curve in Fig. 1 representing specific heat and heat of formation at the same time, is drawn in such a way that the heat of formation of ammonia reaches a maximum at about 800° C., and falls somewhat at lower as well as higher temperatures, so that at no point does it deviate much from a mean value 13,200 grm.-cals. per mol.

In general the heat of formation, Q_t, of any substance at a temperature, t, is connected with specific heats, c_p, c'_p, of the reacting system and of the reaction products respectively by the following equations :—

$$c_p = a + bt + ct^2 + \ldots.$$
$$c_p' = a' + b't + c't^2 + \ldots.$$
$$Q_t = Q_0 + (a - a')t + \tfrac{1}{2}(b - b')t^2 + \tfrac{1}{3}(c - c')t^3 + \ldots.$$

Re-writing Q_t in the form

$$Q_t = A + BT + CT^2 + \ldots.$$

and applying van't Hoff's equation of reaction isochore, we have

$$\log K = \frac{A}{4{\cdot}571T} - \frac{B}{1{\cdot}985} \log T - \frac{C}{4{\cdot}571} T + \ldots. + \text{const.}$$

We can therefore easily check the result of experimental determinations of the heat of formation at any temperature by means of the equilibrium constant at that temperature. In the special case of ammonia we have

$$\log \frac{p_{NH_3}}{p_{N_2}^{\frac{1}{2}}\ p_{H_2}^{\frac{3}{2}}} = \frac{9591}{4{\cdot}571T} - \frac{4{\cdot}98}{1{\cdot}985} \log T - \frac{0{\cdot}00046}{4{\cdot}571} T + \frac{0{\cdot}85 \times 10^{-6}}{4{\cdot}571} T^2 + 2{\cdot}10$$

which is derived from

$$c_p = 13{\cdot}47 + 0{\cdot}00164t$$
$$c'_p = 8{\cdot}62 + 0{\cdot}0035t + 5{\cdot}1 \times 10^{-6}t^2$$
$$Q_t = 10{,}950 + 4{\cdot}85t - 0{\cdot}00093t^2 - 1{\cdot}7 \times 10^{-6}t^3$$

These measurements are a part of a series of careful studies on the thermo-dynamics of ammonia carried out by the author, partly in the Technische Hochschule, Carlsruhe, partly in Auergesellschaft, Berlin, and partly in Kaiser Wilhelm Institut, Berlin-Dahlem, in the laboratory of Professor Haber. It is my pleasant duty to express my indebtedness to Professor Haber, who took great interest in this subject, and gave me most valuable advice and help in every possible way.

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* Tamaru and Ponnaz: Zeits. Elektrochem., 1915, **21**, 89.

London Section.

Meeting held at Burlington House, on Monday, January 3rd, 1916.

MR. A. R. LING IN THE CHAIR.

THE ACTION OF BOILING ACETIC, PROPIONIC, AND BUTYRIC ACIDS ON ALUMINIUM, WITH A NOTE ON THE ACTION OF FORMIC AND SOME HIGHER ACIDS.

BY RICHARD SELIGMAN AND PERCY WILLIAMS.

Introductory.

The work of which the following is an account forms part of an extended inquiry which has been undertaken with the object of clearing up some of the anomalies to be found in literature dealing with the action of acids upon aluminium. The present note refers only to one small section of the work, namely, the action of certain hot, concentrated, volatile fatty acids; it owes its separate treatment to some observations made in technical practice.

Aluminium stills have been used for a number of years for the distillation of acetic acid and it has been found that, whereas some parts of the apparatus withstand the action of the acid in a very satisfactory manner, other parts are subject to rapid corrosion. This subject has recently grown in importance.

It was considered at the outset of the experiments made to determine the conditions governing the rate of attack, that the presence or absence of air might be the main factor, but this assumption was found to be erroneous, although there was some evidence that in the absence of oxygen dissolution is more uniform than when oxygen is present. On the other hand, the question of concentration was found to be all-important, quite exceptionally narrow limits defining the strength of acid which causes rapid dissolution of the metal. As was to be expected, the rate of dissolution falls as the strength of the acid increases, so that a 99% acid has only about one-tenth of the action upon aluminium of a 90% acid. But the astonishing fact was also brought to light that the removal of the last 0·05% of water is sufficient to raise the rate of dissolution a hundred-fold, whilst conversely the addition of 0·05% of water to a corrosive acid suffices to stop the action.

Incidentally it was found that the acetate formed by the action of dehydrated acetic acid on aluminium differs from that obtained by the action of less concentrated acids, and forms a compound which has not been described previously.

Boiling 90% acetic acid dissolves aluminium and produces an insoluble gelatinous basic acetate. Analysis of this compound, dried at 100° C., gives figures agreeing with the formula $Al(O.COCH_3)_2OH$.

By the action of dehydrated acetic acid on aluminium, an acetate is formed which under a magnification of 500 is seen to consist of small rectangular crystals. This substance dissolves very readily in water, forming a solution which has the properties given in the literature of the subject as those of a solution of the normal acetate. It is also slightly soluble in dehydrated acetic acid, but the smallest trace of water added to this solution produces a slow decomposition which may be hastened by warming, the insoluble basic acetate referred to being precipitated. The converse change can be brought about by heating the basic acetate with acetic anhydride in sealed tubes, which is a simple method of preparing the crystalline acetate; when prepared in this way the crystals seem to differ slightly in appearance from those obtained by direct dissolution of the metal. The exact composition of the crystalline acetate has not yet been established, and at the moment it can only be stated definitely that it contains more acetic acid than the least basic acetate heretofore described.

Shortly after the conclusions indicated above had been arrived at, it was found possible to establish the close analogy existing between concentrated butyric and acetic acids with regard to their action on aluminium. Boiling butyric acid of about 99 % strength has practically no effect whatever upon aluminium. Nevertheless when an aluminium dephlegmating column was fitted to a technical butyric acid still, whereby the concentration of the acid was increased by about 1 %, rapid and extensive corrosion immediately occurred. Experiments confirmed that if the butyric acid were completely dehydrated, its action on aluminium was similar in all respects to that of dehydrated acetic acid, rapid dissolution of the metal taking place.

This experience led to a similar series of experiments with propionic acid. In this case also perfect analogy between the acids was established.

It has not been possible to experiment with dehydrated formic acid, but the action of boiling 77 % acid has been briefly examined. This acid attacks aluminium very rapidly, a crystalline salt being formed.

Finally, experiments were made with a mixture of higher fatty acids, containing 55 % palmitic acid, 40 % stearic acid, and 5 % oleic acid. At temperatures up to 300° C. aluminium has been presumed to be quite unaffected by these acids, but occasionally in the course of industrial work a case of pitting has come to light which it has been quite impossible to explain.

Eastertield and Taylor (Chem. Soc. Trans., 1911, **99**, 2298) state that at temperatures above 300° C. aluminium is attacked by stearic acid, and that the corresponding ketone, stearone, is produced by the decomposition of the aluminium stearate originally formed. It seemed at first incredible that traces of water should play any part in stopping the action of these acids, at the high temperature involved. Nevertheless, observations have been made pointing to the conclusion that this is the case with the higher as with the lower acids. On heating aluminium with the mixture of the higher acids referred to, no action was noted in 6 hours below 270° C., but the metal was attacked occasionally at temperatures between 270° and 300° C. Above 300° C. attack invariably took place and, once started, continued if the heating were stopped until the temperature had fallen as low as 100° C. The form of attack is very similar to that of butyric acid, although far more rapid. When the acid was heated in a current of dry hydrogen, it was found that the attack started as low as 200° C.

To explain the immunity which aluminium enjoys from attack by ordinary concentrated acetic acid, the view may be advanced that it is due to a continuous coating of insoluble gelatinous basic acetate on the surface of the metal. The fact that a crystalline acetate, which could not form a continuous coating, is produced in the absence of all water would then account for the rapid increase in the rate of dissolution by the dehydrated acid, the sensitiveness of this action to minute traces of water depending on the rapid decomposition which the crystalline acetate undergoes on heating with water.

The action of 77 % formic acid on aluminium points to somewhat the same conclusion. Boiling 77 % formic acid differs from acetic, propionic, and butyric acids in that it dissolves aluminium rapidly. The formate produced is crystalline and, unlike the crystalline acetate, propionate, and butyrate, is stable in 77 % acid, no gelatinous formate being produced. It must, however, be noted that the attack by 77 % formic acid differs from that by the dehydrated acids investigated, in that it is uniform and not local; in this it resembles the attack by dilute acetic acid. The fact that dilute acetic acid attacks aluminium readily is not destructive of the view that the basic acetate is the protective agency, because the solubility of the acetate increases rapidly as the strength of the acid falls.

As an alternative to the above suggestion it may be proposed that the rate of dissolution of aluminium in all these acids is very high, but that whenever water is present the metal becomes coated with the well-known film of oxide which retards the action of the acid. In the absence of water this protective film would not be formed. This view finds support from the appearance of the pits formed by the dehydrated acids, and from the fact that the rate of dissolution is highest in cases where the surface of the metal has been shielded from oxidising agencies during the preparatory cleaning of the surface. This is strengthened by the behaviour of aluminium in stearic acid. It has been stated that up to a temperature of 300° C. aluminium is immune from attack by stearic acid; if, however, a piece of aluminium be amalgamated with mercury and then immersed in molten stearic acid at a temperature of 100° C., dissolution proceeds rapidly and uniformly. The rapid oxidation of amalgamated aluminium is considered to be due to the fact that a continuous protective coating of oxide cannot be formed over the surface of the metal. It is in accordance with this view that attack by stearic acid proceeds at quite low temperatures. If this alternative suggestion be correct, it should be possible to promote corrosion at low temperatures by mechanically removing the film of oxide, but this has not been found possible up to the present.

Experimental.

The metal used for the experiments was in the form of thin rolled strips 0·5 mm. thick, 70 × 25 mm. in size. The composition of the metal, when of importance, is given in the case of each experiment.

In order to eliminate any discrepancies due to the physical state of the metal, all the samples were carefully annealed at 440° C. before use. The method of annealing, which consisted of heating in a sulphur vapour bath, was selected with a view to making the conditions easily reproducible whilst ensuring a thorough release of all strains due to the rolling of the metal.

(Note.—Since these notes were written certain observations have cast some doubt on the completeness with which the annealing of aluminium can be effected at 440° C.)

After being annealed, unless otherwise stated the samples were cleaned by immersion in warm 5 % caustic soda, washed with water, plunged into warm nitric acid (1 vol. of acid of sp.gr. 1·42 to 1 vol. of water), again washed, and finally dried in an air bath at 100°—120° C.

The numerical results are all given as milligrammes of aluminium dissolved per 24 hours per 100 sq. cm. This is termed the solution rate (S.R.) throughout. Whilst this denomination is a convenient one, the figures must not be taken as indicating more than the order of the rate of attack, especially when the latter is at all local in character.

Series A. The experiments in this series were made with a view to determine the effect of air in promoting the attack of boiling acetic acid on the metal. As stated above, no acceleration of the attack due to the presence of air could be detected.

Experiment AI. The composition of the metal used was as follows:—Si 0·14 %, Fe 0·14, Cu 0·02, Al (by diff.) 99·7 %. A preliminary experiment was made in an open tube restricted at the lower end, the three test strips being at different heights above the boiling liquid. Under these conditions it was assumed that the acid vapours surrounding the upper strip (No. 50) would be diluted by a large amount of oxygen, whereas the lowest strip (No. 48) would be surrounded by almost pure acetic acid. The results show no relation between the solution rate and the position of the strip in the tube, and were quite irregular, probably owing to the difficulty of controlling the vapour supply.

TABLE I.

Time from start.	Solution rate (mgrms. per 100 sq. cm. per 24 hours).		
	Test strip, 48.	Test strip, 49.	Test strip, 50.
2 hours	3·3	6·7	6·7
8 hours	4·5	2·2	2·2
14½ hours	6·2	5·1	8·2

After 14½ hours there was evidence of local action in the shape of a small number of clean-cut circular pits. In view of the unsatisfactory result obtained in this and similar attempts, experiments were made in sealed tubes.

Experiment AII. A test strip, of which the composition was Si 0·14, Fe 0·14, Cu 0·02, Al 99·7 %, was heated, together with 99 % acetic acid and oxygen, in a sealed tube suspended in an atmosphere of boiling acetic acid vapour. After 18½ hours the tube was opened and found still to contain oxygen. The aluminium strip showed no signs of pitting, and the solution rate was only 4. The surface of the metal was covered with a uniform coating of basic acetate, insoluble in water.

Experiment AIII. Experiment AII was repeated, with the difference that instead of adding oxygen, all the air was expelled from the tube by boiling the acid and sealing the tube whilst the acid was boiling. On opening the tube under water after it had been heated during about 16½ hours, it was found to contain about 2 c.c. of gas, presumably hydrogen. The strips showed no signs of pitting, and the solution rate was only 8·5. If anything, therefore, oxygen would appear to restrain the rate of dissolution, or the diminished pressure facilitating the liberation of hydrogen was responsible for the increased rate of dissolution (cf. Ditte, Comptes rend., **110**, pp. 573, 752; see this J., 1890, 549, 654). However, both figures are very small absolutely.

Experiments AII and AIII were repeated with 90 % acid in place of 99 %. Here again the solution rate was somewhat higher *in vacuo* than in the presence of oxygen (92 against 77), but in the latter case there was distinct evidence of local action in the formation of a number of pits.

Series B. The object of this series was to determine the effect of the concentration of the acid on the rate of attack. The apparatus used in these experiments consisted of a wide boiling tube containing sufficient acid to cover the samples (about 60 c.c.). In order to prevent evaporation the boiling tube was loosely stoppered by means of a narrower tube expanded at its upper end and supplied with a cork carrying water inlet and outlet. The results are given in Table II.

It was found that, as in the case of the action at ordinary temperature, the rate of dissolution was largely increased by dilution. At the same time, the experiments indicate the influence of the composition of the metal. Until high concentrations are reached the purest metal is found to be least attacked, but with the strongest acids where the attack is small the results are less definite. Later it will be seen that with dehydrated acid very striking discrepancies obtain.

TABLE II.

Concentration of acid.	Composition of aluminium.		
	Si 0·13, Fe 0·14 Cu 0·00. Al 99 73	Si 0·21 Fe 0·19, Cu 0·00. Al 99·6	Si 0·45, Fe 0·45 Cu 0·00. Al 99·1
50 %	S.R. 315	S.R. 340	S.R. 415
60 %	285	340	405
70 %	240	280	330
80 %	210	220	295
90 %	100	120	165
98 %	33	28	35
99·9 %	3	3	7

In all cases the metal was attacked uniformly without any indication of pitting. During the course of the experiments, which were carried on during four hours, the acids up to concentrations of 98 % became turbid, owing to the separation of basic acetates.

Series C. The experiments so far described gave no evidence of the rapid corrosion occasionally observed in practice, but in one of the attempts made to control the composition of the vapours surrounding the metal, after the failure of experiment AI, the following arrangement was adopted.

Experiment CI. The test strip was placed in the upper part of a wide tube drawn at the bottom into a small bulb in which the concentrated acid was boiled, whilst by means of a glass tube a stream of dry oxygen was caused to play upon the surface of the metal. After the experiment had been in progress during nearly two hours, the surface of the test strip was covered with a white crust; when this had been removed, the metal was found to have been heavily attacked. Although a large amount of metal had passed into solution, the attack was not uniform, as in the case of the acids of low concentration. The surface of the metal was covered by a mass of small, circular, sharply defined pits. These pits were clean and bright, thus differing signally from those sometimes formed by cold acetic acid, which are almost always irregular in shape, black, and usually encrusted with a deposit of basic acetate. The distribution of the pits was by no means regular; this fact probably accounts for much of the variation in the solution rates found in subsequent experiments.

At the time, this experiment was held to confirm the view that the presence of oxygen was the governing factor, but repetition led to the most astonishing variations in the result. The experiment was repeated again and again under what appeared to be identical conditions. On some occasions the corrosion started in 15 minutes, in others no action whatever could be detected after 2 hours. The solution rates varied from 0 to over 1000.

Amongst the hypotheses raised to explain this discrepancy were the presence of traces of hydrogen chloride, the presence of sodium chloride, the presence of the aluminium acetate, and the concentration of the acid used. Each of these was tested experimentally, and it was only by a process of exhaustion that the conclusion was reached that the acetic acid underwent some change during the course of the experiment. This view was confirmed by the following experiment.

Experiment CII. The acid used in the first experiment in which a high rate of corrosion was observed had been kept, and was used again with a fresh sample of aluminium. It was found to be very active and gave the high solution rate of 1700, corrosion starting within ten minutes. This acid was found to have reducing properties, and it was thought possible that some product of decomposition of the acid was the active agent. Tests were therefore made in which small quantities of alcohol, acetaldehyde, formaldehyde, and formic acid were added to the 99% acetic acid. In each case the result was negative. Moreover, it was established that the addition of a small quantity of 99% acid to the active sample of acid used in experiment CI sufficed to destroy its activity.

The acid used in all these experiments melted at 11·14° C., equivalent to a strength of about 99%. In spite of the fact that increase in concentration between 90% and 99% led to a decrease in the solution rate, the only remaining explanation of the facts was that by passing dry oxygen through the boiling acid the concentration had been further increased. Experiments were therefore made with acid containing less water.

Experiment CIII. An acid melting at 16·16° C. was prepared by freezing out. On boiling a strip of aluminium in this acid whilst passing a slow current of dry oxygen through the liquid, rapid corrosion set in after about 70 minutes, and the mean solution rate during 2 hours was found to be 780. This experiment was repeated with fresh samples of acid melting at 16·16° C., and similar results were always obtained. Moreover, it was established that even acid melting at 16·16° C. underwent changes during the boiling, because a fresh test strip placed in the acid which had been used in a previous experiment began to corrode in about 5 minutes.

The following figures may be given as typical of those regularly obtained with acid of about 99·8% concentration.

Experiment CIV. Test strip No. 164. Composition—Si 0·14 Fe 0·14, Cu 0·02%. Original weight, 2·1276 grms. Area of surface, 36 sq. cm. M.pt. of acid before experiment, 16·16° C. Current of dry oxygen passed into boiling tube. Deposit and pitting appeared 50 mins. from start. Duration of experiment, 2 hours. Actual loss in weight of strip, 0·0126 grm. Mean solution rate, 420. M.pt. of acid after experiment, 16·51° C. Acid contained in solution Al_2O_3 equivalent to 0·69% of the normal acetate.

The experiments of this series demonstrate clearly that on boiling acetic acid in a slow current of oxygen a lower boiling constituent, which inhibits the action of the acid on aluminium, is removed, and in view of the experiment made with 99% acid and oxygen in a sealed tube (AII), it seemed clear that the action of the moving gas was not of a chemical nature. Nevertheless it was desirable to repeat the experiments of Series C, using an indifferent gas in place of oxygen. The experiments were carried out in a boiling tube closed by a rubber stopper through which three tubes passed.

By means of one tube a current of dry hydrogen was led to the bottom of the boiling tube. A secondary hydrogen inlet was formed by bending the inlet tube so that the gas played on the rubber stopper, thus preventing condensation of acid vapours. A steam coil wound around the top of the boiling tube also served to prevent condensation. (These experiments were made at a time when it was not possible to obtain ground glass apparatus.) The gases left the apparatus by means of a third tube which was furnished with a trap serving to prevent air from being sucked into the boiling tube in case of a momentary fall in the pressure.

Experiment CV. About 60 c.c. of acid (m.pt. 16·26° C.) was boiled for several hours in a current of dry hydrogen. A strip of aluminium having the composition, Si 0·13%, Fe 0·14, Cu 0·00, Al (by diff.) 99·73%, was then introduced into the acid. Streams of gas bubbles were given off within 5 minutes. After 3 hours the formation of solid acetate was noted, the acid remaining clear. During 4 hours the mean solution rate was found to be 1300.

Experiment CVI. Further to exclude the action of any possible impurities, experiment CIV was repeated with a sample of acetic acid purified by fractional distillation with potassium permanganate, as recommended by Bousfield and Lowry (J. Chem. Soc., 1911, **99**, 1432), the middle fraction, boiling between 118·3° and 118·4° C. (uncorr.), being retained. This acid, melting at 16·19° C., was boiled in a current of dry hydrogen in the apparatus described above, so as to avoid any possibility of oxidation. After one hour the melting point was redetermined and found to be 16·39° C. After a further hour it had risen to 16·46° and finally reached 16·57° C. in three hours, after which no further rise was observed.

The concentrated acid was found to attack aluminium after 20 minutes in a current of dry oxygen, thus duplicating the result obtained with unpurified acid under similar conditions.

These experiments were repeated a number of times to confirm the result obtained, and also to determine the effect of the composition of the metal on the rate of attack.

Although qualitatively the result was always the same, in that the formation of the very characteristic pits described under Experiment CI was always observed, quantitatively the results showed great variability. The solution rates fluctuated between 1300 and 77, whilst in all cases the attack measured by the rate of dissolution was greater on metal containing only 0·13% Si and 0·14% Fe than upon metal containing 0·21% Si and 0·19% Fe, but less than on metal containing 0·45% Si and 0·45% Fe. No explanation can be offered at present on this point which, however, does not appear to be of much practical importance. When dissolution ceases to be uniform, solution rates cease to be an accurate measure of the rate of corrosion. Nevertheless it is a remarkable if not unique fact, as far as aluminium is concerned, that the number of pits on the purer metal should in most cases largely exceed that on the less pure sample.

The experiments of this series show that by boiling acetic acid in a current of gas a lower boiling constituent is carried away. That this constituent can only be water was finally confirmed by Experiment CVII.

Experiment CVII. The same apparatus was used as in the last two experiments. The boiling tube was charged with dehydrated acetic acid from a previous experiment, which, therefore, contained some crystalline acetate in solution. A further quantity of the acetate was added in the solid form. The presence of this crystalline acetate served to keep the bulk of the acid dehydrated during the course of the experiment. A strip of aluminium was suspended above the surface of the boiling liquid so that it was merely bathed by the condensing acid. A current of hydrogen was passed through a U-tube, filled with glass wetted with sulphuric acid, into the vapour. Corrosion started wherever the acid condensed on the surface of the metal and continued normally. After a time, the strip was withdrawn and a fresh piece of aluminium introduced into the tube. The drying tube was now removed and the hydrogen passed directly into the vapour. No corrosion occurred in the course of the three hours during which the experiment was continued.

Series D. This result was confirmed by further experiments in sealed tubes.

Experiment DI. A strip of aluminium was heated during 22 hours at 116° C. in a sealed tube with acetic acid melting at 16·46° C. No signs of corrosion could be distinguished.

Experiment DII. A further quantity of the acid was boiled during 3 hours in the apparatus used in Experiment CIV. in a current of dry hydrogen. A small tube with capillary was then lowered into the acid and filled by alternate heating and cooling. When full the tube was withdrawn and the capillary sealed. The small acid reservoir thus formed, together with a test strip of aluminium, was placed in a thick-walled glass tube. A current of dry oxygen was passed through the tube, which was gently warmed to expel all moisture, and after cooling in a current of dry oxygen, the tube was sealed at both ends.

A second tube was prepared in the same way, except that dry hydrogen was used in place of oxygen. Both tubes were then suspended in a vapour bath of boiling acetic acid. On the temperature in the tubes rising sufficiently, the acid reservoirs, which were of thin glass, broke. By this means, any complications due to possible interactions at low temperatures were avoided, as the acid and metal did not come into contact until the boiling point had been nearly reached. In both cases corrosion commenced within a few minutes of the breaking of the tubes, but whereas, in the case of the hydrogen tube, the interaction continued until it was thought desirable to stop the heating, in the case of the oxygen-filled tube the action, vigorous at first, rapidly fell off and ceased owing to the formation of water.

Series E. Attempts were now made to prepare acid of the requisite concentration by other means. It was not found possible to effect this by fractional distillation, but heating concentrated acetic acid with acetic anhydride led to the desired result. 50 c.c. of acetic acid melting at 16·36° C., and 2 c.c. of acetic anhydride, were heated during two hours in a sealed tube at 100° C.

Experiment EI. The acid thus prepared was boiled with a strip of aluminium in the apparatus used in Experiment CIV but without a current of gas. Corrosion commenced in two minutes.

Experiment EII. A second test strip was placed in the acid used for Experiment EI, and a current of oxygen passed through the acid. Corrosion commenced in three minutes. Substituting hydrogen for oxygen the same result was obtained.

Quantitative experiments, made with acid containing a small excess of anhydride, gave results corresponding perfectly with those obtained with dehydrated acetic acid. The solution rates were of the same order, whilst the appearance of the pitted samples and the acetate formed was in every way identical. As in the case of dehydrated acid, made by passing dry gas through glacial acid, the purest metal suffered the greatest attack.

In order to make sure that the action was not due to the acetic anhydride, it was desirable to examine the effect of anhydride free from acetic acid on aluminium. This was not practicable, but by boiling samples of the metal in anhydride containing 9 % of acetic acid, which was the purest available, some evidence was obtained that the anhydride was not responsible for the particular form of attack noted with dehydrated acid containing a small amount of anhydride. In this case dissolution was perfectly uniform, without any sign of pitting, and the solution rates were 133 and 160 for the purest and less pure metals respectively.

Effect of surface condition.

During the experiments with dehydrated acetic acid prepared by heating glacial acid with a slight excess of anhydride, the influence of varying the preliminary treatment of the surface of the metal was first observed.

In the case of acids up to 99·9 % concentration, the preliminary treatment of the surface was found not to be of importance. Identical results were obtained by treatment with caustic soda, whether followed by nitric acid or not. With dehydrated acid, however, the effect of a preliminary nitric acid treatment is to retard the action. By omitting the nitric acid bath, solution rates as high as 6600 were obtained. Marked retardation was also observed in cases in which pure water was allowed to evaporate slowly on the surface of the metal.

The action of concentrated propionic acid on aluminium.

The action of boiling concentrated propionic acid on aluminium was found to be entirely analogous to that of acetic acid. The fall in the rate of attack as the concentration increases, and the almost entire absence of attack in the case of the highly concentrated acid, are very marked, whilst the attack by the dehydrated acid is vigorous in the extreme, but is very uniform in distribution.

The acid used was a sample bought as "pure concentrated propionic acid." It is probable, however, that it contained higher homologues, as the titrated strength of even the dehydrated acid was only 99·6 %. The dehydrated acid was prepared by passing a current of dry hydrogen through the boiling acid, whereby its boiling point was raised from 140° to 140·5° C. (uncorr.).

The experiments with 80 % and 99 % acids were carried out in the apparatus used in the experiments of Series B.

Concentration of acid.	Composition of aluminium.		Duration of experiment.
	Si 0·21, Fe 0·19, Cu 0·00, Al 99·6.	Si 0·45, Fe 0·45, Cu 0·00, Al 99·1.	
80 %	S.R. = 265	S.R. = 385	4 hours
98—99 %	S.R. = 5	S.R. = 10	5 hours
Dehydrated	S.R. = 200,000	S.R. = 110,000	30 mins.

With the 80 % acid no visible evolution of gas and no pitting occurred.

In the experiment with the 98—99 % acid, the whole of the loss occurred in the last hour, when the acid had almost reached the dehydrated state. During the experiment the boiling point rose from 127° C. (uncorr.) to 140° C. (uncorr.).

With the dehydrated acid action started in one minute. In six minutes the action was extremely violent, with stormy evolution of hydrogen.

The contents of the tube after the last experiment were almost solid, owing to the formation of a heavy white deposit. Under the microscope, this deposit appeared to be crystalline, but it was rapidly decomposed by moisture. Owing to the difficulty of removing the excess of propionic acid without decomposing the salt, it has not been possible to characterise the latter more closely.

The action of boiling concentrated butyric acid on aluminium.

The action of butyric acid was found to be entirely analogous to that of acetic acid. The acid used was a commercial sample, obtained through the kind offices of Messrs. Everitt and Co., of Southall. Determinations of the rate of dissolution were made (1) with acid of about 80 % concentration, (2) with the highest strength obtainable by a simple fractionation, and (3) with a dehydrated sample prepared by boiling in a current of hydrogen, by which means the titrated strength rose about 2 %. The first two experiments were made in the apparatus used in the experiments of Series B, the third in an open boiling tube into which the hydrogen was passed through a small glass tube.

Concentration of acid.	Composition of aluminium.			Duration of experiment.
	Si 0·13 Fe 0·14 Cu 0·00 Al 99·73	Si 0·21 Fe 0·19 Cu 0·00 Al 99·6.	Si 0·45 Fe 0·45 Cu 0·00 Al 99·1.	
About 80%		S.R.=275	S.R =350	4 hrs.
Obtained by simple fractionation		S.R.=2	S.R.=2	4 hrs.
Dehydrated acid	S.R.= 12,000	760	14,500	3 hrs.

With the 80% acid, no evolution of gas was noted, and solution was uniform, no pitting occurring. With the acid obtained by simple fractionation no evolution of gas and no pitting occurred. In the first hour the solution rate for both samples was 7; in the remaining 3 hours it was *nil*. When the dehydrated acid was used action commenced in 3 minutes, and after 1 hour solution proceeded rapidly. The action was intensely local. In the case of the first and third samples the pits were so numerous that they had joined up, and the whole original surface had been removed. On the second sample they were less numerous, but very large and curiously uniform in size and shape. Between the pits the metal seemed quite unacted upon.

From the acid used in the above experiment a considerable amount of a white solid was deposited on cooling; under the microscope this material was seen to be crystalline.

The action of boiling concentrated formic acid on aluminium.

To complete the series it was desirable to investigate the action of dehydrated formic acid on aluminium, but this was not feasible. An experiment was made, however, with a commercial sample of the acid boiling at 107·2° C., and having therefore the composition of the highest boiling mixture, namely, 77% acid and 23% water. In this case, a very different result was obtained from those given by the higher acids, the 77% formic acid resembling in this respect the dehydrated acetic, propionic, and butyric acids, but differing from these in that the attack was quite uniform. Solution rates of 800 to 1000 were found, and the formation of a crystalline formate was noted. This substance was insoluble in water and cold 1 : 1 nitric acid but readily dissolved by hot nitric acid. Its solubility in 77% formic acid was very small. Under the microscope the deposit appeared to consist of masses of cubic crystals which showed total extinction when viewed between crossed Nicols.

In conclusion, attention may be drawn to the practical bearing of the observations made.

For acetic, propionic, and butyric acids of high concentration, aluminium plant should have a reasonable life so long as there is no possibility of the formation of the anhydrous acids. Wherever these can be produced, as for instance by heating acetic acid with acetic anhydride, or where efficient dephlegmating arrangements are in use, the vessels are likely to be very seriously attacked unless small quantities of water can be introduced at the threatened points. Aluminium plant is not likely to have a prolonged life where it is in contact with hot acids of lower concentration.

DISCUSSION.

Professor ARMSTRONG said that the results which Dr. Seligman had put forward seemed to him to be altogether rational, and the explanation he had given seemed to be a satisfactory one from many points of view. In the case of aluminium there was a great difference between normal salts which were almost incapable of existing under these conditions, and basic salts. The fact that oxygen had so little influence in a case of this kind was not altogether surprising, since cases in which oxygen was particularly effective were those such as copper, in which the acid did not act at all, and required assistance; in the case of a metal like aluminium, which developed such a high electromotive force when it was dissolved in an acid, they would expect the hydrogen to be given off at such a rate that it would be impossible for oxygen to be absorbed by the metal.

Mr. A. C. CHAPMAN said that, to the technologist, it must be of the very greatest possible interest to know that a difference of something like 0·5 or even 0·1% made all the difference between the suitability of a certain material and its complete non-suitability for the construction of a plant. He asked what effect the physical character of the aluminium had. After all, the segregation of chemical impurities was not by any means the only factor which affected the rate of corrosion or solubility of the metal. For example, he had recently seen a large copper pipe about 6 inches in diameter, which had been bent to make an elbow, and had never been used, but had been kept in a damp store. The whole of the outer rim was perforated right the way through with large longitudinal pits, and, on the other side, where there had been compression, apart from dragging strain, no pitting had occurred.

Dr. C. A. KEANE asked if Dr. Seligman had studied the metal photo-micrographically. As pointed out by Mr. Chapman, the physical condition of these metals might be of importance, and possibly the initial pitting in the case of the butyric acid, though not visible to the naked eye, might be visible under the microscope.

Mr. CHAPMAN mentioned that electrolytic copper was very much more acted upon than copper containing ½% of impurities. That was something comparable to the action on aluminium.

The CHAIRMAN said that according to the experiments, aluminium differed from other metals. It was generally found that pure anhydrous acids had less action than in presence of water. He would ask, however, whether in preparing the anhydrous acid by acetic anhydride, the authors had distilled the two together, and had purified the acid so obtained by fractional distillation and freezing out. In other words, had they actually dealt with absolutely anhydrous acetic acid?

Dr. SELIGMAN, in reply, said that all the samples had been annealed under identical conditions, but he was not quite satisfied that the specimens were absolutely identical, because there was a question as to the efficacy of annealing aluminium at the usual annealing temperatures. But the differences remaining were extremely small, and could not possibly account for anything like the extraordinary variations shown. With regard to Dr. Keane's remarks as to the photo-micrographical examination of the samples, he said that aluminium was a very difficult subject to study photo-micrographically. It was difficult to polish, and in all cases of corrosion photo-micrographs had the disadvantage that by the time the microscope was got at work the spot which originated the corrosion had gone.

With regard to the Chairman's remarks, he mentioned that anhydrous sulphuric acid was without action on aluminium, whereas ordinary vitriol attacked it vigorously.

THE ACTION OF CERTAIN CHLORINATED HYDROCARBONS ON SOME METALS IN THE PRESENCE OF MOISTURE.

BY SOSALE GARALAPURY SASTRY.

The chloro-derivatives of ethylene and ethane that have been placed on the market as solvents for organic substances (fats, resins, etc.) are destined to take perhaps the most important place amongst the industrial solvents on account of their very high solvent power and their non-inflammability. Moreover, these solvents present a very wide range of boiling points, from 55° C. to 159° C. This affords the manufacturer an opportunity to choose the one best suited to his purpose. At present there are on the market the following chlorinated hydrocarbons :—

	Specific gravity.	Boiling point.
Dichloroethylene	1·25	55° C.
Trichloroethylene	1·47	88° C.
Perchloroethylene	1·62	121° C.
Tetrachloroethane	1·60	147° C.
Pentachloroethane	1·70	159° C.

Whilst their physical properties and solvent power seem to have been studied by a number of workers, their chemical properties, so far as they affect the manufacturer, seem to have been neglected to a certain extent, since any published work on the subject is lacking. Veley (Roy. Soc. Proc., 1910, B., **82**, 217—225 ; see this J., 1910, 233) studied the physiological properties of these solvents, and came to the conclusion that tetrachloroethane is three times as toxic as chloroform, whilst trichloroethylene was 1·5 times as toxic, molecule for molecule. Gowing-Scopes (Analyst, 1910, **35**, 238—244 ; see this J., 1910, 844) has recorded that when trichloroethylene is inhaled "it is liable to produce unpleasant symptoms." On the other hand, Clément and Rivière, who have studied some of the properties of these chlorinated hydrocarbons, have stated in their account (Caoutchouc et Gutta Percha, 1910, **7**, 4021—4022 ; see this J., 1910, 718) that tetrachloroethane is only slightly anæsthetic, whilst trichloroethylene is non-anæsthetic. In the same paper Clément and Rivière state that tetrachloroethane attacks iron and copper, whilst trichloroethylene has no action on metals in the presence of moisture.

Even though the chlorinated hydrocarbons are very stable substances, resisting the action of a large number of chemicals, yet in the presence of moisture and under the influence of heat many of them are liable to slow decomposition, especially if they are impure. It is well known that chloroform slowly decomposes under the influence of air, moisture, and sunlight, giving decomposition products such as carbonyl chloride, hydrochloric acid, etc. Even the best commercial articles are apt to contain impurities that promote the decomposition of the substance with which the impurity is associated. The chlorinated hydrocarbons are practically insoluble in water (compare Clément and Rivière, *loc. cit.*), and unless specially treated contain a certain amount of moisture. The idea naturally arose that if the chlorinated hydrocarbons decomposed to any appreciable extent under the influence of heat and moisture, then the metal of which the extraction apparatus is made may be subject to attack from this influence. If the corrosion due to the action of the decomposition products were appreciable, then the depreciation of the plant would be considerable, and manufacturers should be very careful before they use indiscriminately the solvents advertised on the market.

A series of experiments was carried out by the author to see the effect of some of the chlorinated hydrocarbons on metals in the presence of moisture. Since a number of different oil-seeds are extracted by these solvents, some of the experiments were done in the presence of some oil-seeds. The oil-seeds chosen were coconut, ground nut, and linseed.

Thin strips of metal (1½ in. by ½ in.) were heated with the solvents under a reflux condenser for ten hours, and the influence of the solvent examined by weighing the metal before and after the experiment. The solvents were used as obtained from chemical stores, without purification, and no precautions were taken to exclude moisture. However, care was taken to see that the solvents were neutral before they were used, since some of them are acid to litmus. The seeds used contained an appreciable amount of moisture. When the metals were used in contact with fatty material, they were thoroughly washed with ether and dried before weighing. The solvents examined in this way were carbon tetrachloride, dichloroethylene, trichloroethlyene, tetrachloroethane, and pentachloroethane. The metals used were wrought iron, mild steel, copper, nickel, aluminium, and lead. In the following account, whenever it is stated that the action is slight, the important fact should not be forgotten, that in a factory the materials are not extracted for only ten hours as is done in a laboratory, but for several years probably in the life of the plant, so that it is the *cumulative effect* that is to be kept in mind by the manufacturer, and in all cases it is essential that the works chemist should conduct a similar series of experiments under the peculiar conditions applicable to that factory, and advise the manufacturer on any particular solvent to be employed.

In the following tables the loss referred to applies to a surface of ½ sq. in. for ten hours :—

	Mild steel.	Wrought iron.	Nickel.	Copper.	Aluminium.	Lead.
I. Carbon tetrachloride—						
(1) In the presence of oil seeds	nil	nil	nil	0·0025	nil	0·0015
(2) By itself	nil	nil	nil	0·0050	nil	slight
II. Dichloroethylene—No action was observed on any of the metals, either alone or in the presence of oil seeds.						
III. Trichloroethylene—						
(1) In the presence of oil seeds	0·0025	0·0028	slight	0·0020	slight	0·0010
(2) By itself	slight	slight	nil	nil	nil	nil
IV. Tetrachloroethane—						
(1) In the presence of oil seeds	0·0050	0·0050	0·0008	0·0090	destroyed completely	0·0040
(2) By itself	0·0140	0·0150	0·0035	0·0150	destroyed completely	0·0062
V. Pentachloroethane—						
(1) In the presence of oil seeds	slight	slight	nil	nil	destroyed	nil
(2) By itself	0·0035	0·0030	0·0030	0·0060	destroyed	0·0060

An old specimen of carbon tetrachloride, which had been kept for a long time exposed to air, moisture, and sunlight, gave greater losses than those shown above, but the experiment could not be verified by a duplicate owing to lack of material. The specimen had not been tested for acidity and must have decomposed to an appreciable extent.

Tetrachloroethane gave the most divergent results. The table gives the most consistent obtained. In all the experiments with tetrachloroethane, it was observed that aluminium was the most easily attacked, and in almost all the cases completely destroyed. Since it is the most electropositive of the metals used it is not surprising that it should be the most liable to attack by tetrachloroethane, or rather by its decomposition products. Each of the metals was attacked to an appreciable extent. Even the smallest amount of moisture is sufficient to start the decomposition in the case of this solvent. An experiment was carried out with tetrachloroethane which had been dried over calcium chloride for 15 hours and then redistilled, and the fraction distilling at 146°—147° C. collected. Even this attacked the metals to an appreciable extent, and the attack on aluminium begins immediately on the commencement of boiling. Since tetrachloroethane itself boils at 147° C., no great amount of water can exist in solution at that temperature; still the decomposition takes place. Probably in the presence of metals and under the influence of heat tetrachloroethane loses a molecule of hydrogen chloride, giving trichloroethylene as follows:—

$$CHCl_2.CHCl_2 = HCl + CCl_2 : CHCl.$$

The acid would then act on the metals. This view is put forward tentatively.

Some of the remarks made under tetrachloroethane apply equally well in the case of pentachloroethane; the decomposition probably takes place in the following way:—

$$CCl_3.CHCl_2 = HCl + CCl_2 : CCl_2.$$

It is the author's intention to continue this work as time permits.

From the foregoing results it would appear that dichloroethylene and trichloroethylene are by far the safest solvents.

In conclusion, the author desires to express his thanks to Dr. J. L. White for the interest he has taken in the work; to Messrs. R. W. Greeff and Co. for placing at his disposal samples of trichloroethylene, tetrachloroethane, and pentachloroethane; and to the Union Oil and Cake Mills for supplying specimens of oil-seed meal.

DISCUSSION.

Dr. **RIDEAL** said that the action of the chlorinated hydrocarbons on aluminium in the absence of water might have some bearing on Dr. Seligman's results (see preceding paper).

The **CHAIRMAN** said that he did not think the paper had much bearing on Dr. Seligman's results, because in this case the action depended on the liberation of hydrochloric acid which readily attacked aluminium.

The **AUTHOR** agreed with the Chairman that the action was due to hydrochloric acid, and therefore had no bearing on Dr. Seligman's results.

A METHOD FOR THE DETERMINATION OF FREE CAUSTIC ALKALI IN SOAP.

BY F. H. NEWINGTON.

The method usually adopted for the determination of free caustic alkali in soap is to dissolve the sample in hot absolute alcohol, whereby any sodium or potassium hydroxide is obtained in solution with the soap, whilst carbonates, silicates, and borates remain undissolved and are filtered off. The alcoholic solution of soap and free caustic alkali thus obtained is titrated with standard acid solution, using phenolphthalein as indicator. The reason for using the absolute alcohol in this method is that it not only secures the separation of carbonates, silicates, and borates from the free sodium or potassium hydroxide, but it also prevents the hydrolysis of the soap material except in so far as the water in the soap itself can bring this about.

Experience of this method has shown that, in the case of toilet soaps especially, a considerable amount of absolute alcohol is needed to dissolve a sufficiently large weight of soap for test. Secondly, in filtering off the insoluble carbonates, etc., from the hot alcoholic solution, the soap is often precipitated in the form of a jelly, which clogs the filter and retards filtration. This difficulty is only satisfactorily overcome by surrounding the funnel, containing the filter, with a hot-water jacket. Thirdly, if the sample, as in the case of many soft soaps, contains much water, this so dilutes the alcohol as to cause the soap to hydrolyse to some extent, thus causing a neutral soap to appear to contain some free caustic alkali. This last difficulty may be overcome in two ways. Either sufficient absolute alcohol must be used to ensure that the percentage of water in the final solution is not sufficiently large to bring about hydrolysis, or as an alternative the soap may be first dried in a water oven. But this latter procedure introduces the further danger that atmospheric carbon dioxide may convert some or all of the free caustic alkali, that may originally have existed in the sample, into carbonate. It is therefore seen that this method presents certain weak points which are liable to cause loss of time and even error if rather elaborate precautions are not taken, whilst the cost of absolute alcohol is also a serious consideration where many samples are to be tested.

The method described below has been found to combine convenience, accuracy, and rapidity, and it is moreover economical. It is based upon the principle of "salting out" the soap from its aqueous solution by means of sodium sulphate. It is well known that the addition of common salt to an aqueous solution of soap "salts out" or completely separates the soap. This separation of soap can be effected equally well by means of sodium sulphate, and any free caustic alkali present in the sample is separated with the aqueous sodium sulphate solution. The caustic alkali thus extracted is free from soap, and may be readily determined by titrating with $N/10$ sulphuric acid, using silver nitrate as a spot indicator. The advantage of using sodium sulphate to "salt out" the soap is that by this means a solution is obtained which will not produce an insoluble compound with the silver nitrate used as indicator in the titration. If sodium chloride were used to salt out the soap, the solution obtained would, of course, form the insoluble chloride with the silver nitrate, and hence leave no soluble silver salt to react with the hydroxide. A 5 % solution of silver nitrate is sufficiently strong to precipitate any small amount of chloride that may be dissolved from the soap, and still to leave an excess of silver nitrate to react with the hydroxide. This method has been found quite satisfactory in testing toilet, household, and soft soaps, as well as soft soap substitutes.

The sensitiveness of this method has been proved by carrying out tests on neutral soaps of the types mentioned, to which 0·01 % of sodium hyrdoxide had been previously added. This amount can be readily detected and can be estimated with accuracy.

The details of manipulation found to be most convenient in carrying out the test are as follows:— A portion of the soap is taken from the centre of the sample, avoiding any superficial part that has been exposed to the air, and 10 grms. is weighed into a 250 c.c. wide-necked flask; 50 c.c. of freshly boiled, hot distilled water is added, the flask is lightly corked, and the whole heated on a hot plate until the soap is dissolved. 50 c.c. of a hot saturated solution of sodium sulphate is now added, the liquids thoroughly mixed by shaking, the contents of the flask transferred to a narrow-mouthed separating funnel, and the flask rinsed out into the separator with a further 5 c.c. of sodium sulphate solution. The separating funnel is then lightly corked, and stood perpendicularly in a beaker or other convenient stand in a hot-water oven. In a very short time the soap separates out on the surface, whilst the liquid beneath is an aqueous solution of sodium sulphate and any free alkali that was originally contained in the soap. This lower solution is run off into a beaker and titrated with *N*/10 sulphuric acid, using the silver nitrate solution as a spot indicator on a porcelain plate in the usual manner. As long as free hydroxide is present the familiar brown silver oxide is produced, carbonates, silicates, etc., giving no such colour to cause confusion. If any appreciable amount of free hydroxide is found by this first titration, the separated soap in the separating funnel may be again washed with a further 50 c.c. of the sodium sulphate solution, and this when separated is titrated as before. The total amount of *N*/10 sulphuric acid required for the titration is then calculated to percentage of sodium or potassium hydroxide in the original samples.

Throughout this test the sample is very little exposed to the atmosphere, and if the sodium sulphate and silver nitrate are tested as to their neutrality, there appears to be little source of error.

THE ESTIMATION OF CARBON DIOXIDE IN AIR BY HALDANE'S APPARATUS.

BY ROBERT C. FREDERICK.

For the estimation of small quantities of carbon dioxide in air, Haldane's apparatus is the most convenient to use, and in skilled hands it gives sufficiently accurate results. The principle is that the carbon dioxide of the air sample is absorbed by caustic potash and the consequent diminution in volume, measured on the graduated scale, gives a direct reading of the quantity of carbon dioxide present in 10,000 parts of air. A trace of dilute sulphuric acid must always be present in the air burette to keep the air therein saturated with moisture, the same purpose being achieved in the control tube by keeping the stem full. The potash solution should be of about 10% strength and the author prefers to colour it with methyl orange, movements of the liquid being thereby made more apparent; it serves for a large number of tests. A more definite meniscus is obtained if a small sheet of some black material is placed behind the marks on the tubes, R and S (Fig. 1). A blowing bulb may be used to provide the air current for agitating the water in the water-jacket, instead of blowing by the mouth; the water-jacket should be full to within about ½ inch of the top. The glass tubes and air burette must be perfectly clean, and thin pipe cleaners which can pass right through the stopcocks serve admirably for dislodging any dirt.

The air to be examined may either be taken direct into the apparatus and tested at once, or can be drawn into suitable small bottles and despatched where necessary for analysis. In the former case, the examination of the sample only requires the use of the apparatus itself, but in the latter, accessories are needed.

The following is the procedure employed when the air to be tested is taken direct into the apparatus. Having placed it where the sample has to be taken, the tap, A (Fig. 1), is turned to allow of free communication between the air burette, the absorption bulb, F, and outside, and similarly the tap, B, to allow of communication between the control tube, E, the tube, S, and outside. By raising or lowering the potash reservoir, H, the potash level is adjusted to the mark on S; the mercury in the graduated stem of the air burette is adjusted to about zero by the rack-and-pinion arrangement, L. The tap, A, is now turned to establish communication with the outside only, and then the mercury reservoir is taken off the hook at L and raised in the hand until the mercury completely fills the air burette. By replacing the reservoir on the hook, the sample is drawn in and the mercury falls to its former mark near zero. Some mercury is almost invariably caught in the stopcock and must be removed by turning tap, A, into the position that the air burette and the absorption bulb are in communication only and then sharply squeezing, at the point nearest to the stopcock, the rubber tube connecting them. The mercury globule drops into the graduated stem of D and is made to unite with the mercury of the reservoir by giving A ¼th turn, thus closing all communication, and then gently raising K in the hand; the reservoir is replaced on the hook at L. The trouble with the mercury globule can be obviated by using a stopcock, A, of the pattern having two parallel channels, suggested by Butterfield, but this necessitates the introduction of a third stopcock at the top of the tube, R. The apparatus is now placed on a table or bench, out of draughts and in a good light. The tap, A, is now again turned to place the air burette in communication with the absorption bulb only; similarly B is turned to place the control tube in communication with tube, S, only. If the potash level at S has altered, it is corrected by raising or lowering the potash reservoir and then, by raising or lowering the mercury reservoir with the rack-and-pinion arrangement, the potash level is adjusted to the mark on R. The rubber tubing connecting F and H must be sharply squeezed to make sure that the potash levels return to their marks; if they do not, further adjustment is necessary. During the time these adjustments are being made by the right hand, the left is engaged in gently blowing air through the water jacket by squeezing the blowing bulb. The potash levels being correct, the mercury level is read off on the graduated scale and noted. The carbon dioxide contained in the air is now absorbed. The air is made to pass over to the potash in the absorption bulb by taking the mercury reservoir in the right hand and slowly raising it until the mercury almost reaches the stopcock, A, the left hand meanwhile giving an occasional squeeze to the blowing bulb. This operation is repeated four times, the mercury in each case being allowed to fall somewhere in the graduated stem. The mercury reservoir is replaced on the hook at L. With a steady flow of air being maintained through the water jacket, the potash levels are adjusted to the marks on R and S as already described, the same precautions as to nipping the rubber tubing connecting F and H being taken. The mercury level in D is again read off, and this figure, less the first one obtained, gives a direct reading of the quantity of carbon dioxide present per 10,000 parts of air. For example, if the first figure was 2·2 and the second 7·8, the result would be (7·8—2·2) = 5·6 parts per 10,000. When the test is finished, the taps, A and B, should be turned to close communication in all directions, otherwise the potash may rise in the tubes and cause much trouble.

When taking samples of air in bottles for subsequent testing by Haldane's apparatus, the bottles used are 2-oz., narrow-mouthed, squat form, and closed with ground stoppers which are smeared with a thin coat of vaseline. They must be perfectly clean and dry. To prevent the stopper coming out, particularly when the bottles are exposed to changes of temperature and pressure, a broad rubber band is placed over it and under the bottle: another smaller band is doubled over this and round the neck to keep the first one in position.

The air sample is collected in the following manner. One end of a rubber tube ($\frac{3}{16}$ in. bore and about $2\frac{1}{2}$ ft. long) is introduced into the bottle until it rests on the bottom, the other end being held in the mouth; air is then sucked through, and the tube removed while the air is still being sucked up. It need hardly be emphasised that no breath should be allowed to pass backwards into the bottle, and it is also important that the bottle should be held at arm's length to prevent contamination of the air in the immediate vicinity of the bottle. The stopper is inserted, turned round, and secured with the rubber bands.

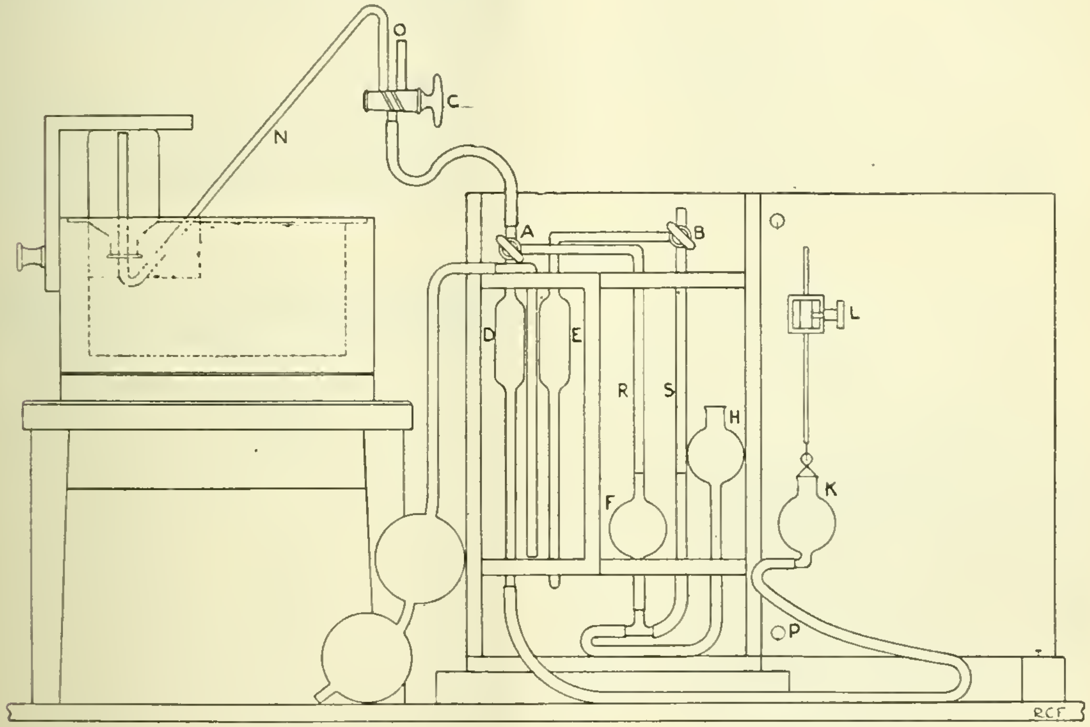

Fig. 1.

Arrangement of complete apparatus for the determination of carbon dioxide in air samples by Haldane's apparatus.

The extraction of the air from these sample bottles requires the use of a mercury bath and a bent glass tube, N, of narrow bore, fitted with a three-way stopcock, C, of the pattern illustrated. This glass tube is attached to the stopcock, A, of the Haldane apparatus by a piece of rubber tubing. The mercury bath is made of wood and has a narrow slit, $\frac{5}{16}$ in. wide, $3\frac{3}{4}$ in. deep, and 6 in. long, which broadens out at the end in which the bottle is opened to a rectangular space, $2\frac{7}{8}$ in. long, $1\frac{1}{2}$ in wide, and $1\frac{1}{2}$ in. deep. Butterfield has suggested the useful clamp shown, and also the provision of a raised flange about $\frac{5}{16}$ in. high, which prevents overflow of mercury during the process of removing the stopper of the bottle. A lid which fits the depression caused by this flange prevents access of dust whilst the bath is not in use. It is necessary that the bath be raised up, and the author has had the little table shown made for this purpose. It is $7\frac{1}{2}$ in. high, and the top, $9\frac{1}{2}$ in. long and $7\frac{1}{2}$ in. broad, has a rim $\frac{3}{4}$ in. high round it which prevents any loss of mercury. The arrangement of the complete apparatus is shown in Fig. 1. The Haldane apparatus itself rests on a block of wood inside a dish, which serves to catch any water that may overflow when the water in the water jacket is being agitated. The bottle is placed, neck first, into the mercury, the stopper removed by two fingers, and the bottle clamped rigid. The taps, A and B, of the Haldane apparatus are turned to allow of free communication throughout in the manner previously described. The potash is then adjusted to the mark at S and the tap, A, turned to establish communication between the air burette and the outside only; the mercury should read about 7 on the graduated scale of D. The rubber tubing fastened to the stopcock, C, the latter being open to the bent tube, N, is attached to the stopcock, A. Holding the glass tube, in the left hand, over the mercury bath, the mercury reservoir is taken from the hook at L and raised in the right hand until the mercury completely fills the air burette, the rubber connection, and the glass tube. Still holding the mercury reservoir above the level of the bent tube, N, the tap, C, is turned to close communication in all directions; the tap, A, is similarly treated by giving $\frac{1}{8}$th turn. The tube, N, is now pushed through the mercury in the bath into the sample bottle and the mercury reservoir attached to the hook, P. Stopcock C is opened to A and N, and A to the air burette only. The mercury now returns to the reservoir and air from the sample bottle is drawn into the Haldane apparatus. When D becomes about half full of air, the rubber tube between A and C is closed by firmly pressing with two fingers, and when the mercury has quite stopped flowing, the fingers are suddenly withdrawn and the mercury allowed to continue running. This last operation is necessary to dislodge mercury which frequently remains in the

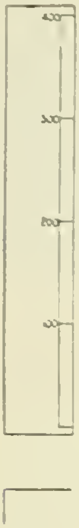

FIG. 2. Scale for use with Haldane's apparatus.

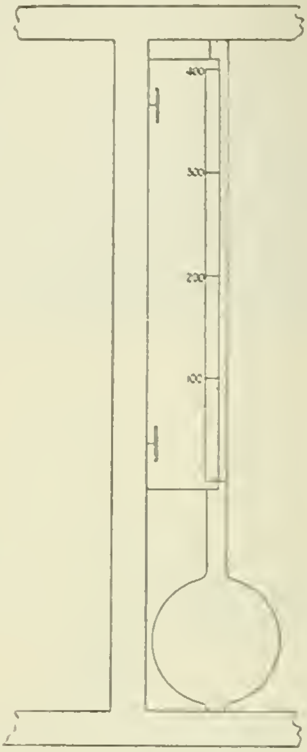

FIG. 3. Scale in position

rubber connection. In a few seconds the mercury comes to rest and the taps, C and A, are again turned to close communication in all directions. More air has been extracted than is required for the test, and the excess is blown off by placing K on the hook at L, opening A to C and the latter to O. The tap, A, is turned to establish communication between the air burette and the absorption bulb only, and similarly B to place the control tube in communication with the tube, S, only. From this stage the manipulation is the same as described in the account of the procedure employed when the apparatus alone is used, and the same point, namely, the admission of the air into the Haldane apparatus, has been reached. The mercury globule is removed, the potash levels adjusted, the carbon dioxide absorbed, and the levels readjusted as before, the same attention to detail being manifested.

With the ordinary small Haldane apparatus, the method of using, which has just been described, gives readings up to 100 parts per 10,000. In the great majority of cases this is quite sufficient, but it sometimes occurs that the amount of carbon dioxide is much above this figure, and the following is an account of the author's simple device for making the apparatus record up to 500 parts per 10,000.

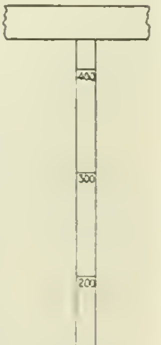

FIG. 4. Graduation of tube itself.

First, it is necessary to measure with absolute accuracy the distance the potash level rises in the glass tube, R (Fig. 1), when the mercury is brought from 100 to 0 on the air burette scale, the level in S being kept at the mark. It is understood that air is enclosed as it would be if ready for absorption of carbon dioxide. A stiff piece of cardboard is now marked down one side with four divisions, each being exactly this distance found; the other side is bent at right angles. The result is a scale as shown in Fig. 2. This is pinned with drawing pins to the outside of the water jacket, as shown in Fig. 3, the zero coinciding with the mark on R (Fig. 1), and the edge of the scale running down the centre of the tube. When in use, the potash level is adjusted in the usual way, after absorption of carbon dioxide, to the nearest hundred mark, and the reading on the air burette scale also taken. If the mercury reservoir has been raised the result is obtained by adding the increase on the air burette scale to the reading on the cardboard scale, and similarly, if the mercury reservoir has been lowered, by subtracting the decrease on the air burette scale from the reading on the cardboard scale. Two examples will make this clear.

Ex. 1. Before absorption. Air burette scale, 6·4.
After absorption. Air burette scale, 77·8. Cardboard scale, 200.
(77·8 − 6·4) + 200 = 271·4 parts CO$_2$ per 10,000.

Ex. 2. Before absorption. Air burette scale, 8·6.
After absorption. Air burette scale, 2·8. Cardboard scale, 300.
300 − (8·6 − 2·8) = 294·2parts CO$_2$ per 10,000.

Such a cardboard scale is, of course, only meant for occasional use; a permanent arrangement can be obtained by having the tube, R, itself (Fig. I) graduated as shown in Fig. 4.

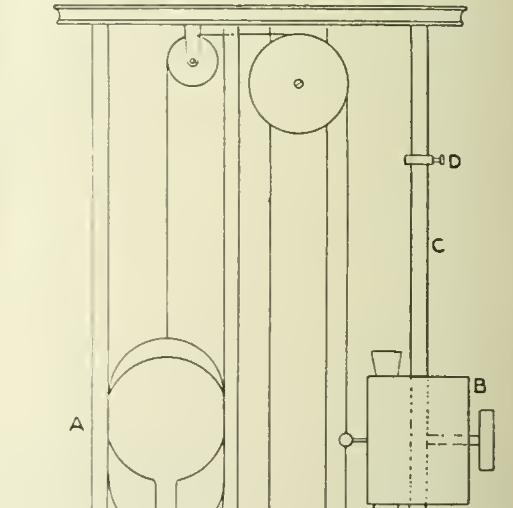

FIG. 5. Mercury reservoir propelling apparatus.

The apparatus shown in Fig. 5 is a useful adjunct to the Haldane apparatus when used for testing samples in the laboratory. If a large number of tests have to be done, the physical effort required to lift the mercury reservoir up and down becomes a serious consideration. This apparatus is 19¾ in. high, and the sizes of the parts can be judged from this. It is large enough to work with the more modern form of the Haldane apparatus, which is contained in a larger case than the older pattern. A is a boxwood cage or nest into which the mercury reservoir can easily be placed and as easily removed. It is connected by a cord, over pulleys, to a brass lead shot container, B, which slides up and down the rod, C. This container balances the mercury reservoir. In use, the reservoir, after the first reading has been taken, is placed in the cage and raised or lowered by moving B down or up C. The adjustable stops, D, compel the mercury to travel between any points desired, and prevent it rising too far and flowing into the potash or falling too low and drawing in the potash. The narrow bore of the air burette ensures that the mercury will not travel too quickly. When sufficient absorptions have been given, the mercury reservoir is taken from the cage, replaced on the hook of the rack-and-pinion arrangement, and the analysis completed in the ordinary way. The idea was suggested to me by Macfarlane and Caldwell's gas analysis apparatus, and the instrument is made by Messrs. Baird and Tatlock, London.

DISCUSSION.

Mr. J. S. S. **BRAME** said that he, in conjunction with the author, had had a good deal of experience in teaching medical officers of the Navy to try and use this apparatus. They had met with a good deal of difficulty, owing to the fact that a person without experience put the potash into the mercury and the mercury into the potash, *ad lib.*, and the apparatus had to be taken down. Any improvement, such as Mr. Frederick's, which enabled that difficulty to be overcome, was of great use. He did not regard the Haldane apparatus as one likely to give accurate results without considerable practice and experience. When the percentage of carbon dioxide did not exceed 0·04 or 0·05% on 22 c.c. of air, the total absorption would be very minute and required very delicate manipulation, and a good deal of practice, to get good results. He thought the stirring apparatus was the most faulty point, provided the water was blown through. Blowing through the water was a bad method. He had found that by blowing with the mouth, which was necessary, a rise in temperature of 0·033° C. per minute was produced. With a gentle blow, 0·022° C. was obtained. To get over that difficulty, he had introduced a rubber pressure bulb, but there again the difficulty occurred that the air which went in was not saturated with water, but came out saturated. The apparatus must be carefully used to get the temperature fairly constant. He suggested it would be a great improvement in the use of the apparatus if the air were first warmed, and bubbled through the water before being passed into the bath.

Dr. S. **RIDEAL** said that the useful additions the author had made to the Haldane apparatus could be applied to other apparatus worked on the same principle by the lifting of a mercury bulb. Dr. E. K. Rideal had recently brought before the Society of Public Analysts an apparatus for determining the amount of humidity in the air by a bulb in the same way, in which air was passed through hydrochloric acid instead of potash for absorbing the moisture. It was practically on the same principle as Dr. Haldane's apparatus. A box had been made for that purpose, of the same size as the Haldane apparatus. For frequent determinations of the humidity in the air, the method of raising the mercury would apply equally, and it might be used in any apparatus which involved the use of a mercury bulb.

Mr. W. J. A. **BUTTERFIELD** said that some 25,000 samples of air had passed through his laboratory for analysis by the Haldane apparatus. He doubted the accuracy of the method of determining higher proportions than 100 parts in 10,000 by the modification described, because the tube in which the measurement of the larger volume was made, if he understood it, was outside the water jacket. He thought a far better way was to use a burette with a wider stem graduated for the larger proportion. It was generally known whether the sample of air was likely to contain less or more than 100 parts or thereabouts of CO_2 per 10,000. Mine air frequently contained 2 or 3% of CO_2, and an apparatus fitted with another burette was used. With regard to the arrangement for relieving oneself of the mercury bulb, an assistant of his had devised a very similar device, and he had also used the method of blowing through an ordinary Woulffe's bottle containing water, instead of blowing direct into the water jacket. He did not see that the temperature of the breath or the cooling by evaporation came into account, because the essence of the apparatus was the complete control it afforded over the effect of changes of temperature. The whole principle of the construction of the apparatus was that changes of temperature in the water jacket within any reasonable limits, could not affect the results.

Mr. R. C. **FREDERICK**, in reply, said that he had used the ordinary small apparatus with this graduation, in tests carried out by Professor Haldane and himself, and in every case they had obtained concordant results. As to blowing air through the water jacket, a great deal of difficulty came in, because in the older type of bulb of the air burette, it came so close to the top of the Haldane case that it was really never covered. In the newer form in which the water jacket was a cylindrical glass jar, the bulb was very much lower in the water, and was covered. He had drawn Professor Haldane's attention to that fact, and Prof. Haldane said that he did not think he could go very far wrong if he omitted to blow at all in the newer one, although it was essential in the older ones. Very bad results were obtained, because people did not pay sufficient attention to that. Certainly in the published accounts of the apparatus, sufficient attention had not been paid to that point.

EXHIBITS.

Mr. C. A. **HILL**, representing the British Drug Houses, Ltd., exhibited specimens of barium hydroxide, chromic acid, copper sulphate, iodic acid, molybdic acid, ammonium molybdate, ammonium oxalate, potassium chromate, potassium bichromate, potassium iodide, and stannous chloride, prepared as analytical reagents to meet the standards of purity laid down by the Joint Committee of the Institute of Chemistry and the Society of Public Analysts.

Dr. **WILBRAHAM**, representing Coley and Wilbraham, Ltd., exhibited natural and synthetic succinates.

Mr. **SHERARD COWPER-COLES** (Lead, Ltd.) showed various pieces of apparatus coated with lead.

Messrs. **J. MONCRIEFF, LTD.**, exhibited chemical apparatus made of their new glass, which is stated to be capable of resisting the action of chemical reagents to an extent quite equal to that of Jena glass. Among their exhibits was some combustion tubing, manufactured in Great Britain, which was stated to be unique.

Dr. Morris W. Travers (Duroglass, Ltd.) gave a brief description of an exhibit of chemical glass ware, also made to replace Jena glass.

Messrs. Doulton & Co., Ltd., had a large display of chemical porcelain ware, including some very large evaporating basins. This firm state that they have overcome all difficulties in the manuacture, and there is independent testimony that Doulton's porcelain is as good as, if not superior to that previously made in Germany.

Mr. Thomas D. Morson (T. Morson and Sons, Ltd.), Hon. Secretary, showed filter cloths woven from glass wool which could be employed for filtering acids and alkalis. This glass cloth, he said, was the outcome of an idea of his colleague, Dr. Roy; it presented, when viewed under the microscope, a linted appearance, which was an important aid to filtration. Since it did not absorb any of the filtered material, the fabric could be cleansed readily and used again and again.

Obituary.

HENRY ENFIELD ROSCOE.

The sudden death on December 18th of Sir Henry Enfield Roscoe removed from our midst one of the pioneers of scientific and technical education in this country. Born in 1833 in London, Roscoe received his school education in Liverpool, but in 1849 returned to London and entered University College. Here he turned by a natural proclivity to chemistry and under the inspiration of Graham made up his mind to adopt this branch of science as his profession. After graduation in 1853 he proceeded to Heidelberg and commenced work under Bunsen, a step which proved decisive in his career. Roscoe's association with Bunsen soon ripened into a close and enduring friendship and his outlook on science and education received an impress which it never lost. At this time were commenced the researches on the photochemical action of light, which were pursued at Heidelberg during summer vacations until 1862.

Shortly after his return from Germany, Roscoe was appointed in 1857, at the early age of 24, Professor of Chemistry at the Owens College and entered on the chief work of his life. For thirty years he occupied this Chair, exerting an incalculable influence on the development of scientific education, at first in his immediate surroundings and more gradually throughout the whole country. During his professorship the Owens College gradually grew in strength and importance and not long before his retirement, and largely in consequence of his persistent labours, it was constituted one of the colleges of the Victoria University (1880). With the College grew the Chemical School, and by 1885, the 15 students who had greeted the youthful professor in 1857 had increased to 120.

Fresh from the busy laboratory of Bunsen, Roscoe plunged into research at Manchester and met with gratifying success. The merit of his investigations on the chemical action of light was recognised by his election to the Royal Society in 1863. The well-known work on the boiling points of the aqueous acids was also published in these early years, and in 1865 commenced the researches on vanadium, which resulted in the preparation of the pure metal and the discovery of its true relation to the other elements. Many other subjects were investigated and with the aid of Schorlemmer, first as lecturer and then as professor of organic chemistry, and a long list of distinguished assistants, an atmosphere of original research was created and a true school of chemistry founded in Manchester, which still flourishes and is one of the chief ornaments of the Northern University.

Roscoe's teaching was eminently simple and practical. He himself delivered two courses of lectures—senior and junior—each well illustrated by striking experiments successfully arranged—or even sometimes engineered—by his inimitable assistant, Joseph Heywood. To this was added a daily perambulation of the laboratory—every student came into frequent direct contact with the professor and received advice and criticism according to his needs. In this lay one of the secrets of his success as a teacher, and the inroads which the practice must have made upon his time were well repaid by the increased zeal and interest of his students.

Roscoe's influence as a teacher was extended far beyond the limits of his laboratory by his writings on chemistry—ranging from the Primer (1870)—written in three weeks and enormously successful—through the Elementary Lessons (1866) to the Treatise on Chemistry, familiar to his students as "Roscoe and Schorlemmer" and still filling a definite place in scientific literature.

The situation of Manchester in the midst of industries—chemical, engineering, textile—of which it formed the business metropolis, could not fail to produce a profound impression on a man of Roscoe's disposition. He saw all round him evidences of a lack of co-ordination between the various industries of the district, and even between different branches of the same industry. He saw also and keenly realised to what a large extent many industries suffer, alike from the lack of scientific knowledge of the manufacturers and from the inadequate education of the workmen. In different ways Roscoe became actively engaged in the improvement of all these conditions. The institution of provincial universities has provided the manufacturer with the opportunity, unfortunately still too seldom seized, of obtaining a sound scientific education, and at the same time created a school of young well-trained men capable of taking up the duties of scientific assistants in technical concerns.

As regards the provision of technical education in the principles of the great industries of the country, Roscoe took a very prominent part. He was one of the members of the Royal Commission on Technical Instruction (1881) and devoted a large amount of time and energy to the cause. The Commission, after a series of visits to the chief centres of technical instruction on the Continent, issued its well-known report in 1884. This was followed by the formation of the National Association for the Promotion of Technical Education in 1887, by the passing of the Technical Instruction Act in 1889, and by the allocation of the necessary funds in 1890. Since that time much has been said and done on the vexed question of technical education, but to Roscoe and his colleagues on the Commission of 1881 belongs the credit of having inaugurated a system which is likely to be of fundamental importance in the pending industrial struggle. In recognition of his services on this Commission, Roscoe in 1884 received the honour of knighthood, at the recommendation of Mr. Gladstone.

Roscoe also took a leading part in the formation of the Society of Chemical Industry,* among the objects of which were the promotion of the application of chemical science to industries and of the interchange of ideas between professional and industrial chemists. Our Society owes much to the wisdom and foresight of its first President and has always gratefully acknowledged its debt, the crowning mark of this recognition being the award of the Society's medal in 1914 (see this Journal, 1914, 723).

In 1885, largely influenced by the hope of aiding in the improvement of the position of education in this country, Roscoe successfully contested the Parliamentary division of South Manchester and he continued to represent the division until 1895, when he was defeated by the Marquis of Lorne. In Parliament he supported the Liberal and Home Rule Party but devoted himself chiefly to the cause of secondary and technical education. Political occupations in London were soon found to be incompatible with academic duties in Manchester, and to the great regret of his colleagues and students Roscoe resigned his chair in 1885. His life in London was for many years one of great activity, and he took a leading part in many of the scientific and educational movements of the day. Thus he was very appropriately President of the British Association at the Manchester meeting in 1887, and for six years (1896—1902) did battle as Vice-Chancellor on behalf of the London University. Academic and scientific distinctions were showered upon him and science was honoured in his person in 1909, when he was appointed a Privy Councillor.

Advancing age, accompanied by increasing deafness, gradually caused him to withdraw from most of his public engagements, and to seek rest and quiet in his charming country house on the Surrey Downs.

He always, however, retained his membership of the Governing Body of the Lister Institute, in the foundation of which in 1891 he had taken a prominent part, and devoted much time and thought to its affairs. The end came suddenly and cut him off in the full enjoyment of his mental faculties, interested to the very last in all that concerned his chosen science.

He married in 1863, Lucy, daughter of Edmund Potter, F.R.S. Their only son died while a student at Oxford. Lady Roscoe died in 1910, and two daughters survive him.

Roscoe was a man of the most genial character; everywhere he made friends, and always he rejoiced to meet them. To become a student of Roscoe's was to gain a friend for life, and the bond of affection between him and his former students was pleasantly manifested on many occasions—in the presentation of his portrait after his resignation of the Chair of Chemistry at Owens; at the celebration of the jubilee of his graduation (1904), and finally in the presentation of his portrait bust to the Chemical Society (1913) on the completion of his eightieth year.

Throughout his long and busy life Roscoe was distinguished by breadth of outlook, decision of mind, and a sound commonsense view of affairs. Such qualities can ill be spared and many of us who knew him well will look back with regret at his empty place during the period of storm and trial which now awaits us.

Arthur Harden.

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*For a full account of this, see the Journal, 1906, 661, and Roscoe's Life and Reminiscences, p. 173.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

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I.—GENERAL; PLANT; MACHINERY.

Patents.

Furnace walls. R. Grabowsky, Hanover, Germany. Eng. Pat. 2617, Feb. 18, 1915.

To prevent the deposition of clinker, water-cooled bars of wedge-shaped section are embedded in the walls, with their bases projecting beyond the surface on the side open to the grate. —W. F. F.

Extraction by means of a volatile solvent [*e.g.*, *of oil from seeds*]; *Operating plants for* ——. C. Downs and R. A. Bellwood, Hull. Eng. Pat. 4070, Mar. 15, 1915.

Heat is economised by using the hot vapour expelled from the residue, after removal of the solution of the extracted matter, to evaporate the solvent from this solution.—W. F. F.

Vacua; Production or regulation of —— *and means therefor.* Siemens und Halske Akt.-Ges., Siemensstadt, Germany. Eng. Pat. 14,918, Oct. 21, 1915. Under Int. Conv., Nov. 14, 1914.

The apparatus utilises the repulsive action of a heated surface on the molecules of residual gas. A surface which may be blackened and heated, electrically or by heat rays or otherwise, on one side, and insulated on the other side, is placed in an auxiliary vessel connected with the vessel to be evacuated, with the blackened surface facing away from the space to be evacuated. The length of the working space, *i.e.*, the distance between the heated surface and the outlet for the gas, is approximately equal to the mean free path of the molecules. A pump for producing and maintaining a preliminary vacuum is used. Several modifications and combinations of repelling surfaces are described.—W. F. F.

Separator; Centrifugal ——. D. Burtch, Toronto. U.S. Pat. 1,161,839, Nov. 30, 1915. Date of appl., Dec. 31, 1914.

The drum is rotated about a horizontal shaft supported by two standards, one of which is fixed and carries a cylindrical casing enclosing the base of the drum; a set of pans, enclosing the remainder of the drum, extends from the cylindrical casing to the opposite standard, which is adjustable horizontally. The material to be separated is fed into the drum through one end of the shaft, which is made hollow for that purpose.—W. H. C.

Separator: Centrifugal ——. G. E. Sanford, Oak Park, Ill., Assignor to Sanford Clarifying and Separating Co. U.S. Pat. 1,161,981, Nov. 30, 1915. Date of appl., Feb. 27, 1911.

A rotating vertical cylinder is provided at its open ends with annular flanges directed inwards, the lower flange being slightly the wider. Conical plates are mounted within and on the same shaft as the cylinder so as to deflect the liquid to the lower part of the periphery. The liquid is discharged at the upper flange, its surface being skimmed by an annular ring dipping into it, and situated just below the discharge flange. —W. F. F.

Filter. I. Kitsee, Philadelphia, Pa. U.S. Pat. 1,162,214, Nov. 30, 1915. Date of appl., Apr. 24, 1914.

A mixture of comminuted particles of a material which can be charred, with a cement consisting of a compound of phenol and formaldehyde, is moulded and heated under pressure in a closed vessel, to form filter-plates.—W. H. C.

Refrigeration; Process of ——. G. A. Gase, Assignor to The Iceless Machine Co., Cleveland, Ohio. U.S. Pat. 1,162,346, Nov. 30, 1915. Date of appl., June 11, 1914.

Aqueous ammonia is heated so that part is driven in the liquid form in one directon, and part has the gas driven off in another direction and liquefied. The liquefied gas and solution are directed towards one another, the latter being in such quantity that it passes the expansion coil and checks the liquefied ammonia before the latter reaches the expansion coil. The temperature of the residue of the solution is then reduced, whereby the displaced solution is drawn back, followed by the refrigerating gas, and the latter is re-absorbed. —W. F. F.

Drying-cylinder. O. W. Dodge, Spokane, Wash. U.S. Pat. 1,163,224, Dec. 7, 1915. Date of appl., Oct. 2, 1912. Renewed Mar. 8, 1915.

Steam is admitted through a hollow trunnion at one end of a horizontal drying cylinder and is conveyed through a pipe to the opposite end before discharge. A drain pipe is provided for any condensed water, and scoops, connected by bent pipes with the drain pipe, serve to remove liquid from the bottom of the cylinder.—W. H. C.

Evaporating or concentrating liquids: Apparatus for ——. E. Shaw, London. U.S. Pat. 1,164,413, Dec. 14, 1915. Date of appl., Mar. 16, 1915.

See Eng. Pats. 13,602 of 1914 and 128 of 1915; this J., 1915, 809.

Methods of exhausting incandescence lamp bulbs or similar glass receptacles. Eng. Pat. 1088. *See* IIb.

Separation of china-clay, ochre, and similar materials. Eng. Pat. 24,077. *See* VIII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Nitrogen in coal and coke; Determination of ——. O. Simmersbach and F. Sommer. Stahl u. Eisen, 1915, **35**, 601—605. Z. angew. Chem., 1915, **28**, Ref., 481—482.

In the authors' process, which is based on Dumas' method, 1 grm. of the finely-divided coal or coke is mixed with 26—27 grms. of finely divided copper oxide, the mixture filled into two boats of glazed porcelain and heated in a combustion tube in a Heraeus electric furnace; before heating the combustion tube, air is displaced from the apparatus by carbon dioxide. The volume of nitrogen, after purification in the usual way, is measured. Small quantities of carbon monoxide and nitric oxide are always formed. To remove these, the gas is mixed with a small quantity of oxygen, and then treated in an absorption pipette first with ammoniacal cuprous chloride and then with dilute sulphuric acid; the nitrogen peroxide reacts with the ammonia to form ammonium nitrate and nitrite. The volume of the gas is then again measured, and the mean of the two values is taken as the true volume of nitrogen. This method gives considerably higher values than the various modifications of the Kjeldahl method, namely up to 55% higher in the case of coal and up to 27% in the case of coke, and by its use it was possible to obtain satisfactory agreement between the nitrogen content of a gas coal and the sum of the nitrogen contents of the coke, tar, ammonia, cyanogen compounds, and gas derived from the coal.—A. S.

Petroleum; Cracking and distillation of —— under pressure. B. T. Brooks. J. Franklin Inst., 1915, **180**, 653—672. (See also this J., 1915, 412.)

From 3 to 20% of gasoline, boiling below 150° C., was obtained by cracking Texas solar oil (sp.gr. 0·8862), alone and in the presence of various contact substances, at temperatures between 400° and 600° C., at atmospheric pressure; the gasoline was highly unsaturated, the loss by treatment with concentrated sulphuric acid averaging about 28%. Various proposed methods of hydrogenation are also considered; the oil-steam-iron process for hydrogenating olefines and preventing deposition of carbon is stated to be inadequate. The disagreeable odour of highly cracked gasoline was removed by treatment (desulphurisation) with alkaline plumbite, copper oxide, or metallic sodium. In experiments on the distillation of heavy petroleum oils—mainly Oklahoma reduced oil. 30° B. (sp.gr. 0·875)—under pressures up to 450 lb. per sq. in., the yield of gasoline increased with the pressure, up to about 32% at 250 lb., and then declined; the olefine content of the gasoline decreased as the pressure increased up to 200 lb. and then remained constant, this result being ascribed to polymerisation rather than hydrogenation. As regards processes in which oil is cracked while in the form of vapour, it is pointed out that heavy oil can only be completely vaporised at very low pressures. Gasoline obtained by cracking the vapour of Oklahoma reduced oil under a pressure of 100 lb. per sq. in., consisted chiefly of normal paraffin hydrocarbons but contained about 8% of benzene, toluene, and *m*-xylene. The formation of aromatic hydrocarbons from petroleum oils by this means is regarded as due to the splitting or cracking of high-boiling, complex hydrocarbons containing the phenyl radicle (not to the dehydrogenation of naphthenes, formation of acetylene, and condensation of the latter to benzene, etc.), and evidence is adduced in support of this hypothesis.—W. E. F. P.

Gasoline from heavier petroleum oils. C. Ellis and A. A. Wells. J. Ind. Eng. Chem., 1915, **7**, 1029—1033.

The results of experiments with several forms of tubular cracking apparatus are described. Using kerosene of 42° B. (sp.gr. 0·814), yields of gasoline (b.pt. up to 150° C.) of 18—28% were obtained at 450°—600° C. By distilling off the gasoline and re-treating the residue, and also scrubbing the gaseous reaction products with oil, yields of 40—45% of gasoline were obtained. The gasoline was denser than normal gasoline of the same boiling point, had a higher refractive index, and was unsaturated; the iodine value of the distillation fractions was higher the lower the boiling point, a fraction of b.pt. below 70° C., for example, having an iodine value of 310, whilst a fraction of b.pt. 150°—165° C. had an iodine value of about 50. On standing for a long time the gasoline became darker in colour, and when subsequently distilled, a violent reaction occurred at about 160° C., resulting in the production of a dark brown viscous oil. A similar reaction occurred at about 110° C. on distilling under diminished pressure (6—10 mm.). The viscous polymerised product reacted violently with sulphur and with sulphur chlorides, a viscous oily mass being produced. Hydrogenation improved the odour of the gasoline, changed the colour from light straw-yellow to water-white, and destroyed the tendency to polymerise. About 16—18% of uncondensable gases was produced during cracking. The gas contained up to nearly 40% of olefines, and small quantities of carbon dioxide and monoxide, oxygen, and hydrogen. When it is treated with chlorine, a liquid of sp.gr. 1·176 and b.pt. 90°—200° C. is formed. No difference could be detected between the effects of water and of steam in the cracking process. The yield of gasoline diminished when the ratio of water to oil was greater than 30 : 70. The gasoline left a gummy residue when used in a carburettor, but gave satisfactory results after hydrogenation. The chief disadvantages attaching to the various methods of cracking petroleum are summarised as follows:—*Still cracking under normal pressure.* Very high cost of maintenance owing to rapid destruction of the still bottom; the method has been practically abandoned. *Still cracking under high pressure.* Short life and limited size of the stills. *Tube cracking.* Local superheating of tubes, and formation of carbon deposits which clog the tube and tend to weaken the metal by carburisation. *Heating with aluminium chloride, etc.* High cost of recovering the reagents. *Contact with molten metal.* Difficulty of obtaining efficient admixture. —A. S.

Bituminous shale oils containing sulphur (ichthyol oils); Chemical constituents of ——. H. Scheibler. Ber., 1915, **48**, 1815—1826.

On distilling a sample of crude shale oil containing sulphur, from the South of France, under reduced pressure, the lower fractions distilled without difficulty, but on continued distillation there was much frothing and decomposition. All fractions, particularly the high-boiling fractions, contained substances, probably organic acids, phenols, and mercaptans, together with hydrocarbons such as cyclopentadiene, indene, and fluorene, which combined with sodium giving dark-coloured nsoluble compounds. On removing these constituents by treatment with sodium, and then basic substances by treatment with dilute acid, the oil becomes lighter coloured, loses its original unpleasant smell, and can be distilled under reduced pressure without decomposition. Traces of oxygenated substances, probably ketones, which remain after the removal of these constituents, can be removed by means of magnesium halogen-alkyl derivatives, when a light yellow oil with a pleasant smell remains. The greater part of this oil distils at 140°—200° C. at 360 mm., the argest fraction distilling at 170°—180° C. The ower fractions are almost colourless, the colour gradually deepening, until the final fractions are yellowish-brown with a marked green fluorescence. The sulphur content gradually decreases from 15% n the lowest boiling fraction to 11·4% in the highest boiling fraction. The fraction 170°—180° C. at 360 mm.) on treatment with aluminium hloride and acetyl chloride yields propyl- or butyl-aceto-thienone, giving a crystalline semicarbazone or mixture of isomeric or homologous semicarbazones, m.pt. 178°—192° C., indicating that this fraction consists largely of propyl- or butyl-thiophene or closely-related thiophene compounds. Similar substances are present also in the remaining fractions. When a drop of any fraction is mixed with an ice-cold solution of phenanthraquinone in a large excess of glacial acetic acid, and a drop of concentrated sulphuric acid added, a violet-red coloration is produced. On pouring the reaction mixture on to ice and then extracting with chloroform a yellowish-brown colouring matter is obtained.—T. C.

Oil from the Kimmeridge shale of Saint-Champ; Sulphur-containing ——. J. Demesse and G. Réaubourg. Bull.Sci.Pharmacol.,1915,22,28—31.

A sample of the shale from St. Champ (Ain, France) had the following composition:—Clay, 3; Fe_2O_3, 2·6; MgO, 3·3; CaO, 45·0; SO_3, 0·2; P_2O_5, 0·2; CO_2, 38·6; oil and bituminous matter, 6·7; and water and loss, 0·4%. On dry distillation it yielded a brown oil with greenish fluorescence, sp.gr. 0·955 at 16·5° C., and the following composition:—H, 9·2; C, 77·3; S, 11·99; N, 0·37; and O, 1·14%. When this oil was fractionally distilled the first portion (80° to 100° C.) contained no sulphur; the fractions (about 50%) distilling between 100° and 260° C. corresponded to the "ichthyol" of Baumann and Schotten (Ber., 1884, R., 176); and the fractions above 260° C. also contained sulphur and could be readily sulphonated. This shale oil has antiseptic and therapeutic properties, which are increased by sulphonation.—C. A. M.

Utilisation of aromatic hydrocarbons from cracked petroleum [for the preparation of trinitrotoluene]. Rittman. *See* III.

Patents.

Fuel or the like; Furnaces for the preparation of artificial ——. V. Groom, London. Eng. Pat. 24,085, Dec. 15, 1914.

In a furnace for coking briquettes or ovoids of combustible substances, each of a number of superposed heating chambers communicates with a common vertical flue, which in turn communicates with the combustion chamber of the heating unit. An opening from each combustion chamber leads the combustion products to passages surrounding the heating units. The material to be coked is contained in receptacles having fluted and perforated sides and bottoms.—W. F. F.

Briquettes, etc.; Process of making dry —— containing soluble binding materials (e.g., sulphite-cellulose liquor) resistant to weather. A. Jabs, Zürich. Ger. Pat. 287,015, Aug. 2, 1912.

The material is subjected to the action of waste gases from gas-engines, furnaces, etc., or other gases containing carbon dioxide, at a temperature below 120° C., until sufficiently weather-proof and dry, a suitable temperature being obtained by mixing the used gas with fresh hot combustion gases.—F. W. A.

Peat briquettes: Process of making —— which will retain their shape until burnt. A. G. Wihtol, Hanau. Ger. Pat. 287,016, Mar. 15, 1913.

Finely divided peat moss is added to the peat and binding material, *e.g.*, concentrated sulphite-cellulose liquor. The product retains its form during combustion, and is hence completely burnt with the maximum development of heat. —F. W. A.

Briquetting lignite or peat dust; Process of ——. E. Schimansky, Berlin. Ger. Pat. 287,157, Sept. 13, 1913.

The dust produced in the working of a briquetting installation for lignite or peat is intimately mixed, in an air-dry condition, with sawdust, treated if necessary with dry steam, and submitted to a pressure of 1200 to 1500 atm. in moulds.—F. W. A.

Gas-producer. J. A. Herrick, New York. U.S. Pat. 1,162,357, Nov. 30, 1915. Date of appl., Mar. 26, 1909.

The producer has a fixed upper and lower body portion with an intermediate rotary portion, from which an arch is supported and revolved within the body of the producer and to which the gas-discharge pipe is attached. The cover of the producer is also capable of being rotated and carries the fuel hopper, which revolves with it.—W. H. C.

Gas producer. W. B. Chapman, Assignor to Chapman Engineering Co., Mount Vernon, Ohio. U.S. Pat. 1,162,452, Nov. 30, 1915. Date of appl., Mar. 16, 1915.

A stationary shell, adapted to receive the fuel, is provided with a slot around its circumference and a liquid seal for the slot. A U-shaped, rotary charge-agitating device, extending through the seal and slot into the shell, is suspended from above in such a manner that it adjusts itself automatically to the height of the charge, means being provided for rotating the device.—B. N.

Gases from which carbon separates; Process and apparatus for treating —— in the electric furnace. K. Gruhn, Bitterfeld. Ger. Pat. 285,665, June 19, 1913.

The gas, *e.g.*, any cheap hydrocarbon gas, or atomised liquid hydrocarbon, such as petroleum residue or tar, is introduced into an electric arc formed between carbon electrodes. The hydrocarbons are decomposed, with separation of finely-divided carbon, which falls to the bottom of the reaction chamber. The electrodes are fixed to rotating spindles to prevent accumulation of carbon thereon, and the insulators, which surround the electrodes where they enter the reaction chamber, are enclosed in casings through which a gas, such as hydrogen or illuminating gas, or hydrocarbon vapour, is passed to prevent deposition of carbon on the insulators. By using continuous current, carbon may be separated at only one electrode. The carbon is removed from the water-cooled bottom of the reaction chamber by means of a screw conveyor, and the gases pass through the layer of carbon, which acts as a filter, to a discharge tube which is of fairly large diameter so as to prevent carbon being carried away mechanically by the gases.—A. S.

Motive fluid [mixture of steam and combustion gases]; Method and means for the generation of compound ——. B. L. Rinehart, Philadelphia, Pa., U.S.A. Eng. Pat. 6290, Apr. 27, 1915.

Oil and air in measured quantities are forced to a spray nozzle at one end of a closed combustion chamber, and water from a heater is forced through heating coils in the combustion chamber to a nozzle at the other end, which is provided with a weighted valve. When the water issues from the nozzle, steam is immediately formed owing to the reduction of pressure and passes with the combustion products to an engine, the exhaust from which passes through the feed water heater. The fuel, air, and water pumps are worked by an engine, started by hand and subsequently operated by the motive fluid generated in the apparatus. The pressure of the motive fluid is kept constant by regulating the engine by a valve, operated by the action of the motive fluid on a diaphragm. —W. F. F.

Petroleum and its products; Process for refining ——. F. W. Mann and M. L. Chappell, Berkeley, Cal., Assignors to Standard Oil Co., Richmond, Cal. U.S. Pat. 1,163,025, Dec. 7, 1915. Date of appl., Apr. 6, 1915.

Petroleum oils are treated with alcohol at a temperature below 32° F. (0 °C.) and the resulting layers separated. The low temperature may be obtained by carrying out the process in the presence of a liquefied gas, such as liquid sulphur dioxide.—C. A. M.

Petroleum; Process of and apparatus for distilling ——. L. Stewart, Los Angeles. Assignor to Union Oil Co. of California, Oleum, Cal. U.S. Pat. 1,163,570, Dec. 7, 1915. Date of appl., July 7, 1910.

Petroleum oil is fractionated into products of different density by heating under pressure in a connected series of vessels, arranged at different levels and progressively heated by means of a medium which is made to flow from the lower to the upper receptacles. As the oil descends, the pressure is successively relieved at points between the vessels, and the vapours are collected and condensed, the heat being utilised in the preliminary heating of the charges in the upper vessels.—C. A. M.

Coking and gasifying coal; Shaft-furnace for ——. J. Lütz, Bredeney, Germany. U.S. Pat. 1,164,295, Dec. 14, 1915. Date of appl., June 19, 1912.

See Ger. Pat. 250,576 of 1911; this J., 1912, 1172.

Oil-gas generators. W. Mitchell, Malden, Mass., U.S.A. Eng. Pat. 5830, Apr. 19, 1915.

See U.S. Pat. 1,141,072 of 1915; this J., 1915, 706.

Peat; Utilisation of —— [for making gas]. N. Testrup, London, T. Rigby, Dumfries, and O. Söderlund, London, Assignors to Wetcarbonizing, Ltd., London. U.S. Pat. 1,164,429, Dec. 14, 1915. Date of appl., Aug. 1, 1912.

See Eng. Pat. 17,610 of 1911; this J., 1912, 1171.

Preparation of chemically pure carbon dioxide from waste gases obtained in distillation of ammoniacal liquor. Ger. Pat. 286,971. *See* VII.

Manufacture of asphalt cements from natural asphalts. U.S. Pat. 1,163,593. *See* IX.

Bomb calorimeter. U.S. Pat. 1,163,367. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Destructive distillation of resinous wood; Process of redistillation of products of ——. H. M. Chase and J. L. Grafflin, Assignors to National Wood Distilling Co., Wilmington, N.C. U.S. Pats. (a) 1,161,844 and (b) 1,162,036, Nov. 30, 1915. Date of appl., Apr. 17, 1915.

(a) The pitch and tar obtained by the destructive distillation of resinous wood are heated to 500° F. (260° C.) and maintained at that temperature until all substances having an odour of creosote have been distilled off. The residue is then heated to 700° F. (370° C.) and a viscid oil free from creosote odour is obtained. (b) Distillation products from resinous wood, having a creosote odour, are heated to 390° F. (200° C.) and superheated steam is injected until all substances having an odour of creosote have been distilled off. The temperature is then raised to 500° F. (260° C.) with continued injection of superheated steam, and an oil free from creosote odour is obtained.—W. H. C.

Heating liquids and other purposes; Production of heat and its application for ——. D. La Cour, Charlottenlund, and C. V. Schou, Copenhagen, Denmark. Eng. Pat. 1745, Feb. 3, 1915. Under Int. Conv., Oct. 13, 1914.

In a heating cartridge of the type in which a mixture such as powdered aluminium and iron oxide is compressed into a capsule and ignited by the combustion of a suitable mixture in a cavity thereof, a fusee is provided which can be inserted in the ignition mixture just before use. The fusee may be secured by inserting it in a hole in the lid having inwardly projecting tongues which are bent down. The cartridge container may be immersed in the liquid and provided with a tube for the introduction of a match. Alternatively, the bottom of the liquid container may be of copper and may have a raised portion so as to form a cavity which is placed over the ignited cartridge; in this case the bottom of the container is preferably provided with studs which are pressed into the ignited cartridge.—W. F. F.

Incandescence lamps or similar glass receptacles; Methods of exhausting ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 1088, Jan. 22, 1915.

The glass receptacle, of relatively high melting point, is heated during the exhaustion to a temperature slightly below its softening point, and the exhaustion continued at a temperature at least 100° C. lower; with magnesium boro-silicate glass, the temperatures employed are 550° to 600° C. and 400° to 500° C.—B. N.

III.—TAR AND TAR PRODUCTS.

Aromatic hydrocarbons in the vapour phase; Thermal reactions of ——. W. F. Rittman, O. Byron, and G. Egloff. J. Ind. Eng. Chem., 1915, 7, 1019—1021.

In each experiment 500—600 c.c. of hydrocarbon was subjected to "cracking" conditions in the apparatus described previously (this J., 1915, 1199), but the initial working pressure was developed by means of natural gas instead of by decomposition of some of the sample used. Tests were made at 650°, 725°, and 800° C., and under vacuum and at 1, 12, and 18 atmospheres pressure respectively. The liquid and solid products were collected, the liquid products fractionated, and the specific gravities of the original liquid and of the fractions determined. Cymene yields xylene, toluene, benzene, naphthalene, and anthracene; xylene yields toluene, benzene, naphthalene, and anthracene, but no cymene; toluene yields benzene, naphthalene, and anthracene, but no cymene or xylene; benzene yields naphthalene and anthracene, but no benzene homologues; naphthalene yields anthracene, but no monocyclic hydrocarbons; anthracene yields only tarry matter, carbon, and gas. Other compounds than those mentioned, including diphenyl, are also formed, but were not identified. In general the course of the reaction is in the direction of decrease in size of molecule when degree of unsaturation is unchanged, but in dehydrogenation reactions either larger or smaller molecules may be formed. The general direction may be indicated as follows:—higher benzene homologues→lower homologues →benzene→(diphenyl)→naphthalene→anthracene; reverse reactions occur only in practically negligible amounts. The following table shows the total percentage of liquid products obtained from benzene, toluene, xylene, and cymene respectively. No quantitative results are given for naphthalene and anthracene:—

Temp.	Pressure.	Percentage formation of liquid aromatic hydrocarbons.															
		Benzene formation.				Toluene formation.				Xylene formation.				Cymene formation.			
		Cymene.	Xylene.	Toluene.	Benzene.	Cymene.	Xylene.	Toluene.	Benzene.	Cymene.	Xylene.	Toluene.	Benzene.	Cymene.	Xylene.	Toluene.	Benzene.
°C.																	
650	Vacuum	0·2	0·3	0·0	78·5	[14·5]	2·6	91·6	1·6	17·8	80·0	3·4	0·8	34·5	1·9	0·0	0·4
	1 atm.	9·2	4·1	3·9	66·5	2·5	15·4	85·0	0·0	5·9	37·7	0·0	0·0	21·6	2·2	0·5	1·0
	12 atm.	12·0	3·8	21·8	59·4	2·7	18·7	55·0	0·1	4·0	31·7	0·0	0·0	21·3	0·7	0·0	0·0
	18 atm.	15·1	0·6	18·3	57·0	1·9	9·2	31·0	0·5	4·9	45·0	0·0	0·0	10·6	0·6	0·0	0·0
725	Vacuum	0·2	0·0	2·1	77·5	3·9	9·2	70·5	1·4	8·9	52·5	4·2	1·4	17·0	2·4	0·2	2·8
	1 atm.	3·7	2·0	17·3	61·5	7·4	34·5	34·0	0·9	5·2	40·0	0·0	0·7	5·4	6·0	1·6	0·7
	12 atm.	10·2	3·2	30·7	39·7	2·3	15·2	7·5	0·0	2·1	27·0	0·7	0·0	3·0	0·0	1·2	0·0
	18 atm.	3·8	0·0	10·4	42·3	5·0	12·6	2·7	0·0	2·8	26·0	0·0	0·0	7·5	0·0	0·9	0·0
800	Vacuum	1·5	0·7	5·6	63·0	4·7	18·5	49·5	1·0	9·5	35·6	0·0	1·7	14·5	2·3	0·1	6·9
	1 atm.	1·6	8·3	17·6	35·6	1·9	7·2	6·6	0·5	1·6	4·5	0·0	0·5	1·6	0·9	0·0	3·0
	12 atm.	3·8	9·1	16·4	16·1	1·3	8·6	7·5	0·0	1·6	7·9	1·2	0·0	5·7	0·0	0·0	0·0
	18 atm.	0·0	5·4	3·0	12·1	0·0	0·8	4·0	0·0	0·0	1·1	1·6	0.0	0·0	1·5	6·7	0·0

—A. S.

Filament for incandescence electric lamps. T. A. Edison. Llewellyn Park, Orange, N.J., Assignor to General Electric Co., Schenectady, N.Y. U.S. Pat. 1,163,329, Dec. 7, 1915. Date of appl., May 31, 1907.

Tungsten is vaporised by an electric discharge in a vacuum and deposited on a revolving surface in the path of the discharge, the film thus formed being afterwards separated from the surface and used for the manufacture of electric lamp filaments. —B. N.

Aromatic hydrocarbons derived from cracked petroleum; Utilisation of —— [for the preparation of trinitrotoluene]. W. F. Rittman. J. Ind. Eng. Chem., 1915, 7, 1014—1019.

Toluol prepared from petroleum by the U.S. Bureau of Mines vapour-phase cracking process (see this J., 1915, 411, 1199) is contaminated by olefines and paraffins which cannot easily be separated by fractional distillation. Experiments with samples containing respectively about 66 and 73% of toluene, showed that mononitrotoluene of a satisfactory degree of purity can be obtained by first removing olefines from the crude toluel by means of concentrated sulphuric acid, and then nitrating directly, after removal of the acid sludge; the proportion of nitrating acid used should be based on the actual content of toluene. For the conversion of mononitrotoluene into trinitrotoluene, a yield of about 70% of the theoretical quantity was obtained under the following conditions:—50 grms. of mononitrotoluene was heated for ½ hour at 115° C. with 107·6 grms. of mixed acid (1 part by weight of nitric acid of sp.gr. 1·5 to 2 parts of sulphuric acid of sp.gr. 1·84), cooled, the spent acid drawn off, and the crude dinitrotoluene nitrated further by heating for 1 hour at 95° C. and 1½ hours at 120° C. with 100 grms. of oleum (20% SO_3) and 63 grms. of nitric acid of sp.gr. 1·5. The nitro-product was washed several times with hot water, and, after drying, melted at 78°—79·5° C. (commercial specification, 75° C.).—A. S.

Sulphur in alkali sulphide; Solution of —— as a reducing agent. [*Preparation of aromatic diamines.*] A. Cobenzl. Chem.-Zeit., 1915, 39, 859—860.

A solution of sulphur in sodium sulphide may be utilised for the reduction of sulphonated azo dyestuffs, and hence for the preparation of diamines from aromatic amino-compounds, the base from which the corresponding diamine is to be produced, being first coupled with diazobenzene-*p*-sulphonic acid and the resulting azo dyestuff reduced in aqueous solution under pressure with the solution of sulphur in sodium sulphide. For the preparation of *p*-aminodiphenylamine, for example, 77·5 kilos. of the sodium salt of diphenylamineazobenzene-*p*-sulphonic acid (Orange IV) is mixed with 600 litres of boiling water, a mixture of 12 kilos. of flowers of sulphur, 70 kilos. of crystallised sodium sulphide, 5 kilos. of sodium hydroxide, and 120 litres of boiling water is added, and the whole heated under a pressure of 2 atmospheres. The insoluble *p*-aminodiphenylamine is then separated by filtration. Directions are also given for the preparation of *p*-aminomethyldiphenylamine from methyldiphenylamine, 1.4-naphthylenediamine from α-naphthylamine, dimethyl-1.4-naphthylenediamine from dimethyl-α-naphthylamine, phenyl-1.4-naphthylenediamine from phenyl-α-naphthylamine, amino-α-dinaphthylamine from α-dinaphthylamine, *p*-anisidine from nitroanisol, and *m*-phenetidine from *m*-nitrophenetol, the two last-named by direct reduction with the solution of sulphur in sodium sulphide.
—W. P. S.

m-Phenetidine and some of its derivatives. F. Reverdin and J. Lokietek. Bull. Soc. Chim., 1915, 17, 406—409.

m-Phenetidine was prepared from *m*-aminophenol by ethylating its acetyl derivative by boiling in alcoholic solution with sodium hydroxide and ethyl bromide, and subsequent hydrolysis of the acetyl group by heating with 35% hydrochloric acid. It is a colourless liquid, b.pt. 248° C.; its sparingly soluble hydrochloride crystallises in small leaflets, and its picrate in yellow needles, m.pt. 158° C. Its formyl-, benzoyl-, toluene-*p*-sulphonyl-, and toluene-*o*-nitro-*p*-sulphonyl-derivatives were prepared, and also a number of azo-dyes obtained by coupling its diazo-derivative with β-naphthol which gave red needles, with salicylic acid giving a yellow dye, with resorcinol giving a brownish-red, etc.—G. F. M.

Wood alcohol as a denaturant. U.S. Treasury Decision No. 3368.

The United States Commissioner of Internal Revenue has announced a change as regards acetone content in the specifications for wood alcohol used as a denaturant. Paragraph 5 should now read as follows:—

5. *Acetone content.*—It must contain not more than 20 nor less than 10 grms. per 100 c.c. of acetone and other substances estimated as acetone when tested by the following method (Messinger):—One c.c. of mixture of 10 c.c. wood alcohol with 90 c.c. of water is treated with 10 c.c. of 2-*N* soda solution. Then 50 c.c. of *N*/10 iodine solution is added while shaking, and the mixture made acid with dilute sulphuric acid three minutes after the addition of the iodine. The excess of iodine is titrated back with *N*/10 sodium thiosulphate solution, using a few drops of starch solution for an indicator. From 10·3 to 20·7 c.c. of *N*/10 iodine solution should be used by the spirit. The solution should be kept at a temperature between 15° and 20° C.

Calculation:—X = grms of acetone in 100 c.c. of spirit. Y = number of c.c. of *N*/10 iodine solution required. N = volume of spirit taken for titration.

$$\text{Then } X = \frac{Y \times 0{\cdot}096672}{N}$$

A blank containing a known amount of pure acetone should be run at the same time.

Cracking and distillation of petroleum under pressure. Brooks. *See* IIa.

Formation of pyridine and isoquinoline bases from casein. Pictet. *See* XX.

Patents.

Asphaltic substances [*from wood tar*]; *Manufacture of spirit-soluble ——.* Chem. Fabr. Flörsheim Dr. H. Nördlinger. Ger. Pat. 286,650, July 17, 1914.

Wood tar or wood tar oil is treated with strong sulphuric acid, the resulting water-soluble substances removed, and the oily constituents separated from the residue by means of steam, air, or solvents. The residual mass is soluble in alcohol, and is suitable for the preparation of black varnishes, paints, etc., which are not attacked by alkalis or acids or removed by benzene or lubricating oils. The alcoholic solutions have therapeutic properties.—C. A. M.

Indole; Preparation of —— [*from o-aldehydophenylglycine*]. W. Gluud, Bremen. Ger. Pat. 278,282, Dec. 25, 1913.

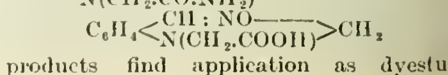
o-Aldehydophenylglycine is warmed with acetic anhydride, preferably with addition of fused sodium acetate, when carbon dioxide and water are split off, and indole is produced.—F. W. A.

o-Aldehydophenylglycine; Preparation of ——. W. Gluud, Bremen. Ger. Pat. 286,761, Dec. 25, 1913.

o-Aldehydophenylglycine-oxime is decomposed by means of sulphurous acid or its salts; the *o*-aldehydophenylglycine may be obtained as the bisulphite compound. The method is applicable to derivatives of the oxime in which the carboxyl, oximino, or imino group is substituted.—F. W. A.

o-Aldehydophenylglycine-oxime and its derivatives substituted in the carboxyl group; Preparation of condensation products of ——. W. Gluud, Bremen. Ger. Pat. 286,762, Dec. 25, 1913.

The oxime or derivative is submitted for a short time at a high temperature to the action of an aldehyde under such conditions that the oxime group is not removed. In the case of formaldehyde, the reaction is apparently as follows:—



$$C_6H_4\left<\begin{matrix}CH:NOH\\NH.CH_2.CONH_2\end{matrix}\right. + HCHO \rightarrow$$

$$C_6H_4\left<\begin{matrix}CH:NO\text{———}\\N(CH_2.CO.NH_2)\end{matrix}\right>CH_2 + NaOH \rightarrow$$

$$C_6H_4\left<\begin{matrix}CH:NO\text{———}\\N(CH_2.COOH)\end{matrix}\right>CH_2$$

The products find application as dyestuffs, medicinal preparations, materials for the preparation of indoles, etc.—F. W. A.

1.4-*Dichloronaphthalene ; Preparation of* ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 286,489, Oct. 22, 1913.

On treating naphthalene with the calculated amount of sulphuryl chloride at temperatures above 100° C., dichloronaphthalene is exclusively produced, the 1.4-isomer being the main product; it constitutes a valuable raw material for the production of dyestuffs.—F. W. A.

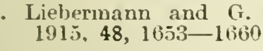
Hydroxytriphenylmethanecarboxylic acids : Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 286.744, Apr. 29, 1914.

By the action of carbon dioxide on hydroxytriphenylmethanes in the usual manner, carboxyl groups are introduced. The products, *e.g.*, 2-chloro-4′.4″-dihydroxy-3′.3″-dimethyltriphenylmethane-5′.5″-dicarboxylic acid, 4′.4″-bisdimethylamino-3-hydroxytriphenylmethane-4-carboxylic acid, are used in the production of dyestuffs. —F. W. A.

IV.—COLOURING MATTERS AND DYES.

Indigotin ; Oxidation product of ——. P. Friedländer and N. Roschdestwensky. Ber., 1915, **48**, 1841—1847.

The oxidation product obtained by boiling solutions of indigo in solvents of high boiling point is shown to be identical with the substance obtained by A. G. Perkin (this J., 1907, 464) by subliming indigo in a limited supply of air, and with the product of the oxidation of indigo or isatin with neutral permanganate (Ger. Pats. 276,808 and 281,050; this J., 1914, 1151; 1915, 545). It has the formula $C_{15}H_8N_2O_2$, that ascribed to it in the German patents being erroneous. It melts at 261° C., is insoluble in dilute acids and alkalis, is reduced by hydrosulphite and re-oxidises in the air to the original yellow colour; when warmed with hydrosulphite it is converted into indoxyl, it forms an oxime and a phenylhydrazone, and is decomposed by boiling with aqueous alkalis into equimolecular proportions of isatin and anthranilic acid. The substance is therefore regarded as anhydro-α-isatin anthranilide,



$$C_6H_4\genfrac{}{}{0pt}{}{\diagup CO.C:N \diagdown}{\diagdown\!\!-\!\!-\!\!-\!\!-N.CO \diagup}C_6H_4$$

and this constitution is confirmed by its synthesis (a) from isatin chloride and anthranilic acid by dissolving in boiling xylene and filtering from the deposited anthranilic acid hydrochloride, (b) from isatin anilide and anthranilic acid in acetic acid solution in presence of a dehydrant such as sulphuric acid or acetic anhydride, (c) from *o*-nitrosobenzoic acid and indoxyl.—G. F. M.

Azafrin. C. Liebermann and G. Mühle. Ber., 1915, **48**, 1653—1660.

It has not been possible to ascertain the exact formula and molecular weight of azafrin, owing to the unstable and amorphous character of its salts, excepting the chlorate. The empirical formula, $C_{31}H_{42}O_5$, which has been suggested, is supported by the examination of methylazafrin and its derivatives (see this J., 1913, 745). A crystalline, stable iodide has been prepared by the action of iodine on azafrin in benzene solution; it contains a percentage of iodine intermediate between that required by the formulæ, $C_{31}H_{42}O_5I_3$ and $C_{31}H_{42}O_3I_4$. Reduction with hydrogen in presence of palladium black converts azafrin into a colourless oil, which is not re-converted into azafrin by oxidising agents: in this respect it resembles bixin. (See also this J., 1911, 531.) —F. W. A.

Dyes ; Export of —— from Switzerland prohibited.

The exportation of all colouring matters and dyes from Switzerland has been prohibited (see page 145, Trade Rept.).

Sulphur in alkali sulphide ; Solution of ——as a reducing agent [for azo dyestuffs]. Cobenzl. *See* III

m-Phenetidine and some of its derivatives. Reverdin and Lokietek. *See* III.

Notification of toxic jaundice. *See* XIXb

Diazo reaction of albumin. [Azo dyestuffs from histidine and tyrosine.] Pauly. *See* XXIII.

Patents.

Dyes containing selenium or tellurium ; Preparation of ——. A. von Wassermann and E. Wassermann. Ger. Pat. 287,020, Jan. 26, 1913. Addition to Ger. Pat. 261,556.

Instead of using alkali seleno- or telluro-cyanides as specified in the main patent (see Fr. Pat. 443,554 of 1912; this J., 1912, 1025), alkali selenides or tellurides, particularly those of potassium, sodium, and rubidium, are allowed to react with phthalein dyes, or their alkyl or halogen derivatives, in liquefied ammonia, whereby dyes containing selenium or tellurium are directly obtained. —G. F. M.

Preparation of condensation products of o-aldehydophenylglycine-oxime and its derivatives substituted in the carboxyl group. Ger. Pat. 286,762. *See* III.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Starch : Various methods of modifying —— for sizing [cotton warps]. P. Bean. J. Text. Inst., 1915, 4, 223—232.

Wheat flour is the most important sizing material but the starch granules have to be freed from the gluten by some method of modification before use. For pure sizing, without mineral matters, the fermentation method is preferred; it occupies from 6 weeks to 6 months and is slightly uncertain in results, but owing to the formation of soluble matters, large additions to the weight of the yarn may be made without adding to the harshness; the products of fermentation also form a protection against mildew. A method which possesses many advantages, when it is permissible, consists in steeping the flour in a solution of zinc chloride, which liberates the starch granules without loss of the gluten, giving a size which carries clay well, has a sweet smell, and is proof against mildew. Potato farina comes next in importance, giving excellent smoothness and pliability to yarns for goods of light pick and reed. Unless the finest quality be used, farina size is apt to turn "soft" after the goods have been on the weaver's beam for some time; the use of caustic soda for gelatinising the starch prevents this. Farina size loses strength if subjected to prolonged boiling. Sago starch is mainly used in pure sizing, particularly for heavily picked goods; it imparts more strength to the yarn than other sizes and will withstand prolonged boiling without loss of strength; caustic soda may be used with advantage to reduce the time of boiling. Tapioca starch is employed only to a small extent, chiefly for very light goods where a soft feel is desired; since it gives a transparent size it is sometimes used for coloured borders.

Maize starch has come into extensive use in recent years; to get satisfactory results the starch must be thoroughly well boiled, preferably with the assistance of a little caustic alkali. Maize starch produces a very thick size and the sized goods possess a firm feel. Maize flour is sometimes used with wheat flour to increase the stiffness of the size, but owing to imperfect grinding it is impossible to gelatinise the maize flour completely by ordinary boiling and the goods are liable to mildew. All methods of modifying starch which result in breaking down the stiffness of the size are condemned as injurious or of little importance. Dextrin, which is so largely used in finishing, is of very limited application for yarn sizing. The same remark applies to processes for "thinning" starch based on the action of acids, hypochlorite, malt, etc.; the thinning effect takes place at the expense of the strength-giving properties of the size, and in most cases the same result can be attained by reducing the proportion of starch employed, which is often excessive.—J. F. B.

Paper pulp from Sweden; Exportation of ——.

On January 20th the Swedish Board of Trade announced that chemical wood pulp had been added to the list of goods now prohibited for exportation from Sweden to all countries. This step is said to be due to the scarcity of coal and the difficulty of obtaining the necessary chemicals. During the ten months ended October 31st, 1915, the imports of chemical pulp into Great Britain amounted to 338,139 tons, valued at £3,076,613, of which Sweden supplied just over two-thirds.

Wood-pulp and paper in Russia. U.S. Comm. Rept. No. 277, Nov. 27, 1915.

The wood-pulp industry has not yet developed sufficiently in Russia, but its prospects are bright in view of the abundance of raw material supplied by the immense forest area in Russia and of the growing demand for paper. The use of rags as a raw material is rapidly diminishing, though they are still used to some extent for the manufacture of the best and medium grades of paper. There are larger forests of pine and aspen in Russia than in any other country. At the same time there are many deciduous trees in Russia which are little used for construction purposes, and might therefore be profitably utilised for making wood pulp. There are also many wind-fallen trees in the dense forests hindering normal growth. All these materials, which could partly replace rags, the supply of which does not meet the demand, are little utilised in Russia. Therefore the paper industry in Russia is growing slowly and the imports of paper are increasing each year. There is a general shortage of paper pulp, which is imported in increasing quantities. The following table shows the imports into Russia of chemical and mechanical wood pulp in 1913 and 1914 and the principal sources of supply :—

Countries of origin.	Chemical pulp.		Mechanical pulp.	
	1913.	1914.	1913.	1914.
	Tons.	Tons.	Tons.	Tons.
Finland	4,057	13,020	16,032	13,250
Germany	2,946	(*a*)	3,136	(*a*)
All other countries	1,816	2,440	1,398	2,620
Total	8,819	15,460	20,566	15,870

(*a*) Not available.

The figures for 1913 include the imports over all frontiers, but only about 1½ tons of mechanical wood pulp and 15½ tons of chemical wood pulp were imported over the Asiatic frontier in that year; the figures for 1914 refer to the European frontier only. The figures given for chemical pulp in both years include a small amount of pulp from rags, straw, peat, etc.

The Russian wood-pulp industry is steadily growing, however, as is illustrated by the following figures: Mechanical wood pulp, 20,592 tons in 1900, 41,010 tons in 1908, 49,608 tons in 1912; wood cardboard, 12.708 tons in 1900, 22,950 tons in 1908, and 31,070 tons in 1912; chemical wood pulp, 28,922 tons in 1900, 119,092 tons in 1908, and 170,082 tons in 1912. For the last few years an increase of capital invested in this industry is noticeable, but on the whole the output of wood pulp in Russia is limited in comparison with the production of other countries of far smaller forest areas. Russia exports a comparatively small quantity of wood pulp. In 1913 the exports of this article were valued at £87,000, and of paper at £30,000. Much of the raw material hitherto exported from Russia to Germany should be utilised in Russia for the production of wood pulp, cardboard, and paper, the demand for which is growing both in Russia and abroad.

Finishes, etc., for the textile industry [and for paper]. Miksch. *See* VI.

Nitre cake as a substitute for sulphuric acid [for textile purposes]. *See* VII.

Carbohydrates of firwood. Hägglund. *See* XVII.

Patents.

Textile belts; Process of manufacturing ——. C. Kochmann, Charlottenburg, Germany, and J. G. Seldal, Copenhagen, Assignors to Aktieselskabet Drivremmefabriken "Dana," Lyngby, Denmark. U.S. Pat. 1,163,417, Dec. 7, 1915. Date of appl., Dec. 19, 1913.

Webs of fabric formed of vegetable fibres are treated with sulphuric acid so as to convert the surfaces of the webs into an adhesive amyloid-like mass; the treated webs are superposed and united by pressure, the free acid is removed by washing and neutralisation, and the belt dried. —J. F. B.

Straw and other vegetable matter; Production of material capable of being spun and woven, from ——. J. C. M. van Diggelen, Amsterdam. Eng. Pat. 10,899, July 27, 1915. Under Int. Conv., Dec. 18, 1914.

The raw material is boiled, in a vessel fitted with a stirrer, for 15 to 30 mins. in a 10—20% solution of caustic soda, to each litre of which has been added copper sulphate equal to 0·25% of the weight of the vegetable matter treated and 5 or 6 drops of saturated ammonium chloride solution. The material is then drained, washed until the blue colour has disappeared and the material has no longer an alkaline reaction, and then dried. Material capable of being woven and spun is thus obtained by a short treatment, which is not so severe as in certain known processes; the fibres are hence very strong and more solid, as the silicic acid is not completely dissolved out.—F. W. A.

Paper pulp; Process for converting flax straw fibre into ——. J. H. Melchers, Minneapolis, Minn., Assignor to North Dakota Straw Products Co., McCanna, N.D. U.S. Pat. 1,162,797, Dec. 7, 1915. Date of appl., Dec. 2, 1912.

The woody portion of the straw is separated from the fibre, the latter is digested under pressure with a solution of potassium carbonate, and the pulp drained and washed.—J. F. B.

Paper-making. W. H. Millspaugh, Sandusky, Ohio. U.S. Pats. 1,163,251 and 1,163,252, Dec. 7, 1915. Date of appl., Oct. 7, 1909.

Water is extracted from the wet web of paper by drawing or forcing large volumes of air uniformly through the sheet, and the extraction is continued by applying heated air, drawing or forcing it through the sheet until the latter is in a suitable condition for completing the drying without the aid of mechanical compression. The machine comprises, in conjunction with suction-rolls, a porous carrier beyond the making wire, a hot-air chamber over which the carrier passes, and vacuum chambers or suction-rolls at either end of the hot-air supply.—J. F. B.

Paper-making machine. W. H. Millspaugh, Sandusky, Ohio. U.S. Pats. (A) 1,163,253 and (B) 1,163,254, Dec. 7, 1915. Dates of appl., Aug. 18, 1911, and Mar. 13, 1912.

(A) In a paper-machine a felt or other agent carries the sheet between a lower suction-roll and an upper press-roll, the vacuum area of the suction-roll being covered by the felt and adapted to exert suction on the sheet both in front of and behind the line of contact of the rolls. (B) The wet web of paper is transferred from the making-wire to a stack of four co-acting rolls, the bottom roll being covered with felt and having a suction-box in front of the nip, in order to receive the paper and conduct it to the second roll. The second roll has two suction-boxes, acting on the other side of the paper, one after the first nip to receive the paper from the first roll and the other in front of the second nip, the last pair of rolls being press-rolls.—J. F. B.

Silk; Process of degumming ——. Röhm und Haas, Darmstadt, Germany. Eng. Pat. 2010, Feb. 8, 1915. Under Int. Conv., Feb. 9, 1914.

See Fr. Pat. 475,343 of 1914; this J., 1916, 39.

Fibres, artificial; Production of ——. P. Girard and J. Sonnery, Lyon, France. U.S. Pat. 1,164,084, Dec. 14, 1915. Date of appl., Feb. 28, 1912.

See Eng. Pat. 5386 of 1912; this J., 1913, 192.

Purification of caustic soda solutions from dissolved colloids. Ger. Pat. 287,092. *See* VII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Finishes, etc., for the textile industry. K. Micksch. Kunststoffe, 1915, 5, 112. Z. angew. Chem., 1915, 28, Ref., 528.

Aqueous solutions of agar-agar, glue, gelatin, casein, starch, and dextrin are treated with organic sulphonic acids, especially those derived from naphthalene, to prepare finishes for textile fibres or paper. By this means animal glue is obtained in an almost colourless liquid form, characterised by great adhesive power and rapid drying properties; on evaporating the solution to dryness, the residue obtained may be powdered, is readily soluble in cold water, and remains homogeneous in the liquid condition. A stable saturated solution of agar-agar may be obtained with the help of sodium naphthalenesulphonate, and casein may be liquefied in a similar manner after preliminary treatment with soda.—F. W. A.

Nitre cake as a substitute for sulphuric acid [in stripping, dyeing, etc.]. *See* VII.

A new tin-sulphur compound. Epprecht. *See* VII.

Alleged occurrence of tin sulphide, Sn_2S. Fichter. *See* VII.

Preparation of Turkey-red oils from free fatty acids. Erban. *See* XII.

Ricinic acid in Turkey-red oils. Erban. *See* XII.

Patents.

Oxazine dyestuffs; Production of condensation products of —— *with phenols, amines, aminophenols, aldehydes, ketones, and their derivatives [on the fibre].* J. Heilmann und Co., and M. Battegay, Mulhouse, Alsace. Ger. Pat. 286,946, June 23, 1914. Addition to Ger. Pat. 284,877 (this J., 1915, 1140).

In place of the dyestuffs claimed in the main patent, their leuco-compounds are employed. —F. W. A.

Dyeings fast to rubbing, using ice-colours from 2.3-hydroxynaphthoic acid arylides, developed on the fibre; Production of ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 287,212, June 3, 1914.

Glue, gelatin, or other substance precipitated by aldehydes contained in the padding solution, is added to the dye-bath; this prevents the decrease of the fastness to rubbing due to frothing and precipitation of the dyestuff in the dye-liquor.—F. W. A.

Thickeners for tannin dyestuffs from insoluble gums or tragacanth; Process of making ——. L. Beer and J. Klein. Ger. Pat. 287,215, July 3, 1914.

Protective colloids are added to the thickener; suitable substances are salts of benzylsuphanilic, lysalbinic, and protalbinic acids, etc. The resulting colours may be printed quite level without any difficulty.—F. W. A.

Printing surface for colour printing. N. W. Turkin, Moscow, Russia. U.S. Pat. 1,164,037, Dec. 14, 1915. Date of appl., Jan. 12, 1914.

See Eng. Pat. 23,129 of 1913; this J., 1914, 747.

Chromium compound. U.S. Pat. 1,162,210. *See* VII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitre cake as a substitute for sulphuric acid. Chem Trade J., Jan. 8, 1916. (See also this J., 1915, 1121.)

A small committee of users of sulphuric acid in the Yorkshire West Riding, along with a representative of the Ministry of Munitions and officials of the West Riding of Yorkshire Rivers Board, have been considering how to overcome the difficulty in which they are placed by the scarcity of sulphuric acid. The conclusions arrived at are the subject of the following report made by the Secretary to the Committee:—

Experiments in the use of nitre cake have been carried out at a number of mills in the West Riding in connection with the various operations in which sulphuric acid is ordinarily used. (A) For the extraction of grease from piece-scouring suds. (B) For the extraction of grease from wool suds. (C) For the refining of grease. (D) For stripping colour from rags in the making of shoddy. (E) For extracting cotton from mixed fabrics in the shoddy trade. (F) For dyeing rags in the shoddy trade. From the results of these experiments, which have all been on a working scale, it is evident that nitre cake can be used in place of sulphuric acid for the extraction of grease, either from wool suds or piece-scouring suds, for the refining of grease, for the stripping of rags except perhaps where light dyes are to be subsequently used, and for dyeing rags in the shoddy trade, more especially where dark colours are being used. In using nitre cake for extracting cotton from rags, grave difficulties have presented themselves, but even in this case it would appear that nitre cake can be to some extent substituted for sulphuric acid. The use of nitre cake presents certain difficulties, but these for the most part can be surmounted. It is more difficult to handle than B.O.V., since it is in the form of solid cake, and must be used in larger quantities, as it contains only 30% of its weight of pure sulphuric acid, compared with the 75—80% present in B.O.V. In carriage, storage, and handling, the acid liquid draining from it causes damage which may be serious. The great difficulty, however, is that of transporting it either by railway or by road, and this is enhanced by the greater amounts necessary. The best method of using the cake is to dissolve it in hot water by the aid of steam, and to use this solution while still hot. The solution in an equal weight of water usually contains about 13% of sulphuric acid. Where the grease extraction plant is not provided with steam, the nitre cake can be packed into the troughing leading to the soak tanks so as to be dissolved by the suds as these flow into the tanks; if the troughs are not long enough, they can be supplemented by shoots reaching nearly to the bottom of the tanks and packed with pieces of nitre cake. It may be found useful to finish off the cracking process by small quantities of solution of nitre cake, prepared as above, in some part of the premises where steam is available. The cake can be stored with safety by placing it under cover on an asphalted floor, or on a stone floor the joints of which are rendered in asphalt, drained to a catchpit, where any acid can be caught for use.

The chief difficulty to be met is that of railway carriage and cartage, and if nitre cake is to be generally used in place of sulphuric acid, very large quantities will have to be conveyed by rail and road. In this direction the assistance of the Ministry of Munitions has been asked. It is suggested that arrangements should, if possible, be made for depots to be established at certain centres—*e.g.*, Bradford, Dewsbury, Huddersfield, Keighley, Leeds, and Wakefield—at which the cake may be dumped in large quantities, and from which it may be distributed by carts or motor waggons. To such depots regular trains could be kept running from the producing centres. The difficulty of local cartage is as great as that of carriage by railway, and the Ministry has been asked to consider the question of making some arrangements for securing the necessary supply of carts and motor waggons. The introduction of nitre cake, if it is to be substituted for sulphuric acid on a large scale, will entail a great disorganisation of many of the operations in the woollen trade, and several other trades in the West Riding are equally concerned. It is suggested, therefore, that to deal with the various difficulties which must arise, a large and representative committee should be formed by the Ministry, consisting of users of sulphuric acid in the West Riding.

To prevent manufacturers of nitre cake unduly inflating prices, the Ministry have arranged to dispose of a very large amount produced at His Majesty's factories at Queensferry, Cheshire, at Oldbury, and at Gorton Brook, free on rail or at a nominal charge, and as other huge amounts are produced at factories in the neighbourhood of the Thames, where the nitre cake is at present disposed of at considerable cost, it is possible that further arrangements of this nature can be made, and that in these cases the manufacturers or the Ministry may be induced to pay part of the cost of carriage.

The matter is one which interests the Rivers Board very closely, inasmuch as the suds from piece scouring and wool washing require to be treated with acid for their purification, and the Board have instructed their officials to give any information in their possession to any manufacturers who may desire to make use of nitre cake, or who meet with any difficulties in its use.

Nitric acid: Boiling-point of aqueous solutions of —— at different pressures. Part II.—The influence of water-retaining agents on the composition of the mixture of maximum boiling-point. H. J. M. Creighton and H. G. Smith. J. Franklin Inst., 1915, **180**, 703—709. (See also this J., 1915, 277.)

The influence of potassium bisulphate (10 and 20%) and sulphuric acid (10 and 20%) on the boiling point of aqueous solutions of nitric acid was determined at pressures of 760, 360, and 200 mm. Potassium bisulphate had no appreciable effect on the composition of the mixture of maximum b.pt., but the nitric acid content of the latter was lowered by sulphuric acid (the decrease being greater as the proportion of sulphuric acid increased), and still further by diminishing the pressure. The results are regarded as showing why aqueous solutions of nitric acid can be concentrated to over 90% by distillation with concentrated sulphuric acid, whereas potassium bisulphate is of little or no use for such a purpose.
—W. E. F. P.

Viscosity of aqueous solutions, with special reference to nitric acid; Study of the density and ——. Part II. Viscosities. W. R. Bousfield. Chem. Soc. Trans., 1915, **107**, 1781—1797.

Measurements have been made of the viscosities of a series of nitric acid solutions at 4°, 11°, 18°, and 25° C., with an improved viscometer of the Ostwald type, which is also described. At 4° C. increasing concentration gave diminishing viscosity throughout, whilst at 25° C. it gave increasing viscosity. This is attributed to the abnormal constitution of water, to the change in constitution of water produced by heat and by the action of the solute, and to the fact that the molecular dimensions of nitric acid are little different from those of water, though the nitric acid radion is always greater than the water radion (the term radion is used to denote the average molecular radius of any set or group of molecules, including in the average both the undissociated and dissociated portions). When the nitric acid molecule is completely depolymerised, the effect of increasing dilution, and consequently increasing hydration and ionisation, is to increase the nitric acid radion. It is concluded that the elaboration of the general theory of viscosities must be sought in connection with experiments on either aqueous solutions at high temperatures, or, better still, solutions in a solvent in which the association of the molecules of the solvent is much less affected by the solute than is the case with water. The viscosity of dilute aqueous solutions cannot be treated theoretically except in conjunction with the effect of the peculiar constitution of water.—B. N.

Lime recovery from spent causticising mud. J. H. Payne. J. Ind. Eng. Chem., 1915, **7**, 1056—1059.

The general method in use for the recovery of lime from spent causticising mud is as follows:— After the second or third wash water has been drawn off from the causticising tanks, the mud is pumped to a storage tank and then flows or is pumped to a filter, preferably of the rotary vacuum type. The mud from the filter consists of 100 parts of solids to 45 of liquid and drops directly into a brick-lined rotary kiln, 80—150 ft.

long and 6—8 ft. diam., through which it passes in 1½—2 hours. Of the recovered lime about 10% is discarded and replaced by fresh lime to prevent undue accumulation of impurities. The impurities are present largely in the form of unslakable lumps, and it is suggested that the purity could be maintained more effectually by removing unslaked grains by a classifier of the type used in metallurgy than by addition of fresh lime. For mud containing 45% of water, the fuel requirement for a kiln 120 ft. long and 7 ft. diam., with an output of 30 tons per day, averages 675 lb. of coal for producers (including steam for blowing) or 9500 cb.ft. of natural gas per ton of lime. In the estimate given previously (this J., 1914, 1153), a water content of 35% was assumed. For a 30-ton plant the cost averages 8s. 4d. per ton of lime, and for a 15-ton plant from 9s. 6d. to 12s. 6d. per ton. Several recovery plants of this type have now been operating successfully for more than a year. Further economy might be attained by washing the mud from the causticising tanks by the continuous counter-current decantation process widely used in hydrometallurgical operations.—A. S.

Ammonia from waste liquors: Recovery of ——. E. L. Knoedler. J. Ind. Eng. Chem., 1915, 7, 1061—1064.

A DESCRIPTION is given of the recovery, at the works of the Welsbach Co., Gloucester, N.J., U.S.A., of ammonia from waste liquor containing 1% of free and 0·05% of combined NH_3, formerly run to waste. A continuous column still is used. The liquor is pumped to a high-level storage tank by means of a small steam pump, the exhaust from which is led into the still. From the storage tank the liquor flows by gravity through a washer into the coils of a heat interchanger below the still, and then through a heater above the still. It overflows into the upper part of the still, where the free ammonia is expelled, then passes out into a vessel at the side where it is mixed with milk of lime, and back into the lower section of the still, where the combined ammonia is expelled. The spent liquor from the still flows through the heat interchanger before being discharged. The vapours from the still pass out through coils in the heater above the still to a condenser and then to a water-cooled absorber, from which ammonia solution containing 28% NH_3 flows into a storage tank and then, by gravity, to the place where it is required. The milk of lime is supplied to the still through an automatic valve operated by compressed air (also used for agitating the milk of lime) and regulated by a needle valve and bypass between the top and bottom of a cylinder filled with kerosene, in which a piston is working. Steam is supplied to the still through an automatic valve also operated by compressed air and controlled by a thermostat adjusted to operate at the desired temperature of the top of the still. The cost of operation for a 10-hour day, with an output of 3000 lb. of 26% ammonia solution, is :—steam, 12,000 lb., 12s. 6d.; labour and supervision, 5s. 2d.; lime, 10d.; repairs, etc., 1s. 6d.; interest and depreciation, 8s. 0d.: total, 28s. 0d. —A. S.

Ammonia production in the United Kingdom in 1915. Bradbury and Hirsch. Liverpool, Jan., 1916.

THE production of ammonia, calculated as sulphate (including that used in the manufacture of ammonia-soda, munitions, and for other chemical purposes), from all sources in the United Kingdom during 1915, is estimated at 423,000 tons, viz. :—Gas works, 173,000 tons; iron works, 16,000 tons; shale works, 58,000 tons; coke and carbonising works and producer gas, 176,000 tons. Of this quantity it is estimated that England contributed 302,000 tons, Scotland 118,000 tons, and Ireland 3000 tons. The production during the previous three years was :—

	1914.	1913.	1912.
Gas works	176,000	182,000	172,000
Iron works	16,000	20,000	17,000
Shale works	63,000	63,000	62,000
Coke and carbonising and producer gas	171,000	167,000	137,000
	426,000	432,000	388,000

Exports during 1915 amounted to 295,000 tons and home consumption to 128,000 tons, leaving a stock of 26,000 tons to carry forward to 1916.

American production of sodium and sodium peroxide. T. H. Norton. U.S. Comm. Rept. No. 297, Dec. 20, 1915.

SODIUM peroxide is now manufactured exclusively from metallic sodium. The American production of sodium has been somewhat limited. The output has been used chiefly for the manufacture of peroxide. At present, there is an enormous demand for both sodium peroxide and sodium cyanide. Prior to the war the bleaching and metallurgical interests of America were largely dependent upon European sources for both salts. The works at Niagara Falls, engaged in the manufacture of sodium, are unable to meet more than a fraction of the present demand for this metal from manufacturers of peroxide and cyanide. It would appear as if the time is ripe for the establishment, upon a much larger scale than heretofore, of American production of sodium, and it might be advantageous to organise without delay the manufacture of metallic sodium. It would take but a few weeks for the firms now so well equipped for the construction of electrolytic devices to put up the necessary plant. The electrical equipment is of a standard character, and is probably kept constantly in stock. The full complement of electric power at Niagara Falls, guaranteed under the treaty of 1910, for use on the American side of the Falls, has not yet attained its maximum limit. The Castner patents expired a few years since. The American output of caustic soda is now abundant. The available power at the Falls would be fully able to meet any additional demand in connection with the enlargement of the sodium industry. The Darling process for the manufacture of metallic sodium has been utilised to some extent at Philadelphia. It is based upon the use of fused sodium nitrate as electrolyte, nitric acid being produced as a by-product. The mechanical equipment needed for the electrolytic decomposition of sodium nitrate is quite as simple as that employed in the Castner process. The prompt installation of the necessary plant for transforming sodium nitrate into metallic sodium and nitric acid, might be taken up with advantage.

Kelp in British Columbia. U.S. Comm. Rept. No. 281, Dec. 4, 1915.

THE kelp beds of British Columbia are said to be capable of furnishing annually 235,000 tons of potash and 900 tons of iodine.

Perborate; Electrolytic preparation of ——. K. Arndt. Deuts. Bunsen-Ges., Oct. 18, 1915. Z. angew. Chem., 1915, 28, Wirtschaftl. Tl., 621, and Chem.-Zeit., 1915, 39, 806.

SODIUM perborate can be prepared electrolytically from a solution containing 45 grms. of borax and 120 grms. of sodium carbonate per litre, using a platinum gauze anode and a water-cooled cathode made of tin tubing bent zig-zag form and arranged at a distance of 4 mm. on either side of the anode; the temperature of the bath is maintained at

D 2

17°—18° C., and with a current strength of 20 ampères, the potential difference across the bath is 6 volts. The vigorous evolution of gas ensures efficient agitation of the electrolyte. When the content of active oxygen in the solution is sufficiently high, the current is cut off and the electrodes removed. After some time sodium perborate crystallises from the supersaturated solution: it is filtered off with the aid of suction, washed with ice-water, and dried. The mother liquor, after addition of borax and sodium carbonate, is electrolysed again. The loss by cathodic reduction is small: if chromate and Turkey-red oil be added to the bath, the amount of per-salt reduced corresponds to only 3% of the hydrogen formed. If the cathode be smeared with vaseline a concentration of 27 grms. of perborate per litre can be attained. No difficulty has been experienced in working continuously on a commercial scale. (See also Eng. Pat. 12,536 of 1913; this J., 1913, 910.) In discussion F. Foerster expressed the opinion that the production of perborate was due to a secondary reaction; 90% of the maximum yield can be attained by electrolysing sodium carbonate alone and then adding borax (compare Polack, this J., 1915, 1141).—A. S.

Melting points of $CaSO_4.2H_2O$, $BaCl_2.2H_2O$, $Na_2CO_3.H_2O$, $Na_2B_4O_7.5H_2O$, *the hydrates of* $CuSO_4$, *and carnallite: Determination of the —— by means of an electrically heated pressure apparatus.* E. Jänecke. Z. physik. Chem., 1915, **90**, 265—279. J. Chem. Soc., 1915, **108**, ii., 820.

USING an electrically heated pressure apparatus with which the melting point is indicated by a sudden fall of pressure owing to molten material being forced out of the pressure chamber (see Z. physik. Chem., 1915, **90**, 257), the author shows that gypsum melts at 107° C., and is converted into the compound $CaSO_4.\frac{1}{2}H_2O$. This was proved by removing the liquid produced by pressure and weighing the solid residue, the point at which the change occurs being shown by the sudden decrease in the pressure. It is also shown that at 100° C. $BaCl_2.2H_2O$ melts and is converted into $BaCl_2$; $Na_2CO_3.H_2O$ melts at 107° C., and leaves anhydrous sodium carbonate: $Na_2B_4O_7.5H_2O$ melts and is converted into $Na_2B_4O_7.2H_2O$. With copper sulphate the transition points of the three well-known hydrates were obtained, and it is probable that another hydrate, $CuSO_4.\frac{1}{2}H_2O$, also exists. Carnallite melts at 168° C., and on applying further pressure to the molten salt to remove the mother liquor, pure potassium chloride remains behind.

Calcium sulphide; Preparation of phosphorescent ——. P. Breteau. Comptes rend., 1915, **161**, 732—733.

PHOSPHORESCENT calcium sulphide was prepared by heating a mixture composed of 100 parts by weight of pure, precipitated calcium carbonate and 30 of powdered stick sulphur to dull redness in a closed crucible for 1 hour, impregnating the cold product with 0·0001% of its weight of bismuth (a solution of the basic nitrate in absolute alcohol just acidified with nitric acid), heating the mixture to a dull cherry red for 2 hours longer in the closed crucible, and then allowing it to cool slowly in the furnace. An equally phosphorescent product was obtained when, after treatment with the bismuth solution, the mixture was similarly impregnated with 0·01% of its weight of sodium sulphide (Na_2S) and reheated as described, and less phosphorescent products by replacing the bismuth by tungsten, molybdenum, or vanadium. Contrary to the conclusion of Verneuil (Comptes rend., 1887, **104**, 501), the presence of carbonate and chloride of sodium in the original mixture was found to be unnecessary or injurious.—W. E. F. P.

Aluminium salts; Rapid volumetric determination of combined alumina and basic alumina or free acid in ——. W. W. Scott. J. Ind. Eng. Chem., 1915, 7, 1059—1061.

THE following methods have proved of value in the Laurel Hill laboratory of the General Chemical Co. for works control of liquors during the manufacture of aluminium salts and daily routine analysis of aluminium salts. *Determination of basicity or acidity of aluminium salts.* A modification of Craig's method (this J., 1911, 184) is used; 3·4038 grms. of the finely ground sample is dissolved in 100 c.c. of water, the hot solution is treated with 10 c.c. of $N/2$ sulphuric acid, cooled, treated with 18—20 c.c. of the potassium fluoride reagent (*loc. cit.*) and 0·5 c.c. of a 0·1% alcoholic solution of phenolphthalein, and titrated with $N/2$ potassium hydroxide. The amount of alkali used shows whether free alumina or free acid is present. Free $Al_2O_3 = (\text{c.c. } H_2SO_4 - \text{c.c. } KOH) \div 4$. Free acid $= (\text{c.c. } KOH - \text{c.c. } H_2SO_4) \times 0{\cdot}72$. In the case of works liquors, free $Al_2O_3 = (\text{c.c. } H_2SO_4 - \text{c.c. } KOH) \times 0{\cdot}1702 \div \text{sp.gr.}$; and free $H_2SO_4 = (\text{c.c. } KOH - \text{c.c. } H_2SO_4) \times 2{\cdot}45 \div \text{wt. of sample}$. *Determination of combined alumina* (compare Schmatolla, this J., 1905, 349). 3·4038 grms. of the sample is dissolved in 100 c.c. of water, treated with 1 c.c. of phenolphthalein indicator, and the boiling solution titrated with $N/2$ sodium hydroxide: per cent. $Al_2O_3 = \text{c.c. } NaOH \div 4$. If iron salts be present the result must be corrected by deducting $\% FeO \times 0{\cdot}47 + \% Fe_2O_3 \times 0{\cdot}61$. *Determination of ferrous and ferric iron.* 5 grms. of the sample is dissolved, the iron is oxidised by a few drops of strong permanganate solution, the excess of permanganate is destroyed by addition of a drop or two of $N/1$ oxalic acid, and the total iron is determined by titration with stannous chloride solution, after adding 50 c.c. of hydrochloric acid (1 : 1). Another 10 grm. sample is dissolved by boiling with 100 c.c. of hydrochloric acid (1 : 1) in an atmosphere of carbon dioxide, and the ferric iron is titrated with stannous chloride. Ferrous iron is obtained by difference.—A. S.

Aluminium nitride. P. Askenasy. Deutsch. Bunsen-Ges., Berlin, Oct., 1915. Z. angew. Chem., 1915, **28**, Wirtschaftl. Tl., 621—622, and Chem.-Zeit., 1915, **39**, 807.

IN experiments on the production of nitride from alumina, carbon, and nitrogen (see this J., 1913, 361, 485), soot (acetylene soot) was found more reactive than wood charcoal or graphite, and coke the least reactive of the forms of carbon tested. The alkali present in wood charcoal accelerates the reaction, and addition of fairly large quantities of alkali produces still greater acceleration.—J. H. L.

Iron calcium silicates: the system $FeSiO_3$—$CaSiO_3$. N. Konstantinov and B. Selivanov. Ann. Inst. Polyt. St. Pétersbourg, Sect. math. phys. sc. nat., 1912, **17**, 427—445. J. Chem. Soc., 1915, **108**, ii., 837.

THE cooling curve for $FeSiO_3$ shows a distinct break at 1145°—1160° C. With the addition of 25 mols. % $CaSiO_3$ the melting point reaches a minimum (1030° C.), the structure being eutectic. The addition of 25—65 mols. % $CaSiO_3$ gives two components with a radiating, crystalline structure. With 65 mols. % $CaSiO_3$ the melting point is 1200° C., with a break in the curve. With still larger additions of $CaSiO_3$, solid solutions are formed and new crystals separate. The melting point of $CaSiO_3$ (pseudo-wollastonite) is 1510° C.

Tin-sulphur compound; A new ——. G. Epprecht. Chem.-Zeit., 1915, **39**, 341—342.

WHILST repairing a furnace used for the recovery of tin in a silk-dyeing works, the presence of a number of grey crystals was observed. Analysis indicates that they consist of distannic sulphide, Sn_2S. They have a sp.gr. of 5·77, are stable in air and towards cold dilute acids and hot caustic soda solution.

Tin sulphide, Sn_2S: Alleged occurrence of ——. F. Fichter. Chem.-Zeit., 1915, **39**, 833.

The author has examined a sample of a grey metallic sublimate from the tin-furnace of a silk-dyeing works, similar to that described by Epprecht (see preceding abstract). The sample contained 77·87% tin and 20·16% sulphur, or practically the ratio found in stannous sulphide. The fact that Epprecht found too high a proportion of tin is readily explainable, since fused stannous sulphide is miscible in all proportions with fused tin. It is unnecessary, therefore, to assume the existence of a new compound of sulphur and tin.
—C. A. M.

Chloroplatinic acid, and chlorides of gold and palladium; Preparation of ——. E. V. Zappi. Anal. Fis. Quim. Argentina, 1915, **3**, 68—69. J. Chem. Soc., 1915, **108**, ii., 835.

As a solvent for platinum, gold, and palladium, the author recommends a mixture of concentrated hydrochloric acid and chloric acid, chlorine being generated in accordance with the equation, $5HCl + HClO_3 = 3Cl_2 + 3H_2O$.

Potassium platinochloride; Preparation of ——. E. V. Zappi. Anal. Fis. Quim. Argentina, 1915, **3**, 186—188. J. Chem. Soc., 1915, **108**, ii., 836.

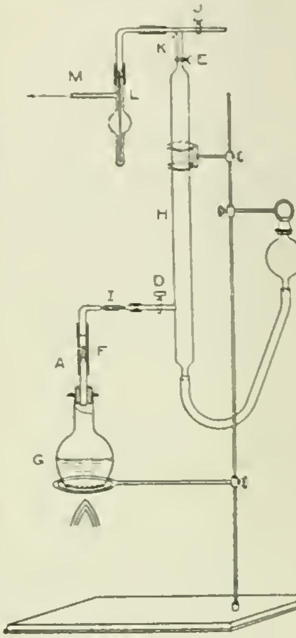
Potassium platinochloride can be prepared by the action of potassium oxalate on potassium platinichloride, the reaction corresponding with the equation. $K_2PtCl_6 + C_2O_4K_2 = K_2PtCl_4 + 2KCl + 2CO_2$.

Chlorine and hydrogen; Combination of ——. Bodenstein. Deutsch. Bunsen-Ges., Berlin, Oct., 1915. Z. angew. Chem., 1915, **28**, Wirtschaftl. Tl., 621, and Chem.-Zeit., 1915, **39**, 805.

Under the influence of α-rays from radium the reaction-velocity (for equal intensity of radiation and complete absorption of the rays) is proportional to the concentration of the chlorine, independent of that of the hydrogen, and inversely proportional to an undetermined function of the concentration of oxygen. One ion causes the interaction of thousands of molecules. The reaction between chlorine and hydrogen at temperatures above the normal and in absence of light, is determined by the product of the concentrations of the two gases; it is therefore of the second order. In this case also oxygen has a retarding influence which is almost directly proportional to its concentration.
—J. H. L.

Radium; Practical methods for the determination of ——. *II. The emanation method.* S. C. Lind. J. Ind. Eng. Chem., 1915, **7**, 1024—1029.

The method described consists broadly in completely removing emanation from the substance under examination, then enclosing the substance in a gas-tight vessel, allowing emanation to accumulate for a definite period (1—4 days and collecting and measuring it; the maximum amount of emanation that would be obtained when equilibrium with the radium present in the substance was reached is then calculated by the aid of the equation, $E_t = 1 - e^{-\lambda t}$, where E_t is the percentage regeneration of emanation at the time, t, and λ the time constant for radium emanation ($= 0·0075$ hr.$^{-1}$) (see Kolowrat, *Le Radium*, **6**, 195; also Curie, *Traité de Radioactivité*, **1**, 419). To prevent loss of radium from solutions by precipitation or adsorption, a considerable excess of a barium compound, which acts as a protective agent, and nitric acid in fairly high concentration should be present. Radium solutions may be divided for analytical purposes into three classes:—(1) Solutions containing barium in large excess of the radium. A quantity of the solution containing about 1×10^{-8} grm. of radium is treated with nitric acid (1 : 1) in a small Jena flask, a few glass beads added, and the solution boiled for 5—10 mins. to expel emanation. After cooling slightly, the flask is closed with a stopper carrying a glass tube drawn out to a capillary at the upper end. The capillary is sealed while the flask still contains some steam, and the partial vacuum produced on cooling should be maintained during the time the flask is kept for the accumulation of emanation, thus affording proof that no leakage has taken place. (2) Solutions containing little or no barium. A portion of the solution is added to nitric acid (1 : 1) saturated with barium nitrate, and treated as in (1). (3) Solutions containing excess of a barium precipitant such as sulphate or carbonate. These are usually solutions from a radium-barium precipitation, and in the case of a solution standing above a precipitate, several separate samples should be taken at intervals and united to form the final sample. A portion of the sample is added to a solution containing excess of barium, and after standing over-night, the precipitate is filtered off, and the filtrate is made acid with nitric acid and treated as in (1). If the precipitate is barium sulphate it is fused with 4—5 times its weight of an equimolecular mixture of potassium and sodium carbonates and treated as described later. Barium carbonate precipitates are treated with a mixture of nitric and sulphuric acids and filtered, the filtrate being combined with the original filtrate, and the precipitate treated as described above. When the radium is present in a substance not soluble in aqueous or acid solution, a suitable quantity is fused with a carbonate fusion mixture in a small boat of porcelain or platinum foil; the boat, after cooling, is enclosed in a glass tube with the ends drawn out and sealed. After allowing emanation to accumulate for a definite period, the tube is connected by means of rubber tubing at one end with a glass stopcock and at the other with the partially evacuated chamber of the interchangeable electroscope (this J., 1915, 610). The sealed tips are then broken inside the rubber connections and the air in the tube drawn into the electroscope, the tube being refilled with air several times through the stopcock. The tube is then withdrawn, broken, and the boat and contents wrapped in filter paper and supported in the neck of a Jena flask half filled with nitric acid. The flask is connected with a gas-burette containing sodium hydroxide solution, as described later, a little of the acid is brought into contact with the material, and the stopcock leading to the gas-burette is opened. Later, the boat is shaken down into the acid, and when the evolution of carbon dioxide slackens, the solution is heated to boiling, the subsequent treatment being the same as described below for boiling off the emanation. In an alternative form of the fusion method, the product from the initial fusion is removed from the boat, placed between plugs of glass-wool in a hard glass tube with drawn out and sealed ends, and after emanation has accumulated, it is drawn into the electroscope by a current of air, carbon dioxide and moisture being removed by means of sodium hydroxide solution and sulphuric acid respectively; whilst the air is passing, the tube is heated strongly by means of a Meker burner and is preferably allowed to bend so that air is drawn through the melt; heating is continued until the tube finally collapses. The presence of a high percentage of silica has an unfavourable effect on both of the fusion methods. For boiling off emanation from solutions and transferring it to the electroscope, the apparatus shown in the figure is used. A stick of caustic soda is placed in C and dissolved by adding boiling water, and C is raised so as to fill the gas-burette, H, up to E, which is then closed, and C lowered. The glass tip, F, inside the rubber tubing is broken (this tip is prevented from being carried forward and lodged in the stopcock, D, by a roll of platinum foil, D, and the flask, G, containing the radium solution heated. As soon as the partial vacuum in the flask is overcome, D is opened, and the solution boiled vigorously for 5—10 mins. until the temperature of all the liquid in the gas-burette is raised to boiling. The flame is then removed, and as soon as liquid begins to be drawn back, D is closed. The apparatus is now connected with the evacuated electroscope chamber at M, the stopcock on the electroscope opened for a moment to produce a vacuum in the drying bulb, L, then closed, and E opened. When the liquid in the burette reaches K, E is closed, and dry dust-free air drawn in through J for a short time. The stopcock of the electroscope is then closed, and E is opened till the liquid falls to 4—5 ins. below the shoulder of the burette; E and J are then closed, and after removing excess liquid from C, E is opened, and air drawn through the liquid into the electroscope to remove any dissolved emanation.



Pitchblende. High-grade pitchblende is readily soluble in boiling nitric acid (1 : 1), and can be treated by either a solution or a fusion method. In low-grade pitchblende, the high silica content interferes in fusion methods. The radium content of pitchblendes may be calculated from the uranium content, as the Ra : U ratio is normal and constant ($3{\cdot}33 \times 10^{-7}$). The same applies to carnotite in large and well-sampled lots (Lind and Whittemore, this J., 1914, 1087). *Carnotite.* The high silica content interferes with fusion methods. The uranium vanadate, together with the radium, is soluble in boiling nitric acid (1 : 1), and the radium may be determined by solution from a sealed glass tube after a month's accumulation, or ignition in a hard glass tube sealed under the same conditions. Direct solution in hot nitric acid (1 : 1) saturated with barium nitrate, followed by accumulation in a closed flask for a few days, without filtering, gives approximately correct results. *Carnotite residues or tailings.* Solution methods are inapplicable, and fusion methods can be applied only after removing all the silica by means of hydrofluoric acid from a sample of at least 10 grms. In most cases the solid α-ray method (Moore and Kithil, Bull. 70, U.S. Bureau of Mines) is sufficiently exact. *Acid filtrates from ore extraction.* These can be boiled and sealed directly after addition of a barium compound. *Barium (radium) sulphates and sulphides* are treated by the fusion method.—A. S.

Ultraviolet light; Transformations and chemical equilibrium of water and solutions of hydrogen peroxide exposed to ——. A. Tian. Thesis, 9—154. J. Chem. Soc., 1915, **108**, ii., 828—830. (See this J., 1911, 25, 510, 773.)

For the estimation of small quantities of hydrogen peroxide, a slight excess of a dilute standard solution of potassium permanganate (*N*/1000 or *N*/2000) is added to the solution under examination, together with manganous sulphate as catalyst, and the unchanged permanganate is then estimated colorimetrically. By this method $0{\cdot}85 \times 10^{-6}$ grm. of hydrogen peroxide may be detected in 50 c.c. of solution, the sensitiveness of the method being thus of the same order as that in which titanic acid is employed. In the photochemical decomposition of hydrogen peroxide in dilute aqueous solution, the velocity increases with increasing frequency of the exciting radiation, and when thin layers of solution of varying concentration are exposed to the light emitted by a quartz-mercury arc lamp, the velocity is proportional to the intensity of the incident radiation and not to the absorbed luminous energy. This result is attributed to the heterogeneity of the radiation and the fact that rays of different wave-length are not absorbed in a constant ratio. The temperature-coefficient for the interval 10°—30° C. is 1·15. The velocity is slightly diminished by the addition of small quantities of acids and very considerably increased in presence of traces of alkali. The reaction between hydrogen peroxide and ozone is accelerated by the action of ultraviolet radiation. Whereas ultraviolet rays of moderately short wave-length ($\lambda 2500$—3000) are able to bring about the decomposition of hydrogen peroxide at a measurable rate, pure water is only decomposed by rays in the extreme ultraviolet ($\lambda < 1900$). If the water contains dissolved oxygen, this reacts with the hydrogen set free in the primary photochemical decomposition of the water, and thus indirectly increases the rate of formation of hydrogen peroxide in that the velocity of the reversed reaction $H_2O_2 + 2H \rightarrow 2H_2O$ is thereby diminished. At the same time, the dissolved oxygen is to some extent transformed into ozone under the influence of the ultraviolet rays, and the ozone formed reacts with the hydrogen peroxide. Special experiments have shown that ozone has no action on water under these conditions. Conditions favourable to the formation of hydrogen peroxide are obtained (1) by the use of a source of ultraviolet light which is rich in rays of very short wave-length; (2) by exposing the water to the action of the light in thin layers; (3) by eliminating as far as possible the factors which tend to bring about the decomposition of the hydrogen peroxide. This decomposition may be diminished by the use of pure water and of ultraviolet radiation from which the rays of moderate wave-length have been cut off. The disturbing influence of ozone may be eliminated to a large extent by passing a current of air through the solution. The radiation from high-tension quartz-mercury lamps which have been in use for some time is not nearly so rich in short-wave rays as the light which is emitted by new lamps of this type or that which is obtained from low-tension lamps.

Some new organic compounds of vanadium. Mertes and Fleck. *See* XX.

Colorimetric determination of copper and iron in pig lead, lead oxides, and lead carbonate. White *See* XXIII.

Patents.

Nitric acid; Process of concentrating ——. F. Raschig, Ludwigshafen. Ger. Pat. 286,973, June 30, 1914.

The nitric acid is distilled with concentrated sulphuric acid at atmospheric pressure, and the diluted sulphuric acid remaining is fed continuously and automatically through a bent barometer tube into a heated vacuum pan situated above, its ascent being assisted by the introduction of air bubbles into the barometer tube. When concentrated, the sulphuric acid is passed back by gravity down a similar tube into the first pan. Spent nitrating acid may be resolved in this way into water, nitric acid, and sulphuric acid, the last-named being removed from circulation without interrupting the process. Any nitro-sulphonic acid formed in this process may be converted into nitric and sulphuric acids, by introducing hydrogen peroxide or Caro's acid with the nitric acid.—E. H. T.

Sulphuric acid: Recovery of —— from burner gases. F. Raschig, Ludwigshafen. Ger. Pat. 287,471, Aug. 18, 1914.

THE warm, moist gases obtained in the ordinary purifying process, are cooled quickly and by indirect means. After the very weak acid has been condensed and removed, the sulphuric acid mist is separated, *e.g.*, by impact against suitable surfaces, and a strong acid, *e.g.*, one of 10° B. (sp.gr. 1·383) is thus obtained. This acid may be utilised at once, *e.g.*, to cool and moisten the hot, untreated burner gases, whereby it will be further concentrated.—E. H. T.

Acetic acid: Production of —— by oxidation of acetaldehyde. J. Behrens, Bremen. Ger. Pat. 287,360, June 19, 1913.

THE oxidation of acetaldehyde is accelerated by the addition of a small amount of water to which catalysts (*e.g.*, iron acetate) may have been added; the reaction mixture may also be exposed to ultraviolet light.—F. W. A.

Caustic soda solutions; Purification of —— from dissolved colloids. F. Küttner, Pirna. Ger. Pat. 287,092, July 1, 1914.

THE caustic soda used in the treatment of cellulose, wood pulp, etc., contains impurities of a colloidal nature, which are removed by dialysis into water or pure caustic soda solution. The caustic soda solution is passed through a series of vessels made of, or provided with partitions of, parchment paper, and closed in to exclude carbon dioxide. The alkali and the water circulate in opposite directions.—E. H. T.

Chlorine and sulphates from chlorides; Process for the production of ——. A. Mond, London. From T. Goldschmidt A.-G., Essen-Ruhr, Germany. Eng. Pat. 23,287, Nov. 30, 1914.

A CHLORIDE, sulphurous acid, and oxygen, or gases containing oxygen, are caused to interact at a temperature above 505° C., but always below the melting point of the solid mass present. For example, the gases are introduced into the lower end of an inclined rotary furnace charged with finely divided sodium chloride, and the reaction, which is exothermic, is started by heating the furnace at this end or by preheating the gases. Fresh chloride is introduced at the upper end of the furnace and the liberated chlorine withdrawn, whilst the sodium sulphate produced is removed from the lower end. The temperature is controlled by regulating the quantity or velocity of the gases admitted, the proportion of oxygen present, or the rate of withdrawal of the gaseous products. Technically pure sulphate is said to be obtained, in almost quantitative yield. With an excess of sulphurous acid, sulphuryl chloride is produced.—F. SODN.

Aluminium nitride: Process and apparatus for the manufacture of ——. Soc. Gén. des Nitrures, Paris. Eng. Pat. 11,271, Aug. 4, 1915. Under Int. Conv., Aug. 14, 1914.

A MIXTURE of carbon and aluminous material is allowed to fall freely, in a state of suspension, through a heated space filled with nitrogen (or gas containing such) which is previously heated to a temperature approaching or exceeding that of the nitride-forming reaction, and the mixture of gas and solid then passes, during a very short time, through an electric arc or other source of intense heat. The apparatus comprises a shoot-tube along which the solid materials pass, one or more chambers for heating the nitrogen, *e.g.*, by an electric arc, a chamber for mixing the solid and gaseous materials, and a reaction chamber surrounding an electric arc and communicating with the mixing chamber by a narrow opening which directs the materials on to the arc. The process is a modification of that described in Eng. Pat. 23,740 of 1913, this J., 1914, 643 (see also Eng. Pats. 23,541 of 1911 and 24,731 of 1913; this J., 1912, 335, and 1914, 421).—F. SODN.

Chromium compound. W. Beckers and I. Dreyfus, Assignors to W. Beckers Aniline and Chem. Works, Brooklyn, N.Y. U.S. Pat. 1,162,210, Nov. 30, 1915. Date of appl., Mar. 24, 1914.

SOLUTIONS of glucose and a neutral chromium compound, such as sodium chromate, are heated together, so as to produce a chromium compound which is not precipitable by alkalis or mordant colours, and the solution obtained is evaporated to dryness.—F. SODN.

Ammonia from calcium cyanamide; Process of making ——. W. S. Landis, Niagara Falls, N.Y., Assignor to American Cyanamid Co., Nashville, Tenn. U.S. Pat. 1,163,095, Dec. 7, 1915. Date of appl., Aug. 16, 1915.

AN alkali hydroxide is added to a mixture of calcium cyanamide and water, of the consistency of "slurry," and sufficient heat is applied (for example, by admitting superheated steam) to start the reaction, which then proceeds exothermically. The mixture should be continuously stirred to prevent the formation of a deposit upon the walls of the containing vessel.—F. SODN.

Ammonium sulphate discharged from saturators; Receptacle for the ——. R. Wilhelm, Altenessen. Ger. Pat. 286,242, July 8, 1914.

THE receptacle consists of a semi-cylindrical vessel mounted on trunnions so that it can be tilted, and provided with a discharge lip and shoot. The mixture of sulphate and liquor is ejected from the saturator into the receptacle, and after settling, the supernatant liquor is removed by means of an adjustable pipe and returned to the saturator, and the receptacle is then tilted by turning a hand-wheel connected with suitable gearing, whereupon the pasty mass of crystals flows through the discharge shoot into a centrifugal machine. The receptacle is supported on a frame mounted on ball bearings so that it can be rotated horizontally in order that several centrifugal machines may be supplied from one receptacle.—A. S.

Magnesium carbonate; Basic —— and process of preparing same. T. Silbermann, Dresden, Germany. U.S. Pat. 1,163,475, Dec. 7, 1915. Date of appl., June 29, 1914.

A SOLUTION of a magnesium salt, *e.g.*, diluted effluent containing magnesium chloride, is heated with partially carbonated ammonia (containing 8—10% ammonia and 4—6% carbonic acid) in such a manner that an excess of ammonia, in respect of the magnesium, is maintained, and a moderate excess of carbonic acid (not more than 63 parts by weight of carbonic acid to 24 parts of magnesium). When the mixture assumes a curdy consistency, it is filtered and the product dried. The basic carbonate obtained is a voluminous granular material, containing about 50% of water of crystallisation; it is converted into a *magnesia usta* when heated to 400°—800° C. —F. Sodn.

Carbon dioxide: Preparation of chemically pure —— from the waste gases obtained in the distillation of ammoniacal liquor. A. Fillunger. Ger. Pat. 286,971, Sept. 20, 1914.

The waste gases are mixed with a combustible gas, *e.g.*, producer gas, and passed over fire-brick and ferric oxide. The crude gas, containing about 90% of carbon dioxide, 9% of hydrogen sulphide, and 1% of nitrogen, with organic compounds and cyanogen, is burnt completely, without external heating, at a dull red heat which prevents the formation of oxides of nitrogen. The products of combustion are washed with water to remove sulphur dioxide and then with permanganate solution.—F. W. A.

Ammonia: Oxidation of —— to nitrogen oxides. Berlin-Anhaltische Maschinenbau A.-G. Ger. Pat. 286,991, Nov. 27, 1914.

A regulator into which both ammonia and air currents are separately passed, allows these gases to be mixed continuously in any desired proportion, before they pass on to the reaction chambers containing the catalyst.—E. H. T.

Oxygen; Apparatus for generating ——. P. A. Smithurst, London. Eng. Pat. 1400, Jan. 28, 1915.

A cylinder in which is a removable perforated reaction vessel, mounted so as to leave a space above the bottom of the cylinder, communicates by a pipe near the base with a second cylinder containing water. The water is forced from the second cylinder into the first, and thence into the reaction vessel by means of compressed air from a pump secured to the base-plate between the cylinders, and the reaction vessel is charged with a substance which evolves oxygen when treated with water. An outlet pipe with reducing valve is fitted to the cover of the generating cylinder, and the second cylinder is provided with a safety valve.—F. Sodn.

Nitric acid; Process and apparatus for concentrating dilute ——. F. Raschig, Ludwigshafen, Germany. U.S. Pat. 1,163,174, Dec. 7, 1915. Date of appl., Feb. 9, 1915.

See Ger. Pat. 286,973 of 1914; preceding.

Hydrochloric acid; Application of —— in manufacturing processes. Soc. Ital. di Elettrochimica, Rome. Eng. Pat. 24,025, Dec. 14, 1914. Under Int. Conv., Oct. 30, 1914.

See Fr. Pat. 476,630 of 1914; this J., 1916, 45.

Calcium cyanamide; Process of making ——. E. Gui, Assignor to Barzano e Zanardo, Rome. U.S. Pat. 1,164,087, Dec. 14, 1915. Date of appl., June 4, 1914.

See Fr. Pat. 456,826 of 1913; this J., 1913, 1108.

Manufacture of urea and of ammonium carbamate for use in such manufacture. Eng. Pat. 23,939. *See* XX.

VIII.—GLASS; CERAMICS.

Manganese in glass; Identification of trivalent ——. S. R. Scholes. J. Ind. Eng. Chem., 1915, 7, 1037.

The violet tint imparted to glass by addition of manganese dioxide, which effectively masks the green colour produced by iron, is regarded by Dralle and by Hovestadt as due to Mn_2O_3, but the state of oxidation of the manganese has not hitherto been demonstrated experimentally. A deep violet glass prepared by the author from a mixture of 10 parts of sand, 5 of soda ash, 6 of red lead, and 1 of manganese dioxide, when powdered and boiled with 30% sulphuric acid, yielded a pink solution, which could be decolorised by oxalic acid and other reducing agents. A more strongly coloured solution was obtained in a similar way from a glass prepared from 5 parts of sand, 5 of potassium carbonate, and 1 of manganese dioxide. The colour was not due to permanganate, for the glass did not yield a coloured solution with water, although it slowly disintegrated. A solution of manganic sulphate, closely resembling the solution obtained from the glass, was prepared by partially reducing manganese dioxide to Mn_3O_4 by heating, and then treating with sulphuric acid. This solution and the solution prepared from the glass both gave a light brown flocculent precipitate on diluting with several volumes of water.—A. S.

Glass making: Formulæ for ——. Proc. Inst. Chemistry, 1915, Part 4.

The following additional formulæ are given to avoid the use of alumina, the price of which has increased considerably:—

No. 13. Sand, 15·35 parts; potash felspar, 32·50 parts; sodium carbonate, 29·10 parts; calcium carbonate, 11·20 parts. This formula was tried on the laboratory scale independently by two workers. It gives a glass fining easily, and quite free from seed. It is a better working glass than No. 1, and should be much cheaper. No. 14. Sand, 51·5 parts; potash felspar, 20 parts; potassium carbonate, 7·2 parts; sodium carbonate, 25 parts; calcium carbonate, 12·5 parts. The amount of felspar present is sufficient to give four parts of alumina (Al_2O_3). The other ingredients are adjusted to give the same composition as No. 11, the adjustment being based on analysis of the felspar used. (See also this Journal, 1915, 424.)

Patents.

Glass-working machines and process of working glass. J. Gray, London. From Empire Machine Co., Corning, N.Y., U.S.A. Eng. Pat. 21,723, Oct. 29, 1914.

Hollow glass ware is made by feeding a stream of molten glass into a receiver and pressing it on the end of a glass-working spindle into a blank with a skin sufficiently strong to retain the fluid interior, the blank being then supported out of contact with heat-conducting material until the skin is sufficiently reheated by conduction from the interior to expand without cracking. The excess glass is extruded into a neck by a plunger with a cup-shaped recess. The stream of glass is severed by a pair of pivoted cutting members, the severed end is thrown to one side of the centre of the blank, and is subsequently pressed into the mass of glass by the plunger with the cup-shaped recess. The plunger has an air relief valve which closes when the molten glass is being formed by pressure into a blank. The machine has travelling carriers each provided with a glass-working spindle and a blow mould, and means for disengaging the driving mechanism when a carrier approaches a preceding stationary carrier, and for re-engaging it when the preceding carrier moves forward.—W. C. H.

Glass-furnace. R. H. Bolin, Kane, Pa., Assignor to Consolidated Machine Co., Bradford, Pa. U.S. Pat. 1,163,584, Dec. 7, 1915. Date of appl., Aug. 4, 1908.

In a tank furnace, a refractory bridge extends over the main body of molten glass and is provided with a drawing opening. One or more refractory rings floating in the molten glass can be brought into alinement with another ring mounted in the drawing opening. The floating rings are provided with skimming openings through which the skimmings therein can pass into a pocket-like extension of the tank provided with auxiliary heating means. The ring mounted in the drawing opening is movable vertically so as to close or open the skimming opening in the floating rings and to screen a given zone above the glass level from the surrounding heat of the tank.—A. S.

Glass-drawing furnace. R. H. Bolin, Kane, Pa., Assignor to Consolidated Machine Co., Bradford, Pa. U.S. Pat. 1,163,585, Dec. 7, 1915. Date of appl., March 22, 1909.

A number of refractory piers extend upwards from the bottom of the tank and are spaced apart transversely across it near the drawing end. Refractory bridges extend from the piers to the wall of the drawing end of the tank, each of which is provided with a drawing opening. The bottom of the tank is provided with a projection beneath each drawing opening, whereby the glass in the tank below the openings is cooled.
—W. C. H.

Mica: Method of and means for treating ——. P. G. Palmer and J. J. Robinson, London. Eng. Pat. 23,067, Nov. 25, 1914.

Sheets of mica are coated, on one or both sides, with a material or composition, such as any suitable pottery glaze or flux, and then heated to a temperature sufficient to convert the glaze into a hard, unscratchable coating, integral with the mica sheet.—W. C. H.

China-clay, ochre, and similar materials; Separation of ——. W. J. Gee, London. Eng. Pat. 24,077, Dec. 15, 1914.

Water containing suspended china-clay or other material is passed through two centrifugal separators in succession. The first runs at relatively low speed and separates the coarser particles, while the second completes the separation of the finer material.—W. F. F.

Exhausting incandescence lamps or similar glass receptacles. Eng. Pat. 1088. *See* IIb.

IX.—BUILDING MATERIALS.

Portland cement; Test of —— for time of setting. T. Hattori. J. Chem. Ind., Tokyo, 1915, **18**, 1189—1225.

A method based on the amount of heat developed is more rational than the use of the Vicat needle, and yields satisfactory results, more especially with quick-setting cements. Uniform results with the Vicat needle may be obtained by selecting as the points the vertices of an equilateral triangle each of which is equidistant from the centre and circumference of the pat, and by regarding the "initial set" as occurring when all three needles, on being lowered, are arrested at 1 mm. above the level of the base of the pat, and the "final set" as when the needles are arrested at 0·5 mm. under the surface (39·5 mm. above the base). The time occupied in gauging judged to be correct should be defined. The test should always be made at the atmospheric temperature of the place where the cement is to be used. It is also suggested that a portion of the sample be hermetically sealed in a glass bottle, another portion aerated for a week or ten days, both tested relatively, and the cement rejected if found to be unduly affected by aeration. Tests made with the Vicat needle on mixtures of cement with finely powdered sand are recommended as being of greater practical value than those made on neat cement.—W. E. F. P.

Cements; Sand-strength of ——. H. Burchartz. Mitt. k. Materialprüf., 1915, **33**, 113—126.

The usual way of expressing the composition of mixtures of cement and sand, in the form 1 : 2, 1 : 3, 1 : 4, etc., is somewhat misleading, for above the ratio 1 : 3, the actual decrease in the amount of binding material is comparatively insignificant. Experiments were made with two Portland cements, A. and B., and two iron-Portland cements, C. and D., A. and C. being of slightly higher quality than B. and D., judged by the results of normal tests. Tensile and crushing strengths were determined of mixtures of cement and normal sand in the ratios 1 : 2 up to 1 : 7 (by weight) after 7, 28, and 180 days under water, and 28 and 180 days' exposure to air. The strength of cements decreases with increasing additions of sand, but the decrease varies with the character of the cement, method of exposure, and strength and age of the test-pieces: it is greater in the "fat" than in the "lean" mixtures, but is not so marked as would be expected from the decrease of binding material. The decrease in strength with increased sand-content is greater with the newer than with the older test-pieces, and the decrease of tensile strength is less than that of the crushing strength. Hardening in air instead of under water does not affect the strength, and there is hardly any difference in the strengths of Portland and slag cement. The mixtures for the above test-pieces were made by weight, and hence the specifically lighter cements would be favoured, for a larger volume of the binding-material would be introduced than in the case of the heavier cements. The sand addition also affects the progress of the hardening process. When the test-pieces are left under water, the tensile and crushing strengths in all cases increase with age, and increase more with the "lean" than the "fat" mixtures. Cements with a lower normal strength, when mixed with sand, develop in time a relatively greater strength than cements with a higher normal strength. From the tensile strength it appears that the hardening process in test-pieces exposed to the air is not so complete with increasing sand dilution as in the case of test-pieces hardened under water. With air-hardened test-pieces the crushing strength up to 28 days is greater than with water-hardened test-pieces.—W. C. H.

Patents.

Timber; Method of impregnating ——. G. B. Shipley, Pittsburgh, Pa. U.S. Pat. 1,163,270, Dec. 7, 1915. Date of appl., June 27, 1914.

Wood is subjected to air pressure and then, without relieving the pressure, to a bath of a preserving composition under pressure higher than the air pressure. The composition is withdrawn and the wood subjected to a partial vacuum, whereby part of the water and composition are extracted, and the wood is then subjected to a waterproofing composition under pressure and a portion of the latter composition is withdrawn under a partial vacuum.—W. C. H.

Timber; Method of fireproofing ——. G. B. Shipley, Pittsburgh, Pa. U.S. Pat. 1,163,271, Dec. 7, 1915. Date of appl., Apr. 5, 1915.

Wood is subjected to treatment in a bath containing cementitious and pulverised silicious material in suspension, under a pressure higher than that of the atmosphere, the bath being agitated during the treatment to keep the materials in suspension.
—W. C. H.

Asphalt cement : Manufacture of —— from natural asphalts. C. N. Forrest, Rahway, N.J., Assignor to The Barber Asphalt Paving Co., Philadelphia, Pa. U.S. Pat. 1,163,593, Dec. 7, 1915. Date of appl., Aug. 20, 1912 ; renewed Feb. 26, 1915.

Asphalt cement for paving purposes is made by heating crude sulphur-bearing asphalt in the presence of a sulphur-absorbing oil, whereby loss of sulphur is prevented, and a proper balance of cohesion and adhesion is retained, sufficient oil being added to obtain the required consistency. —W. C. H.

Slag : Art of converting molten —— into a highly porous mass. C. H. Schol, Allendorf, Germany. U.S. Pat. 1,163,605, Dec. 7, 1915. Date of appl., Sept. 15, 1915.

The slag is granulated by passing into highly heated water. The molten slag passes on to the inclined top of a receptacle, arranged within the reservoir containing the water and about on a level with the top of the water. The water in the receptacle is thus heated, and means are provided for transferring some of this heated water to a point of the outer reservoir, distant from that at which the slag enters.—W. C. H.

X.—METALS ; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steels used for German shells. J. E. Stead. Cleveland Inst. of Eng. Engineer, 1916, 121, 43—44.

The figures given in the table below show the composition of fragments of German shells from various localities :—

Where found.	C.	Mn	Si.	S.	P.	Cu.	N.	Tenacity.
	%	%	%	%	%	%	%	%
West Hartlepool	0·60	0·73	—	0·062	0·085	—	—	—
,, ,,	0·70	0·80	0·35	0·027	0·043	—	—	55
,, ,,	0·670	0·515	0·336	0·037	0·048	0·083	—	62
,, ,,	0·870	1·094	0·252	0·037	0·028	0·080	—	65
,, ,,	0·465	0·794	0·324	0·038	0·028	0·090	—	55
,, ,,	0·600	0·655	0·597	0·046	0·051	—	—	—
,, ,,	0·820	1·266	0·186	0·048	0·052	—	—	—
,, ,,	0·765	0·655	0·364	0·030	0·045	—	—	—
,, ,,	0·630	0·550	0·400	0·042	0·077	—	—	—
,, ,, (8 in. shell)	0·86	1·03	0·186	0·053	0·045	—	—	—
,, ,,	1·12	1·00	0·23	0·054	0·038	—	—	—
Whitby and Scarborough	0·850	1·330	—	0·080	0·105	—	—	—
,, ,,	0·60	1·21	0·334	0·071	0·069	—	0·0112	59
,, ,,	0·74	1·170	0·261	0·044	0·064	—	—	62
Dunkirk	0·675	0·380	0·078	0·083	0·043	—	—	—
Ypres	0·700	1·108	0·221	0·041	0·079	—	—	—
Flanders	0·98	1·05	—	0·055	0·086	—	—	—
,,	0·93	0·98	—	0·059	0·065	—	—	—
,,	0·74	0·98	—	0·054	0·050	—	—	—
,,	0·393	1·400	0·210	0·035	0·041	—	—	—
France	0·930	0·970	0·164	0·032	0·048	—	—	—

Fragments of armour-piercing shells had the following composition :—C, 0·840 % ; Mn, 0·381 ; Si, 0·401 ; S, 0·033 ; P, 0·032 ; Ni, 3·100 ; Cr, 3·351 %. This corresponds to the steel used for the purpose in other countries. It is concluded that the steel used for German high-explosive shells is more liable to break up by shock than that used in this country. Some of the steel was probably made by the basic Bessemer process, as judged by the relatively high nitrogen content of one of the toughest and best fragments, which also contained 0·07 % of sulphur and phosphorus. If the high-explosive shells with between 0·07 and 0·1 % of phosphorus did not burst in the gun, it appears that great freedom from that element has been found unnecessary.

Silver crystals ; Structure of ——. L. Vegard. Phil. Mag., 1916, 31, 83—87.

As the result of examining two crystals of native silver having well developed cube and tetrahedron faces, respectively, by the method of W. H. and W. L. Bragg (Proc. Roy. Soc., A., 88, 428), based on the determination of the reflexion angle of a homogeneous beam of X-rays, it is concluded that the arrangement of the atoms in silver crystals is that of the simple, face-centred lattice, as in the case of copper crystals (this J., 1914, 966). —W. E. F. P.

Ferrous oxide and carbon ; Reaction between —— and between carbon monoxide and iron. V. Falcke. Deutsch. Bunsen-Ges., Berlin, Oct. 1915. Z. angew. Chem., 1915, 28, Wirtschaftl. Tl., 624. (See also this J., 1913, 365 ; 1915, 554.)

From further investigations of the equilibrium between iron and carbon monoxide two different temperature-pressure curves were obtained corresponding to different experimental conditions, and possibly due to the formation of two different carbides. A third curve, not far removed from the others, was derived from a study of the reaction between ferrous oxide and graphite, but it is uncertain whether this indicates a different equilibrium, as the final conditions were approached from one side only.—J. H. L.

Gold ; Reactions of colloidal ——. R. Zsigmondy. Deutsch. Bunsen-Ges., Berlin, Oct. 1915. Z. angew. Chem., 1915, 28, Wirtschaftl. Tl., 623—624.

Pure colloidal solutions of gold are not coagulated when shaken with organic solvents such as benzene, toluene, or ether, provided the latter contain no impurities. Suspensions of microscopic or ultramicroscopic gold particles large enough to subside, are coagulated, however, and the gold collects at the surface of separation of the liquids. This occurs, for instance, when suspensions of gold particles larger than 0·2 μ, are shaken with benzene. The presence of impurities may produce a similar result in the case of true gold hydrosols. For example, extremely minute traces of protein matters cause coagulation of pure, feebly acid, red hydrosols, the colour rapidly changing to blue, and then the gold can be readily shaken out by organic solvents. On neutral or feebly alkaline gold hydrosols, proteins have no coagulating influence but appear to act as protective colloids. —J. H. L.

Pyrite smelting at Mount Lyell, Tasmania. R. C. Sticht. Proc. Austral. Inst. Min. Eng., 1915, 19, 75—125.

Pyrite smelting has been carried out at Mt. Lyell since 1896 without interruption. The hot blast has long ago been discarded owing to its high cost, and replaced by a greater volume of blast (1000 cub. ft. per min. per ft. of hearth length) at high pressure (72—96 oz. per sq. in.), with slightly increased addition of coke. This increase was also rendered necessary by a slight alteration of the ore as greater depth was reached, the iron falling from 45 to 42%, and zinc and lead rising to 1 and 0·7% respectively. The height of ore column in the furnace has been increased from 10 to 18 ft. The composition of the charge, which may be altered several times a day with the object of obtaining a uniform grade of converter matte (45—50% Cu), is usually between the following extremes: Mt. Lyell pyrites, 2240; North Mt. Lyell ore (silicious, with 6% Cu), 1000—1700; limestone, 250; converter slag, 50—550; and coke, 160—250 lb. If the matte grade falls, more silicious ore is added: this does not raise the acidity of the slag, the composition of which remains constant for the same set of conditions (temperature of focus, volume of blast); but the quantity of slag is thereby increased, the excess silica scorifying more iron which would otherwise increase the amount, and lower the grade, of the matte. The charge is fed into the furnace in the largest-sized pieces which it is possible to handle, as all the materials used break up under the influence of heat; hence the furnace acts as its own crusher. Fines are objectionable, because it is necessary that the charge should form a honey-combed column of granular quartz through which the molten sulphide trickles and becomes scorified by the simultaneous action of blast and silica. About 60% of the sulphur in the ore distils as such; 2% goes into the matte, the remainder serving as fuel together with 95% of the iron. Careful feeding and a constant, sufficient blast supply are essential for smooth running; continuous runs of 6 months can be achieved, the longest having lasted more than a year. The slag is granulated and washed away by the jacket water; a typical sample assayed SiO_2 38·7, FeO 41·7, CaO 3·9, Al_2O_3 7·0, BaO 2·6, ZnO 0·7, and Cu 0·4%. The usual ratio of concentration is 18 : 1. The amount of flue-dust formed is small owing to the coarseness of the materials.—W. R. S.

Wolframite in Burma. Times Eng. Suppl., Dec. 31, 1915.

One of the principal sources of the world's supply of wolframite is the district of Tavoy, in Burma, which exports some 1600 tons out of the 8000 tons of the total annual production. Before the war almost the whole of the Burmese output was taken, either directly or indirectly, by Germany. The new Lieutenant-Governor of Burma, on taking over charge of the province at the end of October, found that the process of extraction was much slower and the output much smaller than need be the case, and that this arose from the business being in the hands of small concessionaires, without the capital for development. He has cancelled some of the smaller concessions on equitable terms in the public interest, and has announced that the cost of such expropriation will be borne from the provincial revenue. The output is being rapidly augmented, and under the Defence of India Act rules for the conduct of the industry have been promulgated. It is provided that the collectors in the Tavoy and Mergui districts may order the departure of any person whose presence in the district is detrimental to the industry. Before the war many German agents resided in the mining areas. Germany then controlled fully 80% of the world's output, and bought the whole of the Tavoy tonnage of concentrates at the lowest prices by installing buyers on the spot. (See also this J., 1915, 428.)

Stannite ore at Zeehan, Tasmania; Treatment of ——. J. H. Levings. Proc. Austral. Inst. Min. Eng., 1915, **19**, 183—188.

Three localities are at present known where stannite occurs in sufficient quantity to be treated: the Conrad and Tolwong mines (N.S.W.), and the Oonah Mine, Tas. Reverberatory furnaces were first used, the Conrad mine applying iron precipitation of the tin, the others carbon reduction. At the Oonah plant, pyritic smelting with addition of 4% of coke was next tried: 50% of the tin was volatilised, the bulk of the remainder going into the slag: the recovery of silver and copper was fairly good. Blast-roasting down to 8—9% of sulphur, followed by coke smelting in the blast-furnace, gave a 20% copper matte and a white copper-tin alloy containing Cu 42, Sn 40%, and Ag 660 oz. per ton; a satisfactory price could not be obtained for the alloy. The author proposes the following treatment for stannite ores: (1) Preliminary roasting followed by blast-roasting. (2) Smelting of the roasted product under reducing conditions, giving tin-copper alloy and sufficient 30% matte for the next operation. (3) Converting the mixed alloy and matte to produce silver-copper bullion and volatilised tin oxide, which is condensed. (4) Reduction of the tin oxide.—W. R. S.

Calcium: Metallic —— and its use in gas analysis. Sieverts. Deutsch. Bunsen-Ges., Berlin, Oct., 1915. Chem.-Zeit., 1915, **39**, 804, and Z. angew. Chem., 1915, **28**, Wirtschaftl. Tl., 619—620.

Whilst some specimens of commercial calcium combine with nitrogen only above 800° C., the majority exhibit a second zone of activity between 300° and 660°, with its optimum about 440° C., at which temperature pieces of the metal weighing 2—4 grms. can be quantitatively converted into nitride without any difficulty. The author distinguishes these two kinds of commercial calcium as "inactive" and "active." The former can be transformed into the latter by melting and cooling slowly so as to produce a relatively coarse grained crystalline structure; it then absorbs nitrogen even below 300° and above 650° C. The reverse change is effected by chilling melted calcium from 840° C. Mechanical powdering of the metal does not increase its reactivity but may render it "inactive." The absorption of hydrogen by commercial calcium also depends on the crystalline structure of the metal, though the author found no samples quite indifferent towards hydrogen at all temperatures below 800° C. Samples which absorbed nitrogen between 300° and 660° absorbed hydrogen only between 150° and 300°, and above 600° C., whilst others of coarse-grained crystalline structure reacted at the ordinary temperature. A superficial layer of hydride (or nitride) on the metal facilitates further absorption of hydrogen (or nitrogen). Above the melting point of calcium (810° C.) the rate of absorption of either gas increases very rapidly with rise of temperature. Calcium nitride absorbs hydrogen and forms the compounds, $Ca_3N_2H_2$ and $Ca_3N_2H_4$, of which only the second undergoes appreciable dissociation below 600° C. The nitride also absorbs carbon monoxide, carbon dioxide, and methane, with liberation of carbon. "Active" commercial calcium can be applied to the determination of inert (rare) gases in gas mixtures, at temperatures easily attained with a Bunsen flame, and the author has devised an apparatus for this purpose. It consists of a manometer open to the atmosphere, with narrow glass tubes, and an easily replaceable absorption tube of 50—75 c.c. capacity connected by an air-tight joint covered with sealing-wax. The calcium is used in pieces weighing 3—5 grms. The apparatus is first evacuated as far as possible by means of a water pump and then completely by heating the calcium. It is filled with the gas to be analysed, and the difference in pressure before and after absorption is measured at constant volume and temperature. Determinations of the inert gases in air, oxygen, nitrogen, or crude argon can be completed in 1½ hour. For gases containing carbon monoxide, carbon dioxide, or methane, calcium is used together with calcium nitride. For more exact analyses, such as the determination of inert gases in minerals, a more elaborate apparatus has been devised.—J. H. L.

Transition temperatures of tin, zinc, bismuth, cadmium, copper, silver, lead, and antimony determined by an electrically heated pressure apparatus. E. Janecke. Z. physik. Chem., 1915, **90**, 313—339. J. Chem. Soc., 1915, **108**, ii., 821. (Compare page 112.)

FROM pressure-temperature curves the author has been able to confirm the existence of allotropic forms of the metals tin, lead, bismuth, cadmium, copper, lead, and antimony, as found by Cohen and his collaborators (compare Holt, this J., 1915, 693), and in most cases the transition temperatures now found agree with the values of Cohen, although some slight differences occur. In the case of silver, for which no allotrope has hitherto been recognised, the author shows that a transition occurs at from 118°—122° C. This result is confirmed by the results of Hevesy and Wolff for the thermal E.M.F. of a silver-nickel couple (Physik. Zeits., 1910, 11, 473).

Metals in non-aqueous solutions; Relative affinity of ——, and their reactivity in insulating media. Part I. J. C. Ghosh. J. Phys. Chem., 1915, **19**, 720—733.

SOLUTIONS of pure, anhydrous ferric chloride, mercuric chloride, mercuric cyanide, cadmium iodide, and lead oleate in pure benzene, toluene, aniline, nitrobenzene, chloroform, ethyl acetate, amyl acetate, and amyl alcohol were allowed to remain in contact with pure magnesium, zinc, iron, lead, tin, copper, and mercury in hermetically sealed tubes at atmospheric temperature for periods varying from 25 to 39 days, after which the solution and metal were examined in each case. The specific electrical resistances of the original solutions were generally less than those of the corresponding solvents and varied from about 1 ohm to upwards of 7500 million ohms. The following table, in which metals are arranged in electrochemical series, shows in each case the number of solvents in which the metal of the salt was displaced by the metal immersed in the solution. It is concluded that the displacement series is not a characteristic of the metal but is dependent on the mutual relationship of the metals, the acid radicles, and the solvent present in any given combination; that the velocity of reaction in a solution having a specific resistance of over 500 million ohms, although very low, is never zero; and that the change in velocity in passing from one solvent to another is not comparable with the change in electrical resistance.—W. E. F. P.

Metal.	$FeCl_3$ in 8 solvents.	CdI_2 in 5 solvents.	Lead oleate in 7 solvents.	$HgCl_2$ in 8 solvents.	$Hg(CN)_2$ in 5 solvents.
Mg	8	5	7	8	1
Zn	8	0	7	8	0
Fe	—	3	4	3	2
Pb	8	—	—	—	2
Sn	6	—	—	—	—
Cu	2	4	7	8	5
Hg	0	—	0	—	—

Platinum: Census of stocks of ——.

THE Ministry of Munitions has addressed a circular to dealers in platinum, requiring them immediately to make a return to the Director of Materials of the Ministry of Munitions, Armament Buildings, Whitehall Place, London, S.W., of the whole of the stock of platinum, ores, residues, or bars, containing the same, now on their premises or under their control. Any person buying, selling, or dealing in platinum, or goods manufactured wholly or partly of platinum, offering, or inviting an offer, or proposing to buy, sell, or deal in it or them, or entering into negotiations for the sale or purchase of or other dealing in it or them without a permit, is liable to the penalties provided for offences against the Defence of the Realm Regulations.

Chromium; Supplies of ——. Ch. of Comm. J., Jan., 1916.

PRACTICALLY the only commercial source of chromium is chromite, or chromic iron ore. Rhodesia and New Caledonia are close competitors for the first position amongst the producing countries. Prior to the year 1911 New Caledonia was the largest producer. In 1910 Rhodesia's output was almost equal to that of New Caledonia, and in 1911 and 1912 well ahead. In 1913 the output of New Caledonia was largely increased and again equalled that of Rhodesia. Russia, Greece, and India are the other principal sources of supply.

Rhodesia.—The following table shows the exports of chromite from Southern Rhodesia in 1913 and 1914, with the principal countries of destination:—

	1913.		1914.	
To	Tons.	£	Tons.	£
United States	27,440	61,250	24,855	55,481
France	13,830	31,020	7,918	17,787
Norway	—	—	7,392	16,500
Germany	9,310	20,782	4,009	8,950
Holland	5,409	12,663	2,514	5,725
Belgium	3,829	8,749	2,085	4,778
United Kingdom	3,081	7,030	2,323	5,310
Total	62,899	141,494	51,096	114,531

The exports of chromite from Southern Rhodesia during the nine months ended September 30th, 1915, were 38,496 tons, value £85,956, as compared with 41,128 tons, value £92,281, in the corresponding period of 1914. The ore is mined at Selukwe and transported by rail across Portuguese East Africa to Beira for shipment. Deposits of chromite occur in other parts of Rhodesia, at Victoria, Makwiro, and Lomagundi. The percentage of chromic oxide in the ore varies. At Makwiro it is low and at Selukwe high. Chromite has been mined continuously in Rhodesia, and with a progressive output, since 1905.

New Caledonia.—The output of chromite in 1913 was 62,352 tons, as compared with 41,325 tons in 1912. It was reported in 1913 that the company which controls the deposits of New Caledonia intended to construct hydro-electric works for manufacturing ferro-chrome and ferro-nickel.

Russia.—The output of chromite in Russia in 1912 was 20,934 tons.

Turkey in Asia.—Large deposits of chromite have been worked in the vicinity of Mersina on the coast of Turkey in Asia about 100 miles north-east of Cyprus. The ore is said to contain 51 to 53% of chromic oxide, and it has been exported in large quantities to France and Germany. The occurrence of chromite has been reported at other places in Asiatic Turkey, notably in the neighbourhood of Broussa. In 1909 the output was 11,364 tons, value £31,000; statistics for 1910 and 1911 are not available, but in 1912 the production is recorded as only 115 tons. No statistics of the production since 1912 are available, but during the fiscal year ended June 30th, 1914, 11,830 tons were exported from Turkey in Asia to the United States.

Greece.—The chromite of Greece occurs mainly in the eastern provinces and in the island of Skyros. Grecian ore is specially suitable as a refractory material for lining furnaces. The higher grades of ore are mined in Larissa, the eastern portion of Thessaly, and contain 3 to 5 % of silica and 38 to 42 % of chromic oxide. The low grades occur further south, in the country between Lako Copias and the channel of Talanta, which affords convenient water transport. Grecian "chromiferous iron ore" ranges in composition from 46 to 52 % of iron, 6 to 14 % of alumina, 5 to 11 % of silica, 2 to 3 % of chromium, with smaller proportions of nickel, cobalt, and sulphur, and traces of phosphorus and titanium. The ore is easily mined and can be conveniently shipped at 5s. or 6s. a ton.

Bosnia-Herzegovina.—There are chromium mines at Dubostica in Bosnia-Herzegovina. The output in 1911 was 250 metric tons of chromite, valued at £739, and in 1912, 200 metric tons, value £542.

Japan.—There is a small production of chromite in Japan, the output in 1911 being 1524 metric tons, value £2107, and in 1912, 1617 metric tons, value £2144.

Norway.—It was reported early in 1915 that a company was starting trial work on chromite deposits situated in the province of Nordland in Norway.

United States.—The production of chromite in the United States was only 255 tons in 1913 and 591 tons in 1914, almost entirely in California, but if the increased demand continues other deposits are likely to be opened. The large supplies of foreign ore permit its delivery in American ports at low rates. It is sold on the basis of 50 % content of chromic oxide, and a fair price prior to 1914 for cargo purchases was from $14.50 to $15.50 a ton. Chromic oxide in excess of 50 % is sold at the rate of 50 to 60 cents per additional unit.

The following are other occurrences of chromium ores in the countries of the British Empire :—

Transvaal, South Africa.—Numerous and extensive chromite deposits occur in the country known as Sekukuniland, situated to the north-west of Lydenburg, in the Transvaal, South Africa. Chromite occurs on the farms Twifelaar, Mooihoek, Hendriksplaats, and others. Analysis of the ore from an outcrop at Mooihoek showed 51·29 % of chromic oxide. Other occurrences in the Eastern and Central Transvaal have rarely shown more than 40 %.

India.—Chromite is known to occur in the "Chalk Hills," near Salem, in the Andamans, in Baluchistan, in Mysore, and in Singhbhum. Attempts were made many years ago to work the deposits near Salem, but were not persisted in. No attempt has been made to work this mineral in the Andamans. Work was begun on the Baluchistan deposits in 1903, the output for the first year of work being returned as 284 tons. During the five years 1909 to 1913 the average annual output of the two producing districts in Baluchistan, viz., Quetta-Pishin and Zhob, has been 3234 tons. The chromite is exported from Karachi, and is of high grade. In Mysore State chromite has been found in the districts of Mysore, Hassan, and Shimoga. It has been worked in the first two districts only, the production for 1907, the first year of work, being 11,029 tons. As only 201 tons of this total was exported from Mormugao, the port of shipment for most of the minerals of Mysore, large stocks have accumulated, and the production fell to nothing during the years 1910–12, there being a slight revival in 1913, indicated by an output of 1414 tons, of an estimated value of £821 In Singhbhum, Bihar, and Orissa, chromite has been found near the Suru Pass on the road from Chaibasa to Sonua, Bengal-Nagpur railway. A sample taken from a total of about 10 tons of ore extracted from twelve prospecting pits showed 50·05 % of chromic oxide, and a picked specimen 53·19 %. Prospecting operations on this and two other occurrences in the immediate vicinity did not at the time disclose any large bodies of ore, but only irregular veins. In 1913 there was an output from Singhbhum of 848 tons, valued at £452, raised in the Saitba block of the Kolhan Government estate. The value of the total output of chromite in India in 1913 is given as £2435, and in 1914 as £2611.

Newfoundland. Several large deposits of chromite are known in Newfoundland. They are chiefly situated at a distance from the seaboard and as yet only one attempt to mine the ore has been made, near Port au Port Bay, on the west coast. Between the years 1895 and 1899 a large quantity of high grade ore was raised and shipped. Since then the industry has not been prosecuted, but several new and extensive deposits have been discovered inland, from the same bay, and again on the headwaters of the Bay d'Est and Gander Rivers.

Canada.—No production of chromite was reported in Canada during 1912 and 1913, but in 1914 a production of 136 short tons, valued at $1210, an average of $8.90 a ton, was reported from the Province of Quebec. Chromite is found in the eastern townships of the Province of Quebec, in the neighbourhood of Coleraine, Thetford Mines, and Black Lake, but only a comparatively small portion of the chromite-bearing area has been actively explored. In the Tulameen district of British Columbia grains and masses of chromite have recently been found, and several claims have been taken up.

Queensland.—A small quantity of chromite was produced from the Elgalla Mine, Cawarral, in 1913 and supplied to the Mount Morgan Company. The output was 177 tons, value £177. No production is recorded for 1914.

Victoria.—Chromite has been observed in Victoria in the Serpentine area, Wellington river, Gippsland, a quarter of a mile east of the junction of Thiele's Creek with Dolodrook Creek.

New South Wales.—At a mine in the Barraba Division, work was carried on for six months during 1914 and 649 tons was raised, valued at £649. The mine is practically worked out, and it is doubtful if any further supplies will be obtained.

Vanadium ; Occurrence of ——. Ch. of Comm. J., Dec., 1915.

The recent growth of the vanadium industry is indicated by the fact that in 1906 the total value of vanadium alloy produced did not exceed £10,000, and that the production in 1911 was valued at £300,000. Vanadium is one of the most widely disseminated of the elements, although commercially available deposits are comparatively rare. It is found in most of the rocks, in clays and shales, and in the ashes of plants. In addition to Mexico, where it was first discovered, vanadium has been found in several parts of the United States, in Peru, Sweden, Australia, Spain, England, Turkestan, Chile, and Argentina. The chief ores from which vanadium is or may be derived are patronite, carnotite, roscoelite, vanadinite, and asphaltite. Coal is also a source of vanadium.

Peru.—The principal commercial source of supply of vanadium at present is in Peru, where the chief deposits known and worked are at Minas Ragra, about 30 miles to the north-west of the

Cerro de Pasco copper mines. In the coal deposits at Minas Ragra, which have been frequently worked and again abandoned owing to the poor quality of the fuel, vanadium occurs in the form of a black mineral, which has the appearance of a slaty coal, is very hard, and contains 30% or more of free sulphur, 11% of silica, 4% of iron sulphide, about 1½% each of nickel and molybdenum sulphides, and about 40% of vanadium sulphide. After burning out the free sulphur the ore contains about 52% of vanadium oxide. This sulphide of vanadium is called patronite and appears in the form of a compact mass about 6 ft. 6 in. thick. It is believed to be scattered over a large extent of country around Minas Ragra. The earth surrounding the patronite veins is highly impregnated with vanadium solutions, and in small catch basins this impregnated earth is being quite extensively worked. There are numerous asphaltite deposits in Peru, among the best known being those of Yauli. The ash from the burnt asphaltite yields 25 to 40% of vanadium oxide. Other mines are located at Matucan and Casapalca, on the Central Railroad of Peru near Callao, at Huari, and at Huancayo. The production of vanadium ore in Peru in 1912 was 3048 metric tons, valued at £150,000, as compared with 2251 tons, value £215,000 in 1911.

United States.—Vanadium has been discovered in the south-western portion of Sierra County, New Mexico, and also on the properties of the South-Western Lead and Coal Co., on the eastern slope of the Sierra de los Caballos, across the Rio Grande. The latter deposits are worked by the Vanadium Mines Co. A concentrate assaying about 8·6% V and 59% Pb is obtained and transported by mule teams to Cutter, where there is a large oxide plant on the Santa Fé railway. The product from this plant is shipped to Rankin, Pennsylvania, where it is made into ferro-vanadium. Deposits of carnotite in the Paradox Valley, Colorado, cover an area over 50 miles in length. Carnotite deposits are also found in Grande and Emery counties, Utah, and in Routt and Rio Blanco counties, Colorado. In the mineral statistics for the United States, the production of uranium and vanadium minerals together in 1911 was valued at £62,731. Roscoelite occurs in the Lower San Miguel mining district, Colorado. The deposits are persistent, thick, and easily worked. The ore averages about 3% vanadium oxide and is milled close to the mines. Vanadinite has been found in mines near Tucson, Arizona. Asphaltite, or vanadiferous coal, is found at Page, Oklahoma, and at Palaside, Nevada. Ash from the Rockvale, Colorado, coal has given 27% of vanadium oxide.

During 1912 American industries produced about 100,000 tons of vanadium-steel, containing 7 lb. of vanadium per short ton of steel. The greater part of the ore was imported from Peru and the balance from sources in the United States, chiefly from Colorado and Utah workings. It is thought that the gradual opening of the vanadium deposits found in the Jurassic and Triassic formations situated within the boundaries of the United States will provide an abundant source of vanadium.

Argentina.—At San Rafael in the province of Mendoza, a lignite, called rafaelite, is found which yields on combustion 0·63% of ash containing over 21% of vanadium. Forty metric tons of vanadium, value not stated, were produced in Argentina in 1912, as compared with 11 tons in 1911.

Chile.—One of the Chile silver mines contains a valuable deposit, known as chileite, a brownish mineral containing 7·5% of vanadium. At Talcuna, Coquimbo, vanadium occurs in the form of a yellow earth between veins of copper ore, and to the north-west of Cordova, in the department of Cruz del Eje, it is met with in veins containing more than 5·5% of the metal.

German South-West Africa.—At Tsumeb-West, in the Otavi district of German South-West Africa, a deposit of mottramite (a vanadate of copper) occurs, and the deposit has been worked to some extent as a vanadium ore. Mottramite is also found and has been worked to some extent on the Rietfontein farm. Vanadinite occurs in the lead-copper ore body at the Tsumeb mine.

Spain.—Deposits of vanadinite have been worked near Santa Marta, Estramaduras. The ore contains an average of 3% of vanadic oxide, which is raised to about 14% by concentration. The deposits have been worked for vanadium since 1899, and up to 1906 they supplied the greater part of the world's requirements. The production of vanadium in Spain in 1912 was 38 tons, value £730, as compared with 199 tons, value £2860, in 1911.

United Kingdom.—At one time vanadium was obtained from mottramite, which occurs with copper ore at Alderley Edge and Mottram St. Andrews in Cheshire. The payable portion of the deposits appears to have been worked out some years ago, when mining was discontinued. Deposits containing vanadium minerals also occur at the Wanlock Head Mine, Dumfries, Scotland.

Mineral output of British India in 1914. Report of Chief Inspector of Mines in India.

The output of coal in India during 1914 was 15,727,631 tons, an increase of 241,313 tons over the output of 1913. In the early part of the year the output was reduced by the effects of the previous year's floods, but the main cause of the small increase was undoubtedly the war. Of the total output, 15,075,587 tons, or 95·85%, was raised in Bihar and Bengal. There was a decrease in the output of mica, 38,189 cwt. having been raised in 1914, as compared with 43,650 cwt. in 1913. The trade suffered severely from the commencement of the war, and the output fell away in consequence. A large proportion of the demand came from Germany, and the export of mica to other countries in Europe was practically cut off and difficulty was experienced with regard to shipments to the United States, to which country considerable consignments are despatched direct in normal times. The output of manganese was 555,672 tons, a decrease, as compared with 1913, of 81,719 tons. The output, however, was well above that of 1912 and the two or three previous years. The average price per unit was 9d., or 2d. less than in 1913. In 1914 the gold output of the previous year was nearly doubled, being 19,873 oz., compared with 11,019 oz. in 1913. The output of copper was 4100 tons, as compared with 3639 tons in 1913. There was again an increase in the output of wolfram, which was 31,526 cwt., as compared with 27,520 cwt. in 1913. Of other minerals an output of 9280 cwt. of bauxite was reported from the Jabalpur district in the Central Provinces, the mine having been unworked during the years 1910 to 1913. For the first time, an output of 16 lb. of pitchblende and 200 cwt. of triplite is shown in the list of minerals raised from mines classed under the Indian Mines Act. Both these minerals were obtained from a mine in the district of Gaya (Bihar and Orissa). From quarries in the Amherst district in Burma 125,318 tons of granite was extracted and there were increases in iron, slate, clay, fuller's earth, limestone, galena, and samarskite, while there were decreases in salt, chromite, corundum, magnesite, tin, and steatite.

Mineral production of the United Kingdom in 1914. Mines and Quarries General Report for 1914. Part III. [Cd. 8111.]

The following table shows the quantity and value (definitive figures) of the minerals produced in the United Kingdom in 1914, as compared with 1913:—

Description of mineral.	1913. Quantity.	1913. Value at the mines and quarries.	1914. Quantity.	1914. Value at the mines and quarries.
	Tons.	£	Tons.	£
Alum shale	8,741	874	6,078	607
Arsenical pyrites ..	35	29	—	—
Arsenic	1,695	16,616	1,988	19,052
Barium (compounds) ..	50,045	42,136	48,930	43,506
Bauxite	6,055	1,563	8,286	2,159
Bog ore	3,835	959	2,342	585
Chalk	4,858,126	213,479	4,291,170	197,154
Chert, flint, etc.	74,858	12,781	76,213	13,304
Chromite ..	—	—	100	50
Clay & shale	13,892,807	1,790,805	13,124,361	1,731,779
Coal	287,430,473	145,535,669	265,664,393	132,596,855
Copper ore	2,569	21,138	2,373	16,985
Copper precipitate ..	163	5,891	185	5,529
Diatomite ..	154	308	—	—
Fluorspar ..	53,663	14,955	33,816	11,005
Gold ore ..	4	434	47	318
Gravel & sand	2,409,152	184,818	2,498,872	215,351
Gypsum ..	285,338	90,450	265,365	83,868
Igneous rocks	7,098,493	1,386,022	7,135,243	1,369,242
Iron ore ..	15,997,328*	4,543,558	14,867,582*	3,921,683
Iron pyrites	11,427	5,988	11,654	4,759
Lead ore ..	24,282	293,525	26,013	309,813
Lignite	81	40	300	150
Limestone (other than chalk) ..	12,740,664	1,369,168	12,158,441	1,295,512
Manganese ore	5,393	4,072	3,437	2,931
Ochre, umber, etc.	15,135	14,460	11,069	10,635
Oil shale ..	3,280,143	822,394	3,268,666	837,249
Salt	2,247,758	608,869	2,069,989	560,893
Sandstone ..	3,977,303	1,143,431	3,464,528	1,057,096
Slate	370,756	926,739	318,912	806,196
Soapstone ..	40	30	180	90
Sulphate of strontia ..	18,425	14,287	13,157	10,439
Tin ore (dressed) ..	8,355	960,134	8,085	661,865
Uranium ore	95	not stated	344	not stated
Wolfram ore	182	17,483†	205	19,722
Zinc ore ..	17,294	69,502	15,419	56,652
Total value	—	160,112,607	—	145,863,032

* Exclusive of 520 tons in 1913 and 400 tons in 1914 of micaceous iron ore used for paint, and placed under the heading "Ochre, umber, etc."

† Value of about 180 tons only for 1913.

The decrease in the total value of the minerals raised during the year is mainly accounted for by the decreased production of coal. The average price of coal was 9s. 11·79d. per ton in 1914 as compared with 10s. 1·52d. in 1913. The quantity of coal exported, exclusive of coke and manufactured fuel and of coal shipped for the use of steamers engaged in foreign trade, was 59,039,880 tons. France received over 12,250,000 tons, Italy 8,500,000 tons, Germany over 5,250,000 tons, Sweden over 4,250,000 tons, Russia over 3,000,000 tons, Denmark over 3,000,000 tons, Spain nearly 3,000,000 tons, the Argentine over 2,860,000 tons, Egypt over 2,500,000 tons, Norway nearly 2,500,000 tons, and the Netherlands nearly 1,750,000 tons. Adding 3,418,394 tons exported in the form of coke and manufactured fuel, and the 18,535,616 tons shipped for the use of British and foreign steamers engaged in foreign trade, the total quantity of coal which left the country was 80,993,890 tons, as against 98,338,104 tons in 1913. The amount of coal remaining for home consumption was 184,670,503 tons, or 3·977 tons per head of the population. 36,289,010 tons was used in the manufacture of coke and briquettes and 18,381,196 tons in blast furnaces for the manufacture of pig iron, as against 39,560,489 tons and 21,223,607 tons, respectively, in the previous year.

The output of iron ore yielded 1,786,090 tons of iron, or more than half of the total quantity of pig iron made in the country.

Iron calcium silicates: the system $FeSiO_3$—$CaSiO_3$. Konstantinov and Selivanov. *See* VII.

Passivity. Foerster. *See* XI.

Colorimetric determination of copper and iron in pig lead, lead oxides, and lead carbonate. White. *See* XXIII.

Patents.

Steel: Manufacture of ——. F. T. Snyder, Oak Park, Ill., U.S.A. Eng. Pat. 1213, Jan. 25, 1915.

Lime and iron ore are added to partly finished steel in an electric furnace, and together form a finishing oxidising slag. The finished steel is run off and the furnace again charged with scrap and pig iron, without further addition of lime. The retained slag, which is high in iron oxide and lime, takes up the greater portion of the silicon and phosphorus from the new charge. It is then run off and replaced by fresh lime and ore to form the finishing slag, which in turn is retained for the next charge.—T. St.

Steel; Process of making ——. A. C. Dinkey, Pittsburgh, Pa. U.S. Pat. 1,162,755, Dec. 7, 1915. Date of appl., Aug. 7, 1914.

Silicon, or untreated high-silicon pig-iron, is added to iron which has been previously dephosphorised in a basic furnace, and the molten mixture is treated in an acid furnace or converter.
—W. E. F. P.

[*Iron and steel.*] *Process of making wear-withstanding coat.* E. A. Eckhardt, Philadelphia, Pa. U.S. Pat. 1,162,149, Nov. 30, 1915. Date of appl., Oct. 22, 1914.

In a process for hardening the surface of an iron or steel article, such as a phonograph stylus, an electric arc is struck between the article and an electrode of refractory metal (*e.g.*, tungsten) and the vapour of the latter transmitted through the arc to the surface to be hardened.—W. E. F. P.

Metals [*iron*]*: Plating of* ——. J. A. Law, London. From The Thermic Plating Process Co., New York. Eng. Pat. 23,576, Dec. 4, 1914.

Iron or steel articles are plated with a less electropositive metal by heating the article, coated with a "non-oxide salt" of the metal, *e.g.*, a chloride, in presence of an ample supply of air, to approximately the welding temperature of iron. Thus in the case of copper, the chloride is ground in a suitable heavy mineral oil and the viscous mixture spread on the article to be plated. This is then passed through a combustion chamber provided with an ample supply of air, and is there heated to approximately the welding temperature of iron. A continuous coating of metallic copper, which cannot be removed by mechanical means, is thus obtained.—T. St.

Zinc oxide and the like; Treatment [*precipitation*] *of volatilised* ——. F. W. Highfield, Caversham, Oxon. Eng. Pat. 6222, Sept. 11, 1914.

An apparatus for electrical precipitation of fume consists of a chamber at the upper end of which one of the electrodes is situated outside the direct path of the gas current; the lower portion of the chamber, into which the fume is admitted through a downwardly directed conduit, forms the other electrode. The bottom of the chamber is formed by a rotary grid through which the precipitated oxide is removed.—W. R. S.

Zinc ore : Removing cadmium from ——. G. Rigg, Palmerton, Pa., Assignor to New Jersey Zinc Co., New York. U.S. Pats. (A) 1,161,885 and (B) 1,161,886, Nov. 30, 1915. Dates of appl., Sept. 4, 1913, and July 27, 1915.

(A) Roasted blende or oxide ore is treated, at a temperature sufficient to reduce and volatilise the cadmium without reducing any substantial quantity of zinc (*e.g.*, 700°—850° C.), with the flame of a reducing gas (*e.g.*, producer gas), in which the gas is largely in excess of the air necessary for complete combustion ; the air supply is periodically increased when the temperature falls below the lower limit. (B) A layer of fuel placed on a layer of oxidised or roasted ore is ignited, and air is passed downwards through the charge to raise the ore to the temperature necessary to reduce the cadmium but not the zinc. The ore layer is of sufficient thickness to retain any zinc which may have been reduced in the contact zone of the fuel and ore layers.—W. R. S.

Zinc ; Process of recovering —— from an acid sulphite solution. C. S. Vadner, Salt Lake City, Utah. U.S. Pat. 1,163,236, Dec. 7, 1915. Date of appl., May 26, 1914.

The solution is electrolysed, a basic carbonate of zinc and lime being added gradually to neutralise the acid as it is liberated.—W. R. S.

Tin ; Extraction of —— from ores. F. B. Dick, Surbiton Hill, Surrey. Eng. Pat. 23,613, Dec. 5, 1914.

The finely divided ore is agitated at a low red heat, *e.g.*, in a rotary furnace, in presence of a reducing gas, and subjected to pressure so as to coalesce the particles of molten metal. The pressure may be produced by the weight of the charge itself, or by means of heavy rods, spheres, etc., and it may be applied after transferring the material from the reducing furnace to another furnace and reheating, with exclusion of air.
—W. R. S.

Subdivided metals ; Use of —— in the form of briquettes or the like. F. B. Dick, Surbiton Hill, Surrey. Eng. Pat. 23,614, Dec. 5, 1914.

Finely divided metallic particles, or materials containing them, are mixed with a substance volatile at or below the temperature at which the metal oxidises or melts, and without oxidising or other ill-effect on the metal, and the mixture is compressed into briquettes. Such briquettes can be heated to the melting point of the metal without loss from oxidation. Thus tin ore which has been reduced by a gas is mixed with about 1 % by weight of kerosene, and briquetted, before being added to a bath of molten tin.—T. St.

Copper surfaces ; Protection of —— against corrosion. C. G. Tietzens Eidam, Bautzen, Saxony. Eng. Pat. 5774, Apr. 17, 1915. Under Int. Conv., June 13, 1914.

Iron or steel dust, filings, etc., is evenly distributed on the copper surface and rolled or pressed into the copper, for the purpose of forming, by subsequent oxidation, a protective coating of ferric oxide on the surface. Sheets so treated may be annealed, bent, and worked, without the iron particles becoming detached.—T. St.

Furnace ; Annealing ——. C. Kugel, Brunswick, Germany. Eng. Pat. 6778, May 6, 1915. Under Int. Conv., Aug. 20, 1914.

In an annealing furnace consisting of a horizontal muffle heated by means of flues formed by vertical partitions between the front and rear walls of the structure, the portions of the muffle between the partitions and walls (*i.e.*, in contact with the heating gases) are bulged outwards.—W. E. F. P.

Metallurgical furnace. U. Wedge, Ardmore, Pa. U.S. Pats. 1,162,532—1,162,534, Nov. 30, 1915. Dates of appl., (A) July 11, 1912, (B) Oct. 23, 1912, (C) Oct. 22, 1913 ; all renewed July 1, 1915.

(A) The furnace has superposed annular hearths, some provided with discharge openings at their inner and outer portions, while alternate hearths have discharge openings midway of their width. A central rotating shaft carries rabble arms ; the rabbles operating on the first-named hearths move the material away from, and those on the last-named hearths towards, the middle of each hearth, *i.e.*, in all cases, towards the discharge openings. (B) The furnace consists of a helical treating-chamber and a carrier for rabble-arms which emerge from the chamber when the carrier is moved in one direction, and enter it when the carrier is moved in the other direction. (C) The upper hearth of the circular furnace is adapted for drying the ore by means of hot air delivered from a rotating hollow arm disposed above the drying hearth, and having downwardly discharging openings. The air is heated by circulating through hollow rabble-arms moving over the lower roasting-hearths, and is conveyed to the drying-hearth through ducts carried by the central rotating shaft. The air is introduced into a casing which surrounds the lower portion of the central shaft and communicates with ducts leading to the rabble-arms.—W. R. S.

Furnace ; Metallurgical ——. F. Meyer, Uerdingen, Germany, Assignor to Dwight and Lloyd Metallurgical Co., New York. U.S. Pat. 1,162,634, Nov. 30, 1915. Date of appl., Jan. 13, 1911 ; renewed Apr. 24, 1915.

The charge is supported on a horizontal, annular grate mounted, on wheeled supports, to rotate about a vertical axis above an annular trough containing water. Vertical, annular plates, with cross plates between them, extend into the water from the bottom of the grate, thus forming below the latter a series of water-sealed chambers into which air under pressure is introduced successively from a central conduit by means of radial ducts.
—W. E. F. P.

Furnace ; Electric [smelting] ——. C. Hering, Philadelpiha, Pa. U.S. Pat. 1,162,773, Dec. 7, 1915. Date of appl., May 1, 1913.

Molten metal, such as iron or steel, is treated electrically by confining it in masses, in communication with each other through a portion of the metal confined in one or more closed channels, the diameter of the latter being small in comparison with the length. An electric current, the strength of which is great in comparison with the cross-section of the confined material, is passed, whereby the pinch effect is produced, stirring the mass and causing a flow of material through the channel. One of the masses is treated with a basic slag, another with an acid slag, and raw material is introduced into the third.—B. N.

Metallic articles ; Process of forming a protective metal coating upon ——. J. H. Maddy, New York, and B. H. Schubert, Weehawken, N.J., Assignors to The Lohmann Co., New York. U.S. Pat. 1,161,944, Nov. 30, 1915. Date of appl., Feb. 2, 1915.

A mixture of powdered metal with mercuric chloride, with or without zinc chloride solution, is applied to the surface of the article, and subjected to a hot blast to fuse the coating metal.
—W. F. F.

Ores ; Process of treating metallic ——. A. Estelle, Hagen, Westphalia. U.S. Pat. 1,162,150, Nov. 30, 1915. Date of appl., Apr. 6, 1914.

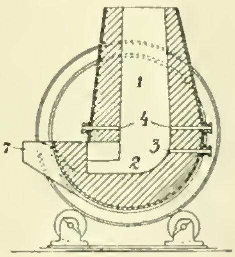
In a cyclic process for treating ores or products consisting essentially of iron sulphide, the material is leached with hydrochloric acid (either direct or after preliminary treatment to render the iron sulphide soluble) and the solution electrolysed to recover metallic iron. The spent electrolyte is treated with the hydrogen sulphide generated in the leaching vat to reduce the ferric iron present and cause the deposition of sulphur, and is then used for leaching a further quantity of ore. The residue in the leaching vat is subsequently treated for the recovery of metals originally present, or deposited therein, as insoluble sulphides.—W. E. F. P.

Metal alloy. R. H. Patch. Philadelphia, Pa. U.S. Pat. 1,162,186, Nov. 30, 1915. Date of appl., Sept. 16, 1915.

An alloy of iron 60—70 (65)%, cobalt 30—40 (34·5)%, and manganese 0·2—2 (0·25)%.—W. F. F.

Ores; Apparatus for continuous smelting of sulphide ——. G. Haglund and A. Grönningsæter, Christianssand, Norway. U.S. Pat. 1,163,234, Dec. 7, 1915. Date of appl., Mar. 26, 1914.

The apparatus (see fig.) is a combined blast-furnace and converter adapted to be tilted. The upper part consists of a vertical shaft, 1, with tuyères, 4; the lower part, 2, has tuyères, 3, and an outlet consisting of a submerged opening in communication with an exterior lip, 7.—W.E.F.P.



Metal bodies; Method of making composite ——. *Method of uniting metals. Composite metal body.* W. D. Coolidge, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pats. (a) 1,162,339, (b) 1,162,340, (c) 1,162,341, and (d) 1,162,342, Nov. 30, 1915. Dates of appl., Aug 21, 1912, Mar. 4, 1914, Dec. 7, 1914, Mar. 19, 1915.

(a) Copper is freed from gas and brought into contact with wrought tungsten in a vacuum, at a temperature slightly above the melting point of copper. (b) Copper and tungsten are heated in contact in a vacuum at about 1400° C., and allowed to cool in the vacuum. (c) An X-ray target comprises a body portion of cast copper with an integral facing of wrought tungsten. (d) A body of ductile tungsten is provided with an adherent coating of an alloy of gold and platinum. —W. F. F.

[*Burning or*] *agglomerating flue dust or other finely-divided material; Process of* ——. C. Giesecke, Brunswick, Germany. U.S. Pat. 1,162,600, Nov. 30, 1915. Date of appl., May 10, 1915.

The material (flue dust or fine ore) is moistened and charged with fuel into a shaft furnace. Compressed air is forced tangentially into it, thereby subjecting a stratum to high temperature and then immediate cooling.—W. F. F.

Manganese steel; Heat treatment of ——. Manganese Steel Rail Co., New York, Assignees of W. S. Potter, Pittsburg, Pa., U.S.A. Eng. Pat. 3786, Mar. 9, 1915. Under Int. Conv., Apr. 17, 1914.

See U.S. Pat. 1,123,003 of 1914; this J., 1915, 181.

Pyrite or other iron sulphide: Treatment of ——. L. T. Wright, London. U.S. Pat. 1,164,049, Dec. 14, 1915. Date of appl., Nov. 18, 1912.

See Eng. Pat. 26,128 of 1911: this J., 1913, 29. The sulphur is distilled off at a temperature of about 3000° C.

Converting molten slag into a highly porous mass. U.S. Pat. 1,163,605. *See* IX.

XI.—ELECTRO-CHEMISTRY.

Passivity. F. Foerster. Deutsch. Bunsen-Ges., Berlin, Oct., 1915. Z. angew. Chem., 1915, 28, Wirtschaftl. Tl., 622—623.

The author applies the term passivity to all cases of abnormal resistance to the passage of ions into or out of a liquid, and discusses in particular the polarisation accompanying the discharge of halogen ions at a platinum anode and the deposition of metals of the iron group at a cathode. The former case is attributed to the discharge of hydroxyl ions and the production of oxygen or oxides of platinum at the anode; these either act as negative catalysts or form a coating over parts of the metallic surface so that the current density at other parts is increased. In the electrolysis of acid solutions of iodides the anode remains unpolarised, but in alkaline solutions polarisation develops to a degree depending on the proportion of hydroxyl to iodine ions in the solution. At anodes with a surface of platinum black the discharge of halogen ions requires a higher potential after the metal has been subjected to anodic polarisation in sodium hydroxide or sulphuric acid solutions than after cathodic polarisation. Just as the presence of alkalis retards the anodic discharge of halogen ions, so acidity retards the cathodic deposition of metals of the iron group (cp. Schildbach, this J., 1910, 1389), the discharged hydrogen ions acting as negative catalysts. (Cp. Flade, Grave, Schmidt, Schoch, and Senter, this J., 1912, 694, 1120; 1913, 1113, 1114.)—J. H. L.

Electrolytic preparation of perborate. Arndt. *See* VII.

American manufacture of sodium and sodium peroxide. Norton. *See* VII.

Patents.

Batteries; Galvanic ——. C. B. Burdon, London. From Siemens-Schuckertwerke G.m.b.H., Berlin. Eng. Pat. 112, Jan. 4, 1915.

Carbon electrodes, which are not attacked, are immersed in an anode solution containing hydriodic or hydrobromic acid with a hygroscopic substance such as sulphuric acid, and in a cathode solution containing nitric or chromic acid or the like as an oxygen carrier. A reducing substance, such as sulphurous acid, is added to the anode liquid to regenerate the acid from the liberated halogen, and the final reaction product is again converted into the reducing agent by heating.—B. N.

Battery. C. F. Burgess, Madison, Wis., Assignor to C. F. Burgess Laboratories. U.S. Pat. 1,162,449, Nov. 30, 1915. Date of appl., Dec. 10, 1913.

A depolarising mixture for dry batteries is composed of 30% of carbonaceous material, such as impalpable graphite, finer than "200 mesh graphite" and of higher electrical resistance, with a partly hydrated manganese depolariser and the usual salts and water.—B. N.

Furnace; Electric ——. J. M. Lohr and H. W. Gillett, Ithaca, N.Y. U.S. Pats. (a) 1,162,178 and (b) 1,162,179, Nov. 30, 1915. Date of appl., Aug. 31, 1915. (Dedicated to the public.)

(a) A series of crucibles are spaced from each other by heating elements located between them in an annular trough-shaped, refractory casing, so that heat is transmitted directly to the crucibles and only indirectly to the casing. The crucibles are also spaced from the bottom of the furnace so that they may be easily manipulated or lifted. (b) One or more refractory walls, either square or rectangular, are provided with electric heating elements extending inwards, and substantially perpendicular to the casing, so as to divide the furnace into equal heating chambers. The elements from adjacent walls, converging inwards in pairs, are connected electrically in pairs at their inner ends.—B. N.

Impregnating electrical conductors; Method of drying and ——. D. Hurley and J. E. O'Shea. New York. U.S. Pat. 1,163,342. Dec. 7, 1915. Date of appl., Mar. 17, 1909.

THE covering of the electric conductors is heated internally by passing an electric current through the conductors, and the external part of the covering is heated simultaneously in an air-tight compartment at atmospheric pressure. The heating is continued after reducing the pressure in the vessel, and an impregnating compound is applied during the heating by forcing it into contact with the covering by pressure within the compartment. —B. N.

Ozone generator; Tubular ——. M. P. Otto, Paris. U.S. Pat. 1,163,768, Dec. 14, 1915. Date of appl., Sept. 18, 1913.

SEE Fr. Pat. 418,580 of 1912; this J., 1913, 433.

Process and apparatus for treating gases from which carbon separates in the electric furnace. Ger. Pat. 285,665. *See* IIA.

Process and apparatus for preparing beverages and products produced thereby. U.S. Pat. 1,162,212. *See* XIXA.

XII.—FATS; OILS; WAXES.

Palm oil; Catalytic bleaching of ——. S. G. Sastry. Chem. Soc. Trans., 1915, **107**, 1828—1831.

RESULTS of experiments are recorded in which palm oil was bleached by blowing air through it in the presence of various catalysts. The oil was contained in a flask immersed in a water-bath at 80°—90° C. and the air was admitted through a coil surrounding the flask and also immersed in the water-bath. The catalysts used consisted of the oxides and salts of manganese, cobalt, nickel, iron, and lead. The best catalysts were found to be the salts of cobalt and manganese, and of these salts the borates yielded the better results. Sixty litres of air completely bleached 64 grms. of palm oil in 3·5 hours when the oil contained 0·1% of its weight of cobalt borate; the same effect was obtained in 4·5 hours with 104 litres of air when the oil contained 0·2% of manganese borate. The bleached oils were kept for 15 months without developing any trace of colour; the bleaching did not affect the soap-making qualities of the oil.—W. P. S.

Oil of wild grape seed, Vitis riparia. G. D. Beal and C. K. Beebe. J. Ind. Eng. Chem., 1915, **7**, 1054.

THE ground seeds of the wild grape, *Vitis riparia*, when extracted with light petroleum spirit, yielded 19·4% of an oil having a greenish-amber colour, a peculiar acrid odour, and a taste similar to that of castor oil. The oil had the following characters:—sp.gr. at 15° C., 0·9425; n_D^{15} = 1·4781; saponif. value, 187·8; iodine value, 76·5; acetyl value, 61·3; insoluble fatty acids, 90%; neutralisation value of fatty acids, 173·4; mean molecular weight of solid fatty acids, 268·6. The fatty acids consisted of 95% of liquid acids (iodine value, 92) and 5% of solid acids. The latter consisted of about 64% of palmitic and 36% of stearic acid. The liquid acids consisted of about 44% of oleic and ricinoleic acids and 56% of linolic acid, as determined by the bromination method.—A. S.

Tobacco-seed oil. N. H. Cohen. Meded. Proefstat. Vorstenland Tabak, 1915, No. 14, 57—65. Bull. Agric. Intell., 1915, **6**, 1481.

THE oil of tobacco seed is an excellent substitute for linseed oil. The seeds should be gathered immediately after the top leaves of the plant have been harvested; at present their collection and drying present certain difficulties. About 3 cwt. of seed is obtained from 1 acre of tobacco, and this amount furnishes 1¼ cwt. of oil. The oil-cake contains about 4·2% of nitrogen. (See also Ampola and Scurti; this J., 1905, 97.)—E. H. T.

Phytosterol in animal fats; Detection of —— *according to Bömer's method by precipitating the phytosterol and cholesterol with digitonin.* B. Kühn, F. Bengen, and J. Werwerinke. Z. Nahr. Genussm., 1915, **29**, 321—329. J. Chem. Soc., 1915, **108**, ii., 844.

THE fatty acids obtained from 50 grms. of the fat are warmed and treated with 25 c.c. of digitonin solution, the mixture is kept at 70° C. for one hour, 20 c.c. of chloroform is then added, the precipitate is collected on a filter, washed with chloroform and ether, and dried at 100° C. for ten minutes. The precipitate is then heated with 5 c.c. of acetic anhydride, the hot solution is mixed with four times its volume of 50% alcohol, cooled, the precipitate collected, washed with 50% alcohol, and recrystallised in the usual way. Animal fats usually give almost pure cholesteryl acetate after the first crystallisation, and the presence of phytosterol from vegetable oils is already indicated at this stage.

Fatty acids; Determination of soluble and insoluble ——. F. H. Smith. Chem. News, 1915, **112**, 319—320.

A SIMULTANEOUS determination of the saponification value, soluble and insoluble fatty acids, and mean molecular weight of the latter may be made as follows:—5 grms. of the fat is heated on the water-bath with 50 c.c. of approximately $N/2$ alcoholic potassium hydroxide beneath a reflux condenser until saponified, while the same quantity of the alkali solution is also heated beneath a reflux condenser for the same length of time. After saponification the contents of the first flask are slightly cooled, and the excess of alkali titrated with $N/2$ hydrochloric acid, to obtain the saponification value. The alcohol is now evaporated on the water-bath, the residue dissolved in 100 c.c. of warm water, and sufficient $N/2$ hydrochloric acid added to give an excess of 1 c.c. over the amount required by the alkali solution in the second flask. The flask is loosely stoppered and heated on the water-bath until a clear layer of fatty acids is obtained. It is then cooled in ice water, the liquid decanted through a filter into a litre flask, and the disc of fatty acids washed with cold water, again melted with 150 to 200 c.c. of hot water, and solidified and washed as before. This treatment is repeated three times, and the united washings are made up a litre, and two 100 c.c. portions titrated with $N/10$ potassium hydroxide solution. The readings are multiplied by 10, and 5·00 subtracted to correspond to the 1 c.c. excess of $N/2$ acid originally added, and the difference is expressed in mgrms. of alkali required to neutralise the soluble fatty acids in 1 grm. of the fat. The filter is dried and washed with absolute alcohol into the flask containing the insoluble fatty acids, and the flask heated on the water-bath and then at 100° C. until the fatty acids are constant in weight (about 2 hours). They are then dissolved in alcohol, and the solution titrated with $N/2$ alkali to obtain the molecular equivalent of the fatty acids.—C. A. M.

Fatty acids; Catalytic hydrogenation of——. H. Dubovitz. Seifensieder Zeit., 1915, **42**, 304—306. J. Chem. Soc., 1915, **108**, i., 1049—1050.

A LABORATORY method for the hydrogenation of oleic acid is described. The hydrogen employed is prepared from arsenic-free zinc and is purified by passing it successively through a mixture of ferric oxide and sawdust, potassium bichromate and sulphuric acid, sodium hydroxide solution, a tube containing palladium, and concentrated sulphuric acid. The catalyst is obtained by dissolving 50 grms. of nickel nitrate in hot water, adding pumice-stone washed previously with hydrochloric acid and ignited, evaporating the mixture, and igniting the residue in a nickel basin until all nitric acid has been expelled; the ignited residue is then packed into a tube 163 cm. in length. The oleic acid, dried previously at 110° C., is contained in a flask connected with one end of the tube, the air is exhausted from the whole apparatus, and the hydrogen then passed through the oleic acid heated at 270° C.; the tube containing the catalyst is heated at 300°—350° C., the nickel oxide having been reduced in a current of hydrogen under reduced pressure at 100° C. The hydrogen bubbling through the oleic acid carries with it a quantity of oleic acid vapour (a low pressure being maintained in the apparatus), and the gaseous mixture passes into the tube containing the catalyst, where hydrogenation of the oleic acid takes place.

Turkey-red oils from free fatty acids: Preparation of——. F. Erban. Seifenfabrikant, 1915, **35**, 477—479, 519—521. Z. angew. Chem., 1915, **28**, Ref., 515.

CRUDE ricinoleic acid prepared from pure castor oil contained 83·11% of ricinoleic acid, 13·43% of diricinoleic acid, 1·80% of neutral fat, and 1·66% of water, etc. When sulphonated with 15% of sulphuric acid it yielded a light yellow, fairly viscous oil which gave no deposit after standing for a month. The solution was slightly turbid, very viscous, and gelatinous in the cold, but homogeneous; on standing it formed a white crystalline deposit. Sulphonation with 25% of sulphuric acid gave an oil which agreed in colour and appearance with the properties of a good light-coloured Turkey-red oil. Similarly good products were also obtained by sulphonation with 35% of acid. Turkey-red oils from ricinoleic acid have less emulsifying power when mixed with other fats than have ordinary Turkey-red oils. Turkey-red oils prepared from oleic acid and ricinoleic acid are not very stable in the presence of acetic or dilute sulphuric acid, and are therefore unsuitable substitutes for ordinary Turkey-red oils in acid-dye baths or other acid media.—C. A. M.

Ricinoleic acid in oil preparations [Turkey-red oils]. F. Erban. Seifenfabrikant, 1915, **35**, 578—581, 598—600. Z. angew. Chem., 1915, **28**, Ref., 515.

THE composition of Turkey-red oil prepared by sulphonation with 25% of sulphuric acid differs materially from that obtained by sulphonation with 15% of acid. While the latter contains only 5·26 mols. of sulphuric acid in combination with diglyceride, the former contains 9·2 mols., of which about one-fifth is combined with diglyceride, and the remainder must be regarded as combined with diricinoleic acid. The proportion of diricinoleic acid and in particular of free ricinoleic acid is considerably higher in the Turkey-red oil obtained with the larger proportion of sulphuric acid. Hence the alkali required to neutralise the carboxyl groups is 8·74% as against 3·36% in the case of the product prepared with the lower proportion of sulphuric acid. The amounts of alkali required for decomposition of the oils are 8·12% for the product prepared with 15% of sulphuric acid, and 6·06% for the product obtained with 25% of sulphuric acid.—C. A. M.

Oilseed trade and oil industry of India. Board of Trade J., Jan. 6, 1916.

THE exports of oilseeds from India in the year ended March 31, 1915, decreased to 953,900 tons, valued at £9,750,000, as against 1,582,600 tons, valued at over £17,000,000, in 1913–14. In normal years about 95% of the exports go to the countries at present involved in hostilities, and the outbreak of the war led to a serious situation, especially in regard to copra and groundnuts. There was a reduction in the value of exports of about £6,666,700 in the eight months ended March, 1915. With the decreased demands prices fell to a much lower level than in 1913–14. Noticeable decreases occurred in the quantity and value of the exports of rape seed, groundnuts, sesamum, and castor seeds. The export of oilseeds from Bombay showed a decrease of 42%, from Sind, 64%, and from Madras, 38%. The following table gives the quantity and value of the different descriptions of oilseeds exported from India during the year ended March 31, 1915, as compared with the previous year:—

Exports of oilseeds.

—	1913–14.		1914–15.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	Rupees.	Tons.	Rupees.
Castor......	135,000	20,000,000	83,000	11,600,000
Copra	38,000	15,600,000	32,000	12,300,000
Cotton	284,000	21,300,000	208,000	15,100,000
Groundnuts	278,000	48,800,000	138,000	22,700,000
Linseed	414,000	66,900,000	322,000	52,500,000
Poppy	19,000	4,700,000	7,000	1,400,000
Rape	249,000	42,800,000	97,000	16,300,000
Sesamum ..	112,000	27,000,000	47,000	10,700,000
Mowrah	33,000	5,500,000	7,000	800,000
Mustard ..	5,000	1,061,000	3,000	606,000
Essential oil seeds	8,000	1,458,000	6,000	1,409,000
Other seeds	7,000	1,810,000	4,000	1,130,000

The United Kingdom took 206,110 tons of linseed, nearly 50,000 tons more than in 1913–14. In 1913–14, 80% of the exports of groundnuts from India went to France. The decline in exports to France was from 222,380 tons in 1913–14 to 109,108 tons in 1914–15. Ordinarily the share of Madras in the export of groundnuts was 70% of the total exports. In 1914–15 exports from Madras fell by 42%, and freight rates from Madras to Marseilles rose from 22s. 6d. per ton in April, 1914, to 87s. 6d. at the end of March, 1915. Owing to unfavourable weather conditions, the 1913–14 crop of rapeseed decreased by nearly 12% as compared with the previous season, but the 1914–15 crop was better by 10% than the 1913–14 crop. The percentage of exports to production is about 19% in normal years, but in 1914–15 it was less than 10%. The United Kingdom took a larger quantity than usual—viz., 24,681 tons, as compared with 14,099 tons in the previous year. The percentage of exports of sesamum to the production is normally about 20%. Last season's crop was estimated at 578,000 tons, or 43% more than that of 1913–14.

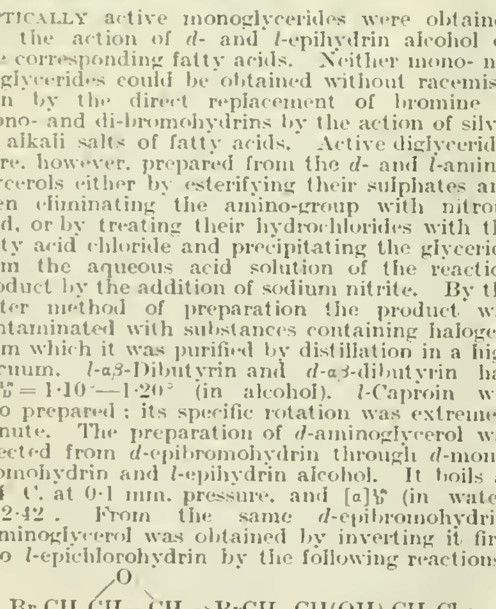
Trade in cottonseed in 1914–15 fared better than that in rapeseed, sesamum, and groundnuts, as it is chiefly carried on with the United Kingdom. Exports of castor seed from India to the United Kingdom decreased from 55,675 tons to 35,284 tons in 1914–15. Prices for castor oil remained low, but there has recently been a large demand for export and the value has risen. The average value of copra declined from about 27s. 3d. to about

25s. 10d. per cwt. Shipments to Russia, Germany, and Belgium decreased, but those to the United Kingdom, the Netherlands, and France increased. Formerly Germany was the principal consumer of Malabar copra, which was used in the manufacture of margarine and edible fats. The exports of copra from India to Germany in 1913–14 amounted to 23,990 tons out of a total export for that year of 38,192 tons, while the exports of copra from India to the United Kingdom increased from 352 tons in 1913–14 to 8523 tons in 1914–15. As a result of the war, copra is now being crushed in the United Kingdom for home consumption.

India's exports of oils are relatively small when compared with the great volume of exports of oilseeds. An immense quantity of oil is, however, manufactured in India by more or less crude processes. Village oil mills, worked by bullocks, and presses worked by hand, exist in all parts of the country. These supply most of the local demand for oils. There has been a great increase in recent years in the number of oil mills worked by steam or other mechanical power. These crush all the more common oilseeds, and this development has been especially noticeable in the case of mustard oil, castor oil, and groundnut oil. Castor oil mills have been working successfully in Bombay, the Punjaub, the United Provinces, and elsewhere; mustard oil manufacture is a flourishing industry in Bengal: there are several coconut oil mills on the Malabar coast, and in Cochin, and groundnut oil mills in Bombay. Some of the large mills deal with a great variety of seeds.

Fats; Preparation of optically active ——. III. Synthesis of the four possible optically active butyrins. Inversion of C_3-compounds into the optical enantiomorphs. E. Abderhalden and E. Eichwald. Ber., 1915, **48**, 1847—1865. (See also this J., 1915, 668.)

Optically active monoglycerides were obtained by the action of *d*- and *l*-epihydrin alcohol on the corresponding fatty acids. Neither mono- nor di-glycerides could be obtained without racemisation by the direct replacement of bromine in mono- and di-bromohydrins by the action of silver or alkali salts of fatty acids. Active diglycerides were, however, prepared from the *d*- and *l*-aminoglycerols either by esterifying their sulphates and then eliminating the amino-group with nitrous acid, or by treating their hydrochlorides with the fatty acid chloride and precipitating the glyceride from the aqueous acid solution of the reaction product by the addition of sodium nitrite. By the latter method of preparation the product was contaminated with substances containing halogen, from which it was purified by distillation in a high vacuum. *l*-αβ-Dibutyrin and *d*-αβ-dibutyrin had $[\alpha]_D^{15} = 1{\cdot}10°—1{\cdot}20°$ (in alcohol). *l*-Caproin was also prepared; its specific rotation was extremely minute. The preparation of *d*-aminoglycerol was effected from *d*-epibromohydrin through *d*-monobromohydrin and *l*-epihydrin alcohol. It boils at 134° C. at 0·1 mm. pressure, and $[\alpha]_D^{15}$ (in water) $= 2{\cdot}42°$. From the same *d*-epibromohydrin, *l*-aminoglycerol was obtained by inverting it first into *l*-epichlorohydrin by the following reactions:



$$Br.CH_2\overset{O}{CH-CH_2} \rightarrow BrCH_2.CH(OH).CH_2Cl \rightarrow \overset{O}{CH_2-CH}.CH_2Cl$$

and then subjecting the latter to the same series of reactions as *d*-epibromohydrin (see above). These reactions are of interest as they afford another instance of the conversion of an optically-active substance into the two optical isomerides without intermediate racemisation.—G. F. M.

Nitre cake as a substitute for sulphuric acid [for extracting and refining grease from suds]. *See* VII.

Linseed oil drying process. Fritz. *See* XIII.

Patents.

Fats; Preparation of a stable catalyst particularly suitable for hardening [hydrogenating] ——. Bremen-Besigheimer Ölfabriken. Ger. Pat. 286,789, Dec. 18, 1910.

The catalytic metal is precipitated in pyrophoric form on an inorganic powder, and the mass immediately made into an emulsion with the oil, in which catalytic particles are distributed in microscopic fineness.—C. A. M.

Operating plants for extraction by means of a volatile solvent [e.g., of oil from seeds]. Eng. Pat. 4070. *See* I.

Preparation of varnish from semi-drying oils, such as marine animal oils, especially for oilcloth and linoleum manufacture. Ger. Pat. 286,798. *See* XIII.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Red lead. J. Milbauer. Chem.-Zeit., 1915, **39**, 858—859.

At low temperatures (300° C.), the presence of silver oxide in lead oxide increases the peroxide content of the resulting red lead; at higher temperatures the silver oxide does not appear to have any favourable effect. The yield of red lead is not diminished when the lead oxide contains from 0·02 to 2·4% of bismuth oxide, but the pigment has a brownish tint. The presence of zinc oxide or of antimony oxide decreases the yield of the peroxide but does not influence the colour; iron and copper do not accelerate the formation of red lead from lead oxide, but large quantities of these metals have an influence on the colour of the red lead. A synopsis is given of much of the previous work by the author on this subject (see this J., 1909, 612, 1049; 1910, 282; 1911, 37; 1912, 193; 1913, 97, 161; 1914, 703).—W. P. S.

Japan lac; Chief constituent of ——. V. Constitution of hydrourushiol. R. Majima. Ber., 1915, **48**, 1593—1597. (See this J., 1909, 532, 1212; 1912, 998; 1914, 91.)

The synthesis of 3.4-dimethoxy-1-pentadecylbenzene and of the next higher and lower homologues having failed to produce substances identical with the dimethyl ether of hydrourushiol, although, like it, they furnished palmitic acid on oxidation, the preparation of simple alkyl derivatives of catechol with the alkyl group in the ortho-position was undertaken. These substances behaved towards ferric chloride very similarly to hydrourushiol, giving an evanescent green colour which rapidly changed to a black precipitate, and on the hypothesis that this reaction is characteristic of ortho-alkylated catechols, 2.3-dimethoxy-1-pentadecylbenzene, $(CH_3O)_2C_6H_3{\cdot}C_{15}H_{31}$, was synthesised (see following abstract), and found to be identical with hydrourushiol dimethyl ether. The constitution of urushiol is thereby determined save for the number and position of the double bonds in the side chain.—G. F. M.

Japan lac; Chief constituent of ——. VI. Synthesis of hydrourushiol. R. Majima and J. Tahara. Ber., 1915, **48**, 1606—1611.

Hydrourushiol dimethyl ether was synthesised from sodium-dodecine and 2.3-dimethoxyphenylpropionyl chloride by the following series of reactions:

$$(CH_3O)_2C_6H_3{\cdot}CH_2{\cdot}CH_2COCl+NaC:C{\cdot}(CH_2)_9{\cdot}CH_3\rightarrow$$
$$(CH_3O)_2C_6H_3{\cdot}(CH_2)_2{\cdot}CO{\cdot}C:C{\cdot}(CH_2)_9{\cdot}CH_9\xrightarrow{Pt+H_2}$$
$$(CH_3O)_2C_6H_3{\cdot}(CH_2)_2{\cdot}CO{\cdot}(CH_2)_{11}{\cdot}CH_3\rightarrow$$
$$(CH_3O)_2C_6H_3(CH_2)_{14}{\cdot}CH_3$$

Dodecine was prepared from dodecanol-(1) by dry distillation of its palmitic acid ester, bromination of the dodecene thus obtained, and treatment of the latter with alcoholic potassium hydroxide. The dimethoxyphenylpropionic acid was obtained by condensing *o*-vanillin methyl ether with ethyl acetate and reduction of the cinnamic acid derivative produced. The saturated ketone, obtained as above by reducing the initial dodecine condensation product with hydrogen in presence of platinum black, formed white needles, m.pt. 47°—49° C. The unsaturated ketone was non-crystalline, and decomposed on distillation, and was therefore not isolated. The reduction of the ketone to hydrourushiol dimethyl ether was effected by boiling for 10 hours with amalgamated zinc and hydrochloric acid, and a product of m.pt. 36°—37° C. was obtained identical with that prepared from the natural product.—G. F. M.

Isohydrourushiol and its lower homologue. R. Majima and I. Nakamura. Ber., 1915, **48**, 1597—1603.

3.4-Dihydroxy-1-pentadecylbenzene (isohydrourushiol) was prepared by condensing catechol with *n*-pentadecylic acid in presence of tin chloride, and reducing the resulting ketone,

$$(HO)_2C_6H_3{\cdot}CO{\cdot}(CH_2)_{13}{\cdot}CH_3,$$

with amalgamated zinc and hydrochloric acid. It forms leaflets, m.pt. 91° C., and differs from hydrourushiol in giving with ferric chloride a permanent green colour. 3.4-Dihydroxy-1-tetradecylbenzene was similarly prepared from catechol and myristic acid, and melted at 84° C. Isohydrourushiol dimethyl ether was again synthesised (compare this J., 1914, 91) by a new method, namely by the condensation of methylvanillin with methyldodecylketone in presence of 10% sodium hydroxide, and reduction of the resulting unsaturated ketone first with hydrogen in presence of platinum black and then with zinc and hydrochloric acid. It formed flat leaflets, m.pt. 50°—51° C. and differed from the corresponding ether of hydrourushiol in giving only a mononitro-derivative.—G. F. M.

Linseed oil drying process. F. Fritz. Chem. Rev. Fett-Ind., 1915, **22**, 60—61. Z. angew. Chem., 1915, **28**, Ref., 514.

According to Hertkorn (Chem.-Zeit., 1903, **27**, 856; this J., 1910, 704) the oxidation of linseed oil is most pronounced when the oil is acid, is much slower with neutral oil, and is practically inhibited by making the oil alkaline. This was not borne out by the author's experiments. A boiled oil containing lead dried more rapidly than after an addition of 2% of linseed oil fatty acids. On the other hand a varnish in which 2% of a strongly alkaline soap was dissolved, dried almost as rapidly as the control sample. Calcium hydroxide oil-paint dried more rapidly than pure linseed oil varnish, and linseed oil containing 5% of calcium hydroxide could be readily converted into linoxyn at 50° C.—C. A. M.

Amber (*succinite*). A. Tschirch and C. de Jong. Arch. Pharm., 1915, **253**, 290—305. Z. angew. Chem., 1915, **28**, Ref., 513.

Two monocarboxylic acids were obtained by the decomposition of Aweng's crude succinoabietic acid (Arch. Pharm., 1894, 232, 660), viz., succoxyabietic acid, $C_{19}H_{29}O_2.COOH$ (m.pt. 120° C.) and succinoabietinolic acid, $C_{39}H_{59}O_3.COOH$ (m.pt. 100° or 112° C.). Both acids were also detected in succinite. Succinoabietinolic acid could be decomposed into succinosylvic acid, succinoabietol, and borneol. The portion of succinite insoluble in alcohol (the succinin of Berzelius) yielded a substance (succinoresene) with the properties of a resene. This is the main constituent of succinite and of amber, and is the cause of the resistance of amber to reagents.—C. A. M.

New Zealand Government control of kauri-gum trade. U.S. Comm. Rept. No. 281, Dec. 1, 1915.

The New Zealand Government has passed a law authorising the Minister for Lands to enter into contracts for the purchase of tools and plant for the extraction and treatment of kauri gum, and to purchase and sell gum on any terms and conditions he thinks fit. The minister may in future insert a condition in kauri gum digging licenses that the holder must give the minister the first opportunity of purchasing all gum obtained under the license, otherwise the minister may cancel the license. It gives the Government power, by order in council, to set apart any area of Crown land not exceeding 10,000 acres in a kauri-gum district for the purpose of promoting the systematic recovery of kauri gum and other valuable products. This land may be leased by the Land Board to approved persons on condition that it is worked for the extraction of kauri gum and that no lease shall extend over more than 3000 acres, or be for more than 21 years. Many of the exporters fear it may seriously interfere with the trade in general, and it is a very important industry giving employment to about 6000 men.

The exports of kauri gum during the four years ending with 1913 were as shown in the following table:—

	1910.	1911.	1912.	1913.
	Tons.	Tons.	Tons.	Tons.
United Kingdom and Possessions	3,385	2,462	2,547	3,532
Germany	913	1,142	1,053	833
United States	4,149	3,514	3,894	3,995
All other countries	246	469	414	420
Total	8,693	7,587	7,908	8,780

The total value of the exports in 1913 was over £500,000. The known kauri-gum fields are all located north of Auckland, and cover about 814,000 acres, of which approximately one-half is Crown land. The gum may be found anywhere from the surface to 20 feet down, and often under heavy forests where the standing trees are said to be from 2000 to 3000 years old. About 350,000 tons of kauri gum has been exported during the past 40 years, and it is estimated that there is still an equal amount available. There is talk of imposing an export tax of £1 per ton. The price of kauri gum is steadily advancing, the average in 1894 having been £47 per ton, when the quality was much better than it is now, to £61 for 1913. The heaviest exports were made in 1899 and 1900, when they reached 11,116 and 10,159 tons respectively.

Colorimetric determination of copper and iron in pig lead, lead oxides, and lead carbonate. White. *See* XXIII.

Patents.

Carbon-black; Apparatus for making ——. G. L. Cabot, Cambridge, Mass. U.S. Pat. 1,162,131, Nov. 30, 1915. Date of appl., July 16, 1914.

Carbon-black is deposited from burners upon parallel, laterally-spaced cylinders, revolving above the burners, inside a pipe parallel with the cylinders. The deposit is removed by means of scrapers supported by straps arranged between the cylinders.—E. W. L.

Varnish from semi-drying oils such as marine animal oils and the like ; Preparation of —— especially for oilcloth and linoleum manufacture. E. Girzik, Vienna. Ger. Pat. 286,798, Dec. 31, 1913. Under Int. Conv., Oct. 18, 1913. Addition to Ger. Pat. 286,019.

The proportion of fatty acids naturally present in the oil is increased by hydrolytic or enzymic action preferably up to 25 to 30%, and the free acids are then saponified by the addition of alkali lye. The residual oil is separated from the saponified fatty acids and boiled or polymerised as described in the chief patent (see Fr. Pat. 468,003 ; this J., 1914, 973).—C. A. M.

Paints and printing colours : Manufacture of——. N. W. Turkin, Moscow, Russia. U.S. Pat. 1,164,036, Dec. 14, 1915. Date of appl., Jan. 10, 1914.

See Eng. Pat. 23,128 of 1913 : this J., 1914, 757.

Hard compositions of matter : Manufacture of —— from aldehydes and their derivatives and phenols with tars, turpentine oil, and related bodies, and other substances. K. Tarassoff, Moscow. Eng. Pat. 7560, Mar. 25, 1914.

See Fr. Pat. 470,810 of 1914 ; this J., 1915, 187.

Process and apparatus for treating in the electric furnace gases from which carbon separates. Ger. Pat. 285,665. *See* IIa.

Manufacture of spirit-soluble asphaltic substances [from wood tar]. Ger. Pat. 286,650. *See* III.

Separation of china-clay, ochre, and similar materials. Eng. Pat. 24,077. *See* VIII.

XIV. INDIA-RUBBER ; GUTTA-PERCHA.

X-Rays : Rubber gloves for surgeons operating with ——. Guinochet. J. Pharm. Chim., 1916, **12**, 16—18.

Gloves are rendered opaque to X-rays by coating them 3 or 4 times at intervals of about half an hour with a paste made by mixing in a mortar 100 grms. of finely powdered lead carbonate, 50 grms. of rubber solution (similar to that employed for repairing cycle tyres), and 50 grms. of light mineral oil. Large surgical gloves require 40—50 grms. of the paste each : it is applied with a soft brush, preferably to the inner surface after the gloves have been turned inside out and filled with a powder. It adheres best after a preliminary coating of dilute rubber solution. It is not affected by prolonged contact with water containing phenol or with strong alcohol, but becomes blackened if left for ¾ hour in boiling water, and then tends to crack when the gloves are stretched. The paste can be applied directly to the hands, being readily removed afterwards by means of mineral oil. It must be thoroughly mixed before use.—J. H. L.

Indiarubber production in 1915. S. Figgis and Co., London. Jan. 4, 1916.

Exports of plantation rubber from Ceylon and India in 1915 amounted to 20,600 tons, and from Malaya, Sumatra, Java, and Borneo to 72,800 tons, compared with 14,800 tons and 49,700 tons respectively in 1914 ; these figures do not include some direct Dutch shipments. The supply from Brazil, including Amazonas, Bolivia, Peru, etc., was 37,500 tons, as against 37,000 tons in 1914 and 39,000 tons in 1913. The total supply of raw rubber in 1915 is estimated to have been 146,000 tons. Supplies from Central America were very small. The west coast of Africa exported about 7000 tons, but little was received from the east coast. The supply of balata was steady. Imports of rubber of all kinds into England amounted to 79,351 tons, compared with 59,409 tons in 1914 and 55,270 tons in 1913.

Patents.

[Rubber.] Treatment [vulcanisation] of plastic material. R. B. Price, New York, Assignor to Rubber Regenerating Co. U.S. Pat. 1,161,965, Nov. 30, 1915. Date of appl., Jan. 25, 1913.

The rubber or other material to be vulcanised is heated to a temperature below the vulcanising temperature and subjected to a reduced external pressure, for a definite period of time, whereby expanded, entrapped fluids will be withdrawn, and is then heated to the vulcanising temperature in a medium consisting of a dry vapour. —E. W. L.

Vulcanised [rubber] articles ; Manufacture of ——. R. B. Price, New York, Assignor to Rubber Regenerating Co. U.S. Pat. 1,161,966, Nov. 30, 1915. Date of appl., Jan. 14, 1915.

Tyres or other articles are made up of vulcanisable plastic and fibrous materials to substantially their final form, and are then vulcanised in contact with a heated liquid such as glycerin. The bead portions of a tyre may be subjected to a restraining pressure and a vulcanising temperature by means of rigid walls, whilst the rest of the surface is unconfined. The vulcanisation may be only partially carried out in this way, the tyres being afterwards given their final form, and vulcanisation completed. —E. W. L.

Vulcanised plastic articles : Method of producing ——. R. B. Price, New York, Assignor to Rubber Regenerating Co. U.S. Pat. 1,161,967, Nov. 30, 1915. Date of appl., Jan. 16, 1915.

Vulcanised plastic articles are produced by dipping a form once or more times in a solution of vulcanisable plastic, and after each dip exposing the form and the plastic thereon in an enclosed space to a reduced pressure. In this way the solvent is removed from the plastic material but does not escape, and the deposition of moisture and dust on the article is prevented.—E. W. L.

Rubber ; Process of vulcanising ——. A. D. Warner, Mishawaka, Ind., and R. B. Price, New York, Assignors to Rubber Regenerating Co. U.S. Pat. 1,163,050, Dec. 7, 1915. Date of appl., Jan. 30, 1913.

Rubber is subjected first to a heating process at a temperature below 212° F. (100° C.) for a definite period of time, and then, whilst still hot, to an increased pressure of about 25 lb. for compacting it ; finally it is vulcanised by raising the temperature to about 265° F. (130° C.).—E. W. L.

Caoutchouc ; Production of ——. I. Ostromislensky. Fr. Pat. 475,565, July 22, 1914.

Caoutchouc is obtained by the polymerisation of β-myrcene, either alone or in the presence of other compounds. Polymerisation may be brought about either spontaneously, or by the action of heat, light, or electricity, and either in presence or absence of catalysts. β-Myrcene is obtained when isoprene, either alone or in the presence of a catalyst, is allowed to stand at the ordinary temperature, or heated to not above 150° C., or exposed to ultra-violet light. The β-myrcene thus produced, in company with other products of the reaction, may also be polymerised by the action of alkali- or alkaline-earth metals, or of their alloys, mixtures, or amalgams. β-Myrcene, $C_{10}H_{16}$, is a mobile liquid, b.pt. 63·5° C. at 20 mm. and 58° C. (approx.) at 13 mm. ; sp.gr. 0·8472 at 20°/4° C., refractive index, $n^{21} = 1·53680$. The following examples are given of the production of β-myrcene :—(1) One kilo. of isoprene is heated for 10 days at 80°—90° C. in a closed vessel; (2) one kilo. of isoprene and 50 grms. of barium peroxide, or of benzoyl peroxide, or of an ozone derivative of β-myrcene, are heated at 90° C. for 10 days; (3) 100 parts of isoprene and 6 parts of potassium sulphite are heated at 60° C. for 20 days; (4) 100 parts of isoprene and 5 parts of piperidine dithiocarbamate or 3 parts of glycerin and 6 parts of urea are heated together at 120° C. For the production of caoutchouc from β-myrcene the following examples are given:—(1) The mixture of products from one of the above reactions is heated with 20 grms. of sodium wire at 70° C.; (2) 100 grms. of purified β-myrcene is heated at 70° C. with 2 grms. of sodium and 100 grms. of barium peroxide for 2—6 days; (3) 100 parts of β-myrcene and 5 parts of sodium are exposed, in a quartz vessel, to ultra-violet light for several days; (4) 100 parts of β-myrcene and 5 parts of sodium are heated to 70° C. for several days; (5) 100 parts of β-myrcene and 5 parts of benzoyl peroxide are kept in a closed vessel at the ordinary temperature for several months.—E. W. L.

Vulcanised rubber; Process for obtaining a substance identical with or analogous to natural ——. I. Ostromislensky. Fr. Pat. 475,601, July 23, 1914.

Synthetic rubber is vulcanised by heat in presence of substances belonging to one or other of two groups:—(1) resins, balsams, tars; (2) alcohols and their derivatives, hydrocarbons, or solvents of rubber, or substances in which rubber swells. In the latter case the mass must be basic in reaction, *e.g.*, through the presence of metallic oxides such as those of zinc, magnesium, and lead. The process may be varied by adding to the synthetic or to natural rubber, or to the mixture containing the first group of substances, a nitrogenous compound, such as an amine, an alkaloid, an aldehyde-ammonia, or a derivative of one of these, together with a metallic oxide, and vulcanising the mass by the hot or cold process. The following examples are given:—(1) a mixture of "normal" isoprene rubber, 100; colophony, 12; sulphur, 18; and zinc oxide, 20 parts, is heated at 135° C. for 1 hour 40 mins.; (2) 2 parts of hexamethylenetetramine is added to the preceding mixture; vulcanisation is then completed in 15—18 minutes at 130°—135° C. or in 40—45 minutes at 120° C.; (3) β-myrcene-rubber, 100; colophony, 18; sulphur, 4·5; piperidine piperidyldithiocarbamate or di-isobutylamine dithiocarbamate, 0·5; zinc oxide, 10; and magnesium oxide, 10 parts, are heated at 135° C. for 35—40 minutes; (4) a mixture of β-myrcene-rubber, 100; solution of colophony in coal-tar, 15; sulphur, 9; brown factice, 10; piperidine piperidyldithiocarbamate, 0·5; zinc oxide, 10; and magnesium oxide, 15 parts, is vulcanised at 135° C. for 50 minutes; (5) rubber obtained by autopolymerisation of dimethylerythrene at ordinary temperature, 100, is mixed with sulphur, 8; colophony, 10; zinc oxide, 20; terpineol, 6; and hexamethylenetetramine, 6 parts, and vulcanised for 45 minutes at 130° C.; (6) the mixed xanthate of zinc and menthyl ether is used in place of the hexamethylenetetramine in example (5); vulcanisation is effected in the same time at the same temperature; (7) a mixture of rubber obtained by heating dimethylerythrene at 60°—150° C., 100; colophony, 8; zinc oxide, 15; menthol, terpineol, or geraniol, 6, and hexamethylenetetramine, 4 parts, is vulcanised at 135° C. for 50 minutes; (8) β-myrcene-rubber, or "normal" isoprene rubber, 100, is mixed with vaseline oil, 1, and piperidine piperidyldithiocarbamate, 2 parts, rolled into thin sheet, and vulcanised by immersion in a 2·5% solution of sulphur chloride in carbon bisulphide for 20—80 seconds. (See also this J., 1916, 58.)—E. W. L.

Vulcanising agent, and method of manufacture. P. Rodier. Fr. Pat. 476,059, Apr. 1, 1914.

Vulcanisation can be effected at a temperature of 50° to 60° C. by the use of a vulcanising agent —"oxysulphochloram"—prepared by saturating a well-cooled mixture of ammoniacal chloride of sulphur and sulphuric monochlorohydrin with chlorine. This substance is a solid melting at about 54° C., and in use is mixed with the rubber or oil to be vulcanised, together with varying amounts of an alkali sulphide.—E. W. L.

Rubber; Pliable, plastic, and elastic substitute for ——. J. de la Fresnaye and L. Aimond. Fr. Pat. 476,509, Apr. 24, 1914.

Cholesteryl esters, obtained by the action of oxidised or non-oxidised oils, such as linseed or *Hevea*-seed oil, upon the non-saponifiable resins of rubber or guttapercha, are treated with sulphur chloride, at ordinary or increased pressure, and in the presence of an inert gas, such as carbon dioxide, or not. For example, 100 kilos. of *Hevea*-seed oil is heated with 100 kilos. of non-saponifiable rubber or guttapercha resins, in presence or absence of a catalyst such as 32% hydrochloric acid, for 2 hours. The ester obtained resembles lanoline in appearance. It is washed and pressed to remove glycerin, transferred to an autoclave mixer, into which carbon dioxide at 2 atmospheres pressure is introduced, followed by a fine stream of 5 to 15 kilos. of sulphur chloride. The temperature is kept down by means of water-circulation. Loading materials such as zinc oxide, barium sulphate, etc., may be added before or after the addition of the sulphur chloride.

—E. W. L.

Butadiene; Production of pure ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 286,640, Apr. 25, 1913.

To separate butadiene from other gases (hydrogen, methane, carbon monoxide and dioxide, nitrogen, etc.) of no value for the production of artificial rubber, the gaseous mixture is treated with liquid sulphur dioxide or a solution of sulphur dioxide in an anhydrous solvent, *e.g.*, toluene, at a temperature at which no separation of a precipitate occurs; the butadiene is absorbed quantitatively and is obtained in a pure state, after removing the sulphur dioxide by distillation, or by treatment with bases. By this method the isolation of the solid compound of butadiene and sulphur dioxide is avoided.

—F. W. A.

XV.—LEATHER; BONE; HORN; GLUE.

Nitrogen in leather waste; Determination of ——. R. P. Rose. J. Assoc. Off. Agric. Chem., 1915, 1, 396—398.

The amount of available organic nitrogen in treated leather waste, determined by the neutral permanganate method, is always higher than when determined by the alkaline permanganate method, the former giving constant results whilst the results given by the latter method are variable. This was found to be due to retention of ammonia in the alkaline permanganate method in the form of complex ammonio-manganese compounds, as shown by the liberation of a further amount of ammonia when the residue after distillation is treated with potassium sulphide and again distilled.—T. C.

XVI.—SOILS; FERTILISERS.

Soil analyses; Interpretation of ——. G. S. Fraps. J. Assoc. Off. Agric. Chem., 1915, 1, 418—421.

Soil analyses are made by three distinct methods, to wit: by determining the total plant food and the other soil constituents, by finding the plant food soluble in hot concentrated hydrochloric acid, and by estimating the phosphoric acid, the potash, and the lime soluble in weak solvents, *e.g.*, in $N/5$ nitric acid. (The total nitrogen is estimated in all three methods.) The first method is defective because it does not bring out any relation between the total plant food and the soil deficiencies. The second is widely used, but chemists are not agreed upon the standard to be adopted in the interpretation of the results. At the Texas Agricultural Experiment Station it has been shown that there is an average relation between the total nitrogen, the active phosphoric acid and potash (deduced from their solubilities in $N/5$ HNO_3), and the average deficiencies of the soil for these constituents as found in pot experiments. The method based upon these data is held to give the best criterion of the soil fertility as well as the best means of deducing its deficiencies. The results afforded are relative and not absolute; they are based on the assumption that plant food is the determining factor in production, and there may be other factors; and generally, the application of the analytical results to field conditions is difficult. However, the method has proved of great value in dealing with Texas soils.—E. H. T.

Soil protozoology: New methods in ——. N. Kopeloff, H. C. Lint, and D. A. Coleman. Science, 1915, **42**, 281—286. Bull. Agric. Intell., 1915, **6**, 1452—1453. (See this J., 1915, 1155).

A MODIFICATION of the microscopical apparatus used for counting blood corpuscles affords the best and most accurate means of enumerating protozoa. Its advantages are many, although the initial cost is high and numerous counts have to be averaged to ensure accuracy. The production of ammonia is an unreliable index of the action of soil protozoa upon bacteria, because it is also formed by the activity of soil fungi. To obviate this source of error, fungi can be eliminated by plating on special fungi media and making sub-cultures from the fungus-free solution which collects in the cavity of the agar plate. As regards cultural media for soil protozoa, 10% hay infusion is the best medium for small flagellates and for small and large ciliates, and the same liquid, containing also 0·5% of egg albumin, is the best for all ciliates. Although inferior to the last-named medium, soil extract is also excellent, and small ciliates develop very well in a 3% chicken manure medium. The nature and number of protozoa developed in a cultural medium depend upon its nature, the kind of soil used, and upon the time of incubation; they appear usually in the following sequence: small flagellates, small ciliates, large flagellates (if any), large ciliates.—E. H. T.

Amino-acid nitrogen of soil. R. S. Potter and R. S. Snyder. J. Ind. Eng. Chem., 1915, **7**, 1049—1053.

USING Kober's copper method (J. Amer. Chem. Soc., 1913, **35**, 1516) no amino-acid nitrogen could be detected in a dilute acid extract of soil, even after adding a small quantity of an amino-acid to the soil. In an extract prepared with 2% sodium hydroxide solution, on the other hand, practically the entire amount of amino-acid added to the soil could be recovered. The same quantity of amino-acid nitrogen was found after extracting the soil with dilute alkali for 1, 2, 4, and 6 hours respectively. In the case of two soils containing respectively 0·151 and 0·180% of total nitrogen, the total amino-acid nitrogen (nitrogen in an amino group in α- or β-position with reference to an unsubstituted carboxyl group) was 7·95 and 23·1 parts per million, the free amino-acid nitrogen (*i.e.*, in "free" amino-acids) was 5·45 and 14·7, and the total peptide nitrogen (α- and β-amino-nitrogen of amino-acids from hydrolysed peptides) was 31·5 and 30·9 parts per million. No tendency for amino-acid nitrogen to accumulate in acid soil could be observed whether the soil was untreated, or limed, or heavily manured with horse manure. In the heavily manured soil the nitrate-nitrogen showed a decided decrease at first, but increased after 4—6 weeks. The content of amino-acid nitrogen was lower than that of ammonia-nitrogen, but usually varied in a similar manner.—A. S.

Humification of plant constituents. A. Trouseff. Selskoie Khosiaistvo i Liesovodstvo, 1915, **247**, 575—605. Bull., Agric. Intell., 1915, **6**, 1453—1454.

THE humification of plant remains, of carbohydrates, proteins, etc., was investigated experimentally both on the soil surface and beneath it. It is concluded that soil humus is derived primarily from lignin, proteins, starch, chlorophyll, tannic bodies, phlobaphenes, some fats, and gums, and that cellulose, hemicellulose, mono- and disaccharides, glucosides, organic (including amino-) acids do not humify. Black humus is formed rapidly when lignin, proteins, pigments, and tannins are present together; its production is much slower when only the first two, or even when proteins alone, undergo decomposition. Since bacteria are rich in proteins, it is possible that their bodies may humify, and the organic matters concerned in their nutrition may indirectly produce humus. Natural humification is confined to those organic substances which are readily transformed artificially by the action of very active chemical agents. The composition of humus varies, but it always contains the decomposed residues of lignin, proteins, etc. (See also this J., 1915, 808.)—E. H. T.

Soil; Changes in —— brought about by heating. A. Wilson. Sci. Proc. Roy. Dubl. Soc., 1915, [N.S.], **14**, 513—520. J. Chem. Soc., 1915, **108**, i., 1090—1091.

SOILS which were heated at temperatures from 60° to 150° C. showed a regular depression in the freezing points of its aqueous extracts, which increased from 0·06° in the case of soil heated at 60° C. to 0·19° in the soil heated at 150° C.; coincidently, the electrical conductivities of the extracts showed an increase from $36{\cdot}0\times10^{-5}$ to 198×10^{-5}. It is therefore evident that the amount of soluble matter is increased by heating. Whilst extracts of the original soil were practically colourless, the extracts of the heated soil varied from a faint brownish-yellow colour (60° C.) to a very deep brown (150° C.). Soils which were heated at the higher temperatures absorbed more water than unheated soils. Experiments in which the soil extracts were prepared by stirring the soils with water and filtering, instead of by percolation, gave similar results. The conclusion is drawn that the increased fertility of heated soils may be partly due to the increase in soluble constituents and to the change in soil texture resulting in an increased power of retaining water.

Lime: magnesia ratio in soil amendments. W. Thomas and W. Frear. J. Ind. Eng. Chem., 1915, **7**, 1042—1044.

EXPERIMENTS were made with clover on a run-down silty loam soil showing a lime requirement, by Veitch's method, of 1500 lb. per acre-7 in.; paraffined wire baskets, 5½ by 5¾ in. size, were used for holding the soil. In similar unfertilised soil from an adjacent plot, there was 0·365% CaO and 0·509% MgO in the surface soil and 0·377% CaO and 0·679% MgO in the subsoil. The dressings were ground and sifted through a 100-mesh sieve before application and were added in amounts required to neutralise acidity; they consisted of dolomite ($CaO : MgO = 1 : 1$), and mixtures of calcite and magnesite and of calcium and magnesium hydroxides ($CaO : MgO = 1 : 1$, $2 : 1$, and $3 : 1$). It was found that none of the dressings did any harm during the first year after application, and the only distinct difference observed during the period of growth was that the germination of the seed was retarded by 3 or 4 days when highly magnesian dressings were used. The yields were slightly higher from the highly calcareous than from the highly magnesian dressings, and the hydroxides were more beneficial than the carbonates. Dolomite was less beneficial than a corresponding dressing of calcite and magnesite.—A. S.

Determination of nitrogen in leather waste. Rose. *See* XV.

Use of pressed apple pomace. Barker and Gimingham. *See* XVIII.

Alcoholic fermentation in the higher plants. Minenkoff. *See* XVIII.

Patents.

Peat; Treatment of —— for use as fertiliser. N. Testrup, Westminster, T. Rigby, Dumfries, and Wetcarbonizing, Ltd., Westminster. Eng. Pat. 18,838, Aug. 19, 1914.

The fertility of light soils is increased by the application of peat which has been heated in the wet state to at least 60° C. without expelling the moisture (see this J., 1913, 1150; 1914, 783, 911, 912), and the greater part of the water then removed. Such prepared peat is deprived of its slimy and water-binding character, and being spongy acts as a moisture-retaining ingredient in the soil. Its fertilising value is enhanced by subsequent treatment with ammonia (see this J., 1915, 1249).—E. H. T.

Phosphate composition and process of calcining phosphates. S. B. Newberry and H. N. Barrett, Baybridge, Ohio. U.S. Pat. 1,162,802, Dec. 7, 1915. Date of appl., Nov. 25, 1912. (See this J., 1915, 1263.)

Pulverised mineral calcium phosphate is mixed with sufficient alkali-metal compound to yield on calcination an amount of oxide equal to 5—12% of the weight of phosphate, the mixture is rendered porous, and brought into intimate contact with, and heated by a strong current of hot gases at a temperature of 2000°—2700° F. (1500°—1700° C.) whereby the alkali-metal oxide is formed and the volatile components of the charge are expelled. The heating is continued further until the oxide is partly volatilised and most of the phosphate has become citrate-soluble.—E. H. T.

Phosphate fertilisers; Process of making ——. S. B. Newberry and H. N. Barrett, Baybridge, Ohio. U.S. Pat. 1,162,944, Dec. 7, 1915. Date of appl., Nov. 4, 1912. (See preceding abstract.)

The mixture is made permeable by moistening with water and drying rapidly, and it is agitated during the calcination; it never becomes fused but is kept in a porous condition throughout.
—E. H. T.

Fertilisers; Process of manufacturing ——. J. H. Connor, Sharpsburg, Pa. U.S. Pat. 1,163,130, Dec. 7, 1915. Date of appl., Oct. 9, 1913.

Phosphate rock, soda-ash, lime, and blast-furnace slag containing a calcium compound or calcium and magnesium salts, are ground, mixed, and calcined, whereby part of the phosphoric acid, potassium, and calcium is converted into a water-soluble form.—E. H. T.

XVII.—SUGARS; STARCHES; GUMS.

Mauritius Department of Agriculture Report for 1914. [Cane sugar manufacture.] F. A. Stockdale. Intern. Sugar J., 1915, 17, 566—567.

The financial condition of all agricultural undertakings in the colony has improved as a result of a series of good seasons and satisfactory prices, and during 1914 the increase in the monetary value of the crop sugar worked up by the 59 factories amounted to £2,000,000, placing the industry on a strong financial basis, and making possible improvements in cultivation and manufacture. Cane diseases gave little trouble in the period reviewed, though the White Tanna variety is giving indication of some degeneration. Uba cane gave good returns on lands of low fertility, and several Demerara seedlings have yielded promising results in some localities. In the factories the triple circulation type of furnace with long combustion chambers and automatic feed, has proved satisfactory for burning bagasse. Messchaert grooved rollers have given promising results. There is a movement to replace the small vacuum pans found in many houses by larger ones. Suction gas plants for driving the crystallisers and centrifugals have proved economical. Sodium phosphate has been used with satisfactory results on two estates (this J., 1915, 916); it facilitates clarification and reduces incrustation.—J. P. O.

Reducing sugars; Decomposition of —— in cane sugar manufacture. H. C. Prinsen Geerligs. Louisiana Planter, 1915, 40, 10—11.

According to the figures of the Mutual Control of Java, the amount of reducing sugars in cane juices is diminished considerably during clarification and evaporation, whether the defecation-sulphitation or -carbonatation process be used; the decrease is about 15% in the former and 22% in the latter mode of working. Laboratory experiments made by van der Linden in Java (see following abstract), however, indicated that with careful operation the destruction of reducing sugars in the defecation-sulphitation process of clarification may not exceed 5% of the amount originally present in the raw juice, though a notable decrease during evaporation appears inevitable. When applying the single or double carbonatation process, the laboratory experiments indicated that the destruction of reducing sugars depended upon the duration of the action of the caustic lime, and that after treatment by this method the reducing sugars did not decrease during evaporation. This variance between factory and laboratory figures is probably due, according to the author, to inadvertent addition of an excess of lime or the use of too high a temperature in actual practice.—J. P. O.

Reducing sugars; Decomposition of ——, under conditions analogous to those of the manufacture of cane sugar. T. Van der Linden. Archief Suikerind. Nederlandsch-Indië, 1915, 23, 653—685. Bull. Agric. Intell., 1915, 6, 1526—1527.

The decomposition of reducing sugars during clarification and concentration of the syrup was investigated as far as possible under manufacturing conditions, the amount of reduction, the gravity, polarisation, sucrose content, and the acidity or alkalinity being determined. The defecation tests showed that the reducing sugars remained practically unchanged; the sulphitation tests proved that the decomposition did not exceed 5%, and the maximum change during concentration varied from 3 to 16%. The carbonatation tests showed that the decomposition was at a maximum during the treatment, ranging from 3 to 13%. As the figures obtained were much below those found in actual practice by the Mutual Control Factories, it follows that additional factors come into operation on the manufacturing scale. It was further found that the addition of an alkaline organic salt had no appreciable effect; that precipitated matter exerted but very little influence on polarisation; that, except in the defecation tests, the polarisation values increased during clarification; that the sucrose remained constant except where inversion took place; and that clarification with basic lead acetate did not affect the reducing power.—E. H. T.

Sucrose determination; Double polarisation process of —— applied to cane products, and the variation of the constant. H. Pellet. Intern. Sugar J., 1915, **17**, 558—560.

In establishing the constants to be used for calculating the results obtained by the double polarisation method, the highest grade refined sugar should be used in preference to sugar purified by precipitation with alcohol; the latter treatment may yield a product containing a smaller amount of mineral matter, but is less satisfactory in eliminating the reducing sugars. After determining the moisture, ash, and reducing sugars, the true sucrose content may be calculated very exactly by difference, the organic non-sugar being estimated by multiplying the ash percentage by 1·5 or 1·6. It is emphasised that the constant should be determined by the operator in every case for the particular saccharimeter and flasks used, and also for the individual mode of working followed. The author agrees with Staněk (this J., 1914, 433) that muta-rotation of the invert sugar may appreciably affect results in the double polarisation method, and consequently the interval between inversion and reading must be the same in the actual assay as in the control determination.—J. P. O.

Gum-tragacanth industry in Persia. U.S. Comm. Rep. No. 293, Dec. 15, 1915.

The various species of *Astragalus*, from which gum tragacanth is obtained, grow on the mountain ranges which surround the Persian plain. The price of the gum has increased 5 to 10 % since the outbreak of hostilities in Europe. The present prices per pound for the different grades of gum are as follows: First grade, 3s.; second grade, 1s. 8d.; third grade, 1s. 2d.; fourth grade, 10d.; and fifth grade, 6d. The principal Persian markets for gum tragacanth are Hamadan, Shiraz, Kerman, and Kermanshah. From 150 to 200 tons is exported annually from Hamadan. Before August 1, 1914, half of this amount was shipped to Russia and the other half to America and Great Britain; but since that date the amount shipped to Russia has been reduced to one-fifth, the other four-fifths going to America and Great Britain. Great Britain and Russia are the largest importers of Persian tragacanth, followed by Turkey, India, and the United States. The exports in the year 1913–14 were valued at £233,000.

Various methods of modifying starch for sizing [cotton warps]. Bean. *See* V.

PATENT.

Starch; Apparatus and process for purifying ——. L. P. Bauer, Pekin, Ill. U.S. Pat. 1,161,826, Nov. 30, 1915. Date of appl., Apr. 21, 1913.

Water containing powdered starch and impurities of lower specific gravity in suspension, is gently agitated at a level considerably below the surface. The rising impurities are moved horizontally across the surface of the liquid towards an overflow point, at a rate sufficient to prevent them from settling, and the starch is drawn off at the bottom of the liquid. (Cp. U.S. Pats. 986,510 and 986,511; this J., 1911, 503.)—J. H. L.

XVIII.—FERMENTATION INDUSTRIES.

Vinification in a sulphurous medium with and without selected ferments. G. Dalmasso and L. Sutto. La Revista Viticolt., 1915, 21, 385—393. Bull. Agric. Intell., 1915, **6**, 1525.

In order to find the best method of treating the wines of Conegliano when "oxidasic break" ("casse") or "turn" occurs, vats of must were treated respectively with potassium bisulphite, with "biosulphite Jacquemin," with the same and "multilevures Jacquemin," and with the last-named ferment alone. Comparison between the vats and with the control vat showed that sulphitation was in every sense the best method of ensuring a limpid white wine and of preventing oxidasic break and malolactic fermentation. The "biosulphite Jacquemin" was no better than potassium bisulphite. The selected ferments were ineffective and, in the absence of sulphur dioxide, harmful; on the other hand, such ferments have proved very useful in the vinification of grapes damaged by hail, disease, or insects.—E. H. T.

Wine; Reduction of the acidity of —— by means of calcium carbonate (Chaptalisation). T. Paul. Deutsch. Bunsen-Ges., Berlin, Oct., 1915. Z. angew. Chem., 1915, **28**, Wirthschaftl. Tl., 615—617, and Chem. Zeit., 1915, **39**, 801—802.

The author has made a preliminary study of the effect of addition of calcium carbonate on the degree of acidity of wines (see this J., 1915, 1159). The precipitate formed consists essentially of neutral calcium tartrate, and the acidity of the wine as determined by titration is reduced in proportion to the quantity of calcium carbonate dissolved. The solubility of neutral calcium tartrate in pure water at 18° C. is 0·3802 grm. ($CaC_4H_4O_6.4H_2O$) per litre, but is appreciably increased by very small quantities of carbon dioxide. The degrees of acidity of 0·2—1·6 % aqueous solutions of tartaric acid range from 2·77 to 9·33 mgrm.-ions per litre, and these values are reduced by about 50 % when the solutions are saturated with neutral calcium tartrate. Although alcohol lowers the solubility of this salt in water and in solutions of tartaric acid to a considerable extent (*e.g.*, 100 grms. of alcohol per litre lowers both solubilities by about 50 %), it increases only very slightly the degree of acidity of tartaric acid solutions saturated with calcium tartrate. Comparative experiments in which an acid wine was treated with increasing quantities of calcium carbonate showed that small quantities produce a relatively greater fall in the degree of acidity than larger quantities, because the calcium bitartrate first formed remains in solution and depresses the electrolytic dissociation of the tartaric acid.—J. H. L.

Citric acid in wine; Detection of ——. E. Baier and P. W. Neumann. Z. Nahr. Genussm., 1915, **29**, 410—411. J. Chem. Soc., 1915, **108**, ii., 847.

Twenty-five c.c. of the wine is neutralised, then rendered acid with acetic acid, 3 grms. of blood-charcoal, free from calcium carbonate, is added, the mixture is shaken for ten minutes, and filtered. Ten c.c. of the filtrate is treated with 1 c.c. of Denigès' reagent (5 grms. of mercuric oxide dissolved in a mixture of 20 c.c. of concentrated sulphuric acid and 100 c.c. of water), boiled, and filtered if a precipitate forms; 1 % potassium permanganate solution is then added, drop by drop, until manganese dioxide begins to separate, and the latter is dissolved by the addition of hydrogen peroxide. If citric acid is present, the mixture at this stage exhibits a white turbidity, or a precipitate may form. The precipitate (the mercury salt of acetone-dicarboxylic acid) is collected on a small filter, washed three times with cold water, dissolved in 3 c.c. of 10% sodium chloride solution, and a few drops of dilute ferric chloride solution added. A raspberry-red coloration is obtained if the wine contained citric acid.

Maraschino. J. G. Riley and A. L. Sullivan. J. Assoc. Off. Agric. Chem., 1915, 1, 490—496.

Genuine Dalmatian maraschino is prepared by the fermentation of a mixture of the pulp of the marasca cherry, native in Dalmatia, with a small quantity of marasca cherry leaves. After 4 to 5 days' fermentation 10% to 15% of pure alcohol is added to arrest fermentation and the mixture then distilled, the first and last fractions of the distillate being of inferior quality. The distilled maraschino spirit is aged for two to three years and subsequently made into liqueur by diluting with syrup. Such liqueur usually contains 30% to 44% of alcohol and 26% to 36% of sugar. The maraschino prepared from the marasca cherry has a delicate fragrance and a distinct flavour, and is quite different from products prepared in a similar way from other varieties of cherry or other fruits. It contains traces of benzaldehyde and of hydrocyanic acid, but usually no added flavouring matters. Genuine maraschino diluted with water, then saturated with sodium bisulphite and extracted with ether, imparts its original odour to the ether. French, Dutch, and American maraschinos have generally an entirely different flavour from the Dalmatian product and are made by fermenting other varieties of cherries, with or without the addition of other fruits, or by compounding artificial flavouring matters with alcohol, with or without a small proportion of spirit prepared from cherries. Analyses of ten samples of genuine Dalmatian maraschino, nine samples of the French product, four samples of the Dutch product, and three of the American product, together with an analysis of kirschwasser, are tabulated and the conclusion drawn that chemical analysis alone is insufficient to determine whether a sample is genuine or not.—T. C.

Apple pomace; Use of pressed ——. B. T. P. Barker and C. T. Gimingham. J. Board Agric., 1915, 22, 851—858.

From 60,000 to 75,000 tons of pomace is produced annually in the manufacture of cider. It has the following composition:—Water, 68·39—78·15; fat (ether extract), 0·82—1·43; proteins, 1·03—1·82; crude fibre, 4·30—10·5; ash, 0·56—2·27; carbohydrates, 9·5—21·98%. Pressed pomace is a suitable feeding stuff for cows, etc., if used fresh and mixed with other foods. Although pomace decomposes rapidly when exposed to air, it may be preserved for many months by converting it into a kind of silage, with or without the addition of salt. Dried pomace is prepared on a small scale and sold as a cattle and poultry food. Ordinary samples of pomace contain from 0·2 to 0·6% of potash, 0·4—0·7% of phosphoric acid, and 1·6—1·7% of nitrogen, so that it is richer in manurial constituents than is farmyard manure. The objectionable acidity of the pomace, when used as a manure, is overcome by mixing it with chalk or lime; a method adopted in France for preparing a fertiliser consists in mixing the pomace with a quantity of bone or mineral phosphate. "Small" cider may be made by mixing pressed pomace with water or inferior cider, repressing the mixture, and treating the juice in the ordinary way of cider-making.—W. P. S.

Alcoholic fermentation in the higher plants. A. R. Minenkoff. Isviestiia Moskovskago Selskokhosiaistvennago Instit., 1915, **21**, 276—296. Bull. Agric. Intell., 1915, **6**, 1464—1466.

Alcoholic fermentation can take place in higher plants both under aërobic and anaërobic conditions; it is directly related to the vital activity of the organism, particularly to its growth. In presence of oxygen the formation of alcohol is increased when growth is retarded either by high or low temperatures, or by changes in osmotic pressure due to the presence of dissolved organic or inorganic substances. Formation of acid diminishes with increasing production of alcohol and ceases completely before the plant dies. When the retardation of growth is at a maximum, the ratio of carbon dioxide to alcohol approaches that observed in pure alcoholic fermentation. Such fermentation is promoted by absence of oxygen owing to the growth of the plant being inhibited.—E. H. T.

Pancreatic juice; The carbohydrate ferments of ——. J. Mellanby and V. J. Woolley. J. Physiol., 1915, **49**, 246—264.

Pure pancreatic juice free from carbon dioxide hydrolyses starch to dextrin and maltose, the final product containing 25% of the former and 75% of the latter. The hydrolysis is facilitated by the presence of neutral salts, such as calcium and ammonium chlorides, but the final position of equilibrium is the same as when the juice is used alone. It was found that the pure juice had no action on maltose. When starch is treated with pancreatic juice in presence of hydrochloric acid, a mixture of dextrin, dextrose, and maltose is produced, the relative quantities of these products being a function of the hydrogen-ion concentration of the medium; the higher the proportion of acid, the more dextrose is produced until a concentration of acid is reached which inhibits further action, owing to destruction of the enzyme. In experiments with 15 c.c. of 1% starch solution and 0·5 c.c. of pancreatic juice, hydrolysis ceased in one case with the addition of 0·7 c.c. of $N/10$ hydrochloric acid and 6·3 c.c. of water, and in another case with 0·8 c.c. and 6·2 c.c. respectively. Under the most favourable conditions maltose is converted into dextrose to the extent of 54%. It is believed that pancreatic juice contains only one enzyme, amylase, and that, on addition of acid, the hydrolytic power as regards maltose is determined by the hydrogen-ion concentration of the enzyme-acid complex. The activity of the juice in presence of acid suggests that the secretion is capable of hydrolysing starch of foodstuffs to dextrose. Pancreatic juice, either alone or in presence of acids, alkalis, and neutral salts, is without action on lactose or sucrose.

Nipa-palm alcohol in British North Borneo. U.S. Comm. Rep. No. 281, Dec. 1, 1915.

The efforts being made to start the manufacture of nipa-palm sugar and alcohol in the Philippine Islands have aroused interest in the potentialities of British North Borneo, where, although the area of nipa swamp has never been computed, the total is thought to be greater than that of the Philippines. Dense stands are to be found in Labuk Bay, along the north-east coast from Sandakan Bay to Tambisan Island, and in Sandakan Bay. The area of nipa in these three places alone must be well in excess of 50,000 acres, and all this area is easily available from Sandakan. Two hundred acres of nipa under proper management will yield 500 gallons of alcohol a day during the six or seven months the sap flows. Thus the visible supply of palms near Sandakan is more than sufficient for the foundation of a large industry.

Proteolytic power of lactic bacteria (Streptococcus lactis). Barthel. *See* XIXa.

Fermentation of cacao. Perrot's suggested improvements in the preparation of the beans. Knapp. *See* XIXa.

Manufacture of albuminous forage in Germany. Hayduck. *See* XIXa.

Patents.

Beer-fermenting tanks; Process for treating cement ——. F. W. Rickers, Assignor to F. and M. Schaefer Brewing Co., New York. U.S. Pat. 1.162.515, Nov. 30, 1915. Date of appl., Feb. 14, 1913.

The walls of cement tanks are first treated with water for a sufficient time to remove soluble calcium and magnesium salts, then heated to expel moisture and air, and finally coated with a plastic waterproof lining.—J. H. L.

Beer: Process of making ——. C. Rach, Stapleton, N.Y. U.S. Pats. (a) 1.163,453 and (b) 1.163,454, Dec. 7. 1915. Date of appl., Oct. 14, 1911.

(a) A wort of low gravity is prepared from a mash containing at least as much malt as raw grain and a relatively large quantity of water. A concentrated wort is made from a second mash containing a relatively small proportion of malt (*e.g.*, 40% of the total grain, or less) and an abnormally small quantity of water; diastatic action may be arrested before a substantial quantity of maltose has been formed, so that the wort produced contains a low percentage of fermentable matter. This mash is filtered in a press. The two worts are mixed together, boiled with hops, and fermented. (b) Fermented beer wort made from a mash containing at least as much malt as raw grain, is kräusened with wort rich in dextrins but poor in albuminoids and peptones, prepared from a mash in which raw grain predominates (the malt constituting, for example, 30% of the total grain, or less).—J. H. L.

Vinegar; Process for the manufacture of ——. H. Boulard, Paris. U.S. Pat. 1,164,063, Dec. 14, 1915. Date of appl., June 26, 1914.

See Eng. Pat. 25,289 of 1913; this J., 1914, 881.

XIXa.—FOODS.

Milk: Preparation of protein-free ——. H. H. Mitchell and R. A. Nelson. J. Biol. Chem., 1915, **23**, 459—467.

The "protein-free milk" prepared by Osborne and Mendel (Z. physiol. Chem., 1912, **80**, 316) for feeding experiments with animals, contains about 0·7% of nitrogen on the dry substance, and of this about one-half is protein-nitrogen. Preparations containing 0·4—0·5% of nitrogen and giving no distinct protein reactions, were obtained by the authors by treatment with trichloroacetic acid. Ten grms. of dried centrifuged milk, dissolved in 150 c.c. of water, was treated with 12 c.c. of 50% trichloroacetic acid and filtered after about 30 mins.; the filtrate was boiled for 30—60 mins., during which all the acid was expelled, and then filtered again.—J. H. L.

Lactic bacteria (Streptococcus lactis); Proteolytic power of ——. C. Barthel. Centralbl. Bakt., 1915, **44**, 76—89. Bull. Agric. Intell., 1915, **6**, 1529—1530.

To test the theory that *Bacterium casei* is chiefly concerned in the maturation of cheese and that *Streptococcus lactis* has only an indirect importance, pure cultures of bacteria from hard Swedish cheese were inoculated into skimmed milk of known composition, and after incubation at 14°—20° C. the amount of casein decomposed was determined. At the above temperature much casein was decomposed by the *Streptococci*, but at 36° C. the action was much diminished. On the other hand, *B. casei* had little effect at 20° C., but a strong action at 36° C. The water-soluble proteins were less affected by the *Streptococci* than by the lacto-bacilli. Since *Streptococci* predominate during the early maturation of cheese, it is inferred that they take an active part in the process and exert their proteolytic action.—E. H. T.

B. sporogenes; Simple test for —— *in milk and water.* J. Weinzirl. Science, 1915, **42**, 353. Bull. Agric. Intell., 1915, **6**, 1530.

To the milk sample contained in a sterile test-tube, enough solid paraffin is added to give a ⅛-inch layer when melted. When the tube has been heated at 80° C. for 10 minutes and then cooled quickly, the paraffin solidifies and forms an air-tight covering. The culture is then incubated at 37° C. for 24 hours, and if *B. sporogenes* is present, the paraffin layer will be lifted by the gas formed in the digestion of the lactose.—E. H. T.

Cacao; Fermentation of ——. *Perrot's suggested improvements in the preparation of the beans.* A. W. Knapp. Tropical Life, Dec., 1915, 3.

Cacao beans prepared by Perrot's process (this J., 1913, 620) have, when roasted, the well-known properties of unfermented cocoa and are inferior in quality to ordinary fermented cocoa. Very similar cocoa can be prepared by the simpler process of drying the beans in the sun, and the alkalised and steamed cocoa requires much longer to dry than ordinary fermented cocoa. Whilst it might be of value to sterilise the unfermented cocoa on the plantation and ferment it at the factory, thus facilitating the supply of cocoa in a more uniform condition, the author sees no practical advantages in Perrot's process. (See also Reutter, this J., 1913, 709, 802.)—W. P. S.

Enzymes of cacao. H. C. Brill. Philippine J. Sci., 1915, **10**, 123—133. J. Chem. Soc., 1915, **108**, i., 1087.

The pulp surrounding the cacao [cocoa] bean shows activity for the enzymes casease, protease, oxydase, raffinase, and invertase, whilst the fresh beans give reactions for casease, raffinase, and very strongly for oxydase. The fermented bean reacts for casease, protease, oxydase, diastase, raffinase, and invertase. The conclusion is drawn that the presence of these enzymes influences the character of the fermentation, and that the temperature must be controlled during fermentation so that they may not be destroyed.

Shell in ground cocoa; New method of determining ——. R. Wasicky and C. Wimmer. Z. Unters. Nahr. Genussm., 1915, **30**, 25—27. Bull. Agric. Intell., 1915, **6**, 1528—1529.

For estimating the shell in ground cocoa when less than 10% is present, an accurate method involving the use of ultra-violet light and a special form of microscope (Reichert, Vienna) has been devised. 0·01 Grm. of cocoa is treated with 5 c.c. of mixed alcohol and glycerin for 1 hour, the mixture is centrifuged, and the liquid then replaced by 1 c.c. of a solution of borax and glycerin. After well stirring, a drop is examined under the microscope on a glass slide protected with a cover slip. The cacao bean powder gives a fine violet-blue coloration; the shell gives a brownish colour and shows also a mucilaginous tissue of a colour varying from dull white to yellowish-green. The appearance is compared with that of standard

samples and 1% of shell is readily detected. The method may be adapted to the estimation of very small amounts of ergot in cereal flours.
—E. H. T.

Cocoa : Detection and determination of added cocoa-shell in ——. H. Grosse. Preuss. Verb. beamt. Nahrungsmittelchem., Oct. 3, 1915. Chem.-Zeit., 1915, **39**, 816—817.

From 1 to 1·5 grm. of the cocoa is ground with 20 c.c. of hot water, and the mixture boiled and centrifuged (about 500 revs. per minute). The liquid portion is then decanted, the sediment mixed with 25 c.c. of hot water and again centrifuged. The sediment thus obtained will consist of a dark-brown lower layer of cocoa-shell separated by a white layer from a layer of cocoa mass. The upper layers are removed, the lower layer is twice centrifuged in a small tube, then transferred to a basin, dried and weighed. If large particles of cocoa mass are still present, the sediment should be ground with water in a mortar and once more centrifuged. Under this treatment cocoa-shell loses two-thirds of its weight; the weight of the sediment is therefore multiplied by 3 to obtain the weight of the added shell. A sample of commercial cocoa powder examined by this method yielded a sediment corresponding with 6% of cocoa-shell; the cocoa was then mixed with 33·3% of its weight of cocoa-shell and again analysed; 31·6% of added shell was found. The presence of cocoa-shell may be detected by mixing 1·5 grm. of the sample with 20 c.c. of a chloroform-alcohol mixture of sp.gr. 1·41; after 3 hours' standing, the greater part of the shell will have settled to the bottom of the liquid.—W. P. S.

Ginger extract; The alcohol-soluble and ether-soluble solids in ——. C. W. Harrison and A. L. Sullivan. J. Assoc. Off. Agric. Chem., 1915, **1**, 506—510.

The solids in ginger extract prepared with 95% alcohol are practically all soluble in ether, but when prepared with weaker alcohol only a small proportion of the solids is soluble in ether, whilst the amount of total solids increases. Certain possible adulterants are more soluble in alcohol than in ether, and the determination of the solubility of the solids in ether is to be preferred to the determination of the alcohol-soluble solids as an indication of the strength of the extract.—T. C.

Albuminous forage : Artificial manufacture of —— in Germany. Hayduck. Deutsch. Zuckerind. 1915, No. 39, 650—654. Bull. Agric. Intell., 1915, **6**, 1528.

Delbrück's artificial cattle fodder, which has given excellent results, is made by fermenting sugar and ammonium sulphate with a special yeast in open vats. The process takes 5 hours, and 76 lb. of fodder, containing 50% albumin, is obtained from 100 lb. of sugar. The ferment differs from ordinary brewer's yeast in showing a very vigorous growth and by assimilating sucrose directly. The cost is estimated at 12s. 6d. per cwt. for factories producing 4000—10,000 tons of dry fodder per annum. The factories should be large, and situated near sugar or starch works providing a waste liquor containing not less than 0·75% sugar; molasses could also be used.—E. H. T.

Birch wood : Digestibility of ——. Rubner. Kgl. Preuss. Akad. Wiss. Oct. 21, 1915. Chem.-Zeit., 1915, **39**, 861.

Dogs can digest a considerable quantity of birch wood meal, when their daily ration contains not more than 27% of the meal; about 39% of the cellulose present in the meal and 45% of the pentosans are digested. The addition of the birch wood meal does not interfere with the digestion of meat eaten at the same time.—W. P. S.

Cellular tissue of wood; Digestibility of ——. Haberlandt and N. Zuntz. Kgl. Preuss. Akad. Wiss., Oct. 21, 1915. Chem.-Zeit., 1915, **39**, 861.

Feeding experiments showed that the cellular tissue of birch wood (in the form of mechanical wood pulp), after the cell contents, starch, and fat had been removed, is digested by sheep. The woody fibre was digested to the extent of 50%, and the non-nitrogenous substances to the extent of 56% of the quantities present in the cellular tissue.—W. P. S.

Use of pressed apple pomace. Barker and Gimingham. *See* XVIII.

Diazo reaction of albumin. [*Azo dyestuffs from histidine and tyrosine.*] Pauly. *See* XXIII.

Patents.

Nuts, cubes, or similarly shaped pieces of compressed material for use as food for cattle or other animals ; Apparatus for cooling —— and for removing dust and small particles which may be mixed with them. G. R. Schueler, Kingston-upon-Hull. Eng. Pat. 23,655, Dec. 7, 1914.

Two annular vertical chambers are arranged concentrically round a central air chamber. The material to be cooled is introduced into the inner annular chamber and a current of air is passed into the central chamber. The walls of the chambers, with the exception of the outer casing, are perforated so that the air may pass from the central chamber, through the material and into the outer chamber. In the latter the dust, etc., removed from the material by the air current is collected. Means are provided for removing the cooled material and the dust from the respective chambers.—W. P. S.

Seed, meal, or the like for use in the manufacture of cakes, nuts, or the like to be used as food for cattle or other animals ; Apparatus for cooking —— also applicable for cooking other material for other purposes. G. R. Schueler, Kingston-upon-Hull. Eng. Pat. 23,656, Dec. 7, 1914.

The cooker consists of a vertical, steam-jacketed cylinder provided with a number of fixed hollow blades; these blades are perforated so that steam or hot air may be admitted through them into the contents of the cylinder. A central hollow rotating shaft passes down the cylinder and carries blades which may be hollow and perforated so that a further supply of steam may be introduced into the cylinder. Means are provided for introducing the material into the cylinder and for discharging it when cooked.—W. P. S.

Beverages : Process and apparatus for preparing ——, and products produced thereby. J. E. Bloom, Brooklyn, N.Y. U.S. Pat. 1,162,212, Nov. 30, 1915. Date of appl., June 1, 1914.

The beverage is passed at a regulated pressure and temperature through finely divided, insoluble, adsorption material, which is electronegative in acid liquids and electropositive in basic and neutral liquids. During filtration the liquid is kept under insulated conditions and under the influence of an electric field from an alternating current. After filtration also, the further treatment of the liquid is conducted under insulated conditions.—J. H. J.

Flour : Manufacture of ——. C. A. Patterson, Winona, Minn. U.S. Pat. 1,163,168, Dec. 7, 1915. Date of appl., Aug. 3, 1911.

Wheat is wetted and tempered repeatedly for thirty hours to cause moisture to penetrate and whiten the interior substance of the grain, and is also cleaned during the tempering periods. It is then ground into flour without removing the moisture from the internal substance.—J. H. J.

Food products [milk]: Process of desiccating ——. D. J. Hauss, Aurora, Ind. U.S. Pat. 1,163,339, Dec. 7, 1915. Date of appl., Nov. 16, 1911.

Milk is partially evaporated, and while hot is passed through an atomiser with an excess of heated air and delivered into a heated chamber. The temperature in the chamber is sufficient to prevent condensation of the water vapour formed during atomisation. The desiccated milk collects as a powder at the bottom of the chamber, and the air and water vapour pass away through the sides of the chamber at the bottom.—J. H. J.

Beverage extracts; Manufacture of ——. J. L. Kellogg, Battle Creek, Mich. U.S. Pat. 1,163,759, Dec. 14, 1915. Date of appl., Oct. 14, 1911.

See Eng. Pat 2472 of 1915: this J., 1915, 1162.

XIXb.—WATER PURIFICATION; SANITATION.

Water; Liability of —— *to attack reservoirs and mains.* J. Tillmans. Preuss. Verb. beamt. Nahrungsmittelchem., Oct. 3, 1915. Chem.-Zeit., 1915, **39**, 815—816.

The corrosive action of certain waters on iron pipes, reservoirs, etc., is due to the presence of dissolved oxygen and carbon dioxide. There is, however, an equilibrium between bicarbonates and free carbon dioxide, that is, for a definite quantity of bicarbonate a certain amount of free carbon dioxide may be present in the water without causing the latter to corrode metals; corrosion takes place only when this proportion of carbon dioxide is exceeded. Whilst the presence of carbon dioxide is not essential to the process of rusting of iron, this gas, when present, accelerates oxidation of iron; if only free oxygen is present in the water, and no carbon dioxide, localised rusting may take place. When a water containing calcium bicarbonate and free carbon dioxide, in amount not exceeding the above-mentioned equilibrium, is passed through an iron pipe the latter may, at first, be slightly attacked, but owing to the removal, in this way, of a part of the carbon dioxide, calcium carbonate is deposited and forms a coating on the metal, preventing further corrosion. If a larger proportion of free carbon dioxide is present this protective coating is not formed.—W. P. S.

Oxygen [in water]: Determination of —— *by Winkler's method.* G. Bruhns. Chem.-Zeit., 1915, **39**, 845—848.

The author recommends several improvements in Winkler's process for the determination of dissolved oxygen (see this J. 1915, 679). The bottle used should have a capacity of 100—125 c.c. The quantity of the manganous chloride solution used should be 0·5 c.c., and also 0·5 c.c. of the alkali solution which is made up without potassium iodide. These reagents can be conveniently added from dropping bottles, 10 drops being taken as equal to 0·5 c.c. A crystal of potassium iodide is added before acidification. To avoid any liberation of iodine in turning out from the bottle into a flask for titration, 20 c.c. of the clear acidified liquid is withdrawn from the bottle, a little zinc iodide-starch solution added, and titration carried out in the bottle, allowing for the 20 c.c. withdrawn in calculating the result. For titration *N*/10 thiosulphate is used. If dissolved carbon dioxide is present in the water, manganous carbonate is formed, which is not readily oxidised by dissolved oxygen. In this case, after the oxidised precipitate has settled, 1·5 grm. of crystalline potassium bicarbonate is added, and the bottle inverted a dozen times, after which the precipitate settles very rapidly. When nitrites or other substances which would interfere with the titration are present, it is best, after the oxidised precipitate has settled, to insert a tube plugged at the bottom with cotton-wool and withdraw the supernatant liquid by suction, drawing in distilled water afterwards to wash the precipitate if desired. The plug is pushed into the bottle before proceeding with the estimation. The author prefers to return the results as "per 1000 normal," equivalent to the number of c.c. of normal thiosulphate required by a litre of the sample.—J. H. J.

Toxic jaundice: Notification of ——. Statutory Rules and Orders, 1915, No. 1170.

An Order of the Home Secretary, dated November 27, 1915, applies the provisions of Section 73 of the Factory and Workshop Act, 1901 (1 Edw. 7, c. 22), to all cases of toxic jaundice occurring in a factory or workshop: that is, jaundice due to tetrachlorethane or nitro- or amido-derivatives of benzene or other poisonous substance.

This Order came into force on January 1st, 1916.

Rubber gloves for surgeons operating with X-rays. Guinochet. *See* XIV.

Simple test for B. sporogenes in milk and water. Weinzirl. *See* XIXa.

Patents.

Sewage treatment plant. T. J., Assignor to M. C. Belfranci, Oroville, Cal. U.S. Pat. 1,163,058, Dec. 7, 1915. Date of appl., Aug. 3, 1915.

The plant consists of a settling tank, a liquid tank, and a purifying tank in an inclined series and connected by siphons. The tanks are made of material resistant to any acidity which may be produced in the sewage by bacterial action, and are closed by covers cemented on with a friable cement. Each tank is furnished with a sludge outlet at the bottom, closed by a valve, which delivers sludge into a conduit leading to a pump chamber, from which the sludge is forced by a plunger through a pipe opening outside the top of the pump shaft. A vent stack is connected to each tank.—J. H. J.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Cinchona bark: Rapid and exact method of determining alkaloids in ——. F. Lenci. Boll. Chim. Farm., 1915, **54**, 417—422. J. Chem. Soc., 1915, **108**, ii., 850—851.

As a method of estimating the alkaloids in cinchona bark, Hager (Z. anal. Chem., 1869, **8**, 477; 1882, **21**, 415) suggested the precipitation of the alkaloids as picrates and the weighing of the precipitate on a tared filter after drying at 40° C. This precipitation is accompanied by coagulation of the proteins, waxy matter, etc., high results being consequently obtained. The author finds that the following procedure gives good results. To 5 c.c. of a solution of the hydrogen sulphate of the alkaloid is added 50 c.c. of a cold, saturated picric acid solution, the titre of which has been determined by the "nitron" method (compare Busch and Blume, this J., 1908, 298). After half an hour the liquid is filtered, and the residual picric acid in 5 c.c. of the filtrate estimated by precipitation with nitron. Multiplication of the amount of picric acid thus formed by eleven, and subtraction of the product from the picric acid content of the 50 c.c. of precipitant, gives the quantity of the acid which has combined with the amount of alkaloid taken. The results obtained in this way with solutions of various concentrations of the acid sulphates of quinine, cinchonine, cinchonidine, and quinidine show that, in all cases, 2 mols. of picric acid combine with 1 mol. of the alkaloid. These results were controlled by, and found to agree with, estimations of the picric acid in the alkaloid precipitates, the latter being heated with dilute sulphuric acid and the liberated picric acid precipitated by means of nitron. For the various alkaloids, the factors by which the amounts of picric acid in the precipitates must be multiplied in order to arrive at the corresponding quantities of alkaloid are: for quinine and quinidine, 0·7075, and for cinchonine and cinchonidine, 0·6119. For the complex mixture of alkaloids in cinchona bark, the mean factor, 0·6738, gives approximately exact results. The method given in the Italian "Farmacopea Ufficiale" for estimating the alkaloids in cinchona bark, in which the residue of the chloroform extract, after distillation of the solvent, is weighed, gives results which, on the average, are 1·2% in excess of the true values.

Digitalis purpurea: Active principles of ——. E. Berry. Pharm. J., 1915, **95**, 783—788.

Digitalis leaves contain digitoxin, 0·1—0·3%, insoluble in water but soluble in diluted alcohol; digitalein or gitalin, 0·3—0·9%, a glucoside soluble in water; two saponins, 0·6% (*a*) digitonin, amorphous, soluble in water, (*b*) gitin, crystalline, insoluble in water; a fat or resin extracted by ether, which acts as an irritant; a fluorescent body, luteolin or digitoflavone; an active enzyme or oxydase. According to the method of preparation of the tincture or infusion, these substances are present in greater or less proportions and the physiological action is influenced accordingly. Using the heart of the frog, the author has studied the effects of the isolated constituents of the drug separately. Digitoxin has a toxic and cumulative effect on the heart and, as it cannot be washed out, it is possible that it may combine chemically with the heart muscle to form a loose adsorption compound; the ventricle becomes hard and "leathery." Digitonin shows a characteristic saponin action; the heart-beats are accelerated but shortened, and the effect is non-cumulative. Digitalein, when free from saponin and digitoxin, shows a good therapeutic effect, *i.e.*, large slow beats with almost complete recovery. Digitoxin is present in appreciable quantity in hot infusions and boiling-water percolates of the leaves; in full amount in 20% alcoholic tinctures or so-called concentrated infusions; in less amount (but quite toxic) in 60% alcoholic tinctures (B.P.); and in very small quantities in 90% alcoholic preparations. In cold-water infusions digitoxin is present only in traces, although even then its cumulative effect is ultimately observed. When the leaves are previously freed from fat by extraction with ether, the saponins apparently form insoluble combinations with the phytosterols, and the tinctures or infusion prepared subsequently are devoid of the accelerating saponin effect. A preparation made by cold water infusion of defatted leaves is free from saponins, and the traces of digitoxin may be removed by filtration through a kieselguhr "candle": the extract then contains the glucoside digitalein, which possesses a therapeutically desirable action on the heart. To purify this glucoside, the solution, after filtration through the kieselguhr "candle," is concentrated *in vacuo*, freed from colouring matter by precipitation with "dialysed iron," the solution freed from iron by means of ammonia, filtered, evaporated to dryness *in vacuo*, with addition of chalk to prevent hydrolysis, and the residue extracted with a mixture of methyl alcohol and chloroform. The extract is treated with petroleum spirit, filtered through a paper of close texture, centrifuged, again filtered, concentrated *in vacuo*, and allowed to crystallise.
—J. F. B.

Pyridine and isoquinoline bases: Formation of —— *from casein.* A. Pictet. Soc. Chim. Genève, June 3, 1915. Chem.-Zeit., 1915, **39**, 861.

Holding the opinion that many of the plant alkaloids are produced by the condensation of protein decomposition products with the formaldehyde formed in the green parts of the plants, the author carried out the following experiments with casein with the view of confirming the correctness of this hypothesis. Casein was hydrolysed with hydrochloric acid and methylal was added, drop by drop, during the operation; the cooled mixture was then mixed with calcium carbonate, and distilled. The distillate contained primary, secondary, and tertiary bases; the first were removed by means of sodium nitrite, and the tertiary bases by distillation and fractional crystallisation of their picrates. The following bases were isolated and identified:—N-methylpyrrolidine, pyridine, dimethylpyridine, a base (C_7H_9N) which was not identical with any of the known ethyl- or dimethylpyridines, isoquinoline, 4-methylisoquinoline, and a base $C_{11}H_{11}N$ (ethyl- or dimethylisoquinoline). It is possible, therefore, that the pyridine, quinoline, and isoquinoline rings of the alkaloids are thus derived.—W. P. S.

Oil of cassia; Constituents of ——. F. D. Dodge and A. E. Sherndal. J. Ind. Eng. Chem., 1915, **7**, 1055—1056.

From experiments with 600 lb. of cassia oil it is shown that the oil contains at least 0·5% soluble in dilute alkali, consisting of a mixture of about 25% of salicylic aldehyde, 60% of coumarin, 8—10% of cinnamic acid, and small amounts of salicylic acid, benzoic acid, and a volatile liquid acid, not identified. In another experiment with 500 grms. of oil, the presence of about 0·4% of salicylic aldehyde was indicated.—A. S.

Triphenylstibine: Action of antimony trichloride on ——. G. Grüttner and M. Wiernik. Ber., 1915, **48**, 1749—1759.

When triphenylstibine, antimony trichloride, and xylene are heated together for a prolonged period in a sealed tube, the product, after removing xylene and then the excess of antimony trichloride by shaking with 15% hydrochloric acid, consists of a mixture of phenyldichlorostibine and diphenylchlorostibine which cannot be separated by fractional distillation, as the former substance at its boiling point, even under reduced pressure, is gradually decomposed into diphenylchlorostibine and antimony trichloride. The reaction product may be converted by means of magnesium ethyl bromide into the corresponding mixture of diethylphenylstibine and ethyldiphenylstibine (see following abstract) which can then be fractionated at ordinary pressure in a current of carbon dioxide without decomposition. The highest proportion of phenyldichlorostibine (70%) is obtained by heating 30 grms. of triphenylstibine, 40 grms. of antimony trichloride, and 18 c.c. of xylene for 75 hours at 240°—245° C., whilst diphenylchlorostibine is best prepared by heating the distillate obtained by Michaelis' method (Ber., 1911, **44**, 2316) for 4 hours at 200°—210° C. in an atmosphere of carbon dioxide and then removing the antimony trichloride, thereby formed, by shaking with 15% hydrochloric acid.—T. C.

Alkyl-arylstibines: Preparation of mixed ——. G. Grüttner and M. Wiernik. Ber., 1915, **48**, 1759—1764.

Dimethylphenylstibine, obtained by the action of phenyldichlorostibine on ethereal magnesium methyl iodide, forms a colourless, mobile, slightly fuming liquid, b.pt. 112° C. at 16—18 mm., sp.gr. 1·4490 at 20°/4° C., $n_D^{19\cdot5}$ = 1·5983. The corresponding diethylphenylstibine is also a colourless, mobile liquid, fuming strongly in the air, b.pt. 128° C. at 16—18 mm., sp.gr. 1·3187 at 24°/4° C., n_D^{24} = 1·5903. Methyldiphenylstibine and ethyldiphenylstibine prepared similarly from diphenylchlorostibine and methyl or ethyl magnesium bromide, form colourless, rather viscous oils, which do not fume in the air, and have the following constants respectively: b.pt. (16—18 mm.) 172°—180° C. and 190°—192° C., sp.gr. 1·2131 at 20°/4° C. and sp.gr 1·3541 at 19·5°/4° C., n_D^{20} = 1·6021 and $n_D^{20\cdot5}$ = 1·6309. These substances all oxidise very readily in the air at ordinary temperatures, the liquid remaining clear even when oxidation is far advanced. Dimethylphenylstibine gives well-defined, crystalline compounds with methyl and ethyl iodide and also with chlorine, bromine, and iodine. Diethylphenylstibine gives crystalline derivatives with methyl iodide and with iodine only, the chloride and the bromide being colourless oils. Methyldiphenylstibine and ethyldiphenylstibine do not combine with methyl or ethyl iodide but give well-defined crystalline derivatives with chlorine and bromine. —T. C.

symm.-Diantipyrylurea: Derivatives and physiological properties of ——. M. Göttler. Ber., 1915, **48**, 1765—1770.

4-Aminoantipyrine reacts with phosgene in toluene solution to form first antipyrylurea chloride, which then reacts with more 4-aminoantipyrine yielding *symm.*-diantipyrylurea, m.pt. 259°—260° C. Diantipyrylurea has a distinct antipyretic action, as have also the N-aryl derivatives which it yields with primary aromatic amines, but unlike antipyrine itself, these compounds have no antineuralgic action. The condensation product of diantipyrylurea and diethylmalonic acid, N.N'-diantipyrylbarbituric acid, m.pt. 312°—313° C., has neither antipyretic nor hypnotic properties.—T. C.

Nitroglycerin tablets; Stability of ——. W. L. Scoville. J. Ind. Eng. Chem., 1915, **7**, 1054—1055.

Nitroglycerin tablets for medicinal use have a basis of lactose or a mixture of lactose and sucrose, to which the nitroglycerin is added in the form of either a 10—20% alcoholic solution or a 20% paste containing lactose or calcium carbonate. Experiments extending over periods of from six months to four years showed that all tablets prepared with a solution of nitroglycerin, and tablets containing less than 0·01 grain of nitroglycerin made from a paste, lose strength markedly on keeping. It is considered probable that the loss of strength is connected with the existence of two isomeric forms of solid nitroglycerin, one labile and the other stable (Hibbert, this J., 1912, 901; 1915, 984), and that nitroglycerin, which has been slowly frozen and slowly thawed is superior to freshly-prepared nitroglycerin for the preparation of tablets.—A. S.

Acetylsalicylic acid; Researches on ——. *III. Anomalies of the decomposition of acetylsalicylic acid by water.* D. E. Tsakalotos and S. Horsch. Bull. Soc. Chim., 1915, **17**, 401—406.

The curve representing the velocity of the decomposition of acetylsalicylic acid by water at 20°, 50°, and 60° C. has two distinct minima, which occur at the latter temperature, for example, at 88 and 505 mins. from the commencement. This anomaly is probably due to the catalytic action of hydrogen and hydroxyl ions.—G. F. M.

Urea in urine; Determination of —— *by the urease method.* C. H. Fiske. J. Biol. Chem., 1915, **23**, 455—458.

A volume of urine containing 3—6·5 mgrms. of urea-nitrogen is delivered from an Ostwald pipette into a large test-tube and diluted with water to about 3 c.c. Two drops of kerosene and 2 c.c. of urease extract are added, and the tube is closed by a rubber stopper fitted with tubes to enable a current of air to be drawn through the liquid, and left for 15 mins. Through the air inlet tube is then introduced 5 c.c. of a solution made by dissolving 500 grms. of potassium carbonate in 500 c.c. of warm water, adding 10 c.c. of 30% potassium oxalate, filtering, and cooling. A current of air (free from ammonia) is drawn through the liquid slowly for 5 mins. and afterwards rapidly for an hour, and the ammonia is absorbed in 25 c.c. of N/50 hydrochloric acid contained in a narrow-necked bottle of 120 c.c. capacity. The excess of acid is titrated with N/100 sodium hydroxide solution, in presence of 2—3 drops of a 0·05% alcoholic solution of methyl red, until a pink colour appears. The urease was prepared by extracting 25 grms. of powdered soya beans for one hour with 250 c.c. of distilled water, shaking at intervals, adding 25 c.c. of N/10 hydrochloric acid, filtering with suction after five mins., and treating the filtrate with 5 c.c. of a solution of 70 grms. of crystallised disodium phosphate and 27 grms. of monopotassium phosphate in 100 c.c. of water. This extract can usually be kept for 4 weeks at —1° to —2° C. with only slight loss of activity and no marked increase of ammonia-content. The method is accurate to within 0·5% of the amount of urea determined.—J. H. L.

Acetone; Detection of —— *by Frommer's test.* N. O. Engfeldt. Berl. klin. Woch., 1915, **52**, 458—459. J. Chem. Soc., 1915, **108**, ii., 849—850.

Frommer's test depends upon the condensation of acetone with salicylaldehyde in presence of alkali hydroxide to form the red di-*o*-hydroxydistyryl ketone. Ten c.c. of the urine is treated with 1 grm. of solid potassium hydroxide, and, without waiting for the alkali to dissolve, 10 drops of a 10% solution of salicylaldehyde in alcohol are added, and the mixture is heated to 70° C. If acetone is present, a purple-red zone appears at the junction of the two liquids. The test will detect 0·05 mgrm. of acetone in 10 c.c. of water, but the author finds that it may be rendered more sensitive and capable of detecting 0·001 mgrm. of acetone in 10 c.c. when modified as follows. Ten c.c. of the distillate from the urine is mixed with 5 grms. of solid potassium hydroxide and five drops of concentrated salicylaldehyde solution, the test-tube containing the mixture is placed in a water-bath at 50° C., and the water is heated gradually to boiling. As the potassium hydroxide dissolves a crystalline mass is formed which, in the presence of acetone, is coloured bright red. Formaldehyde, acetaldehyde, formic acid, lactic acid, phenols, and alcohol do not give the red coloration, but acetoacetic acid and β-hydroxybutyric acid yield red-coloured compounds in the test. On account of its sensitiveness, the test is not suitable for clinical purposes.

Vanadium; Some new organic compounds of ——. A. T. Mertes and H. Fleck. J. Ind. Eng. Chem., 1915, **7**, 1037—1038.

Organic compounds containing vanadium were prepared by the interaction of vanadium tetrachloride and aniline, dimethylaniline, and phenylhydrazine respectively in benzene solution; of vanadium tetrachloride and toluidine, diphenylamine, and anthracene respectively in carbon tetrachloride solution; by the action of methylamine on vanadium tetrachloride dissolved in gasoline, and by the action of benzene on vanadium tetrachloride. The aniline compound, $4C_6H_5NH_2.VCl_4$, is a black powder, almost insoluble in water. The dimethylaniline compound, $4C_6H_5N(CH_3)_2.VCl_4$, is green, the methylamine compound, $6CH_3NH_2.VCl_4.H_2O$, is yellow, and the diphenylamine compound, $3(C_6H_5)_2NH.2VCl_4$, is indigo blue at first and grass-green after drying. Two compounds appear to be formed with anthracene, *viz.*, $C_{14}H_9.V_2Cl_5$ at the ordinary temperature and $C_{14}H_{10}.2(C_{14}H_9.V_2Cl_5)$ on heating under a reflux condenser. An addition compound is also formed when dry ammonia gas is led into a benzene solution of vanadium tetrachloride. It is almost insoluble in water, which, however, slowly decomposes it. It is decomposed by mineral acids with formation of a bluish-green solution, and when heated in a closed tube yields water and ammonium chloride and a residue (63% V) composed principally of vanadium tetroxide.

Determination of vanadium and chlorine in organic compounds. From 0·5 to 1 grm. of substance is mixed with finely powdered quicklime free from chloride and heated in a combustion tube. The residue is treated with 300 c.c. of water and with nitric acid to dissolve the lime, the mixture filtered, and the solution heated to boiling and the chlorine precipitated as silver chloride. After filtering, the solution is neutralised with ammonia, made slightly acid with acetic acid, and lead vanadate precipitated by adding lead acetate. The lead vanadate, after washing, is dissolved in warm dilute nitric acid, the solution evaporated with 10 c.c. of concentrated sulphuric acid, cooled, diluted, filtered, the filtrate diluted to 300 c.c., and treated with sulphur dioxide gas. The solution is boiled to expel excess of sulphur dioxide, titrated hot with *N*/20 permanganate, then again reduced and re-titrated.—A. S.

Sempervirene. A. E. Stevenson and L. E. Sayre. J. Amer. Pharm. Assoc., 1915, 1458. Pharm J., 1916, 96, 47.

THE authors report further progress in the separation of the alkaloids of gelsemium root, and give details for separating sempervirene from the total alkaloids (see this J., 1915, 216). The crude mixed alkaloids of gelsemium are dissolved in chloroform and extracted with 1% citric acid until practically all the alkaloid is removed from the extraneous material. The acid liquid is made alkaline with ammonia and extracted with chloroform. From this the alkaloid is again extracted by means of 1% hydrochloric acid. Each successive extraction is tested by adding a few drops of saturated sodium nitrate solution, which precipitates the sempervirene. When no further precipitate is formed, the extracts previously obtained are combined and a saturated solution of sodium nitrate added, drop by drop, with stirring, until no further precipitate is produced. This precipitate is sempervirene nitrate, which is quite insoluble in water and practically insoluble in solution containing sodium nitrate. The product can be purified by washing with dilute sodium nitrate solution, followed by distilled water, then dissolving in boiling water, reprecipitating by a few drops of saturated sodium nitrate solution, filtering, washing as before, drying on porous plates, and recrystallising from hot alcohol. It separates in yellow needle-shaped crystals. The free alkaloid is prepared by dissolving in hot water, making the solution alkaline with ammonia, shaking out with chloroform, distilling off the solvent, and cooling the residue. The alkaloid crystallises in reddish-brown needles. It is somewhat soluble in alcohol, very slightly soluble in water, almost insoluble in ether, benzol, and petroleum spirit. The percentage of sempervirene in gelsemium is small—about 0·8 grm. was obtained from 25 grms. of alkaloidal material, which represented the alkaloids from 25 lb. of the drug.

Chemical constituents of bituminous shale oils containing sulphur (ichthyol oils). Scheibler. *See* IIA.

Sulphur-containing oil from the Kimmeridge shale of Saint-Champ. Demesse and Réauborg. *See* IIA.

PATENTS.

Urea; Manufacture of —— and of ammonium carbonate for use in such manufacture. J. Y. Johnson, London. From Badische Anilin u. Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 23,939, Dec. 11, 1914.

AMMONIUM carbonate may be manufactured by the direct combination of ammonia and carbon dioxide in suitable proportions under pressure, with or without cooling. If the temperature is maintained at 130°—140° C., urea is formed. *Example.*—An autoclave lined with lead or silver is filled with gaseous ammonia under pressure. Sufficient carbon dioxide is then introduced to produce ammonium carbonate, which solidifies if the vessel is allowed to cool. To produce urea, the vessel is only cooled sufficiently to keep the pressure below 50 atm. during the first reaction, and the temperature is subsequently maintained at 130°—140° C. until no more urea is formed. —F. SP.

Acetic ester [ethyl acetate] from acetaldehyde; Manufacture of ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. Eng. Pat. 1288, Jan. 26, 1915.

ETHYL acetate is prepared by treating acetaldehyde with a filtered solution of aluminium ethoxide in an organic solvent of high boiling point, *e.g.*, nitrobenzene, xylene, solvent naphtha, etc., at 0°—15° C. A yield of 86% of the theoretical amount may be obtained, with a consumption of about 5% of aluminium ethoxide. *Example.*—400 parts of acetaldehyde is gradually stirred into a filtered solution of 16—20 parts of crude aluminium ethoxide in 45 parts of dry solvent naphtha, the mixture being kept at 0°—15° C. by thorough cooling. After standing for about 24 hours it is fractionally distilled. The first fraction contains aldehyde and may be used again. The next fraction consists of almost pure ethyl acetate, the yield being about 85%. The solvent naphtha is recovered from the residue by steam distillation.—F. SP.

Silver glycocholate; Compound of —— readily soluble in water and process of making same. K. Kautzsch, Assignor to Farbwerke vorm. Meister, Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,161,867, Nov. 30, 1915. Date of appl., Jan. 30, 1915.

SILVER glycocholate is treated with a solution of hexamethylenetetramine to obtain hexamethylenetetramine-silver glycocholate as a colourless compound. It is soluble in water, 90% alcohol, and methyl alcohol, but is nearly insoluble in petroleum spirit. On treating its aqueous solution with hydrochloric acid it is decomposed, yielding hexamethylenetetramine hydrochloride and a precipitate of silver chloride mixed with sparingly soluble glycocholic acid. (See also this J., 1915, 1166.)—C. A. M.

Bismethylaminotetra-aminoarsenobenzene; Preparation of a ——. C. F. Boehringer und Söhne. Ger. Pats. (A) 286,667, Oct. 15, 1912, and (B) 286,668, Jan. 14, 1913. Additions to Ger. Pat. 285,572.

(A) For the reduction of dinitromethylnitraminophenylarsinic acid to bismethylaminotetra-aminoarsenobenzene, the tin and hydrochloric acid prescribed in the chief patent (see U.S. Pat. 1,081,079 of 1913; this J., 1914, 41) may be replaced by other heavy metals or salts of heavy metals in presence of acid. Suitable reducing agents are stannous chloride with hydrochloric or hydrochloric and acetic acids, zinc with strong hydrochloric acid or acetic acid, and iron with hydrochloric acid. To avoid formation of arsine, the reaction mixture is heated only until a clear solution is obtained. (B) Reduction of the dinitromethylnitraminophenylarsinic acid is effected in stages by means of different reducing agents. For example, reduction to 4-methylamino-3.5-dinitrobenzene-1-arsinic acid is effected by means of mercury and sulphuric acid, and this is reduced to bismethylaminotetra-aminoarsenobenzene by means of sodium hydrosulphite; or bismethylhydrazinotetra-aminoarsenobenzene is first formed (see Ger. Pat. 285,573; this J., 1915, 1165), and is afterwards reduced further; or reduction to bismethylaminotetranitroarsenobenzene is effected by means of phosphorous or hypophosphorous acid, and this subsequently reduced to the tetra-amino compound with tin and hydrochloric acid.—A. S.

Hexa-aminoarsenobenzene: Preparation of a ——. C. F. Boehringer und Söhne. Ger. Pats. (A) 286,854, Mar. 5, 1913, and (B) 286,855, Aug. 30, 1913.

(A) 4-Amino-3.5-dinitrobenzene-1-arsinic acid is reduced with the calculated amount of sodium hydrosulphite to the corresponding triamino-compound, and this is then further reduced with hypophosphorous acid to 3.4.5.3′.4′.5′-hexa-aminoarsenobenzene; or the dinitroarsanilic acid may be reduced first with hypophosphorous acid to the corresponding nitro-arsenobenzene, which can be easily further reduced to the hexa-amino-compound. Both 3·4·5-triaminobenzenearsinic acid and hexa-aminoarsenobenzene are characterised by comparatively slight toxicity, and the latter has valuable therapeutic properties on account of its powerful spirillocidal action. (B) 4-Amino-3.5-dinitrobenzenearsinic acid is reduced directly with a quantity of sodium hydrosulphite sufficient to reduce both the nitro-groups and the arsinic acid residue, and the resulting sulphur-containing compound is decomposed with acids into sulphur dioxide and a salt of hexa-aminoarsenobenzene.
—G. F. M.

2-Chloro-4-aminobenzene-1-arsinic acids: Art of preparing ——. L. Ach, Mannheim-Waldhof, and A. Rothmann, Heidelberg, Assignors to Farbwerke vorm. Meister, Lucius, und Brüning, Hochst, Germany. U.S. Pat. 1,156,015, Oct. 12, 1915. Date of appl., Jan 26, 1914.

See Ger. Pat. 286,546 of 1913; this J., 1915, 1165. Other derivatives of *m*-chloroaniline than the dimethyl derivative may be used, viz., those of the general formula, $ClC_6H_4NR_1R_2$, where R_1 represents alkyl and R_2 alkyl or hydrogen.

Hydroxyisopropyl derivatives of hydrocarbons: Preparation of ——. Farbenfabr. vorm F. Bayer und Co. Ger. Pat. 286,920, Nov. 29, 1913. Addition to Ger. Pat. 280,226 (this J., 1915, 378).

Instead of acting on hydrocarbons with acetone-sodium, as claimed in the main patent, the acetone-alkali is allowed to act in the more reactive nascent form by treating the hydrocarbon with acetone in presence of an alkali metal or alkali amide. Acetylene gives 3-methylbutinol by this method.
—F. W. A

Infectious diseases: Preparation of protective and curative medicaments for ——. Farbenfabr. vorm. F. Bayer und Co. Ger Pat. 286,977, June 6, 1913.

Bacteria, protozoa, or virus species are extracted with aqueous solutions of complex organic mercury compounds in which the mercury is directly united with carbon, such as the mercury-carboxylic acids and -phenols. These compounds do not precipitate albumin, but are fatal to bacteria and protozoa, so that the killing and extraction are accomplished in one operation, without injuring the constituents of the bacteria or protozoa acting as antigens.—G. F. M.

α-Bromoisovaleramide derivative: Preparation of a ——. Knoll und Co. Ger. Pat. 287,017, July 2, 1914.

α-Bromoisovaleramide reacts with oxalyl chloride according to the equation:

$$2(CH_3)_2CH\cdot CHBr\cdot CONH_2 + C_2O_2Cl_2 =$$
$$[(CH_3)_2CH\cdot CHBr\cdot CO\cdot NH]_2CO + 2HCl + CO.$$

The derivative produced possesses sedative and hypnotic properties, and also serves as the starting point for the preparation of α-bromoisovalerylurea.—G. F.M.

Glycyrrhizic acid: Preparation of derivatives of ——. J. D. Riedel Akt.-Ges. Ger. Pat. 287,126, Nov. 9, 1913.

Glycyrrhizic acid is converted into its salts with the heavy metals, with the exception of lead, by the usual methods. Some of these compounds are soluble in dilute alkalis, and have the property of wetting oily surfaces, which is valuable from the point of view of their disinfectant action. Thus the silver and mercury salts are useful for treating intestinal infection, etc., the copper salt for tubercular affections, and the iron salt as a soluble intestinal iron preparation.—G. F. M.

2-Arylquinoline-4-carboxylic acids: Preparation of derivatives of —— easily soluble in water. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 287,216, Dec. 25, 1913.

The following quinoline derivatives can be converted into soluble compounds by treatment with a warm aqueous solution of sodium formaldehyde-sulphoxylate, acidifying the resulting solution, dissolving the precipitate in dilute sodium hydroxide solution and re-precipitating, and finally precipitating the mono-sodium salt from aqueous solution by the addition of alcohol: 2.2′-aminophenylquinoline-4-carboxylic acid, 2.3′-amino- and 2.4′-aminophenylquinoline-4-carboxylic acids, 6-methyl-2.3′-aminophenylquinoline-4-carboxylic acid, and 6-amino-2-phenylquinoline-4-carboxylic acid.—G. F. M.

Ethylene from acetylene: Preparation of ——. W. Traube, Berlin. Ger. Pat. 287,565, Aug. 6, 1913.

Acetylene is converted into ethylene with the aid of chromous compounds in acid solution; the chromous salts are readily regenerated from the chromic salts so obtained by reduction with zinc or by electrolytic reduction.—F. W. A.

Acetaldehyde [from acetylene]; Manufacture of ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. Eng. Pat. 24,153, Dec. 16, 1914.

See U.S. Pats. 1,151,928 and 1,151,929; this J., 1915, 1031.

[Hexa-]amino-arsenobenzenes: Art of preparing ——. L. Ach, Mannheim, and A. Rothmann, Heidelberg, Assignors to Farbwerke vorm. Meister, Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,156,014, Oct. 12, 1915. Date of appl., Mar. 24, 1913.

See Eng. Pat. 7188 of 1913; this J., 1914, 41.

Manufacture of spirit-soluble asphaltic substances [from wood tar]. Ger. Pat. 286,650. *See* III.

Preparation of condensation products of o-aldehydophenylglycine-oxime and its derivatives substituted in the carboxyl group. Ger. Pat. 286,762. *See* III.

Preparation of dyestuffs containing selenium or tellurium. Ger. Pat. 287,020. *See* IV.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic plates ; Resolving power of ——. O. Tugman. Phot. J., 1915, **55**, 292—302.

The resolving power of a photographic plate may be defined as the power to reproduce closely adjacent objects. Mees determined the comparative resolving powers of photographic plates by photographing the reduced image of a fan-shaped object having alternate black and white sectors. He also photographed the reduced image of a black and white line grating and of a slit covered with a black wedge, and deduced that resolution depends on irradiation, caused by reflecting and refracting scatter. Scheiner and Mees both showed that the increase of size of an image varies with the log. of the exposure. Goldberg made contact prints through conical holes in a metal plate and plotted exposures against increase in diameter. The slope of the curve at any point he called the "turbidity factor," δ, and defined this as $\frac{d\,x}{d\,log\,I}$, where x is the distance from the edge of the disc and I the intensity of the light at that point. These two definitions are not consistent, as $\frac{d\,x}{d\,log\,I}$ is dependent only on light distribution, while δ, as obtained from his curves, is dependent also on development. The conditions given by the use of a circular hole, although similar to those of star photography, are not quite the same as in line work, and there is the possibility of interference by reflection from the sides of the hole. In the author's experiments a straight edge in contact with the plate was used, as suggested by Nutting; it was obtained by cutting a secant strip from a nickel cylinder and carefully grinding the edges. The edge was placed on a strip of plate which was then exposed in a parallel beam of monochromatic light. The plate was cut in two across the straight edge and the two halves separately developed. The density gradient of the edge of the image thus obtained (*i.e.*, the part formed not by direct illumination but by irradiation) is dependent on the light distribution and on the photographic qualities of the plate, and was taken as a measure of the resolving power. The first measurements of this gradient were made by means of a Koch micro-photometer in which a silvered quartz fibre, suspended between two metal plates having a difference of potential of 200 volts, is controlled by two photoelectric cells both receiving light from the same light source through a microscope. A photograph is taken of the movement of the quartz fibre as the graded density is passed across the beam of light thrown on one of the cells. A number of measurements were made with this apparatus and some of the results obtained are given, but the number and uncertainty of the necessary corrections led to the use instead of an adaptation of a König-Martens polarisation photometer, a microscope being used to throw the two images to be compared on to the opal glass front of the polarising tube. Most of the objections to the Koch instrument were avoided, but it was still not possible to measure densities of more than 1·5, owing apparently to scattered light in the microscope system. Distances (x) in microns were plotted against densities. A few of the curves obtained are shown. With normal exposures the same slope was obtained for both short (2 mins.) and long (5 mins.) development; with over-exposures longer development gave a steeper curve. Violet light gave a steeper gradient than green light. Cross-sections of the film were also examined showing the grain distribution both through the thickness of the film and across the edge of the image. It is suggested that the light distribution due to Irradiation from the edge of the image is given by the equation $I = I_0 (e^{-k(x+y)})$ where I_0 is the initial intensity, and I the intensity at a point at depth x and lateral distance y.—B. V. S.

Photographic developing baths ; Chemical study of ——. R. Namias. L'Ind. Chim., Min., e Met., 1915, **2**, 462—464.

The experiments were made mostly with a bath containing 6 grms. of quinol, 1 grm. of metol, 40 grms. of crystallised sodium sulphite, 20 grms. of anhydrous sodium carbonate, and 2 grms. of potassium bromide per litre. Comparison of the fresh developer with that in which six and twelve plates (12 × 16 cm.) respectively had been developed, showed that the most important change was a considerable increase in the content of bromide, whereas the reducing power and the content of sulphite and of carbonate were diminished only to a slight extent. For example, after twelve plates had been developed, the bath still retained three-quarters of its original reducing power. A developer which has been used may be made ready for use again by mixing it with an equal quantity of fresh developer without bromide, restoring the original alkalinity by addition of a concentrated solution of potassium carbonate, and adding crystallised sodium sulphite in the proportion of 1 grm. per 200 c.c. for every six plates developed. The developer should be preserved out of contact with air, and if the container is not full, the air above the liquid should be displaced by a non-oxidising gas, such as coal gas. A method of utilising old developers which is recommended consists in developing first in a fresh bath until the image appears and then completing the development in a bath which has been used previously; or the old developer may be used for both the first and second baths, if a small quantity of caustic soda be added to the first bath to counteract the retarding action of the excess of bromide.—A. S.

XXII.—EXPLOSIVES ; MATCHES.

Nitrotoluene still ; Explosion of a ——. Board of Trade, Marine Dept., Dec., 1915.

This report deals with the failure of a nitrotoluene still at a chemical works in Yorkshire. The body of the still was 5 ft. diameter by 10 ft. long, and made of $\frac{3}{8}$-in. mild steel plate. An essential detail was a solid drawn steel coil of 3-in. pipe reduced to 2 in. where the ends passed through the front plate; there they were secured by back nuts, one on each side of the plate. The coil was braced and supported inside to prevent sagging and to obviate risk of undue stress on the connections. The explosion was due to the fracture of the coil pipe circumferentially at the back of one of the inside nuts. Steam thereby entered the still proper and blew out part of the mountings, including the clearing door. Subsequent examination showed a thinning by corrosion of the wall of the 2-in. connection on the steam inlet side. The coil, which had been tested to 500 lb. hydraulic pressure when it was supplied about six years ago, was working under steam from a boiler fitted with safety valves loaded to 250 lb. per square inch. The pressure on it at the time the accident occurred was probably about 220 lb. There was no relief valve on the still, which has since been repaired and is now fitted with one. Attention is directed to the fact that a coil might sustain successfully a considerable pressure and yet fracture by nipping where it was screwed for securing to the end plate unless it was adequately supported, or if it was free to vibrate.

Utilisation of aromatic hydrocarbons from cracked petroleum [for the preparation of trinitrotoluene]. Rittman. *See* III.

Patents.

Fuzes for projectiles. R. H. S. Bacon and J. H. Mansell, Coventry. Eng. Pat. 24,305, Dec. 18, 1914.

The fuze contains two charges of high explosive, one larger than the other. The second, larger charge is divided into two portions one of which, nearer to the first charge, consists of loose explosive, whilst the other is composed of compressed explosive.—C. A. M.

Explosives. C. G. Redfern, London. From Dinamite Nobel Soc. Anon., Genoa, Italy. Eng. Pat. 24,352, Dec. 19, 1914.

The explosives are composed of aromatic nitro-compounds containing in their molecule both the picric acid and nitroglycerol groups. Such compounds may be obtained by nitrating phenyl esters of glycerol or esters of other phenols with glycerol or other polyhydric alcohol. The explosives are much more stable than those containing free picric acid.—C. A. M.

Explosive powder; Process of and apparatus for forming —— into spherical grains. E. du Pont, Assignor to Ball Grain Explosives Co., Wilmington, Del. U.S. Pat. 1,162,757, Dec. 7, 1915. Date of appl., July 31, 1915.

A pasty mass of the explosive is divided into separate particles, which may be cylindrical in form. These are dried superficially and then simultaneously heated and agitated, *e.g.*, by rolling on a heated surface.—C. A. M.

Explosives; Manufacture of ——. A. T. Cocking, Assignor to Kynoch, Ltd., Birmingham. U.S. Pat. 1,164,170, Dec. 14, 1915. Date of appl., Dec. 9, 1912.

See Eng. Pat. 28,178 of 1911; this J., 1913, 111.

Matches. Bryant and May, Ltd., London. From The Diamond Match Co., New York. Eng. Pat. 3761, Mar. 9, 1915.

See U.S. Pat. 1,150,857 of 1915; this J., 1915, 1031.

XXIII.—ANALYSIS.

Copper and iron in pig lead, lead oxides, and lead carbonate; Colorimetric determination of ——. B. S. White. J. Ind. Eng. Chem., 1915, 7, 1035—1036.

For pig lead, litharge, and lead carbonate, the finely-divided sample (30 grms. in the case of refined and 10 grms. for crude products) is dissolved in hot nitric acid (1 : 1) and treated with 32 c.c. of sulphuric acid (1 : 1). The lead sulphate s washed with warm water by decantation and on the filter, and the iron precipitated with ammonia. The solution is then neutralised with hydrochloric acid and two drops in excess added, the copper is precipitated with six drops of potassium ferrocyanide solution (1 : 10), and the precipitate collected on a double close-texture filter and dissolved, without washing, by alternate treatment with ammonia solution and hot water. The solution (30—40 c.c.) is made slightly acid with hydrochloric acid, diluted to 100 c.c., and the colour matched by adding a standard copper sulphate solution (1 c.c.=0·0001 grm. Cu) to a mixture of 10 c.c. of dilute ammonium chloride solution, 90 c.c. of water, and two drops of concentrated hydrochloric acid (Carnelly, Sutton's "Volumetric Analysis," p. 201). In the case of red lead, 30 grms. is treated with 40 c.c. of nitric acid (1 : 1), and the lead peroxide dissolved by boiling with 30-40 c.c. of 3% hydrogen peroxide or by adding small portions of sodium sulphite and boiling after each addition. The determination is then completed as described. The iron precipitate is dissolved in hydrochloric acid, the solution diluted to 300 c.c., and 10 c.c. treated with 3 drops of nitric acid and 10 c.c. of ammonium thiocyanate solution (1 : 15), diluted to 100 c.c., and the colour compared with that of a standard ferric ammonium sulphate solution (prepared from ferrous ammonium sulphate by oxidation with permanganate) treated in a similar manner (Schaeffer, J. Ind. Eng. Chem., 1912, 4, 659). If much zinc be present, it should be removed by treating the filtrate from the ferric hydroxide with acetic acid and sodium ammonium phosphate (5 c.c. of an 8% solution) before precipitating the copper.—A. S.

Mercury salts; Determination of small quantities of —— in very dilute solutions. W. Böttger. Deutsch. Bunsen-Ges., Berlin, Oct. 1915. Chem.-Zeit., 1915, 39, 817.

The author has worked out a gravimetric method based on the separation of mercury diphenylcarbazone by electrolytes in presence of hydrocarbons. The mercury solution is treated with an alcoholic solution of diphenylcarbazide, and petroleum spirit and aluminium sulphate (as electrolyte) are added; mercury diphenylcarbazone is precipitated as a film at the junction of the two liquid layers. It is collected on a small asbestos filter, decomposed by the Carius method in a small sealed tube, and the mercury recovered from the residue by electrolytic deposition on a weighed gold wire. It was found by this method that a solution of calomel saturated at 16°—17° C. contains 1·5 mgrms. Hg per litre. The mercury diphenylcarbazone has a bluish-violet colour, and a spectral-photometric method for its colorimetri determination has been devised in which th light of the mercury arc ($\mu\mu=546$) is used Details of the method are given in a dissertation b R. Heinze.—J. H. L.

Albumin; Diazo-reaction of ——. [Azo dyestuff from histidine and tyrosine]. H. Pauly. Z. physiol. Chem., 1915, 94, 284—290.

The azo dyestuffs obtained by combining histidin or tyrosine with diazobenzenesulphonic acid a fairly readily soluble in water and cannot b obtained pure, whilst the corresponding dyestuf with diazobenzenearsinic acid (diazotised atoxy are only sparingly soluble and are readily obtaine pure. The latter compounds contain 1 mol. histidine or tyrosine combined with 2 mols. of th diazo compound, the azo groups being probab directly attached to carbon atoms as shown by th formulæ, $C_6H_7O_2N_3(N:N.C_6H_4.AsO_3H_2)_2$ ar $C_9H_9O_3N(N:N.C_6H_4.AsO_3H_2)_2,2H_2O$ respectivel They form light-brown, microcrystalline powde sparingly soluble in water and insoluble in orga solvents, but soluble in alkalis and in dilute hydr chloric acid. The tyrosine colour dyes silk golden yellow shade from an acid bath, whilst t histidine colour gives a dull yellow shade with strong reddish cast.—T. C.

Determination of nitrogen in coal and coke. Simmersbach and Sommer. *See* IIa.

Wood alcohol as a denaturant. [Determination of acetone content.] *See* III.

Rapid volumetric determination of combined alumina and basic alumina or free acid in aluminium salts. Scott. *See* VII.

Practical methods for the determination of radium. II. The emanation method. Lind. *See* VII.

Test of Portland cement for time of setting. Hattori. *See* IX.

Reactions of colloidal gold. Zsigmondy. *See* X.

Metallic calcium and its use in gas analysis. Sieverts. *See* X.

Detection of phytosterol in animal fats. Kühn and others. *See* XII.

Determination of soluble and insoluble fatty acids. Smith. *See* XII.

Determination of nitrogen in leather waste. Rose. *See* XV.

Double polarisation process of sucrose determination applied to cane products, and the variation of the constant. Pellet. *See* XVII.

Detection of citric acid in wine. Baier and Neumann. *See* XVIII.

Simple test for B. sporogenes in milk and water. Weinzirl. *See* XIXA.

New method of determining shell in ground cocoa. Wasicky and Wimmer. *See* XIXA.

Detection and determination of added cocoa-shell in cocoa. Grosse. *See* XIXA.

Alcohol-soluble and ether-soluble solids in ginger extract. Harrison and Sullivan. *See* XIXA.

Determination of oxygen [*in water*] *by Winkler's method.* Bruhns. *See* XIXB.

Determination of alkaloids in cinchona bark. Lenci. *See* XX.

Determination of urea in urine by the urease method. Fiske. *See* XX.

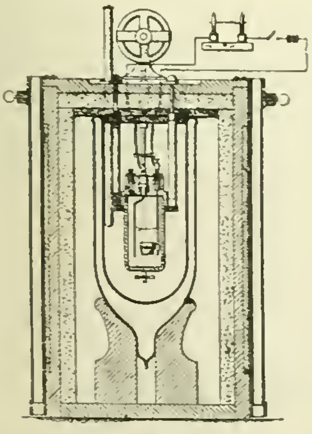
Detection of acetone by Frommer's test. Engfeldt. *See* XX.

Some new organic compounds of vanadium. [*Determination of vanadium and chlorine in organic compounds.*] Mertes and Fleck. *See* XX.

PATENTS.

Bomb-calorimeter. J. A. Riche, Woodhaven, N.Y. U.S. Pat. 1,163,367, Dec. 7, 1915. Date of appl., June 2, 1914.

THE bomb (see fig.) is suspended, in a closed Dewar cup, upon a ring support attached to vertical arms extending through the cover. The cup is enclosed in a heat-insulated vessel, and adjustable means are provided for holding the cover in raised position relative to the cup.



—W. E. F. P.

Testing liquids and other materials: Method and apparatus for ——. B. and E. Sági, Budapest. U.S. Pat. 1,163,693, Dec. 14, 1915. Date of appl., June 30, 1913.

SEE Ger. Pat. 268,897 of 1913; this J., 1914, 223.

Trade Report.

Army recruitment. Reserved occupations.

THE following list is supplementary to those published in this Journal, 1915, pages 1275 and 1276:—*Turpentine and white spirits distillation:* Foremen, stillmen. *Gypsum industry:* Foremen, miners and quarrymen, millers, furnacemen. *Printing ink manufacture:* Foremen, varnish makers, head oil boilers, head oil refiners, head ink grinders, head printers' roller makers. *Animal charcoal industry:* Foremen, grease extractors, retort men, mill men. *Gold refineries:* All classes of workpeople. *Assay offices:* Drawers and markers.

Prohibited exports: Switzerland. Board of Trade J., Jan. 13, 1916.

A DECREE of the Swiss Federal Council, dated the 30th December, 1915, prohibits the exportation of the following articles from Switzerland, as from the 3rd January, 1916:—Asbestos, mica, and micanite in sheets, even if combined with tissues, and in pipes and other specially shaped articles, even if combined with other materials. Asphalt and bitumens of all kinds, crude. Coal tar colours —artificial alizarin, aniline colours, anthracene colours, naphthalene colours, and other coal tar colours and mixtures thereof—even if prepared. Indigo, natural and artificial; indigo solution. Colouring materials and colours—all others, in so far as their exportation from Switzerland is not already prohibited. Various kinds of paper and cardboard, including coated papers and photographic paper not sensitised. Receptacles of ordinary black, brown, or green glass, for the transport of acids, even enclosed in or encircled by sheet iron—of a capacity of 25 litres or more. Wine lees, dry.

Books Received.

PROHIBITIONS OF EXPORT IN FORCE IN BRITISH INDIA, THE SELF-GOVERNING DOMINIONS, EGYPT, AND CERTAIN OTHER BRITISH POSSESSIONS. Supplement to the Board of Trade Journal, Jan. 13, 1916. Price 3d.

MINES AND QUARRIES. GENERAL REPORT, WITH STATISTICS, FOR 1914, BY THE CHIEF INSPECTOR OF MINES. PART II.—LABOUR. [Cd. 8135.] Wyman and Sons, Fetter Lane, E.C. Price 5½d.

THE publication contains a general report and statistics relating to persons employed and accidents at mines and quarries in the United Kingdom, and to the enforcement of the Mines and Quarries Acts.

MINES AND QUARRIES: GENERAL REPORT, WITH STATISTICS, FOR 1914, BY THE CHIEF INSPECTOR OF MINES. PART III.—OUTPUT. [Cd. 8141.] Wyman and Sons, Fetter Lane, E.C. Price 2½d.

THIS Return contains statistics of the quantity and value of various minerals raised in the United Kingdom. The value of the mineral output of the United Kingdom in 1914 was £145,863,032, a decrease of £14,249,575 as compared with 1913. (See pages 122, 123.)

Metallurgical Smoke. By C. H. Fulton. U.S. Bureau of Mines, Bulletin 84. 94 pages, 9½ × 6 in.

A general account is given of the smoke problem from its chemical and legal aspects, and the methods proposed for the treatment of flue dust and fumes and the recovery of useful constituents are described briefly.

Report of the Division of Chemistry. Canada Department of Agriculture. By F. T. Shutt. 48 pp.

Lime in Agriculture. By F. T. Shutt. Bull. 80, Dept. of Agriculture, Canada. 16 pages.

Potash in Agriculture. By F. T. Shutt. Circular No. 7, Dept. of Agriculture, Canada. 8 pages.

Manures and Fertilisers. By F. T. Shutt. Circular No. 8, Dept. of Agriculture, Canada. 8 pages.

Electrothermic Iron Ore Smelting in Sweden. By Dr. A. Stansfield. Report No. 344. Canada Dept. of Mines, Mines Branch, Ottawa. vi. + 65 pages, 10 × 6¾ in.*

This report contains an account of electric iron smelting industries in Sweden, comparing it with Canadian practice. A full description of the Elektrometall, Helfenstein, and Rennerfelt furnaces is given, with a discussion of their efficiencies and operating costs. Detailed accounts are appended of the electric smelting plants at Domnarfvet, Hagfors, Trollhättan, and Notodden.

Southall's Materia Medica. Eighth Edition. Revised and Enlarged by E. W. Mann. J. and A. Churchill, 7, Great Marlborough Street, London, W. xx + 390 pages. 8½ × 5½ in. Price 7s. 6d.

The present edition of this well-known book has been brought up-to-date with the British Pharmacopœia of 1914, and revised throughout. It commences with a list of the more important medicine-yielding plants classified under natural orders. The main portion of the text is divided into three sections, of which the first deals with organised drugs of vegetable origin (subdivided as phanerogamous and cryptogamous), the second with unorganised drugs of vegetable origin, and the third with drugs of animal origin. A brief appendix on the constitution of the alkaloids, a useful glossary of botanical terms commonly used in describing vegetable materia medica, and a comprehensive index, complete the work.

Perfumery and Essential Oil Record Year Book and Diary for 1916. Edited by J. C. Umney. G. Street and Co., Ltd., 8, Serle Street, London, W.C. Price 2s. 6d.

The literary portion of this Year Book consists of 44 pages, and contains a review of work on essential oils, perfumery, and allied products in 1915, together with a large amount of information as to the characters and analysis of essential oils. The diary consists of about 30 pages, 10½ × 7½ in., interleaved with blotting paper. The advertisements occupy well over 100 pages.

An Introduction to the Physics and Chemistry of Colloids. Second Edition. By Emil Hatschek. J. and A. Churchill, 7, Great Marlborough Street, London, W. ix. + 105 pages. 7½ × 5 in. Price 3s.

The second edition of this eminently useful little book does not differ materially from the first edition, published in 1913, save for the addition of a chapter on experimental technique, which will be welcomed by those who desire to learn something of the methods and apparatus used in the study of colloids. The inclusion of a bibliography or some references to the literature of the subject would have been useful.

A Textbook of Inorganic Chemistry. Edited by J. Newton Friend. Vol. VIII. The Halogens and their Allies. By Geoffrey Martin and E. A. Dancaster. Charles Griffin and Co., Ltd., Exeter Street, London, W.C. xviii. + 337 pages. 9 × 6 in. Price 10s. 6d.

The complete work, of which this volume is a part, is to be published in nine volumes, each dealing with a specific group of the periodic table. The present volume is concerned with the seventh group, namely, the halogens and manganese. Chapter I. is of an introductory nature, and deals with the members of the group as a whole. Chapters II., III., IV., and V. are devoted to fluorine, chlorine, bromine, and iodine respectively, and their compounds with hydrogen and oxygen. The salts of the halogen acids are considered in other volumes. Chapter VI. deals with manganese and its compounds with the various elements, and includes the manganates and permanganates.

Report on the Non-Metallic Minerals used in the Canadian Manufacturing Industries. By H. Frechette. Canada Dept. of Mines, Mines Branch, Report No. 305. viii. + 199 pages, 9¾ × 5½ in.*

The following minerals are dealt with :—Asbestos, barytes, calcium and magnesium carbonates, chromite, clays, corundum and emery, cryolite, felspar, fluorspar, fullers' earth, garnet, graphite, gypsum, iron oxides, mica and mica schist, phosphates, peat, pebbles, pumice, pyrites, pyrolusite, quartz and sand, rottenstone, salt, shale and slate, sulphur, talc, tripolite, volcanic ash, and witherite.

Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1911 to 1913. By A. C. Fieldner, H. J. Smith, A. H. Fay, and S. Sanford. U.S. Bureau of Mines, Bulletin 85. x. + 444 pages, 9 × 5¾ in.

Preliminary Report on the Bituminous Sands of Northern Alberta. By S. C. Ells. Canada Department of Mines, Mines Branch, Report No. 281. iv. + 92 pages, 9¾ × 5½ in.*

The bituminous sands of Alberta outcrop at a number of points along the Athabasca river and its tributaries, north and south of McMurray. Many of these outcrops should prove of commercial value, but a very large proportion is considered to have no importance at present. The volume contains forty photographs.

Annual Report of the Mineral Production of Canada during 1913. By J. McLeish. Canada Dept. of Mines, Mines Branch, Report No. 320. 363 pages, 9¾ × 5½ in.*

A detailed report of the mineral production in 1913, abstracts from which have been given in this Journal for 1914, pp. 424, 834.

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* A limited supply of the publications marked * is available for free distribution.

Journal of the Society of Chemical Industry.

No. 3, Vol. XXXV. FEBRUARY 15, 1916. No. 3, Vol. XXXV.

Official Notice.

PROPOSED FORMATION OF AN INSTITUTION OF CHEMICAL ENGINEERS.

In the course of a letter on the proposed formation of an Institution of Chemical Engineers, addressed to the Editor of the Chemical Trade Journal, and published in the issue of January 22nd last, the President of the Society, Dr. Charles Carpenter, writes :—

The starting base of all engineers is mechanical engineering: the application of common sense to the preparation and disposition of the raw materials of nature in the service of man. When these principles have been mastered, their application to various industries is a comparatively simple matter of specialisation. For instance, the generation of water vapour in closed vessels under pressure is an operation with which the engineer becomes familiar through the universally adopted steam boiler, and the precautions necessary, and the dangers to be avoided in working, are elementary to him. The haystack boiler of the days of Boulton and Watt produced steam the flow of which could be easily controlled by a cast-iron valve jointed on the boiler by a cement of iron borings and sal ammoniac. The superheated steam of to-day could not be used with such an appliance, and the engineer has therefore substituted another metal for cast iron, and instead of cement relies on mechanical contact for soundness in connecting the various component parts of his apparatus.

He has adapted himself to the altered conditions. The early steam engines were worked at a pressure of but a few pounds above the atmosphere. The pressure in the case of a modern oil engine may run up to as much as one thousand pounds per square inch, but the engineer has successfully dealt with the problems involved thereby. Instances might be multiplied, but those given will suffice. The engineer did not become either a "steam" engineer or an "oil" engineer in working out these revolutionary changes; he remained a mechanical engineer, specialising in the principles underlying the use of high-temperature steam in the one instance, and in the other of pressures reaching the explosive point.

Now, these are problems similar in character to some of those of which the chemical industry of to-day requires solution, and it is certain that if they are handed over to the mechanical engineer he will solve them successfully, provided he is made familiar with the conditions within which he must work.

Is, then, an Institution of Chemical Engineers necessary to the promotion of that branch of engineering knowledge, the importance of which cannot be minimised at the present crisis? I think not. I believe on the contrary that to shut up chemical engineers in a water-tight compartment by themselves would be a positive disadvantage.

I have endeavoured to show that they are, first and foremost, practitioners of mechanical engineering, and I would suggest that to the Institution representative of that branch of knowledge they should affiliate themselves as a matter of course. There remains the question of their specialisation. I cannot think they could do better than to adopt Mr. Carulla's advice and join one or other of those sections of the Society of Chemical Industry which are conveniently situated at the important centres of industry. They will there come into contact with the very people on whom the chemical industry of to-day largely depends, whether as experts or managers, theorists or practitioners, and such association cannot fail to be of the greatest possible advantage to themselves and to the industry in which they are interested.

Birmingham Section.

Meeting held at Birmingham University on Thursday, December 9th, 1915.

MR. W. J. REES IN THE CHAIR.

THE PREPARATION OF DIETHYLAMINE ON A LARGE SCALE IN THE LABORATORY.

BY T. SLATER PRICE, D.SC., S. A. BRAZIER, M.SC., AND A. S. WOOD, B.SC.

In conjunction with other Institutions the Birmingham Technical School was asked some months ago to prepare large quantities of diethylamine. The reactions made use of consist in the formation of *p*-nitrosodiethylaniline hydrochloride, by treating diethylaniline in hydrochloric acid solution with sodium nitrite, and the hydrolysis of the *p*-nitroso-compound by means of sodium hydroxide, the hydrolysis taking place in accordance with the equation :—

$$NO.C_6H_4.N(C_2H_5)_2+H_2O = NH(C_2H_5)_2+NO.C_6H_4.OH.$$

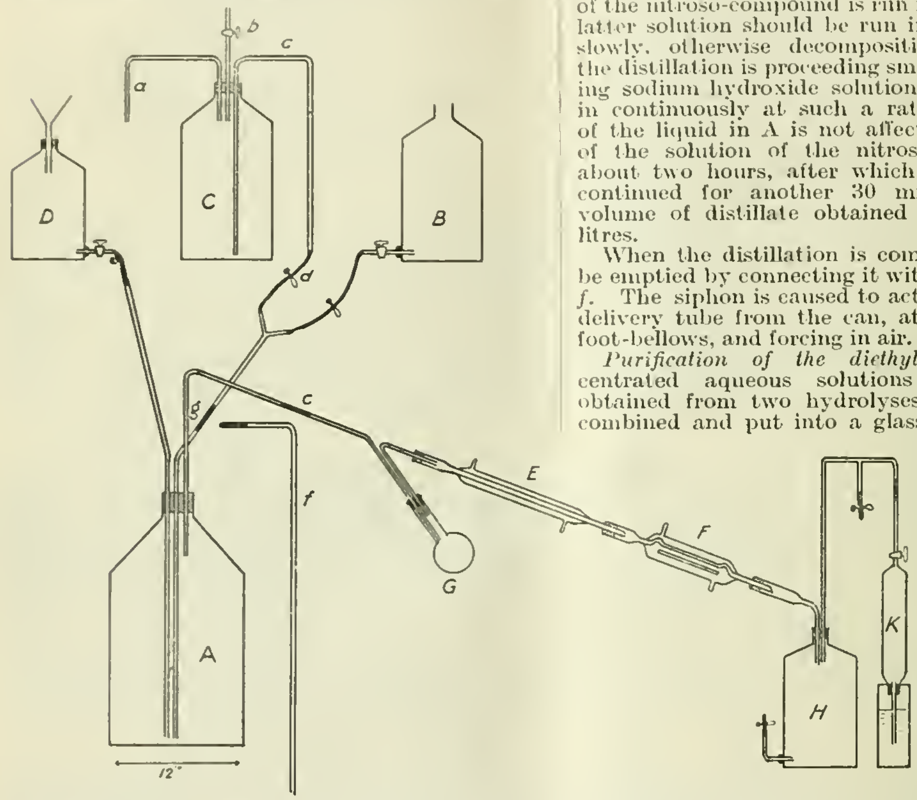
The instructions given were briefly as follows :—The *p*-nitroso-diethylaniline is prepared by the action of sodium nitrite on a solution of diethylaniline hydrochloride, the whole being cooled in a freezing mixture of ice and salt. The hydrochloride is then hydrolysed with sodium hydroxide, the diethylamine distilling over being collected in an excess of hydrochloric acid. The dry diethylamine hydrochloride, obtained by evaporating this solution to dryness, is warmed with a strong solution of sodium hydroxide, when the free amine distils over, and can be obtained pure by one more distillation. The yield of pure substance is 75 % of the theoretical.

The preparation on a large scale, involving as it does the condensation and absorption of the base in hydrochloric acid, evaporation of the resulting solution, and subsequent treatment of the dry residue with a concentrated solution of sodium hydroxide, leads to a maximum amount of labour, to waste of materials, and consequent loss of yield.

We have found that the base may be condensed directly, and by treatment of the concentrated aqueous solution with *solid* sodium hydroxide, followed by a simple fractionation, pure diethylamine can be obtained, even from impure materials. Using this modified method, one worker is able to produce about one kilo. per day, without even soiling his hands.

The process may be divided into three parts, namely, the preparation of the nitroso-compound, hydrolysis of the same, and purification of the diethylamine.

Preparation of nitrosodiethylaniline hydrochloride.—To 2560 grms. (2200 c.c.) of commercial hydrochloric acid, contained in a glazed earthenware pan (called a "jowl" in the Midlands) is added 1000 grms. of crushed ice. The whole is well stirred by an efficient mechanical stirrer, electrically driven, and 1200 grms. (1280 c.c.) of commercial diethylaniline (containing 5—10 % of monoethylaniline) is added. The temperature is then reduced to about 5° C. by the judicious addition of ice. A soluton of 610 grms. of 98—99 % sodium nitrite, that is, 10 % excess, in 1400 c.c. of water is then added slowly, the time required to add all the nitrite being about two hours. The temperature of the reaction mixture is kept at 5—8° C. by the addition of ice from time to time, this temperature being more satisfactory than 0° C. When all the nitrite has been added, the stirring is continued for 15—30 minutes, and then the solution siphoned off into a glass holder, B, which is roughly graduated in litres. If solid nitroso-hydrochloride separates out in any quantity, enough water is added to dissolve it, before siphoning takes place. The volume of the solution thus obtained is about 10 litres.



Hydrolysis.—A large, stout iron can, A, of 10 gallons capacity, is closed by means of a stout cork, carrying three tubes connecting with various reservoirs mounted above the level of the can, and with the condensing apparatus, as shown in the diagram. Twelve litres of water is run into the graduated glass holder, C, by means of the tube, *a*, which is directly connected with the water tap. The tap, *b*, is open at first, the clip, *d*, being closed. When about 11 litres of water has been run in, *b* is closed, so that an excess of air pressure is set up in C whilst the last litre of water is run in. The clip, *d*, is then opened, when the water immediately commences to siphon over into the can; when all of it has siphoned over, *d* is closed.

The smaller graduated glass holder, D, contains 2050 grms. of sodium hydroxide dissolved in 4 litres of water. Half of this solution is run into the can, the contents of which are then heated to boiling. As soon as steam issues from the delivery tube, the latter is connected at *e* with the condensing part of the apparatus, which consists of an ordinary Liebig condenser, E, and a Davies double surface condenser, F, in series. A trap, G, is fitted between the delivery tube and the condensers, for retaining any tarry matter which may distil over. It is heated on a water bath, and is fitted with a siphon tube (not shown in the diagram) for emptying it from time to time.

About 500 c.c. of the solution of the nitroso-compound is now run in from B, when the crude diethylamine immediately commences to distil over, and is collected in the receiver, H. Any escaping vapour is absorbed by the trap, K, which is filled with small glass tubes, moistened with hydrochloric acid, and opens into a jar containing hydrochloric acid solution (1 : 1). The liquid dropping from the end of the Davies condenser is yellow in colour and should be quite clear. As soon as it becomes milky, more solution (500 c.c.) of the nitroso-compound is run into the can. This latter solution should be run in quickly, and not slowly, otherwise decomposition occurs. When the distillation is proceeding smoothly, the remaining sodium hydroxide solution in D can be run in continuously at such a rate that the boiling of the liquid in A is not affected. The addition of the solution of the nitroso-compound takes about two hours, after which the distillation is continued for another 30 minutes. The total volume of distillate obtained is about 1·7 to 2 litres.

When the distillation is complete, the can may be emptied by connecting it with the siphon tube, *f*. The siphon is caused to act by connecting the delivery tube from the can, at *e*, with a pair of foot-bellows, and forcing in air.

Purification of the diethylamine.—The concentrated aqueous solutions of diethylamine obtained from two hydrolyses (distillations) are combined and put into a glass holder connected with a two-gallon can, containing 2500 grms. of powdered sodium hydroxide, by a glass tube passing to the bottom of the can. Another glass tube, also passing to the bottom of the can, is connected to a rubber hand bellows for forcing air into the can and mixing up the contents. A delivery tube from the can is led into and reaches to the bottom of a distilling flask. The side tube of the flask, which is fitted with a thermometer, is connected with a condensing arrangement similar to that shown in the diagram of the hydrolysis apparatus, the bottle collecting the distillate being cooled, however, in a freezing mixture. The flask contains a few pieces of porous tile, and is heated to 60—70° C. on a water bath, its object being to trap any traces of the nitrosamine of monoethylaniline which may come over.

The aqueous solution of diethylamine is run slowly into the can, and the heat of the solution of the sodium hydroxide is sufficient to cause distillation of the diethylamine to commence. The sodium hydroxide retains the water, and pure diethylamine, b.pt. 56° C., distils over. When the rate of distillation slackens, the can is gently heated, the contents being well mixed from time to time by blowing in air. As soon as any trace of the yellow nitrosamine of monoethylaniline appears in the trap, the temperature of the thermometer begins to rise and the distillation is stopped. It is remarkable to notice how constant the thermometer remains at 56° C. during the whole of the distillation.

The average yield of diethylamine from two lots of diethylaniline (2400 grms. of 93 % diethylaniline) was 943 grms., the theoretical quantity being 1090 grms., that is, an 86·5% yield is obtained.

The concentrated solution of sodium hydroxide remaining in the can, and which still contains a little diethylamine, is used for the hydrolysis of the next lot of *p*-nitrosodiethylaniline hydrochloride. Thus a fresh solution of sodium hydroxide has only to be made up for every second hydrolysis. The hydrochloric acid used to prevent the escape of the diethylamine vapour during distillation gradually becomes transformed into diethylamine hydrochloride. The diethylamine is recovered from this, when necessary, by adding to it the aqueous diethylamine solution before distillation.

Finally, it should be mentioned that in order to prevent leakage all corks were covered with plaster of Paris. At the temperatures used the coating is very efficient; in the case of the hydrolysis apparatus no part of which, with the exception of the rubber connections at *e* and *g*, had to be disconnected after being once set up, one coating of plaster of Paris was sufficient for all the distillations (about 20) we carried out.

A NEW METHOD FOR THE ANALYSIS OF MIXED AND SPENT ACIDS.

BY L. WUYTS.
(Chemist of the Belgian State Laboratories.)

The mixtures of sulphuric and nitric acids used for nitration in the manufacture of explosives and for other technical purposes, are of two classes, the one used in the preparation of mononitrotoluene, and the other for trinitrotoluene; they are known respectively as "Mixed acids M.N.T." and "T.N.T." From these are obtained the acids, known as "Spent acids M.N.T. and T.N.T.," in which the greater part of the nitric acid has been used.

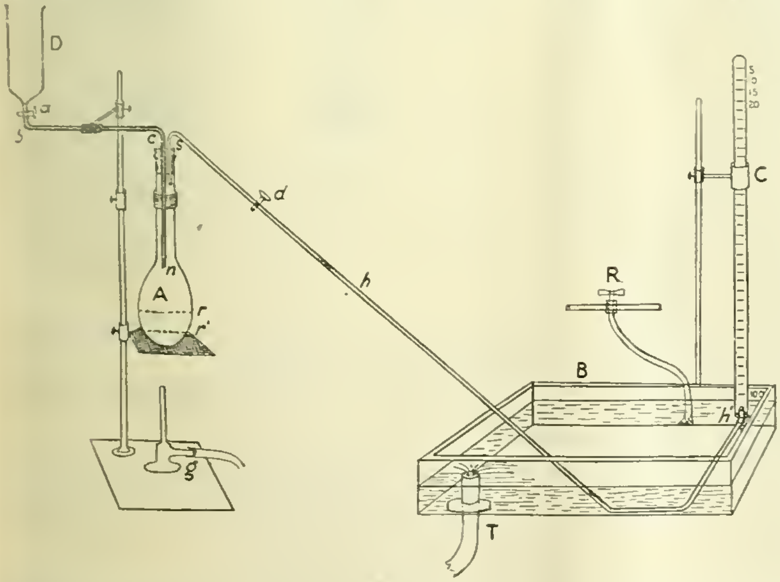


FIG. 1.

The composition of these various acids is of considerable importance, and the following determinations are usually made:—Total acidity, water, sulphuric, nitric, and nitrous acids. It is proposed in this paper to consider only the determination of nitrous and nitric acids. So far as the author's experience goes, the nitrometer method is used exclusively for this purpose in English factories. Without in any way disparaging this excellent method, it will be shown that equally accurate results can be obtained far more rapidly by a slight modification of the well-known Schloesing method.

The method depends on the decomposition of nitrous and nitric acids in the presence of a ferrous salt and a strong mineral acid, the nitrogen being set free as nitric oxide, the volume of which may be measured directly. From this volume the percentage of nitric acid may be readily calculated, either directly or by comparison with a standard volume; the latter method is preferable. In the experiments described in this paper, ferrous chloride and hydrochloric acid were found to give the most satisfactory results.

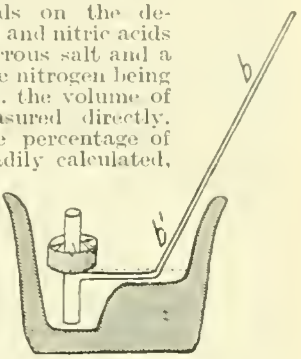


FIG. 2.

The proposed apparatus is shown in Fig. 1, and consists of a pear-shaped Kjeldahl flask of 200 c.c. capacity, provided with a tap-funnel of 40 c.c. capacity and a delivery tube. The stem of the tap funnel is bent twice at right-angles and is of capillary tubing; this serves the double purpose of removing the material to be analysed to a considerable distance (17 cms.) from the direct heat of the Bunsen burner, which might otherwise decompose the strong acids, and also allowing for the gradual introduction of the liquid into the flask, and subsequent washing, without risk of unknown quantities of gas lodging in the tube. The delivery tube should be fitted with a tap, and bent so as to collect the gas over water. The end of the tube passing under the eudiometer should be covered by rubber tubing.

The eudiometer tubes used were of 100 c.c. capacity and graduated in $\frac{1}{10}$ c.c. The difficulty of the method is to prevent the water passing back into the flask, and although the author had no difficulty in this matter, yet it may be advantageous to call attention to the ingenious device of L. L. de Koninck,[*] for overcoming this difficulty (see Fig. 2).

The gas is really collected over mercury under water as the delivery tube ends in a cross-piece, one end of which dips under mercury to just above the level of the junction, whilst the other end passes under the gas measuring burette. Thus should there be any back pressure, mercury instead of water is carried up the delivery tube, and owing to the greater density, the operator has more leisure to readjust the conditions.

The following solutions are required: A nitrate solution of known strength prepared by dissolving 16·5 grms. of pure dry sodium nitrate or 20 grms. of pure dry potassium nitrate in 1000 c.c. of water. A solution of hydrochloric acid prepared by mixing 1 volume of fuming acid with 2 volumes of water and boiling to expel air. A ferrous chloride solution obtained by dissolving 450 grms. in distilled water, adding a few drops of hydrochloric acid and making up to 1000 c.c. This solution should be kept in narrow, well stoppered bottles of not more than 120 c.c. capacity.

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[*] Z. anal. Chem., 1894, 33, 300.
[*] Wiley "Principles and Practise of Agricultural Analysis."

In carrying out the determination, 40 c.c. of the ferrous chloride solution and 30 c.c. of the hydrochloric acid solution are introduced into the Kjeldahl flask, which is then closed by the stopper carrying the tap funnel and delivery tube.

In the examination of "Mixed acid M.N.T.," about 15 c.c. of water * is introduced into the tap funnel and sufficient allowed to pass into the flask to displace the air in the capillary tube. The contents of the flask are now boiled until all the air is expelled and a eudiometer tube filled with water, free from air, is placed over the end of the delivery tube. By means of the bulb pipette shown in Fig. 3. about 0·7 c.c. of the mixed acid is introduced into the tap-funnel. This, together with the water already there, is allowed to pass drop by drop into the boiling ferrous chloride in the flask. A further 10 c.c. of water is then slowly added to rinse the funnel. The nitric oxide is then disengaged and collects over the water in the eudiometer tube.

In the meantime the amount of acid taken is weighed. When the evolution of gas has almost ceased the funnel is rinsed twice more with water, and, when all the gas has come off, the eudiometer tube is transferred to a glass trough containing water saturated with nitric oxide (*vide infra*). Without interrupting the boiling, the operation may now be repeated with the same or a different sample of the mixed acid, fourteen determinations being possible without changing the original contents of the flask.

The estimation of "mixed acid T.N.T." is carried out in exactly the same way, except that a weight corresponding to about 0·9 c.c. is taken in order to get a similar volume of nitric oxide. With "Spent acid T.N.T." the same method is used, except that dilution with 25 c.c. of water is necessary, and a weight corresponding to 4 c.c. should be taken.

In the analysis of "Spent acid M.N.T." dilution with 25 c.c. of water is necessary, and a weight corresponding to 10 c.c. should be taken.

If the standard solution of sodium nitrate has been made up as above, 20 c.c. should be taken, and this will give a volume of about 95 c.c. of nitric oxide. Generally two determinations with the standard solution are made, one at the beginning, and the other at the end, or one only may be made in the middle of the other determinations. The trouble of making determinations with the standard solution on every occasion may be avoided by making two or three determinations, and preserving that tube which gives the average result.

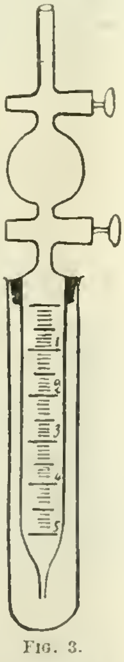

Fig. 3.

The difficulty arises, however, of choosing a liquid over which to preserve the gas. Mercury is unfortunately slowly attacked, and the tube becomes dirty and difficult to read. Of all the liquids tried, a solution of nitric oxide in water was the most successful. The solution was saturated in the following manner: Two or more burettes filled with nitric oxide were placed in a gas cylinder filled with distilled water, and left until their volumes, after reduction to standard temperature and pressure, no longer diminished. The water was then considered to be saturated.

When reading the volume of the standard tube of gas, great care must be exercised to avoid heat from the body reaching the tube. Standard burettes may be kept in one limb of a water level filled with water saturated with nitric oxide, and by raising or lowering the other limb so as to bring the level inside the eudiometer tube to that of the liquid outside, the volume at atmospheric pressure can be read without touching the tube at all (Fig. 4). The movable limb should be kept a little lower than the other when the reading is not being taken, so as to have a somewhat reduced pressure in the gas-tube itself. A tube of gas was also kept immersed in the movable limb so as to provide for losses due to changes in temperature and pressure. Kept in this manner a standard tube of gas was found to have suffered practically no change in volume after many weeks.

The weight of nitric acid may be calculated directly from the volume of nitric oxide, but it is much simpler to compare this volume with that of the standard tube of gas.

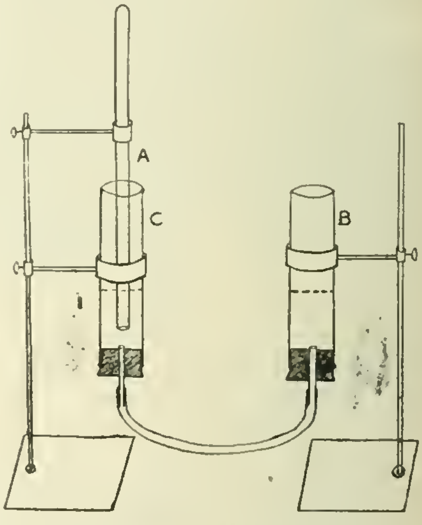

Fig. 4.

Let V_0 be the volume of gas in the standard tube and V'_0 the volume obtained from the sample of acid taken of weight W.

Now in 20 c.c. of the standard solution there i 0·330 grm. of $NaNO_3$, corresponding to 0·21462 grm. of HNO_3.

Therefore the percentage of

$$HNO_3 = 24{\cdot}4629 V_0' \div V_0 . W.$$

Since V_0 varies very little, we may take factor F corresponding to $24{\cdot}4629 \div V_0$ and mak a table, allowing for the ordinary variations o temperature and pressure.

Then $\% \ HNO_3 = V_0'.F \div W.$

An example will show the working of the result using this table. Let the volume of nitric oxid given off from 1·4206 grm. of acid be 97·5 c.c. and the volume of the standard tube at that temperature and pressure be 92·2 c.c. Then in th table we read opposite 92·2 the factor F, which i given as 0·2653.

$$\text{Hence } \% \ HNO_3 = \frac{97{\cdot}5 \times 0{\cdot}2653}{1{\cdot}4206} = 18{\cdot}20\%.$$

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* This water is necessary to avoid loss of the fuming acid by evaporation, to lessen the violence of the reaction, and to prevent the distillation of unchanged nitric acid.

Table A.

c.c. in standard tube.	Natural number 0	1	2	3	4	5	6	7	8	9
87	·2812	·2809	·2805	·2802	·2799	·2796	·2793	·2789	·2786	·2783
88	·2780	·2777	·2774	·2771	·2767	·2764	·2761	·2758	·2755	·2752
89	·2749	·2746	·2742	·2739	·2736	·2733	·2730	·2727	·2724	·2721
90	·2718	·2715	·2712	·2709	·2706	·2703	·2700	·2697	·2694	·2691
91	·2688	·2685	·2682	·2679	·2676	·2674	·2671	·2668	·2665	·2662
92	·2659	·2656	·2653	·2650	·2647	·2644	·2642	·2639	·2636	·2633
93	·2630	·2627	·2624	·2622	·2619	·2616	·261	·2610	·2608	·2605
94	·2602	·2600	·2597	·2594	·2591	·2589	·2586	·2583	·2581	·2578
95	·2575	·2572	·2570	·2567	·2564	·2562	·2559	·2556	·2554	·2551
96	·2548	·2546	·2543	2540	·2538	·2535	·2532	·2530	·2527	·2525
97	·2522	·2519	·2517	·2514	·2512	·2509	·2507	·2504	·2501	·2499
98	·2496	·2494	·2491	·2489	·2486	·2484	·2481	·2479	·2476	·2474
99	·2471	·2469	·2466	·2464	·2461	·2459	·2456	·2454	·2451	·2449
100	·2446									

Table B.

	New method.				Nitrometer method.			
	Mixed acid.		Spent acid.		Mixed acid.		Spent acid.	
	M.N.T.	T.N.T.	M.N.T.	T.N.T.	M.N.T.	T.N.T.	M.N.T.	T.N.T.
1	20·29	18·39	0·67	2·99	20·24	18·36	0·68	2·96
2	20·07	18·28	0·45	2.82	19·96	18·19	0·45	2·84
3	20·35	18·40	0·36	4·39	20·32	18·48	0·35	4·46
4	20·41	18·10	0·30	4·37	20·46	18·12	0·29	4·41
5	20·18	18·12	0·61	4·40	20·10	18·02	0·62	4·35
6	19·94	18·48	0·71	4·46	19·85	18·41	0·72	4·48
7	20·09	18·32	0·69	4·27	20·05	18·27	0·68	4·21

Table B. shows the results obtained using the above method compared with the results obtained from the same samples by the nitrometer method as ordinarily used.

Some of these have been verified by Dr. G. Dechamps and Dr. C. De Smedt in the Research Laboratory of an Explosives Factory.

When the determination of nitrous and nitric acids in the mixed and spent acids is carried out in this way an accuracy of 0·1 % is obtained, which is not surpassed by that of any other method. In addition the method is very rapid, and seven or eight determinations may be made in one hour.

The apparatus is cheap, a smaller number will be needed, and the space required is not great.

The author's thanks are due to Prof. T. B. Wood, of the School of Agriculture, Cambridge University, for the use of the laboratory and materials.

London Section.

Meeting held at Burlington House on Monday, January 3rd, 1916.

MR. A. R. LING IN THE CHAIR.

ON THE VISCOSITY OF OILS IN THE REDWOOD AND OSTWALD VISCOMETERS.

BY CHARLES A. SAVILL AND ARTHUR W. COX.

The viscometer in general use in this country is that designed by Sir Boverton Redwood, in which the sample flows from a cup of standard size through an orifice of definite dimensions. The best known of the U-tube viscometers is that designed by Ostwald, and is shown in Fig. I. With this viscometer the "absolute viscosity" can be obtained, and it is the one with which most of the purely scientific work on viscosity has been done. From the authors' experience the only method at present known for the conversion of viscosity determined in an Ostwald viscometer into viscosity determined in a Redwood viscometer (or *vice versa*) requires the use of intricate formulæ of doubtful accuracy; and it is with a view to obtaining a more simple but perfectly accurate method of effecting this conversion, and also an improved method of calibration of the Ostwald viscometer, that this work has been undertaken.

Apparatus used and methods of testing.

(1) The usual type of standardised Redwood viscometer was used. The oil to be tested, after careful filtration through fine muslin, was placed in the inner cup and heated by means of the outer bath, which was filled with water or oil, according to the temperature of the experiment. When the temperature had remained constant for about 10 minutes, the level of the oil was adjusted, and the time of outflow of 50 c.c. was determined. This experiment was repeated several times, and an average of the results obtained was taken as the figure for "Seconds flow in Redwood."

(2) The Ostwald viscometer used had the following dimensions: Capillary C. (see Fig. I). 6 cm. long × I mm. bore; bulb A., 4 c.c.; bulb B., 8 c.c.; length over all, 15 cm. The oil to be tested, previously filtered through muslin, was poured into one arm of the viscometer until the level roughly coincided with the marks, c and d (Fig. I). The instrument was placed in a bath of water or paraffin

wax, carefully regulated to the desired temperature and provided with a mechanical stirrer. The verticality of the instrument was assured by reference to a plumb-line suspended in the bath. After 10 minutes at the required temperature, the oil was carefully adjusted to the etched marks, c and d, by means of a warmed pipette. The oil was then sucked up just above the mark, a, and allowed to run down, and the time taken to flow from a to b noted. This was repeated several times and the results averaged.

(3) The specific gravity was obtained by suspending a 10 c.c. specific gravity bottle, previously calibrated, and provided with an etched mark on the neck, in the same bath as the Ostwald viscometer. After 10 minutes' immersion the oil was adjusted to the mark by means of a warmed pipette, and the bottle removed from the bath, cooled, and weighed.

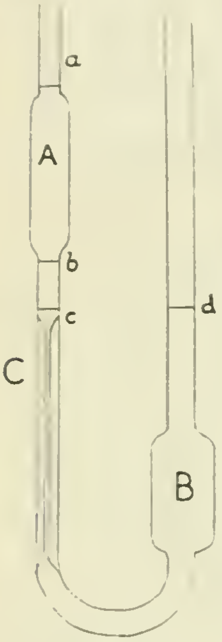


FIG. 1.

Calibration of the Ostwald viscometer.

It is obvious that the time taken by an oil to flow through a viscometer of this type will depend on the size of the capillary, and to correct all viscosities to the same unit a constant (K) is necessary. The value of K can be found by measurements of the size of the capillary and the pressure exerted on the oil when flowing. This method is not a satisfactory one for several reasons, the chief being the difficulty of obtaining the exact diameter of the capillary tube, the unequal diameter of this capillary, and the variation of pressure on the oil during the test. A more accurate and practical method is to calculate the constant from actual results obtained with the instrument. The usual method is to find the results given in the viscometer by pure phenol, and thus to calculate the value for K for the particular viscometer. This is not a matter of great difficulty in a research laboratory, where the phenol can be obtained quite pure, but in works practice it is attended by many difficulties.

By means of pure phenol Dr. Dunstan has calibrated his viscometers and has also obtained the viscosities of varying strengths of sulphuric acid at 25° C. These have been plotted on a chart, the values of η being ordinates and those of % strength of sulphuric acid abscissæ. If now one obtained the viscosity of sulphuric acid of accurately known strength in a particular instrument, one could find, by reference to this graph, the absolute viscosity of that acid, and so, by simple substitution in the formula, $K = \frac{\eta}{td}$, obtain the value of K.

In the calibration of the viscometer which was used in these experiments the authors employed the following methods. Concentrated sulphuric acid was placed in the viscometer and the time of flow at 25° C. was determined. The sp.gr. at 25° C. was also obtained. The acid was carefully titrated against standard alkali and the percentage strength determined. By reference to the graph (Dunstan, Proc. Chem. Soc., 1914, 93, 30) connecting viscosity of sulphuric acid with percentage strength, the viscosity of the acid used was obtained, and by substituting these figures in the formula, $K = \frac{\eta}{td}$, a result of log K = $\bar{3}$·0321 or K = 0·00108, was obtained. Previous, but less accurate determinations of K gave log K = 3·0476 and 3·0462, or K = 0·001116 and 0·00112. A significant fact is that Dr. Dunstan, independently determining K for this instrument, but using phenol for the calibration, obtained a result 3·0414. These logs. of K represent 0·00108 and 0·00110, and are seen to be in close agreement.

Absolute viscosity is calculated from the formula, $\eta = Kdt$, where η = absolute viscosity, K = constant for viscometer, t = time of flow in seconds, and d = sp.gr. at temperature of determination.

Temp. ° C.	Sp. gr.	Seconds flow in Redwood.	Seconds flow in Ostwald.	η
1. *Bottle-nose sperm oil.*				
15·5	0·8935	238	522	0·502
25	0·8872	166	355	0·339
45	0·8754	87	181	0·171
70	0·8582	54	95·5	0·0882
100	0·8397	42	54	0·0500
125	0·8242	38	36	0·0319
2. *Filtered cylinder oil.*				
70	0·8630	281	556	0·517
100	0·8458	100	197	0·179
125	0·8309	57	105	0·0939
150	0·8158	44·5	65	0·0571
3. *Engine oil (Galician).*				
50	0·9035	227	457	0·444
70	0·8901	99	195	0·187
100	0·8706	49·5	80	0·0750
125	0·8530	40	45	·0413
4. *Engine oil (American).*				
50	0·9258	218	444	0·443
70	0·9133	92	176	0·173
100	0·8948	46·5	67	0·0645
125	0·8783	38	38	0·0359
5. *Light Galician oil.*				
15.5	0·8981	249	549	0·531
25	0·8896	153	337	0·323
50	0·8754	62	115·5	0·109
70	0·8633	46	63·5	0·0590
6. *Motor-car oil, Grade A.*				
70	0·8696	266	547	0·512
100	0·8482	99	198	0·181
125	0·8347	60·5	106	0·0953
150	0·8197	46	64·5	0·0569
7. *Motor-car oil, Grade C.*				
50	0·8816	364	755	0·717
70	0·8696	159	330	0·309
100	0·8534	68	128·5	0·118
8. *B.B.B. Compound engine oil.*				
35	0·9087	355	720	0·704
50	0·8970	160	337	0·325
70	0·8855	77	151	0·144
100	0·8680	45	61·5	0·0575
9. *Excelsior cylinder oil.*				
85	0·8594	220	465	0·430
100	0·8543	130	268	0·247
125	0·8354	83	137	0·123
150	0·8226	50·5	84	0·0744
10. *Goeasy lubricating oil.*				
50	0·8906	231	470	0·451
70	0·8783	103	205	0·194
100	0·8588	52	82	0·0758
11. *Rape oil.*				
50	0·8971	149	315	0·304
70	0·8856	86	181	0·173
100	0·8661	54	90	0·0839

All the above oils were very carefully filtered through fine muslin before being tested,

The above results of each oil have been plotted on graphs, one of which is reproduced in Fig. 2, and it will be noted that the curves are quite regular.

FIG. 2

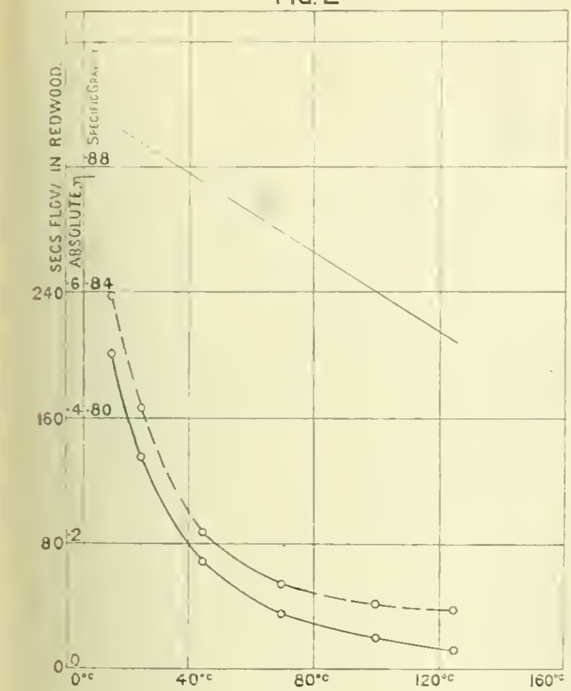


FIG. 3

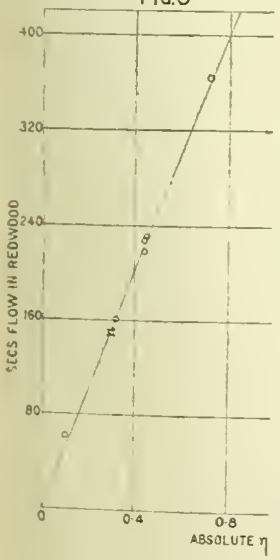
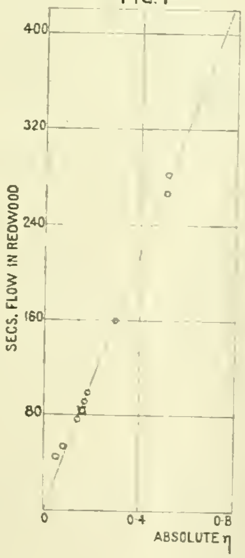


FIG. 4



From the foregoing experiments it is clear that the connection between absolute viscosity and seconds flow in the Redwood viscometer can be expressed by a straight line graph. Two such graphs are reproduced in Figs. 3 and 4, and show the connection existing at 50° and 70° C. respectively. Similar graphs can be drawn for any other temperatures. It is worthy of note that these graphs pass through the origin, as of course they should, theoretically. The value of these graphs is illustrated by the preceding table.

Rape oil.

Temp.	η	Seconds flow in Redwood viscometer.	
		Observed.	Read from graph.
50° C.	0·304	149	149
70° C.	0·173	86	87

The last few results of low viscosity depart a little from linearity, probably due to experimental error.

The authors wish to express their indebtedness to Dr. Dunstan for assistance and advice in the preparation of this paper, and for the use of apparatus, etc.; also to Messrs. Gross, Sherwood and Heald, Ltd., for samples of oils numbered 6 to 10 in the table.

Manchester Section.

Meeting held at Grand Hotel, Manchester, on Friday, December 3rd, 1915.

MR. W. THOMSON IN THE CHAIR.

THE OXIDATION OF SEWAGE WITHOUT THE AID OF FILTERS. PART III.

BY E. ARDERN AND W. T. LOCKETT.

DISCUSSION.

Mr. ARDERN having given a resumé of the above paper, as printed in the Journal of September 30th, 1915, page 937,

Dr. G. J. FOWLER said that he had had the pleasure of advising the Sewerage Commission of Milwaukee, and also Dr. Bartow, of the University of Illinois, and exceedingly interesting results had been accumulated. The city of Milwaukee were now experimenting with the continuous process in connection with activated sludge on a scale of about 20,000 gallons, and proposed to construct tanks capable of dealing with anything up to 2,000,000 gallons. Experiments were being made in this country by Mrs. Mumford with regard to the manurial value of activated sludge; the results were excellent. The purification of the sewage was a mere incident. By means of activated sludge chemists were within sight of bringing back the nitrogen to the soil which had been wasted for so many years. What that meant in national capital only time could show, but that it was already accomplished was proved by the fact that in the case of Milwaukee a quantity of the sludge had been sent to the stockyards of Chicago, where a process had been developed for converting it into a portable form. A method had been discovered of drying the sludge and eliminating grease. In the result a profit had been made amounting to 100%. The fertilising value of activated sludge was now admitted, and was higher than that of practically every other kind of nitrogenous manure. Careful tests had been made at the University of Illinois, taking the same nitrogen unit in every instance. As a result of experiments made at the University of California it had been ascertained that the availability of the nitrogen in activated sludge was as great as in any other kind of organic manure they had tried. The process would also have a great bearing upon the purification of rivers and sensibly tend to lessen the troubles of Rivers Boards. Without the slightest desire to prophesy, he thought the time would come when local authorities would be only too glad to lay down sewage works on the lines set forth in the paper.

Mr. HALLIWELL (Preston) said that of late years local authorities had been earnestly endeavouring to carry out their duties in regard to the purification of rivers, and they would be all the more likely to persevere in that direction if there was possibility of pecuniary profit, particularly in manufacturing districts. The suitable treatment of sewage had been the bugbear of corporations for generations, and it was therefore a great satisfaction to find that Messrs. Ardern and Lockett were endeavouring, step by step, to prove that this new method of treatment was really practicable, rather than make claims which could not subsequently be justified. In the past many processes of sewage treatment had been advocated, but had not come up to expectations, so that local authorities were now extremely dubious about adopting new ones. He would instance the gradual choking of contact beds, which decreased the working capacity of the beds and finally necessitated the washing of the material. Septic tanks, which at first were stated entirely to resolve the suspended matter, were found to give large quantities of sludge; and the sprinkler or percolating filters gave an effluent which contained so much suspended matter that humus tanks had to be installed. In each case the further necessary expenditure was a very unwelcome surprise. He asked whether the prime cost of plant included a duplicate plant for effecting aeration. It would probably be found desirable to have the plant in duplicate. Secondly, it was very desirable to know the amount of sludge produced. On theoretical grounds the high nitrogen content might be due either to the oxidation of carbonaceous matter in the suspended matter, leaving a high percentage of nitrogen in the resultant sludge, or to the abstraction of nitrogen from an outside source, with the amount of sludge produced greater or less than by ordinary methods. The total weight of solids calculated from suspended solids in sewage was equivalent to 345 grms. The weight of solids calculated from increase of sludge was 856 grms., showing an increase of 511 grms. of sludge from a source other than from the original suspended matter. Again, statements had been made that the nitrogen content of the sludge was very much greater than it was in any other known method. Since there was an increase of sludge, and also a very marked increase of nitrogen content, the nitrogen must come from some extraneous source, and it might be that on that premise was based Dr. Fowler's optimistic remark that not only was it practicable to have a completely purified sewage, but also that a manure could be produced which would be of immense value. The question of the increased quantity of sludge gave rise to another vital point. The experiments showed that 1558 litres of sewage gave 36 litres of sludge—practically 2·3% by volume. Would not that necessitate a very considerable area of sludge beds or a large addition to the pressing plant? If local authorities were to understand that it was necessary to put down a very large area of sludge beds, or to adopt some expensive mechanical means of concentrating the sludge, they would be somewhat apprehensive as to the cost. This ought not to be neglected in calculating the cost—capital and working—of the new method. Apparently, all through the experiments, the authors had been dealing with an activated sludge containing 97·6% of water. Was there any particular advantage in a sludge with that content of moisture? Would it not be easily possible to allow a further period of settlement so as to get a stronger sludge, and as a corrollary would allow a further volume of effluent to be drawn off, thereby not only increasing the tank space available, but also decreasing the quantity of air required? Again, when dealing with the provisional estimate of cost of aeration, the authors stated:—"Under working conditions it would scarcely be practicable to remove the purified effluent as far as the sludge level, and therefore a margin of 5% and 10% by volume has been allowed in the two respective estimates, using 20 and 40% activated sludge." Why was it necessary to allow 5% margin for the amount of effluent it was not possible to draw off from the tank when dealing with a 20% sludge, and 10% when dealing with a 40% sludge? In each case the sludge was of the same consistency, namely, of a 97·5% water content. With a 97·5% sludge it appeared to him to be as difficult to draw off the top water when 20% of sludge was used as it was when 40% was used. The amounts of sludge were so large that they presented practically the same problem. To him personally it had always been a matter of some difficulty to draw off the top water from a tank containing at least 20% of sludge without allowing some of the sludge to be drawn off. Assuming a six feet tank, 5% was equivalent to 3½ inches. The drawing off of the top water would be within that distance of the sludge. With a 40% sludge there would be six inches for the workman to work to. Why should there be this difference? And lastly, on the question of filling the tank with sewage, as far as he could understand, the method was to have a tank containing approximately 20% of sludge, and to run sewage into it. During the time that the sewage was running into the tank which contained 20% or 40% of sludge, was air being blown through the sludge, or was aeration not begun until the tank was full? Had the incoming sewage any inhibitory effect on the activated sludge prior to the point when the blowing began? That was a matter of particular interest when trade waste was passed into the sewers. If the blowing commenced at the time of filling, was it allowed for in the cost?

Mr. P. Gaunt drew attention to the authors' anticipation of difficulty in maintaining efficient circulation in activated sludge tanks in the presence of appreciable quantities of grit, etc. Owing to the rapid, and usually unforeseen fluctuations in the rate of flow of sewage, and of the character of the contained suspended matter, the efficient and consistent separation of the solids of higher gravity was a matter of considerable difficulty, and could only be effected by a greater elaboration of the design and control of the preliminary detritus tanks, than was, in his experience, usual in present practice. He believed that in large works, the advantages which the activated sludge process offered in other directions would fully justify such a change of practice, but the relative cost of any elaboration of treatment advanced rapidly as the size of the works decreased, and smaller works might find in this increased cost a substantial obstacle to the adoption of the new method of treatment.

Mr. William Thomson commented on the gradual increase of the amount of saline ammonia up to the 7th day, and the gradual decrease after the 7th up to about the 14th day, also as the saline ammonia decreased the nitrates and nitrites increased. After the 5th day there was 0·06 part per 100,000 of nitrates and nitrites, and after the 7th day 0·57. Again, there was an increase from 5·7 after 12 days to 12·8 after 14 days. This was a very remarkable result. It had been pointed out that there was a difference between the amount of purification by passing the air through an open pipe as compared with passing it through a tile. Was it possible to utilise two or three layers of wire gauze so that the air bubbles might be still further broken up in ascending, and so brought into more intimate contact with the sewage? He also asked of what material the tile was formed. He had not been quite able to follow the meaning of the mercury appliance for regulating the air pressure. Was the air used actually recorded by a meter? The mercury would indicate a constant pressure, at its exit to the sewage, but this would be determined by the depth of the water. It would be interesting to learn whether the bacteria, the growth of which was presumably promoted by aeration, were capable of combining the nitrogen of the air so as to form nitrates, and so produce a continual and greater fructification of plants.

Mr. Ardern, in reply, said that the estimates of cost made provision for a duplicate air plant. The increase in the volume of sludge other than that actually contained in the sewage was so great that until further investigation was made as to its cause he was not prepared to discuss the matter. The difference, however, was not quite so great as indicated by Mr. Halliwell, because he had only calculated on actual suspended matter. In addition to the sedimentation of the visible suspended matter, there was a clotting out of the colloidal matter and also matters from the solutions, such as iron salts. He agreed that the matter was of great importance, and hoped to be able to repeat the determination in the near future. It would not be practicable to reduce the high water content by allowing a further period of settlement, and consequently increasing the next lot of sewage put into the tank. In any consideration of the question under discussion it was important to distinguish between the character of the activated sludge and sludge obtained from sedimentation or septic tanks. The sludge was absolutely non-colloidal in character. It had been proved in the laboratory, and there was no doubt the process could be repeated on a large scale, that the water could be separated very much more readily than from mucilaginous, emulsified sewage sludge obtained by ordinary treatment. The sludge could be quickly reduced to a spadable product by treatment on draining filters. There was of course always the question of handling in the case of large plants. Probably the most feasible way of freeing the sludge from its water content would be by a high speed centrifugal action, and this system could be applied at a reasonable cost. Another method would be by adopting the principle of the vacuum wheel, which was frequently done for the purpose of eliminating water from slime in metallurgical operations. When a larger proportion of activated sludge was employed, viz., 40% by volume, a greater margin was allowed in running off the purified liquors, on account of certain practical difficulties in regard to settlement which did not apply to the same extent when working with a smaller proportion of sludge. Hitherto they had added the sewage and blown in the air afterwards, but in the case of the large scale 400 sq. feet tank that was now being used the air was allowed to enter at the commencement of the filling, mainly with the view of facilitating the mixture of sludge and sewage. He wasnot so much concerned with profit-making, but he did desire to produce a sludge which would be an asset rather than a liability. The figures given with regard to the nitrogen content were if anything on the low side. An activated sludge had been obtained recently from a purely domestic sewage, the nitrogen of which was as high as 6·5 % (dry). He agreed with Mr. Gaunt that the process required that more attention should be given to the scientific design of the preliminary screening and detritus chamber, which in the past had been seriously neglected. With regard to the adoption of wire meshes as air diffusers, this was possibly a feasible proposition. It was a question of durability. Other suggestions had been the adoption of porous metal, coconut matting, and asbestos fibre, but up to the present nothing better had been found than a mineral porous septum. Most of the tiles used up to the present in the course of the experiments under consideration had been made of silica, which was dried and burned. The mercury seal did not measure the amount of air but allowed a constant pressure. The practice was to fill the vessel with water prior to any particular experiment, connect with the air supply, and regulate the mercury to what was approximately correct; then put the apparatus into operation with water, and measure the amount of free air by putting down a funnel and collecting over a large vessel, the mercury being regulated accordingly until the right volume was obtained. During the course of an experiment a series of determinations of the free air issuing from the surface was made as a check against the initial determination. It had been demonstrated that the activated sludge had a large and varied bacterial population. A great deal had yet to be learnt in regard to the complex biochemical reactions involved in the purification process.

Meeting held at Grand Hotel on Monday, January 14th, 1916.

MR. W. THOMSON IN THE CHAIR.

A METHOD FOR THE UTILISATION OF NITRE-CAKE.

BY DR. J. GROSSMANN, M.A., F.I.C.

It is well known that calcium hydrogen sulphite, known in commerce as bisulphite of lime, is decomposed by sodium sulphate as follows:—

$$CaH_2(SO_3)_2 + Na_2SO_4 = CaSO_4 + 2NaHSO_3 \quad (1)$$

A similar reaction takes place if sulphur dioxide is passed through a solution of sodium sulphate which is mixed with calcium sulphite, viz.,

$$CaSO_3 + SO_2 + Na_2SO_4 + H_2O = CaSO_4 + 2NaHSO_3 \quad (2)$$

If now the insoluble calcium sulphate is separated from the liquid part, a solution of sodium hydrogen sulphite is obtained, from which by adding lime caustic soda is obtained in solution, and a precipitate of calcium sulphite:—

$$NaHSO_3 + CaO = NaOH + CaSO_3 \quad (3)$$

But for every equivalent of calcium sulphite which was originally used, we obtain back two equivalents, so that one equivalent is wasted. This appears clearly if the equation is written as follows:—

$$Na_2SO_4 + CaSO_3 + SO_2 + 2CaO + H_2O = 2NaOH + CaSO_4 + 2CaSO_3 \quad (4)$$

This waste is one of the reasons why this reaction, which was first proposed nearly 40 years ago, has not been used for the technical manufacture of caustic soda. For not only must one equivalent of calcium sulphite be removed from the cycle of operations, but the addition of one equivalent of sulphurous acid which this involves complicates the working, and adds to the cost of the plant and process.

If a solution of nitre-cake is used instead of a solution of sodium sulphate, the reactions which take place are more favourable for practical results. Nitre-cake is theoretically a mixture of sodium sulphate and sodium hydrogen sulphate, which for practical purposes is generally looked upon as a mixture of sodium sulphate and free sulphuric acid. Thus, for example, a nitre-cake showing by test about 30% of free sulphuric acid could be expressed by the formula, $5Na_2SO_4 + 3H_2SO_4$, which corresponds to 70·7% Na_2SO_4 and 29·3% of H_2SO_4. It is well known that calcium sulphite can be decomposed by sulphuric acid so as to yield calcium hydrogen sulphite, viz.,

$$2CaSO_3 + H_2SO_4 = CaH_2(SO_3)_2 + CaSO_4 \quad (5)$$

Thus the free sulphuric acid produces the same effect as the addition of sulphur dioxide in equations (2) and (4). A solution of the nitre-cake mixed with calcium sulphate would therefore decompose according to the following equations:—

$$(5Na_2SO_4 + 3H_2SO_4) + 6CaSO_3 = 2Na_2SO_4 + 6NaHSO_3 + 6CaSO_4 \quad (6)$$

and further:—

$$2Na_2SO_4 + 6NaHSO_3 + 6CaO = 2Na_2SO_4 + 6NaOH + 6CaSO_3 \quad (7)$$

It will be seen that we finish up in equation 7 with the same quantity of calcium sulphite with which we commenced in equation 6, so that theoretically the original amount of calcium sulphite used would be sufficient for any number of operations. The solution after separation from the calcium sulphite contains mainly caustic soda and sodium sulphate, the latter free from iron and other impurities which have been removed by the lime in the causticising process. On boiling down, sodium sulphate is fished out, and the final liquor is either used as such or further concentrated and made into solid caustic soda. Incidentally, I may mention that the calcium sulphate produced may possibly be made into pearl hardening, and thus yield a third commercial product.

In practical work it is, of course, not possible to obtain the results as shown in the above equations; a certain amount of calcium sulphite will have to be replaced, requiring the use of lime and pyrites, and the yield in caustic soda, so far as can be judged from laboratory experiments and other considerations, will probably only be two-thirds of the theoretical quantity, so that from 100 tons of nitre-cake about 36 tons of pure sodium sulphate and 15 tons of caustic soda as NaOH would be obtained. The cost of lime and of replacing calcium sulphite would amount to somewhere about £50, that of labour to about £40. About 400 tons of water would also have to be evaporated which, with steam for power, would require about 80 tons of coal, though in multiple effect less than half that amount should be sufficient. Taking it, however, at its worst, with coal at £1 per ton, the charge for fuel would amount to £80, bringing the total expenditure to £170. As the plant would be extremely simple and, without multiple apparatus, cheap, a further £10 per week for depreciation and other charges should be sufficient, so that a total expenditure of £180 per week, at present prices and with crude plant, should be sufficient to work up 100 tons of nitre-cake.

Against this must be considered the revenue to be derived from the sale of caustic soda and sodium sulphate. The sodium sulphate obtained by this process would be purer than saltcake, and should therefore, under equal conditions, realise at least the same price. The price of saltcake at present is £2 2s. 6d. per ton, at which price it is practically unsaleable. If we consider that soda ash is at present sold at £3 2s. 6d. per ton, its equivalent in sodium sulphate is less than £2 6s., so that there is not much inducement for glass-makers to buy it at present prices. I therefore take the price of sulphate of soda in my calculations at only 25s. per ton naked at the works, at which price one could reasonably expect to be able to compete with soda ash where it can replace the latter, and the revenue from this source would therefore be on 36 tons £45 per week. The price of 70% caustic is at present an unknown figure, but ranges from £16 or £17 per ton up to £20 per ton and more. Taking pure caustic, on which these calculations are based, at £14 per ton naked at the works, the revenue from this would amount to £210 per week, and adding the two products together, we have a revenue of £255 per week against an expenditure of £180, leaving a margin of £75, or 15s. per ton of nitre-cake.

Any new process which is to be taken up in these exceptional times, however, should not only show a reasonable profit under present circumstances, but should also prove to be practicable under more normal conditions, though at present it appears most unlikely that for many years, at any rate, we shall have such low prices as we have had in the past. Now it will be seen that the chief expenditure in this process is coal, and that once the feasibility of the process has been established, it would pay to put up more expensive plant in the shape of multiple effect evaporators. That alone would effect a reduction of £50 per week in the expenses. At the same time, the expense for lime and for replacing calcium sulphite and other chemicals would be reduced by at least one-third, causing a saving of about £20, so that with the reductions in these two items, not reckoning any reduction in the cost of labour, we should have an expenditure of £110 per week. Against this, we should have a revenue from sodium sulphate, which should be the same as before, £45 per week, and 15 tons of caustic soda at, say, £9 per ton, *i.e.*, altogether £180, leaving a margin of £70. It thus appears probable that the expenses would be less in proportion as the prices of the materials obtained became reduced, and that the process, which is provisionally protected, would, even in normal times, yield sufficient profit to render its use practicable.

DISCUSSION.

Dr. GROSSMANN, in reply to Dr. T. J. Craig and Professor Knecht, said he had not allowed anything for the cost of the nitre-cake. Most works were only too glad to get rid of it, and some might even pay for having it removed. On account of freight expense, it would be advisable to instal the works near to those where the nitre-cake was produced. It was necessary to work with somewhat more dilute solutions than in the causticising of sodium carbonate. It was not to be expected that during war time anyone would put up a costly plant, and he took it that at present ordinary methods of evaporation would have to be adopted, though even then the cost of evaporation would not be prohibitive. With multiple effect apparatus the cost of evaporation would not differ much from that incurred in the manufacture of caustic soda from sodium carbonate or Leblanc soda lyes.

Nottingham Section.

Meeting held at Nottingham on Wednesday, December 15th, 1915.

MR. JOHN WHITE IN THE CHAIR.

THE ACTION OF SALTS OF HYDROXY-ACIDS UPON CHROME TANNING.

BY HENRY RICHARDSON PROCTER, D.SC., AND JOHN ARTHUR WILSON.

(Contribution from the Procter International Research Laboratory.)

The theory of chrome tanning assumes that tanning will take place if the basicity and concentration of the chromium salt are properly regulated. But cases have arisen where skins would not tan in certain liquors, even when these liquors were rendered very basic. An investigation has revealed the interesting fact that the presence of salts of many, if not all, of the hydroxy-acids has a very marked influence upon the tanning power of chromium salts.

The first salt experimented upon was potassium sodium tartrate, ordinarily known as Rochelle salt. It was found that if much of this salt be added to a chrome liquor, the latter is rendered incapable of tanning. Such a liquor gives no precipitate when rendered slightly alkaline with sodium carbonate. Immediately after Rochelle salt has been added to a chrome liquor the latter may give a precipitate if rendered alkaline, but the precipitate will slowly re-dissolve. If the mixture of salt and chrome is allowed to stand for several hours before adding the soda, no precipitate is formed. It was noted further that an addition of Rochelle salt to a solution of chrome alum produces a change of colour.

These preliminary experiments recall the fact that in qualitative analysis the presence of hydroxy-compounds prevents the precipitation of the metals as hydroxides. The metal ion enters into the negative ion of such hydroxy-compounds as tartrates and citrates. The action is reversible, but the complex ion formed is very slightly ionised, and furnishes even less of the metal ion in solution than does the nearly insoluble metallic hydroxide. This accounts for the fact that Rochelle salt re-dissolves a precipitate of chromium hydroxide.

A chrome liquor was prepared from chrome alum by treating with sodium carbonate in the usual way. From this a series of eight solutions was prepared, varying in concentration of Rochelle salt as follows:—

Solution No.	Grms. chrome oxide per litre.	Grms. Rochelle salt per litre.
1	13	50
2	13	25
3	13	10
4	13	5
5	13	2·5
6	13	1
7	13	0·5
8	13	none

Temperature 24° C.

Into each liquor was put a piece of calf skin which was in a practically neutral condition. The liquors were agitated occasionally, and at the end of 24 hours the skins were examined. That in No. 1 was of a bluish colour, while that in No. 8 was rather a green, the others varying in shade from blue to green. The skin in No. 1 was unusually full and soft, this property becoming less and less marked in the others down to No. 8. But all the skins were nearly or quite tanned, excepting those in Nos. 1 and 2.

Upon adding 150 c.c. per litre of *N*/1 sodium carbonate solution to each liquor, heavy precipitates formed in all but Nos. 1 and 2. In No. 2 there was a lighter precipitate, but in No. 1 there was none. Four hours later the skin in No. 2 was tanned, but that in No. 1 was still untanned. We added 300 c.c. per litre of *N*/1 sodium carbonate, in two portions, to No. 1, and still no precipitate formed, although the liquor was now alkaline to phenolphthalein. 48 hours later the skin was still not tanned.

To make certain that the action of the Rochelle salt was upon the chrome rather than upon the skin, we immersed a piece of skin in a solution of *N*/1 Rochelle salt for several hours, allowed it to drain, and then put it into a large volume of fresh chrome liquor. The volume of liquor taken was so large that, when the Rochelle salt diffused, its concentration would not be sufficient to prevent tanning. The skin tanned very well.

The piece of skin from No. 1, which had not tanned, was now washed, to free it from salt, and placed in a fresh chrome liquor. In a few hours it was completely tanned.

All of the above experiments were repeated with neutral sodium citrate, using equivalent concentrations. The results were apparently identical with those obtained with Rochelle salt. It was also found that the sodium salts of lactic, gallic, and salicylic acids prevent the precipitation of chromium in slightly alkaline solutions.

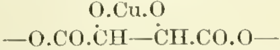
As to possible sources of these compounds in chrome liquors, it is conceivable that they might be formed in quantities sufficient to prevent tanning by reducing the bichromate with impure sugars or by reducing under improper conditions. Sugars themselves are hydroxy-compounds, and very probably yield an abundance of hydroxy-compounds of smaller molecular weights when the oxidation is very incomplete or is carried on at too low a temperature, and it is known that under certain conditions mucic and saccharic acids are formed by the oxidation of carbohydrates. An experiment was tried reducing bichromate at as low a temperature as possible with a commercial dextrin. The result was a liquor which did not at once give a precipitate upon rendering slightly alkaline and became turbid only on long standing. A piece of skin immersed in it tanned with difficulty, and only after adding an excess of sodium bicarbonate. In colour and feel the leather resembled that from No. 2 in the experiments with Rochelle salt.

To deal with the very complex nature of the formation of hydroxy-compounds from the incomplete oxidation of the sugars is beyond the scope of our present research. We shall not even attempt an explanation of the exact reason why the chrome liquor in question behaved as it did. It is sufficient for our purpose to state that, in order to ensure the production of a satisfactory chrome liquor by reducing bichromate with sugars, it is necessary to use reasonably pure sugar, and conditions found to produce a satisfactory liquor should be closely adhered to.

Since sugars themselves are hydroxy-compounds, it might seem that an excess of sugar in a chrome liquor would prevent tanning. As a matter of fact, an excess of sugar, although it produces the fulness characteristic of the effect produced by Rochelle salt, does not prevent tanning, even when present to the extent of 20%. An explanation of why sugars do not prevent tanning is offered by a consideration of the action of Rochelle salt in forming metallic complexes. Rochelle salt has the formula,

$$KO.CO.CH(OH).CH(OH).CO.ONa.$$

This salt ionises not only into sodium, potassium, and tartrate ions, but the tartranion ionises slightly to a still further extent by giving off hydrogen ions from the hydroxyl groups. Since the sodium salt formed by replacing the hydrogen of the hydroxyl groups by sodium is readily ionisable, the addition of sodium hydroxide to a solution of Rochelle salt will result in the neutralisation of the hydrogen ions, and a consequent increase in concentration of the tetravalent negative ion. But this negative ion forms with the heavy metal salts which are very slightly ionised. The most familiar example of this is found in Fehling's solution. When copper sulphate is added to an alkaline solution of Rochelle salt a slightly ionisable cupri-tartrate-ion is formed,



$$\overset{O.Cu.O}{—O.CO.\dot{C}H—\dot{C}H.CO.O—.}$$

It is evident from the foregoing that, if the hydroxyl groups of a certain compound readily give off hydrogen ions, and if the resulting negative ion forms a very slightly ionisable salt with the heavy metals, no addition of alkali will be necessary to form the metallic complexes. But, if the hydroxyl groups do not ionise sufficiently readily an addition of alkali will be required to bring the concentration of the negative ion up to the point required to combine with the metal ion.

This is evidently the case with sugar. If the salt of a heavy metal is added to a solution of sugar, a considerable excess of alkali is required to form the complex. On the other hand, Rochelle salt forms the complex with chromium without addition of alkali.

The formation of the metallic complexes with hydroxy-compounds is discussed somewhat in detail because of its bearing upon points to be discussed presently.

It was originally intended that this research should consist only of a few simple experiments to determine possible reasons why certain chrome liquors refused to tan. But it soon became evident that the subject is rich in possibilities both for theoretical and practical work. Many ideas for the practical application of the principles discussed presented themselves. Of these we shall mention the most promising, leaving it to those to whom any point appeals directly to carry on the research in greater detail.

Probably the most important property of Rochelle salt in this connection is its power to strip chrome leather of its chromium. This property was suspected from the fact that the salt will redissolve precipitates of chromium hydroxide. A piece of chrome leather was immersed in a normal solution of Rochelle salt over night. Upon subjecting to the boiling test, it was found to be no longer tanned. It was then washed and immersed in a fresh chrome liquor. It was soon again fully tanned, showing that chrome tanning is a reversible process.

Experiments were then tried to see how completely it was possible to strip the leather. A piece of air-dried chrome calf was immersed in a cold, normal solution of Rochelle salt and allowed to stand for two weeks. The liquor was coloured a deep green. Upon being washed the skin resembled a bated calf skin, and was found to contain no appreciable amount of chrome. In this case the slow action was due to the low temperature of the liquor. A piece of chrome calf placed in such a liquor at 100° C. soon shrinks to a gummy mass.

There is a point which has long been a puzzle to many tanners. A hide is much easier to split after it has been chromed than in the raw state. But these tanners have not found nearly such a demand for chrome splits as for splits tanned with such materials as quebracho and mimosa bark. It might prove valuable to give the hides a light tannage with chrome, then split, and then strip the splits of their chrome by immersion in Rochelle salt solution. After washing they should be in a condition favourable for tanning with quebracho or mimosa bark.

Since hydroxy-compounds form complexes with other metals, including iron, Rochelle salt might conceivably be used for removing or preventing so-called salt stains. A stain produced by iron and sulphide was easily removed in this way. Treatment with Rochelle salt before liming might prove of advantage in some cases to prevent the formation of iron stains. The skins are easily washed free from the salt.

It is possible that a bath in Rochelle salt solution previous to tanning might be preferable to pickling for some kinds of leather. In the case of heavy leathers this possibly would result in a lighter, but more uniform, preliminary tannage. Such leather should be capable of taking up a much larger proportion of chromium upon being retanned in a fresh liquor, because of the even distribution of the chrome in the preliminary tannage.

While the presence of a large amount of hydroxy-compounds will prevent tanning, a small quantity does not, but does produce a fulness and softness in the leather not otherwise obtained. Many tanners have found that an excess of glucose in their liquors is desirable. Probably small amounts of Rochelle salt would produce the desired effect. The point is at least worthy of consideration.

Another use of this salt lies in its power to strip chrome leather which has been "case-hardened." If very basic chrome liquors are used in tanning there is danger of the interior of the skin absorbing acid while the chrome is being precipitated or fixed upon the surface. The surface becomes heavily tanned while the interior is still in a raw, acid condition. A very long time is required for such a condition to right itself, but the trouble could be overcome easily enough by stripping with Rochelle salt, washing, and retanning in a fresh liquor.

And finally, this stripping power of hydroxy-compounds can be applied to the conversion of chrome shavings and cuttings into glue stock. Pieces of air-dried chrome leather were stripped of their chrome and then converted into glue and gelatine in the usual manner. The importance of this fact needs no emphasis ; it is obvious.

In all of the points discussed the theory of the formation of these complexes should be constantly borne in mind. It will then be evident that, in stripping, the solution must not contain any strong acid. The presence of acid would repress the ionisation of the hydroxyl groups (in which hydrion is liberated) to such an extent as to make the formation of these metallic complexes impossible. In fact, the addition of strong acid to one of these complexes will decompose it, the action being reversible. An alkaline solution is most favourable to the formation of these complexes, and where the presence of alkali will do no harm it will greatly accelerate the rate of action.

Since the property of Rochelle salt which has just been discussed is common, in a greater or lesser degree, to all hydroxy-compounds, the tanner has a wide choice in selecting substances most suitable for his purposes. Rochelle salt might prove too expensive to use freely as a stripping agent, but its use might be made practicable if the salt and chrome could readily be recovered. It is found that this can to a large extent be effected by the addition of sulphuric acid to neutralise the equivalent of soda and reconstitute the acid potassium salt, which is very little soluble and rapidly crystallises out, so that it can be separated and used again with a suitable addition of soda, while the chrome can be precipitated from the mother-liquor as chromium hydroxide. Crude acid potassium tartrate ("tartar") dissolved with addition of soda would be the cheapest source of Rochelle salt. A mixture of equivalent quantities of lactic acid and sodium carbonate might serve the purpose just as well and would probably be a little cheaper. The practical applications of the principles discussed are problems for the tannery chemist, who, it is hoped, will find this work of value. It is also possible that uses may be found in other industries, as, for instance, in the stripping of chrome-mordanted wool.

DISCUSSION.

Mr. J. T. **Wood** said that the paper contained a number of very valuable suggestions. The remarks upon the removal of salt stains were very interesting and ought to be followed up, because those stains were the cause of great loss, especially in France. The suggestion also about splitting and stripping the split was also very good. The Austrians and the Germans were the first to introduce splitting of kips, and in that way they had secured practically the whole trade. Now there were large quantities of them about, and nobody, except the Germans, were prepared to use them. Mr. Trotman had invented a process for stripping chrome leather, in which sodium peroxide was used ; in that case he took it that the skin would not be of much use afterwards. The process was used for stripping chrome shavings, and a great quantity had been so treated by the process.

Mr. R. F. **Innes** said that the recovery of chrome, and also of Rochelle salt, was an important point. Recovery was always difficult in the case of liquors. In his own business hundreds of tons of chrome were allowed to run to waste. That was going on throughout the world, and no attempt seemed to be made to recover such a waste.

Mr. J. M. **Wilkie** said his own view was that an increased demand for tartaric acid seemed to be out of the question. They were dependent upon the wine industry for tartrates, and the tendency now seemed to be to decrease production of wine. In ordinary circumstances there was great difficulty in getting sufficient tartrates for ordinary demands. He wondered whether it would not be better to use some other hydroxy acid.

Mr. **Wood** said that English lactic acid was not so strong as either American or German.

Professor **Procter** said that lactic acid was not a very dear acid in the crude form in which it was used in tanning.

Replying to the Chairman, Mr. **Wilson** said that there were a great many other sources from which hydroxy-compounds could be obtained. For instance, saccharic acid might be obtained from the decomposition of sugar.

Professor **Procter**, in reply, said that they had not considered the practical aspects of the problem as to cost. The investigation was suggested by the fact that certain samples of glucose, and especially white glucose, and glucose syrup, yielded liquors which were dull violet instead of blue-green, and which absolutely would not tan. Under proper control this tendency might be used to get such results as were required. He did not think it was necessary to reject chrome liquors to the extent which was commonly done, and one of his earliest efforts in tanning analysis was to invent control methods through which liuqors could be strengthened for re-employment. A very small quantity of Rochelle salt would give a fuller feel; it made a thicker leather, and if tanning could be continued, a thicker and plumper leather altogether, well adapted to market requirements, would be produced. Sugar had some effect, but it was not so powerful as Rochelle salt.

THE USE OF NICKEL HYDROXIDE IN TANNIN ESTIMATION.

BY PURAN SINGH AND T. P. GHOSE, B.SC.

Forest Research Institute, Dehra Dun, India.

As shown in a paper on this subject by one of us (this Journal, 1911, 30, pp. 936—937), freshly precipitated nickel hydroxide serves as an excellent substitute for hide powder in the estimation of tannin. Situated as we are in India, our supplies of standard hide powder at times run short, and a reliable substitute for hide powder is a great desideratum. With this object in view, we have continued our experiments on the use of nickel hydroxide as a substitute.

Dr. H. H. Mann, of the Poona Agricultural College, was kind enough to compare the nickel hydroxide method with the copper acetate method, which he has been using for years in tannin estimation, and with the hide powder method, with the results shown in Table I.

Table I.

	Babul pods (Pods of *Acacia arabica*).	Tarwad (*Cassia auriculata* whole plant).
	Tannin %.	Tannin %.
Nickel hydroxide paste method ..	26·3	0·7
Hide powder method	23·7	0·84
Copper acetate method	26·6	0·60

A practical difficulty, however, confronted us in the preparation of pure nickel hydroxide free from sulphate. In the form of freshly precipitated paste, we found it extremely difficult to wash it free from sulphate except in very small quantities. The word "paste" carried no definite idea of the percentage content of nickel hydroxide contained in it. For these reasons, we had eventually to abandon the use of paste and to use the fine powder of nickel hydroxide instead. For the purpose, we obtained Kahlbaum's extra pure nickel hydroxide, which, to our great surprise, contained traces of sulphate. After repeated washing with hot water and finally with water containing traces of tannic acid, we got it free from sulphate and in a fairly granular condition. This

Table II.

Serial No.	Description.	Quantity contained in 500 c.c. grms.	Quantity absorbed by nickel hydroxide powder. grms.	Quantity absorbed by chromed hide-powder. grms.
1	Tannic acid	4·56	4·26	4·41
2	Gallic acid	4·52	3·92	3·12
3	Glucose	4·76	2·06	2·36
4	Cane-sugar	4·94	2·79	2·39
5	Tannic acid and gallic acid	2·28 2·26	3·90	3·00
6	Tannic acid and glucose	2·28 2·38	2·55	2·26
7	Tannic acid and cane-sugar	2·28 2·45	2·43	2·48

Table III.

Description of material.	Moisture	Soluble solids	Non-tannin by nickel hydroxide	Non-tannin by hide powder	Tannin by nickel hydroxide	Tannin by hide powder
	%	%	%	%	%	%
Mangrove bark	12·02	42·80	8·85	7·60	33·95	35·20
Mangrove extract	14·33	86·00	12·87	9·46	73·13	76·54
Sal (*Shorea robusta*) bark	10·19	26·70	7·11	8·03	19·59	18·67
Sal extract	16·09	75·80	13·23	12·55	62·57	63·25
Cassia auriculata bark	9·89	32·06	8·64	10·62	23·42	21·44
Do. do.	—	31·55	8·32	9·74	23·23	21·81
Myrobalans, pulp	14·98	70·04	11·09	14 88	58·95	55·16
Do. another sample	9·59	70·16	12·96	16·73	57·20	53·43
Myrobalan extract made at Dehra Dun	11·19	80·36	28·20	28·80	52·16	51·56
Gambier (3·56% asb)	9·83	78·56	18·16	22·56	60·40	56·00
Commercial Katha from Dahra Bazar*	5·02	24·64	7·01	2·69	17·63	21·95
Terminalia tomentosa bark	7·81	14·32	3·91	3·36	10·41	10 96
Babul pods with seeds	10·64	18·96	8·26	10·94	10·70	8·02
Babul (*Acacia arabica*) bark	9·41	19·84	6·53	8·18	13·31	11·66
Pulp of the fruits of *Zizyphus xylopyra*	10·50	58·72	27·41	28·71	31·31	30·00
Cassia fistula bark	7·91	19·39	5·30	6·94	14·09	12·45
Rhus cotinus leaves	—	21·77	8·20	11·20	13·57	10·57
Do. do. a poorer sample	10·73	10·68	5·19	4·35	5·49	6·33
Do. do. another sample	11·26	10·20	4·93	3·91	5·27	6·29
Do. do. do. autumn sample from young tree	9·76	30·00	13·46	16·68	16·54	13·32
Do. do. from old tree	10·30	38·16	12·88	17·20	25·28	21·48

* A sample heavily adulterated with clay (65·65% ash).

nickel hydroxide has been used in the experiments described in this paper.

It has already been shown that nickel hydroxide forms definite chemical salts with tannic acid (this Journal, 1911, **33**, pp. 172—173). It also forms an insoluble salt with gallic acid. The solutions of tannic acid, gallic acid, glucose, and cane-sugar of known strength were treated with chromed hide powder and nickel hydroxide under similar conditions, with the results shown in Table II.

These tests gave sufficiently encouraging results to make comparative estimations with a number of tanning materials, the results of which are shown in Table III.

From these results we conclude that instead of nickel hydroxide paste, as originally proposed, the nickel hydroxide should be used in the form of powder. All other precautions as to extraction and the concentration of tan liquor remain the same; instead of hide powder 20 grms. of nickel hydroxide free from water should be added for detannisation. Only in the case of Babul pods it was seen that the nickel tannate formed was in such a minute state of division that it would not settle, and the filtrates obtained were somewhat turbid. This was overcme by mixing the filtrates with well dried kaolin and passing once more through fresh filters.

We are using this method of tannin estimation in this laboratory, and we consider that it is as reliable as the hide powder method, perhaps preferable to it, considering that nickel hydroxide is unlike hide powder a standard substance, and that this method can be used in all cases where organic and mineral acids likely to dissolve nickel hydroxide are not present.

Discussion.

Mr. J. T. Wood asked Professor Procter what advantage, if any, nickel hydroxide had over sprouted alumina; the latter was a definite compound, and seemed to absorb tannin and reject gallic acid; that was what was wanted.

Professor Procter said that however excellent nickel hydroxide might be as an absorbent material, it was hardly worth discussing, at least for commercial purposes, as the method could only be empirical, and the hide powder method under present conditions had firmly established itself as an empirical commercial method, and also had the advantage, perhaps not very real but appealing to the tanner, that it attempted to be an actual tanning process on a small scale. Nickel hydroxide was not by any means the only material which could be used successfully in a similar way. In 1904 Professor H. Wislicenus (see this Journal, 1904, 765), prepared aluminium hydroxide by treating the metal with a trace of mercuric chloride, with which he obtained results probably as satisfactory as those with nickel hydroxide, but which for the reasons cited above never came into use. Probably also other hydroxides might be substituted in the same way. Nickel hydroxide seemed to be inferior to hide powder as regards distinguishing gallic acid from tannin, though neither was particularly satisfactory in that respect. Some of the results with particular tannins and with mixtures of tannin and gallic acid also appeared to be anomalous. But if nickel hydroxide were more easily obtained in remote districts than hide powder, there seemed to be no reason why the method should not be used as a preliminary one in forming a judgment for forestry purposes. A method was quoted, but without reference, for the determination of tannins with copper which also appeared, at least in the cases noted, to give satisfactory results. It had long been known that copper methods with certain tannins were capable of considerable concordance and accuracy, but a large class of tannins gave precipitates which were soluble in ammoniacal copper solutions, and for which therefore these could not be used. It was possible, however, that some copper salt of a suitably weak acid, or copper sulphate mixed with a neutral salt of such an acid, might be used direct to precipitate tannins, and if a method of that sort could be found which would give rapid, if even only approximate results, it would be of great value in the practical control of the tanning process, for which a rapid method was much wanted, even if it were quite unsuitable for the commercial analysis of extracts. On theoretical grounds he was extremely doubtful whether most of the tannins were capable really of forming definite salts at all; certainly most of the compounds should rather be regarded as colloidal precipitates than as true salts in the ionic sense.

Mr. Wilkie referred to the paper by D. B. Dott (this J., 1915, 1124), in which the use of copper salts was advocated.

Mr. Wood said that the only criticism Mr. Dott had made was that two chemists did not get identical results. The results appeared to show satisfactory concordance in the case of sumach, although the extraction appeared to have been at fault. In a paper which he (Mr. Wood) had read at Brussels some years ago, he showed that it was impossible to obtain identical results, because the colloidal precipitate varied.

Professor Procter said that an ingenious method had been suggested at one of the meetings of the Leather Chemist's Association, in which the tannin solution was put in an aluminium basin and an alternating electric current passed through the basin, producing alumina; it appeared to give very satisfactory results as compared with other methods, including the hide powder method. Sumach was an extremely difficult material to extract satisfactorily.

Yorkshire Section.

Meeting held at the Queen's Hotel, Leeds, on Monday, November 29th, 1915.

MR. F. W. RICHARDSON IN THE CHAIR.

THE ANALYSIS OF WAXES WITH SPECIAL REFERENCE TO BEESWAX AND WOOL WAX.

BY F. W. RICHARDSON AND G. A. BRACEWELL.

The analysis of waxes has not, we think, received that amount of attention which has been given to the oils and fats. Although the general literature upon the subject of waxes is considerable, nevertheless even the larger text books give little more than the specific gravity, acid and ester values, and in a few, but not by any means all cases, the iodine values.

Some time ago we decided to investigate more closely the composition and constants of the more important waxes. The methods we have adopted are, with slight modification, those generally employed in oil and fat analysis, and whilst we have not made any startling discoveries, or added many new methods, we venture to think that our results may be of assistance to others, who, like ourselves, have had cause to investigate these substances more closely.

Beeswax.

At the first glance the analysis of beeswax would seem to be easy of accomplishment, definite substances as cerotic acid and myricyl palmitate only having to be dealt with. Indeed, the method usually adopted appears to indicate that the question is of ready solution. The determination of the acid, ester, and saponification values, with the ratio of the acid value to the ester value, is all that is commonly attempted.

The characteristics of the unsaponifiable and saponifiable portions of pure beeswax are not sufficiently described even in the largest text books, and one wonders whether the difficulty of obtaining pure products is not responsible for this. We have been baffled many times in our efforts to separate the pure unsaponifiable and saponifiable matter of beeswax. The conversion of the wax into a mixture of myricyl alcohol and the soaps of lead and other metals, with subsequent extraction of the powdered mass in a Soxhlet apparatus, using several solvents, has been a failure in our hands. The solvent has taken up very appreciable amounts of the fatty acid salts of lead.

Our method is to add 50 c.c. of roughly $N/2$ alcoholic potash to 5 grms. of the wax in an oil (or CO_2) flask, and evaporate the mixture almost to dryness on the water-bath. After emulsifying with boiling water the mass is transferred to a large separator.

By using relatively large volumes of petroleum ether and tightly corking the separator before shaking, thus operating both with heat and pressure, it is possible to separate all the unsaponifiable matter from the saponifiable, and to obtain both in a pure form. It may be necessary to use a litre of petroleum ether to do this, but the end justifies the means.* The unsaponifiable matter so obtained from three English waxes and one foreign wax gave no trace of ash on incineration, and yielded the following figures :—

	Min.	Max.	Average.
Hübl iodine value	5·42	10·04	8·06
Butyro-refractometer at 75° C.	20·9	22·00	21·30
Refractive index at 75° C.	1·4383	1·4392	1·4386

The refractive indices at once furnish a guide as to the presence or absence of such hydrocarbons as those constituting paraffin wax and ceresin, since these, on the average, give about half the butyro-refractometer reading, *i.e.*, ceresin 11·6 and paraffin wax 9·6.

The saponifiable matter from the waxes gave :—

	Min.	Max.	Average.
Melting point, ° C.	50·0	58·4	53·9
Butyro-refractometer at 50° C.	30·3	32·5	31·1
Refractive index at 50° C. ..	1·4454	1·4470	1·4460
Calculated butyro-refractometer at 75° C.	14·8	17·0	15·6
Hübl iodine value	7·7	14·06	11·9

Pure cerotic acid melts at 77·8° C. ; it is therefore evident that here a large proportion of fatty acids of lower melting point is present.

In the last edition of Dr. Lewkowitsch's work on Oils, Fats, and Waxes, there is a footnote to the effect that Marie has found in beeswax about 30 to 40 % of acids homologous to cerotic acid. R. Berg (Z. Unters. Nahr. u. Genussm., 1909, **18**, 390) states that the portion of the fat acids dissolved from beeswax by 80 % alcohol consists for the very least part of cerotic acid, and is composed of unknown acids which may appear in the bleached wax partly as palmitic acid. Berg also suggests that the presence of lactones may account for the difficulties met with in attempts to saponify beeswax. A curious feature in the tabulated data just given is the uniform *increase* in the refractive indices and iodine values in harmony with the melting points, yet with the ordinary fat acids the reverse is the case, the melting point increasing, whilst the refractive indices and iodine values *decrease*.

We wish to utter a plea in favour of the fixing of one uniform temperature for taking the refractive indices of fats and waxes. No two observers seem to adopt the same standard, so that indices at all temperatures from 20° to 75° C. are recorded.

A temperature of 75° C. is very high, and puts some strain upon the instrument and is also difficult to maintain, so we suggest 50° C. for all ordinary cases, with 75° C. for waxes and their products with melting points above 50° C.

We have not been able to find any data in regard to the saponifiable portion of beeswax, and we trust our figures may be useful. The presence of tallow would soon reveal itself in the light of these factors, although the refractive index is not of much help.

	Beeswax fat acids.	Tallow fat acids.
Melting point, ° C.	53·9	46
Butyro-refractometer at 50° C.	31·1	28·2
Hübl iodine value	11·9	46·0

Undoubtedly the best method for estimating tallow or any glycerides in beeswax is to determine the glycerol and, after making due allowance for any reducing agent obtained along with the glycerol in the process and due to the wax itself, to multiply by 10·0.

Here again the determination of glycerol in beeswax is not a very easy matter. Mere saponification and subsequent heating with dilute sulphuric acid furnishes a filtrate in which the glycerol may be readily estimated in ordinary fats and oils ; but this method gives far too high results when applied to beeswax. We find that this is due to the presence of honey unavoidably left in the wax. Before commencing the estimation of glycerides the sample must be repeatedly extracted with boiling water until the concentrated filtrate no longer reduces Fehling's solution.

Five grms. of the sample thus purified is boiled with 50 c.c. of $N/2$ alcoholic potash in an oil flask. The mixture is heated on a water bath to expel all alcohol. To this end two or three concentrations, after addition of boiling water, are necessary. The pasty mass finally obtained is neutralised with acetic acid, and after further dilution it is mixed with a slight excess of basic lead acetate.

The mass is filtered and the precipitate thoroughly washed with cold water. From this the lead is removed by sulphuric acid, and after concentrating the filtrate from the well washed lead sulphate the bichromate method is applied (see Richardson and Jaffe, this J., 1898, 330). Colophony or resin can be readily found by the well-known process depending upon the relative insolubility of cerotic acid and its homologues in hot 50 % alcohol. To estimate the resin and any stearic acid it is best to proceed as in the determination of the acid value, make the hot solution in carbon tetrachloride neutral to phenolphthalein, and then remove the glycerides and the myricyl alcohol, etc., and any hydrocarbons, by means of boiling petroleum ether. From the aqueous soap solution the fat acids are recovered in the customary way. Resin gives to these a very high refractive index and iodine value. Gladding's process can be applied for corroboration.

	Resin (saponifiable)	Saponifiable of beeswax.
Butyro-refractometer at 50° C...	152 (Calc.)	31·1
Iodine value (Hübl)	160 (18 hrs.)	11·9

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* Mr. Reginald Harrison, working in Mr. F. W. Richardson's laboratories, found that after the beeswax is fully saponified and the alcohol removed by evaporation, the presence of 40 % of alcohol, in the form of methylated spirit, will enable the unsaponifiable matter to be extracted by means of benzol, the liquid being made as hot as possible.

The refractive values of the resin are determined by the aid of mixtures or dilutions in coconut oil fatty acids.

Having separated free cerotic acid and its homologues and the resinic and stearic acids, saponification of the remaining portion furnishes the fatty acids from such glycerides as Japan wax and tallow.

	Japan wax.	The fatty acids of tallow.	Beeswax.
Melting point, ° C.	57	46	53·9
Refractive index at 50° C.	30 (Calc. from 84° C.)	28·2	31·1
Iodine value (Hübl)	10·5	46	11·9

The fatty acids of Japan wax are so similar to those of beeswax, that without knowing the percentage of glyceride, giving the total percentages of Japan wax and tallow, the calculation of the actual amount would be difficult, and in some cases practically impossible.

Carnauba wax is said to be used as an adulterant of beeswax. In our experience far less costly substances are employed. Carnauba wax is characterised by its high melting point (86° C.) and its low acid value (4·0). Lewkowitsch quotes Berg to show that carnauba wax gives a butyro-refractometer reading half as high again as beeswax. We calculate beeswax and carnauba wax at 75° C. to give readings of 24 and 47 respectively. There are several points of resemblance between carnauba wax and beeswax, yet one is the exudation of the leaves of a palm and the other is the secretion of an insect. Both yield about the same amount of unsaponifiable matter, and contain ceryl and myricyl alcohols.

A process which seems to offer fruitful conclusions is that based upon the amount of hydrogen evolved when the wax is heated with potash lime. Originally Hell and later Buisine have detailed the mode of procedure, and we have closely followed the particulars given by the latter author.

As is well known, an aliphatic alcohol, myricyl alcohol, for example, when heated with potash lime, gives a molecule of the corresponding fatty acid and two molecules of hydrogen :—

$$C_{30}H_{61}OH + KOH = C_{30}H_{59}O_2K + 2H_2.$$

Following Buisines's process, we melted 1 grm. of beeswax with 1 grm. of pure powdered potassium hydroxide. The cooled wax was ground up with 3 grms. of potash lime (1 of KOH to 2 of $Ca(OH)_2$). Departing now from Buisine we used the Richardson and Jaffé modified eudiometer (this J., 1910, 29, 198), transferring the wax mixture to a hard glass test-tube. This was connected with the eudiometer by means of a rubber cork and then immersed in copper filings in a tin, into which also were placed a thermometer and a modified Reichert's thermo-regulator. Prior to connecting the tube the air was exhausted by a water pump, so that very little more time was needed to produce a complete vacuum in the apparatus. It was not a difficult matter to keep the temperature constant within 2°, and to maintain it very near to 250° C. The hydrogen came off very gradually, and some five hours were required to complete the evolution of gas. We thus obtained 50·4 c.c. of pure hydrogen calculated at normal temperature and pressure. We should have recovered 53·5 to 57·5 c.c.

A mixture of 5·05 % of resin, 30·3 of paraffin wax, 32·3 % of tallow, and 32·35 of beeswax was now tested similarly ; 1 grm. gave 30·5 c.c. of hydrogen, whereas it should only have yielded 16·2 c.c. Again, 1 grm. of a mixture of 4·10 % of stearic acid, 26·5 % of ceresin, 32·2 % of tallow, and 37·2 % of beeswax gave 62·8 c.c. of hydrogen at normal temperature and pressure, or much more than a pure beeswax would have done. In this case the temperature never exceeded 250° C., and the gas came off steadily during 6 hours.

Lewkowitsch says : " If oleic acid be present the temperature should not be allowed to exceed 250° C., as otherwise palmitic acid may be formed with evolution of hydrogen."

$$C_{18}H_{34}O_2+2KOH=C_{16}H_{31}O_2K+C_2H_3O_2K+H_2.$$

We applied the method to 1 grm. of pure oleic acid, and found that at 250° C. it gave no hydrogen. It is, therefore, evident that some other of the adulterants gave the excess of hydrogen.

We applied the process to 1 grm. of tallow and, although the temperature did not exceed 250° C., we obtained 62·8 c.c. of gases. We find that it is the glycerol liberated by the alkali which produces the gas. Glycerol treated in the same way gives off large volumes of hydrogen mixed with some methane.

The presence of stearin, *i.e.*, glyceryl stearate, would therefore vitiate the accuracy of Buisine's method. One grm. of ceresin gave 3·4 c.c. of hydrogen, proving still further that until the potash lime process is better understood its results are valueless when applied to the adulterated wax. Obviously the best results can only be obtained by the application of the Buisine process to the unsaponifiable portion of the sample.

The acetyl value naturally suggests itself as a ready means of estimating the amount of myricyl alcohol in the unsaponifiable portion. In this manner one can calculate indirectly the percentages of paraffin wax and ceresin, which have no acetyl value. Three undoubtedly genuine beeswaxes gave unsaponifiable matter with acetyl values of 91·14, 109·7, and 94·52 respectively (mean value 98·45). Assuming 90 and 110 as the extremes, and calculating upon an adulterated beeswax unsaponifiable matter with an acetyl value of 50, we should find 55·55, or 45·45 % of beeswax unsaponifiable, an error of 10 % ; it is therefore obvious that other data would have to be taken into consideration if a more accurate determination were necessary.

Archbutt and Deeley, in their work on " Lubrication and Lubricants " (p. 224), give acetyl values of the unsaponifiable matter of beeswaxes as 99 and 103, in fair harmony with our own figures.

Wool wax.

As in the case of beeswax, the extraction of the unsaponifiable matter presents some difficulties.

Benzol, and mixtures of ether and benzol, have been suggested as extraction media, but we have not found these substances satisfactory in practice ; a mixture of ether and benzol takes up a large quantity of water and with it, of course, some of the wool fat soap. We have tried various methods of saponification, including the ethoxide method, but we have not found any advantage in this over the use of a strong alcoholic potash solution.

We proceed to extract the unsaponifiable matter as follows :—About 2½ to 3 grms. of the wax is weighed off in an oil flask, and a considerable excess (50 to 60 c.c.) of normal alcoholic potash solution is added, with a few grains of laboratory sand. The flask is connected with a cork and glass tube bent over at an angle of 60°, and leading into a small flask which acts as receiver for the condensed spirit.

The contents of the oil flask are caused to boil vigorously on the water bath, and the flask is repeatedly shaken to ensure complete mixing. The alcohol is now completely evaporated off, and when the residue is quite dry, it is treated with a boiling mixture of equal volumes of spirit and water. The mixture is now introduced into a separator, and the flask completely washed out with more boiling spirit and water.

Whilst the liquid is still almost at boiling point, petroleum ether is added, and the separator tightly corked with an ordinary cork, wrapped in a duster, and well shaken, the cork being held in all the time. The alcoholic layer is now run off carefully into a second separator, and the petroleum ether solution washed with a little hot water and alcohol, and added to this solution. The separator containing the alcoholic soap solution is now plunged into a boiling water bath till it has attained the temperature of the bath, and then the extraction is repeated.

In all about 7 such extractions are necessary. A feature peculiar to wool wax is the formation in the petroleum ether layer of a flocculent deposit of a soap which is difficultly soluble in alcohol and water. This is filtered off and treated with boiling dilute hydrochloric acid, the liberated fatty acids are extracted with petroleum ether, and the solution obtained used to extract the soap solution, after acidification with hydrochloric acid. In this way the unsaponifiable and saponifiable portions of the wax are completely separated.

Three samples of pure wool wax gave the following values:—

Hübl iodine value	25·05	25·09	28·58*
Acid value	3·87	5·20	—
Butryo-refractometer at 50°	76·6	76·0	76·4

* Lanoline.

Saponifiable matter:			
Free fatty acids	1·95	2 6	trace
Neutral esters	57·93	54·70	49·07
Unsaponifiable matter	40·12	42·69	50·93

Three samples of commercial wool fat, *i.e.*, obtained from wool washings and, therefore, containing soap fatty acids, gave the following values:—

Saponifiable matter:			
Free fatty acids	43·51	21·33	19·52
Neutral esters	32·07	45·98	45·32
Unsaponifiable matter	24·42	32·69	35·16

The free fatty acids were removed from these commercial samples with ether, and the neutral waxes then gave:—

Saponifiable matter	56·77	58·45	56·32
Unsaponifiable matter	43·23	41·55	43·68

Thus, with the exception of lanoline, which doubtless has suffered removal of some of the saponifiable matter during purification, these samples yield about 42% of unsaponifiable matter.

The separated saponifiable and unsaponifiable matters were next separately examined. The saponifiable matter gave:—

	Pure.		Comm.	
Hübl iodine value	9·20	8·94	8·48*	9 41
Melting point	44·5	35·5	42	43
Butyro-refr. at 50°	47	42·3	39	41·6
Neutralisation value	136·6	152·1	159·8	154·3

* Lanoline.

The unsaponifiable matter gave:—

	Pure.		Comm.	
Refractive index at 50° C	1·4895	1·4950	1·4930	1·4950
Hübl iodine value	40·38	50·49	50·24	48·7
Acetyl saponif. value	142·8	135·4	129·2	130

The average composition of wool wax may thus be given as—Saponifiable matter: Free fatty acids, 2%; neutral esters, 56%. Unsaponifiable matter, 42%.

The wax itself has the following values:—Hübl iodine value, 25; acid value, 4; butyro-refractometer at 50° C., 76. The fatty acids in the saponifiable matter have the following characters: Hübl iodine value, 8·5—10; m.pt., 42° C.; butyro-refractometer at 50° C., 45; neutralisation value, 136—150. The unsaponifiable matter has a refractive index of 1·489—1·495, Hübl iodine value of 40—50, and acetyl saponification value of 135.

Meeting held at Leeds University on Monday, December 13th, 1915.

Messrs. A. Gallenkamp and Co., of Sun Street, Finsbury Square, London, exhibited a number of their patent electric furnaces, including tube furnaces, with one, two, or four tubes, and muffle furnaces. These furnaces are of simple design, and combine a low current consumption with high efficiency.

The laboratory of the Fuel Department of the University was also inspected, and work being done for the Government in connection with the extraction of benzol and toluol from coal tar was very fully explained.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—
English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.
United States.—1*s.* each, to the Secretary of the Society.
French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive. Belin et Cie., 56, Rue Ferou, 8, Paris (3e); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Factors affecting economy in vacuum pans. Kerr. *See* XVII.

Patents.

Separating solid substances from liquids or liquid masses by suction; Devices for ——. H. Hencke, Charlottenburg, Germany. Eng. Pat. 24,040, Dec. 14, 1914.

The solid material is detached from the surface of suction-drum filters of the type described in Eng. Pat. 29,358 of 1904 (this J., 1906, 7), by a roller or cylinder, which operates by suction and bears resiliently against the filtering drum. To prevent injury to the textile filtering material on the surface of the filtering drum, the solid matter removed by filtration may be deposited on a layer of starch powder, coal dust, kieselguhr, or other permeable material retained on the surface of the drum by suction.—W. H. C.

Separating solids from liquids; Apparatus for ——. H. E. Wetherbee, Assignor to R. F. Grant, Cleveland, Ohio. U.S. Pat. 1,163,875, Dec. 14, 1915. Date of appl., Feb. 27, 1915.

The mixture of liquid and solid matter is fed into one end of a box provided with a baffle-plate; at the other end of the box is a vertical cylinder which can be rapidly rotated. The lower end of the cylinder, which is kept clear of the bottom of the box, has the shape of an inverted cone, and is open, and the upper end, which is provided with water-discharge openings, projects upwards through the bottom of a launder which is fixed above the box and into this the liquid is discharged. The cylinder has inwardly projecting ribs on its inner surface.—W. H. C.

Filtering process. A. Burger, New Brighton, N.Y. U.S. Pat. 1,164,065, Dec. 14, 1915. Date of appl., May 25, 1912.

The supply of liquor to be filtered is stopped when the chambers of the filter-press are partly filled, and wash water is introduced into the spaces between adjacent cakes and forced through the cakes. Compressed air is then introduced to expel the wash water from the cakes.—W. H. C.

Filter. C. Butters, Oakland, Cal. U.S. Pat. 1,165,068, Dec. 21, 1915. Date of appl., Oct. 22, 1913.

A number of superposed shallow pans containing filtering medium, and provided with overflow lips at one end, are fixed in an open frame. The material to be filtered is fed simultaneously on to the filtering medium in each pan, whilst the frame is tilted and the filtrate drawn through the filtering medium.—W. F. F.

Crushers; Gyratory ——. Power and Mining Machinery Co., New York, Assignees of R. Bernhard and J. M. Sholl. Eng. Pat. 4141, Mar. 16, 1915. Under Int. Conv., July 23, 1914.

A valveless pump within the casing of a gyratory crusher, and operated by the eccentric, circulates lubricating oil through the bearings of the eccentric. —W. H. C.

Drying drums; Process for preventing adhesion of the material to the feed shoots of ——. C. Kochen, Krefeld-Bochum. Ger. Pat. 285,817, Apr. 23, 1914.

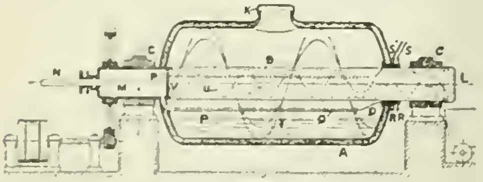
The feed shoot is provided at its upper end with a tube which is connected with a blowing or exhausting device, so that a current of air, to which dust may be added, may be forced or drawn between the bottom of the shoot and the material supplied to the shoot from a hopper. —A. S.

Drying apparatus: Shaft ——. W. Jäger, Halle. Ger. Pat. 286,984, Jan. 10, 1914.

The material descends the shaft in a zig-zag path between two oppositely inclined louvre-walls, and bars for loosening the material are arranged at places where change of direction occurs. The loosening bars are carried by hooks which fit over the edges of the louvre-bars, so that the bars may be easily removed or replaced.—A. S.

Furnace for the preparation of chemical or metallurgical products under pressure. E. Barthelmess, Neuss. Ger. Pat. 286,136, July 27, 1913.

A tube, B, the ends of which are mounted in bearings, C, extends centrally through the furnace chamber, A, which is provided with a lining of heat-insulating material. The tube and furnace chamber may be rotated in either direction by means of gearing. The material to be treated is introduced at K, and gas under pressure may be supplied through the tube, N, to the chamber, M, whence it passes into the reaction chamber through the tubes, P. The apparatus is heated electrically by means of silundum rods, Q, in the tubes, P, to which current is supplied by way of the rings, R, and contact brushes, S. In the interior of the reaction chamber and of the tube, B, are screw-conveyors, T, and U, respectively right- and left-handed. The conveyor, T, serves to mix the charge, and then, on reversing the direction of rotation of the apparatus, to move the material through the opening, V, into the tube, B, where it is moved forwards to the outlet, L, by the conveyor, U.—A. S.



Purifying air or gases; Apparatus for ——. H. Grien, Vienna. Ger. Pat. 286,221, July 28, 1912.

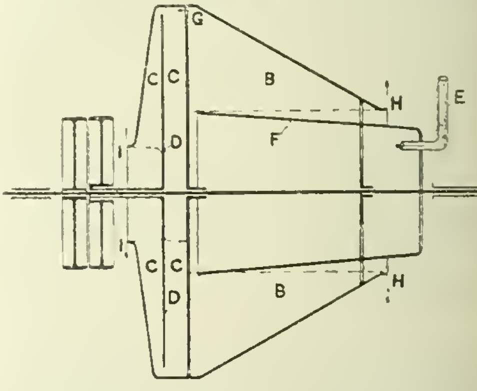
The washer is provided with a central gas-inlet tube, having a conical lower portion dipping into the washing liquid. Around the inlet tube are several concentric conical hoods, also dipping into the washing liquid, the depth of the liquid seal being less the greater the cross-section of the hood. Alternate hoods have perforated upper parts and intermediate hoods have perforated lower parts, the perforations being in all cases arranged concentrically around the central gas-inlet tube.—A. S.

Gaseous mixtures; Separation of constituents of ——. E. Rohlf, Kiel. Ger. Pat. 286,365, Mar. 24, 1914.

The gaseous mixture is absorbed, at a suitable temperature, by lycopodium which has been dried *in vacuo*, and then, by heating gradually, the absorbed gases are expelled in stages.—A. S.

Centrifugal separator. Maschinenfabr. H. Cegielski A.-G., and S. Duchowski, Posen. Ger. Pats. (I.) 286,397, Apr. 30, 1913, and (II.) 286,398, Mar. 24, 1914.

(I.) The liquid to be treated is fed through the pipe, E, into the inlet chamber, F, whence it flows into the conical separating bowl, B. The lighter constituent is discharged at H, whilst the heavier constituent is forced to the periphery and flows through the opening, G. In the chamber, C, is a disc, D, which is rotated at a lower velocity than the separating bowl, the effect of which is to cause the heavier liquid flowing into the chamber, C, to approach the axis, where it is discharged at I. (II.) Two adjustable discs rotating at a lower speed than the separating bowl are mounted in the chamber, C, the one more distant from the bowl merging, near the axis, into an outlet pipe. With this arrangement the heavier liquid flowing into the chamber, C, is forced into the space between the discs, and the rate of discharge can be regulated merely by varying the distance between the discs, without altering the velocity of the bowl or of the discs.—A. S.



Solution of solid substances; Apparatus for the continuous —— especially for slaking lime with sugar juice or water. H. Eberhardt, Maschinen- und Armaturenfabrik, Wolfenbüttel. Ger. Pats. (A) 286,824, Nov. 12, 1913, and (B) 286,825, May 15, 1914. Additions to Ger. Pat. 268,442 (this J., 1914, 127; see also Ger. Pat. 270,045, this J., 1914, 302).

(A) In order to facilitate the exchange between the solvent liquid and the saturated mother-liquor and bring about a continuous passage of the liquid over the particles of matter to be dissolved, the perforated cylindrical dissolving vessels are slowly rotated by overhead gear. The stirrer situated beneath is rapidly rotated in the opposite direction by means of the same driving mechanism, from which the shafts of the dissolving vessels are rotated at a different speed by means of toothed gears. (B) Instead of the spiral conveyors in the dissolving cylinders, horizontal shelves are arranged one above the other in steps, with scrapers for moving the sludge, or the spiral conveyors may have cut-away portions in order that baffles or scrapers may be fixed on the walls of the cylinders.—J. F. B.

Treatment of slimes or the like in rotary drum separators. Eng. Pat. 24,179. *See* VIII.

Method of heating furnaces for metallurgical and other purposes. Ger. Pat. 287,080. *See* X.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal: Microscopic constitution of ——. G. Hickling. J. Soc. Dyers and Col., 1916, 32, 9—11.

The use of improved methods for the preparation of transparent sections of coal has led to further microscopical study of its constitution, and the author describes the results of some of the recent investigations of Jeffrey and Thiessen in America, and of Lomax and himself in this country. This work has tended to support the separation of coals into two dominant types—the bituminous or "humic," and the canneloid or "sapropelic." The latter are commonly the coals rich in spores and they are markedly heterogeneous in composition, while the bituminous coals tend to be relatively homogeneous as regards the material of which they are composed. It is now believed that anthracitic coals may be developed from either of these main types. A section (0·001 0·005 mm. thick) of typical bituminous coal, not too rich in carbon, usually appears, when viewed under the microscope, as an almost uniform deep red or orange mass, with a few darker or paler specks, streaks, or lenticles. Here and there, however, the otherwise homogeneous red bands may show the cellular structure of some plant tissue, the walls of the cells appearing as a deeper stain in the red mass. Fragments of coal showing such structures in a conspicuous manner form only a small percentage of the whole mass; but closer observation reveals the fact that they are very wide-spread, but often inconspicuous owing to the slight difference between the colour of the "cell-wall" and of the material within the cell. Further, if any well-defined piece of plant tissue is traced out, it is usually fonnd that the visible distinction between "walls" and "contents" gradually dwindles to vanishing point, so that the "tissue" merges into what appears to be homogeneous coal; it is probable that tissue structure really exists in the latter though not distinguishable optically. The general impression left after extensive examination of this type of coal, is that it consists mainly of such infilled vegetable tissue. The usually accepted view that coal began as a peat-like mass of vegetable débris, which by compression, followed by the gradual loss of certain chemical constituents, chiefly oxygen and hydrogen, was slowly converted into coal, is fundamentally inaccurate, or at least incomplete, and consequently any views as to the present constitution of coal based on it are on an unsound foundation. It is suggested that by far the greater portion of the carboniferous vegetation which now remains as coal, was reduced by decomposition (probably bacterial) to a liquid state, this liquid being then soaked up by the still undecomposed residues of the vegetation. This liquefying process conferred on coal a kind of homogeneity which otherwise it would have lacked, but on the other hand, it would seem to have led also to a peculiar heterogeneity, manifested by the variation of microscopic appearance with the carbon-percentage of the coal. This heterogeneity is probably to be attributed to the vegetable tissues acting as semipermeable membranes, to a degree varying with their nature, during the process of coal formation.—J. B. C. K.

Naphthalene as a motor fuel. H. K. Bruhn. J. Gasbeleucht., Nov. 2 and 9, 1915. J. Gas. Lighting. 1915, 132, 644—645.

The yield of naphthalene from coal is about 0·3% and the annual production in Germany is nearly 600,000 metric tons. When naphthalene melts its volume increases considerably, the sp.gr. of liquid naphthalene being 0·977 at 80° C. and that of the cast solid 1·15 at 15° C. The latent heat of fusion is 36 calories and the viscosity at 80° C. is 1·11° Engler. The flash point in a Pensky-Martens apparatus is 80° C. and the ignition point in an open vessel is 98° C. It has a calorific value of 9600 calories gross and 9300 net. 100 parts of the following liquids dissolve naphthalene in the proportions shown:—Alcohol at 10° C., 5·00 parts, at 0°, 4·25; petroleum ether at 10°, 11·05, at 0°, 7·75; benzene at 10°, 40·70, at 0°, 32·00; toluene at 10°, 35·30, at 0°, 24·80; xylene at 10°, 29·00, at 0°, 20·80. The addition of 30% of naphthalene to benzene lowers the freezing point from 5° C. to below —3°. Mixtures of naphthalene vapour and air can be satisfactorily used in internal combustion engines but it is necessary first to melt the naphthalene and to keep all pipes sufficiently warm. The following table shows the advance in the output of naphthalene engines.

Year	Number of engines made.	Aggregate H.P.	Metric tons of naphthalene consumed.
1911 ...	68	678	75
1912 ...	283	2961	509
1913 ...	367	3934	1423

In the earlier types of engines the naphthalene was melted by the heat of the exhaust gases; this, however, sometimes caused overheating and was superseded by utilising the heat of the cooling water. To prevent naphthalene depositing in the sprayer it is necessary to heat the air by the exhaust gases. Naphthalene engines have to be started with some form of gaseous or liquid fuel and changed over to naphthalene when hot. The following table, based on motor spirit at £19 6s. 6d. per ton, benzol at £15 4s. 9d., and naphthalene at £6 2s., shows the relative consumption and cost of fuel per horse-power hour.

Fuel	Half load.		Three-quarter load.		Full load.	
	Consumption.	Cost.	Consumption.	Cost.	Consumption.	Cost.
	oz.	d.	oz.	d.	oz.	d.
Petrol	16·6	2·16	13·1	1·68	11·3	1·44
Benzol	14·1	1·44	10·6	1·08	9·5	0·96
Naphthalene	13·4	0·55	11·3	0·47	10·2	0·42

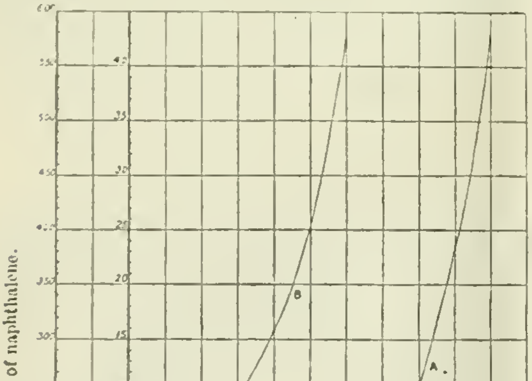
—W. H. C.

Naphthalene: Evaporation of —— in air and coal gas. J. S. G. Thomas. J. Gas Lighting, 1915, **132**, 701—703.

The author determined the vapour pressure of naphthalene by passing a known volume of air or coal gas over a weighed quantity of purified naphthalene. The air or gas was dried by sulphuric acid and by calcium chloride, its pressure measured by a mercury gauge, and dust removed by a cotton-wool filter. It next passed through 10 ft. of glass tubing contained in a water-bath heated by luminous burners controlled by a thermostat and provided with stirrers. The temperature of the bath was determined by a thermometer enclosed in a glass tube, and entirely surrounded by the water. The gas then passed through a calcium chloride tube and two U-tubes containing the naphthalene, all enclosed in a tinned copper box placed in the water-bath, and afterwards through a wash bottle containing sulphuric acid to a large aspirator in which it was measured. The vapour pressure, *p*, was calculated by the formula,

$$p = \frac{62290\ g\ T}{m\ V}$$

where T is the absolute temperature of the gas at which its volume, V, is determined, m the molecular weight of naphthalene, and g the weight of naphthalene carried by the volume, V, of the gas. The values found for coal gas and air agreed. The vapour pressures in mm. at various temperatures are: 0° C., 0·0056; 5°, 0·0101; 10°, 0·0176; 15°, 0·0301; 20°, 0·0506; 25°, 0·0836; 30°, 0·136; 35°, 0·218; 40°, 0·343; 45°, 0·533; 50°, 0·816; 55°, 1·23; 60° C., 1·84. The diagram shows the grains of naphthalene required to saturate 100 cub.ft. of dry coal gas measured at 15° C. and 760 mm.; curve B represents the first part of curve A on a larger scale, so that the saturation values can be read accurately between 0° and 30° C.



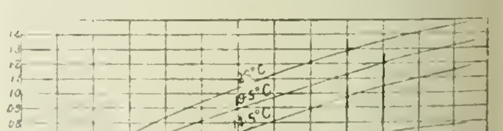
The results obtained are in substantial agreement with those of Schlumberger (this J., 1913, 76) but differ from those obtained by Allen (this J., 1900, 209) for temperatures below 30° C.—W. H. C.

Sewage sludge for gas making. C. J. Snyders, Het Gas, 1915. J. Gas Lighting, 1915, **132**, 613.

Experiments carried out at the Stuttgart gasworks showed that it was only possible to work with sludge containing less than 25% of water. The following results have been obtained with sludge containing 16·21% of total moisture, 45·58% of ash, and 38·21% of combustible matter (ash-free coke 19·17, volatile matter 19·04%). The ultimate analysis of the combustible matter gave C 62·80%, H 4·48%, O + N 32·23%, and S 0·49%. The net calorific power of the sludge was 3673 B. Th. U. per lb. A charge of 176·4 lb. of sludge carbonised at 905° C. for 4 hours gave the following results per 100 lb. of sludge:—67·20 lb. of dry coke, 29·60 lb. of gas liquor, and 0·49 lb. of ammonia; also 5966 cub. ft. of gas per ton at 760 mm. and 15° C. The gas had a density of 0·712, a gross calorific power (at 0° C. and 760 mm.) of 508 B. Th. U.; net 454 B. Th. U. on the dry gas. The illuminating power was 0·34 candle, and the gas contained 30 grains of sulphur per 100 cub. ft. Its composition was:—CO_2, 16·2%; C_nH_m, 4·4%; O_2, 0·1%; CO, 16·5%; H_2, 36·3%; CH_4, 16·2%, and N_2, 10·3%. 16 lb. of coke and 2 lb. of breeze were required to carbonise 100 lb. of dried sludge, and the coke produced contained 70% of ash. Further experiments were carried out in which the sludge was distilled in wrought iron tubes set in the lower part of the generator furnaces and heated by the chimney gases. One metric ton of sludge containing 20% of water gave 4865 cub. ft. of gas having a net calorific value (at 0° C. and 760 mm.) of 416 B. Th. U. Its density was 0·694 and it contained 6·7% of carbon dioxide. The tar (yield 2%) yielded 3·50% water, 26·62% light oils, 18·88% middle oils, 9·75% heavy oils, 13·63% anthracene oils, and 26·25% pitch. Experiments were also made with sludge obtained from sewage treated by the "Kolazite" process in which iron and aluminium salts are added to carry down the organic matter; the resulting sludge can be readily filter-pressed. One metric ton of such sludge, containing moisture 3·4%, coke 63·95%, ash 57·24%, and volatile matter 32·65%, distilled in cast iron retorts gave 6475 cub. ft. of gas having a net calorific power of 415 B. Th. U. and of the following composition: CO_2 10·8%, C_nH_m 6·1%, O_2 0·5%, CO 17·1%, CH_4 22·3%, H_2 41·5%, and N_2 1·7%. Attempts were made to distil a lubricating oil suitable for engines from the tar. A fraction distilling at 300°—360° C. (yield 30% on the tar) had sp. gr., 1·062; flash point, 225° C.; and solidifying point, —19° C. It was free from acids, had a tolerable odour, and was quite suitable for an engine oil though not viscous enough for cylinder oil.—W. H. C.

Benzol [*from coke-oven gas*]. G. Taylor, Coke-Oven Managers Assoc., Dec. 18, 1915. J. Gas Lighting, 1915, **132**, 639—642.

Coke-oven gas contains from 0·8 to 1·6% by volume of benzol, corresponding to a yield of from 4 to 6 gallons per ton of coal. The benzol is recovered by absorbing it, in either tower or



rotary scrubbers, in coal-tar or blast-furnace creosote which should be as free as possible from phenols, bases, water, and naphthalene. To prevent too much of the benzol being absorbed by the tar, the gas should not be cooled below 35° C. before it enters the scrubbers. The extraction of the benzol reduces the gross calorific value of the gas by from 32 to 64 B.Th.U. per cb. ft. The curves in the diagram (see fig.) give the amounts of vapour of 70% benzol in the gas in equilibrium with benzolised creosote of sp.gr. 1·070 at various temperatures. The ordinates represent gallons of benzol per 10,000 cub. ft. of gas, and the abscissæ the percentages of 70% benzol (at 120° C.) in the creosote. From 20 to 35 galls. of fresh oil is required to replace losses for every 100 galls. of benzol recovered. The benzol is recovered from the benzolised creosote by distillation in continuous column stills by wet or by combination of wet and dry steam: the vapours are passed through a dephlegmator and only vapours that condense below 95° C. are allowed to pass on to the condenser, to ensure that the product shall be 65% benzol. The oil in the still should be heated to at least 110° C. or benzol will be retained. The following working data have been obtained from seven different plants:—Benzol in 10,000 cb. ft. of unscrubbed gas, 2·32—3·3 galls.; benzol in return gas, 0·07—0·75 gall.; benzol in benzolised oil, 2·5—1·5%; benzol in debenzolised oil from still, 0·2—1·2%; temperature of oil issuing from still, 95°—112° C. The 65% benzol is either washed direct with sulphuric acid and caustic soda solution to remove impurities or it is partially fractionated before washing. After washing the benzol is fractionated. A coke oven benzol (sp. gr. 0·887) giving with retort test at 100° C., 51%; at 120°, 72½%; at 160°, 82½%; at 180°, 87½%; gave on primary distillation in the laboratory without washing: up to 100° C., 70·6% crude 90's; 100°—120°, 10·0% crude 50's; 120°—160°, 7·6% crude solvent naphtha; 160°—200° C., 6·3% crude heavy naphtha; residue (creosote oil, etc.), 4·6%; and loss on distillation, 0·9%. Further fractionation after washing gave the following results:—Washing losses, 8·2%; distillation losses, 2·8%; CS_2 fraction (sp. gr. 0·890), 2·0%; benzene (sp. gr. 0·884), 54·0%; toluene (sp. gr. 0·872), 11·8%; solvent naphtha (sp. gr. 0·875), 11·4%; heavy naphtha (sp. gr. 0·930), 5·0%; creosote oil, 4·8%. Works distillation of a similar benzol gave 64% of 90% benzol, 6·5% of 90% toluol, 7·5% of solvent naphtha, and 5% of heavy naphtha. The loss (washing, creosote, etc.) was 15 per cent.—W. H. C.

Benzine and benzol: Method of distinguishing ——. H. Mix. Kolloid-Zeit., 1915, **17**, 7—9. Z. angew. Chem., 1915, **28**, Ref., 592.

For distinguishing between benzine and benzol, and for detecting benzol in benzine, the use of Dieterich's dracorubin test-paper is recommended, on account of its simplicity and certainty, in preference to Holde's test depending on the solubility of asphalt in benzol. The test-paper is prepared by impregnating paper with a solution of the purified resin of palm dragon's blood—the dracoresinotannol ester of benzoic acid: this resin is soluble in benzol but insoluble in benzine. The test-paper may also be used for controlling the degree of refining of benzine; the higher the degree of purity of the benzine the less colouring matter is removed from the test-paper.—A. S.

Acetylene-air explosions in mines; Risk of ——. G. A. Burrell and G. G. Oberfell. U.S. Bureau of Mines, Tech. Paper 112. Min. and Eng. World, 1915, **43**, 980—981.

The lowest proportion of acetylene capable of propagating flame in a mixture of acetylene and air at atmospheric pressure was found to be 2·53%, and the highest about 73%; under a pressure of 5 atmospheres the lower limit was between 2·82 and 3%. Acetylene, and mixtures of acetylene and air (containing 10 to 90% of the former) were not spontaneously explosive (*i.e.*, without ignition) at pressures up to 5 atmospheres; under a pressure of 3—5 atmospheres acetylene unmixed with air exploded when sparked or ignited by means of a heated platinum coil. It is concluded that the use of calcium carbide in mines is practically unattended with danger provided reasonable care is exercised.—W. E. F. P.

Roumanian petroleum industry. Board of Trade J., Jan. 27, 1916.

The subjoined table shows the exports of petroleum products from Roumania in 1914:—

—	Total exports.		Exports in 1914 to—			
	1913.	1914.	Germany.	United Kingdom.	Austria-Hungary.	Italy.
	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.
Crude oil	28,622	15,405	92	—	11,180	—
Residues and gas oil	341,912	167,523	17,362	17,144	31,467	58,928
Mineral oil	9,543	8,617	3,678	—	1,974	14
Lighting oils and distillate	418,622	297,900	22,742	45,769	20,898	35,349
Benzine	237,168	164,143	55,290	15,058	18,732	13,783
Paraffin	579	536	—	—	2	70
Total in 1914	—	654,024	99,164	77,971	84,253	108,144
Total in 1913	1,036,446	—	126,295	232,880	77,184	118,643

The decline in the exports in 1914 (about 37%) was in part due to the effects of the war, such as the closing of the Dardanelles, and temporary restrictions and prohibitions to export benzine or residues. In the first seven months of 1914, however, the exports amounted to only 522,777 metric tons as compared with 619,602 metric tons in the corresponding period of 1913. The total exports in the first ten months of 1915 amounted to 349,400 metric tons, as compared with 586,973 metric tons in the corresponding period of 1914. Exports of "mineral oil" in January—October, 1915, have increased largely as compared with the previous year, whilst exports of residues and benzine show large decreases.

Patents.

Coal and similar substances; Process of treating —— *to obtain oils, ammonia, and other products.* F. Bergius, Hanover, Germany. Eng. Pat. 18,232, Aug. 1, 1914. Under Int. Conv., Aug. 8, 1913.

The coal or other solid carbonaceous material is

subjected to the action of hydrogen at pressures above 10 atm., preferably above 100 atm., and to a temperature between 300° and 500° C. Under these conditions the hydrogen reacts directly with the coal, and forms without destructive distillation and without production of uncondensable gases, valuable hydrocarbons, which are either liquid at ordinary temperatures and pressures, or have low melting-points. In place of hydrogen, gases containing hydrogen, such as water-gas, may be employed, or substances which yield hydrogen, such as calcium hydride, may be used. It is advisable to operate the process in the presence of a solvent for the products formed during the reaction, petroleum distillates being suitable for this purpose. The nitrogen of the coal is recovered in the form of ammonia in the reaction vessel.
—J. B. C. K.

Gas retorts, furnaces, and the like: Apparatus for charging —— and withdrawing coke or other residues therefrom. F. J. Bancroft and J. B. Hansford, New Barnet, Herts. Eng. Pat. 4602, Mar. 24, 1915.

Apparatus for charging gas retorts in the manner described in Eng. Pat. 13,218 of 1911 (this J., 1915, 71), is provided with discharging apparatus consisting of a drag bar carrying a withdrawing plate at its inner end. The bar passes under the arched floor plate of the charging tray, and is provided with notches which are engaged by a clutch on the charging device.—W. F. F.

Producer gas; Manufacture of carburetted ——. T. F. Fitzsimmons, Brooklyn, N.Y. U.S. Pat. 1,164,081, Dec. 14, 1915. Date of appl., Dec. 9, 1908.

Producer gas, formed by passing air through a deep bed of fuel, is ignited and passed through a chamber until the delivery end of the chamber attains a predetermined critical temperature for oil. A mixture of hot producer gas and oil vapour is then passed through the hot chamber, and the resulting carburetted producer gas gradually cooled. The operations of heating the carburetting chamber and carburetting the gas are repeated, while air only is passed continuously through the bed of fuel.—W. F. F.

Gas; Process of producing ——. P. G. Schmidt, Olympia, Wash. U.S. Pat. 1,164,408, Dec. 14, 1915. Date of appl., Mar. 29, 1913.

Air is passed upwards through the perforated base of the producer, and also downwards through a ring of openings below the top of the fuel charge. The gas is withdrawn through a vertical central tube having its inlet at the centre of the charge.
—W. F. F.

Gas; Condensing, scrubbing, and washing apparatus for ——. H. Pooley and G. B. Fiddes, Leicester. Eng. Pat. 24,598, Dec. 24, 1914.

The gas is passed over baffle-plates arranged in series, in such a manner that it is obliged to take a zigzag course through the apparatus, and the impurities, such as tar, dust, etc., which collect upon the surface of the baffle-plates, are removed continuously by means of a spray of water, steam, or other cleansing agent. A convenient form of the washer consists of a vertical cylindrical tower, in which conical baffle-plates are arranged one above the other; the gas flows from the top to the bottom of the tower. Alternate plates have central openings and the intermediate plates openings at the peripheries. At the outer circumference of each baffle-plate a dependent flange dips into an annular gutter on the periphery of the plate immediately below, and thus, when the channels are filled with liquid, a seal is provided which prevents the escape of gas. The outer side of each gutter is provided with a lip which prevents collected liquid from falling into the channel beneath it. The spraying nozzles direct the cleansing agent upon the apex of each of the baffle-plates. The impurities gathered by the washing liquid are collected independently from each baffle-plate, to avoid danger of clogging the channels. The overflow from all the channels falls into a tank with a sloping bottom placed beneath the washing tower. The lighter impurities are carried away with the overflow from the tank, while the tar and other heavier impurities collect in the angular space formed between the side and bottom of the tank.—J. B. C. K.

Gas: Apparatus for purifying ——. W. Climie, jun., Glasgow. Eng. Pat. 1045, Jan. 22, 1915. Addition to Eng. Pat. 11,136, May 6, 1914 (this J., 1915, 706).

The apparatus described in the principal patent is modified by the substitution for the rotating blades of a series of wire, fibre, or like brushes, held between discs mounted on the vertical shaft. Liquid passes from a well at the top of the device through grooves in the discs to the bristles.
—W. F. F.

Gas purifiers. R. J. Milbourne, Newport, Salop. Eng. Pat. 2768, Feb. 20, 1915.

The inlet and outlet valves are each arranged in a casing within the purifier. Each valve-box comprises two superposed co-axial vertical cylindrical chambers, communicating at the top and bottom with the upper and lower parts respectively of the purifier, and separated by an inlet space in which a disc valve may be moved up or down to close the mouth of either chamber. The outlet valve box has its valve set in the reverse position to that of the inlet-valve, and the gas may thus be passed through the purifier in either an upward or a downward direction.—W. F. F.

Gas-scrubber. G. M. S. Tait, Montclair, N.J., Assignor to Tait Producer Co., New York. U.S. Pat. 1,165,348, Dec. 21, 1915. Date of appl., Oct. 8, 1910.

Water is maintained at a predetermined level in a chamber in the lower part of the scrubber by a central overflow pipe terminating in a small reservoir outside the vessel. Gas is drawn through the water by suction, the gas-inlet pipe terminating below the level of the overflow. The suction applied is less than corresponds to the difference in level of the top of the overflow pipe and the outlet from the outer reservoir.—W. F. F.

Sulphuretted hydrogen recorder. A. Edwards, Leeds. Eng. Pat. 379, Jan. 9., 1915.

To indicate hydrogen sulphide in coal gas, carburetted water-gas, coke-oven gas, etc., a jet pipe for the gas has its outlet close to the surface of a lead test paper on a rotating drum. The jet pipe is surrounded by a tube also nearly touching the drum, through which the gas, together with induced air, ascends owing to its smaller density, and is burnt at the outlet.—W. F. F.

Petroleum: Process and apparatus for distilling heavy crude ——. H. Tudor, London. From M. E. Venturino, Buenos Ayres. Eng. Pat. 12,570, Sept. 1, 1915.

The crude petroleum is heated in a horizontal retort to about 90° C. and allowed to settle for 2—3 hours for water to separate. The temperature is then raised to 110° C., the water vapour passing from collecting domes through coils in auxiliary retorts above the main retort to a condenser to which the auxiliary retorts are also connected. The vapour outlets are then closed and the pressure in the main retort raised to 2—3 atmospheres

by heating, after which the pressure is reduced gradually by cooling and then rapidly by opening to the condenser. The succession of operations above indicated is continued intermittently up to 420° C. and 5 atmospheres, the temperature conditions in the auxiliary retorts following those in the main retort, but one stage in arrears. The main retort is connected by pipes to a removable closed tank fitted in a recess in the firebox below, so that the heavier residues collect in this tank.
—W. F. F.

Petroleum ; Refining ——. J. C. Black, Oakland, Assignor to Standard Oil Co., Richmond, Cal. U.S. Pat. 1,164,162. Dec. 14, 1915. Date of appl., July 27, 1915.

Petroleum oil is treated with gaseous sulphur dioxide under sufficient pressure to cause the oil to separate into two layers. The lower layer is withdrawn and the pressure reduced so that it also is separated into two layers. The lower of these is withdrawn, freed from absorbed sulphur dioxide, and transferred to a storage vessel, whilst the original and second upper layers are mixed together, freed from sulphur dioxide, and also stored. The gas liberated from the several layers is used for fractionating a fresh charge of petroleum oil, and the gas from this is used for a third charge, and so on.—C. A. M.

Lubricating oils : Improvement of ——. Allgem. Ges. f. Chem. Ind. m. b. H., Berlin. Ger. Pat. 287,309, Mar. 23, 1913.

Lubricating oils are treated with liquid sulphur dioxide in order to remove the resinous or resin-forming constituents, which are soluble therein. The process may be applied to the fractions of the distillate of petroleum oil intended for the preparation of lubricating oils, or to oils which have been purified by treatment with sulphuric acid. The aromatic monocyclic hydrocarbons of mineral lubricating oils are readily soluble, whereas the unsaturated polycyclic hydrocarbons are insoluble in liquid sulphur dioxide.—C. A. M.

Coke hoppers and the like ; Apparatus for discharging ——. A. M. Duckham, Ashtead. Eng. Pat. 85, Jan. 2, 1915.

Gas-producer. G. M. S. Tait, Montclair, N.J., Assignor to Tait Producer Co., New York. U.S. Pat. 1,165,347. Dec. 21, 1915. Date of appl., Mar. 4, 1910.

See Fr. Pat. 415,193 of 1910 ; this J., 1910. 1293.

Process of producing sulphate of ammonia. U.S. Pat. 1,163,752. *See* VII.

Ammonia saturator. U.S. Pat. 1,163,753. *See* VII.

Method of producing carbon monoxide from carbon dioxide. U.S. Pat. 1,163,922. *See* VII.

Decomposition of sulphuric acid compounds obtained in the purification of hydrocarbons. Ger. Pat. 287,755. *See* VII.

Concentration of ores. [Use of acid sludge from petroleum refining as frothing agent.] Eng. Pat. 19,856. See X.

Composite lubricating oil. U.S. Pat. 1,163,856. *See* XII.

III.—TAR AND TAR PRODUCTS.

[Benzene and toluene ; Production of ——.*] Thermal reactions in the vapour phase of various coal-tar oils and distillates.* W. F. Rittman and G. Egloff. U.S. Bureau of Mines. Met. and Chem. Eng., 1916, **14**, 15—18.

In an investigation made to determine the suitability of comparatively cheap coal-tar oils and distillates for the production of benzene and toluene by the vapour phase method of cracking, higher yields of benzene, etc., were obtained from the oils in question than from petroleum under similar conditions, and there was less carbonisation and less variation in the sp.gr. of the products. The proportion of benzene and toluene obtained from the oils was generally from 20 to 40 % of the fractions distilling below 200° C., oils yielding small quantities of distillate below 200° C. being thus unsuitable for transformation.

In the following table the yields from some commercial products are shown :—

Material.	Percentage of original oil distilling below 200° C.	Conditions of cracking.		Yield of benzol (b.pt. 75°—100° C.).	Yield of toluol (b.pt. 100°—125° C.).
		Temp., ° C.	Pressure, atm.		
				%	%
Solvent naphtha	79·9	600	8	9·9	19·5
Creosote oil	2·5	600	11	2·6	1·9
Light dead oil ..	9 5	700	15	2·7	1·7
Naphthalene wash oil	25·7	600	8	4·1	3·3
"Imperial varnish oil" *	64·5	650	8	6·8	10·7
Heavy dead oil .	30·4	650	1	2·8	1·3
Light tar oil † ..	51·8	650	1	10·3	8·2
Secondary oil residue ‡	49·4	650	11	5·7	2·2

* Similar to solvent naphtha, but slightly denser.

† Intermediate between solvent naphtha and creosote oil.

‡ Distillation residue from saturated wash oil from a by-product coke-oven plant.

The results are regarded as confirming the previous conclusions of the authors and others—that inter-aromatic reactions proceed in the order, higher benzene homologues, lower benzene homologues, benzene, naphthalene, anthracene, etc., and are irreversible : the only aromatic hydrocarbons capable of transformation into benzene and toluene are the higher benzene homologues, the latter, in general, having b. pts. not above 175° C. (see this J., 1916, 105).
—W. E. F. P.

Naphthalene as a motor fuel. Bruhn. *See* IIa.

Evaporation of naphthalene in air and coal gas. Thomas. *See* IIa.

Benzol [from coke-oven gas]. Taylor. *See* IIa.

Method of distinguishing benzine and benzol. Mix. *See* IIa.

New reaction of picric acid and its applications. [Detection of picric acid in urine and beer.] Castets. *See* XX.

Patents.

Tar ; Process of treating —— *with atmospheric oxygen.* Bayerische Hartsteinindustrie A.-G., Würzburg. Ger. Pat. 287,236, Aug. 16, 1912.

The tar is heated to about 120° C. and introduced in as fine streams as possible into a chamber, through which a current of hot air passes. In one form of apparatus the hot tar is centrifuged by means of two or more concentrically arranged drums pierced with holes as small as possible, while the current of heated air passes through the space between the drums and encounters the particles of finely divided tar. The ammoniacal liquor present in the tar is thus completely vaporised, and the vapours are withdrawn by means of a fan.—C. A. M.

Carbon powder [from pitch]; Method of and means for the manufacture of ——. A. C. Evans, Hampton Wick, and P. J. Mitchell, London. Eng. Pats. 21,313, Dec. 18, 1914, and 8901, June 16, 1915.

COAL pitch is shaken with a weak solution of caustic soda or other alkali in a closed vessel at about 100° C., and the resulting aqueous extract withdrawn. The residue is then shaken with naphtha at about 100° C. in a closed vessel, preferably beneath a reflux condenser, the mixture allowed to settle, and the supernatant liquid run off. The sludge of carbon may be purified by re-washing with naphtha, and is then dried in a closed vessel, and finally heated to expel volatile substances.—C. A. M.

Benzoic and sulpho-benzoic acids: Manufacture of ——. A. Heinemann, London. Eng. Pat. 23,575, Dec. 4, 1914.

THE methyl group of toluene or toluenesulphonic acid is oxidised to the carboxyl group by treatment with ozone. *Example* 1: 200 grms. of toluene is mixed with 50 grms. of sulphuric acid (sp. gr. 1·835), and ozonised oxygen, sufficient to provide 1 grm. of ozone per hour, is passed into the mixture heated to just below the boiling-point of toluene for 5 hrs. *Example* 2: 50 grms. of toluene-*o*- or *p*-sulphonic acid is dissolved in 100 grms. of water, the mixture heated to just below 100° C., and treated as above.—F. W. A.

o-Chlorotoluene-p-sulphonic acid; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 286,712, June 29, 1913.

AQUEOUS solutions of alkali or alkaline-earth salts of *p*-toluenesulphonic acid are treated, below 80° C., with chlorine or a compound yielding chlorine, in presence of such a quantity of a corresponding inorganic alkali or alkaline-salt that the *o*-chlorotoluene-*p*-sulphonic acid salt which is formed separates from the solution.

—A. S.

Alkali condensation or alkali fusion in the anthracene series; Method of carrying out ——. Badische Anilin u. Soda Fabr. Ger. Pat. 287,270, May 1, 1913.

THE substance to be treated is mixed, in the absence of air, with alkali hydroxide and a little alcohol, and then exposed to the air, or a mixture of the substance and alkali hydroxide is exposed to alcohol vapours in the air, whereby a product is obtained, without notable evolution of heat, which is suitable for carrying out reactions where hitherto the alkali fusion was employed.

—G. F. M.

Organic nitrogenous compounds; Preparation of metallic derivatives of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 287,601, Jan. 30, 1914.

ORGANIC compounds containing hydrogen combined with nitrogen are treated with metallic magnesium or aluminium or mixtures of the two, preferably by heating, if necessary in presence of indifferent organic solvents of high boiling point and with the addition of catalysts. The action of magnesium on acid amides and imides is not claimed. Example: 5 parts of clean aluminium shavings and 100 of aniline are heated at 150°—160° C. under a reflux condenser and the temperature is allowed to rise to the boiling point until the product solidifies on cooling; moisture and air should be excluded. The metallic derivatives are useful in condensation reactions, *e.g.*, aluminium anilide reacts with halogen and sulphur compounds, alcohols, aldehydes, ketones, acids, nitro- and nitroso-compounds.—J. F. B.

Aromatic compounds: Process for the introduction of amino groups into ——. J. F. dé Turski, Prague. Ger. Pat. 287,756, July 14, 1914.

AROMATIC compounds are treated with hydroxylamine and sulphuric acid, if necessary with the addition of metallic compounds. Substances which dissolve in sulphuric acid but are not readily sulphonated are converted into their amino derivatives, *e.g.*, anthraquinone, benzophenone, indanthrene, xanthone, quinoline, pyridine. Substances which do not dissolve in concentrated sulphuric acid or are easily sulphonated are first converted into sulphonic acids and the dissolved sulphonic acids are converted into amino derivatives, *e.g.*, benzene, naphthalene, anthracene.

—J. F. B.

γ-Hydroxycarbostyril; Production of derivatives of ——. Farbw. vorm. Meister, Lucius, und Brüning, Höchst. Ger. Pat. 287,803, Mar. 17, 1914.

N-SUBSTITUTED alkyl or aryl derivatives of anthranilic acid are heated; *e.g.*, on warming with acetic anhydride phenylanthranilic acid gives N-phenyl-γ-hydroxycarbostyril, which may be used in the preparation of azo dyestuffs.

—F. W. A.

Decomposition of sulphuric acid compounds obtained in the purification of hydrocarbons. Ger. Pat. 287,755. *See* VII.

Process for nitrating liquid or easily fusible organic compounds insoluble in water. Ger. Pat. 287,799. *See* XXII.

IV.—COLOURING MATTERS AND DYES.

Indigo in India. Board of Trade J., Jan. 27, 1916.

THE Indian Trade Journal (Calcutta) of Dec. 31st, 1915, publishes a final forecast of the acreage under indigo and the yield of the crop in British India in 1915–16. The total area is 314,300 acres, as compared with the finally revised area of 148,400 acres of last year. The total yield of dye is estimated at 39,900 cwt. as against 25,200 cwt., the revised estimate for 1914–15, and the average outturn per acre 14 lb. as against 19 lb. in the preceding year. The increase in area is due to high prices of indigo on account of the war. The season has not, on the whole, been favourable for the crop, except in Madras, where the crop is generally reported to have done well, except in the Circars. In the United Provinces, although the season was not unfavourable, there was a scarcity of reliable seed. In Madras also much indifferent seed was sown owing to the exceptionally high prices of seed at sowing time. (See also this J., 1915, 1203.)

PATENTS.

Anthraquinone dyestuffs; Manufacture of ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. Eng. Pat. 4510, Mar. 23, 1915.

TRIHALOGEN-α-AMINOANTHRAQUINONES containing at least one heteronuclear halogen in a β-position are treated with aromatic amines. The dihalogenated products in the form of their sulphonic acids constitute valuable blue acid dyestuffs, more soluble and faster to washing and to artificial light

than those which do not contain a heteronuclear halogen. *Example:* 40 parts of dibromo-β-chloro-α-aminoanthraquinone is boiled with 100 parts of *p*-toluidine for 2 hrs., the mixture allowed to cool to 50° C., and 400 parts of methyl alcohol added; after allowing to stand for some time, the product is separated by filtration, washed with methyl alcohol, and dried. It contains chlorine and bromine and dissolves in concentrated sulphuric acid to form a greenish-blue solution, which on pouring into water gives a greenish-blue dyestuff of value for the preparation of colour lakes. On stirring 10 parts of this dyestuff-base with 100 parts of 20 % fuming sulphuric acid at the ordinary temperature for a short time until soluble in water, an acid dyestuff is formed and may be separated in the usual manner; it gives greener shades than the corresponding non-chlorinated dyestuff.
—F. W. A.

Anthraquinone series; Blue vat dyestuffs of the —— containing chlorine and fast to chlorine. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 287,590, Oct. 31, 1913.

THIONYL chloride is used instead of sulphuryl chloride, with or without the addition of diluents, for chlorinating indanthrene. The reaction is brought about by heating at high temperatures, and the products give shades on cotton which are considerably faster to chlorine than the chlorinated indanthrenes hitherto obtained.
—G. F. M.

Cotton disazo-dyestuffs; Preparation of diazotisable ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 287,071, Dec. 1, 1912.

THE tetrazo-compound of benzidine-3-monosulphonic acid, or of benzidine-3.3′-disulphonic acid, is combined with 2 mols. of 1-*p*-aminoaryl-3-methyl-5-pyrazolone with the production of dyes giving extremely clear and brilliant orange shades. The dyes show good fastness especially when produced on the fibre.—G. F. M.

Tetrakisazo-dyestuffs; Manufacture of blue ——. Akt.-Ges. f. Anilinfabr., Berlin. Eng. Pat. 14,789, Oct. 19, 1915. Under Int. Conv., Oct. 29, 1914.

2-NAPHTHYLAMINE-4.8-DISULPHONIC acid is diazotised and combined with a middle component, the intermediate product diazotised and combined with a second middle component, again diazotised and combined with a molecular proportion of a third middle component, and then again diazotised and combined with resorcinol. *Example:* The tertiary trisazo-dyestuff obtained from 32·5 parts of 2-naphthylamine-4.8-disulphonic acid (monosodium salt), 14·3 parts of 1-naphthylamine, 22·3 parts of 1-naphthylamine-6- or 7-sulphonic acid, and 12·1 parts of *p*-xylidine (see Eng. Pat. 3654 of 1903; this J., 1904, 56), is dissolved in hot water, and after cooling to 5° C., diazotised in presence of hydrochloric acid with 7 parts of sodium nitrite; after 3 hrs. the diazo-solution is added to a cold solution of 11 parts of resorcinol kept alkaline with sodium carbonate; the tetrakisazo-dyestuff obtained by salting out dyes cotton reddish-blue shades.—F. W. A.

Colour lakes; Preparation of —— from 1-arylsulphamino-4-aminoanthraquinone-3-carboxylic acids. Act.-Ges. f. Anilinfabr. Ger. Pat. 287,013, May 15, 1914.

THE alkali salts of 1-arylsulphamino-4-aminoanthraquinone-3-carboxylic acids give on precipitation with metallic salts lakes of violet to blue shades fast to light.—G. F. M.

Dyestuffs containing selenium or tellurium; Preparation of ——. A. von Wassermann and E. Wassermann. Ger. Pat. 286,950, Jan. 26, 1913. Addition to Ger. Pat. 261,556.

ALKALI selenides or tellurides, especially those of potassium or sodium, are treated, in an inert atmosphere, with phthalein dyestuffs or their derivatives, especially halogen or alkyl derivatives, in presence of a small quantity of water, insufficient to effect solution. The products are more stable and less poisonous than those prepared in a similar manner from alkali seleno- or telluro-cyanides, as described in the chief patent (see Fr. Pat. 413,554; this J., 1912, 1025; see also Ger. Pat. 287,020; this J., 1916, 107).—A. S.

Triarylmethane dyestuffs; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,003, June 7, 1914.

TRIARYLMETHANE dyes containing a sulphonic group in the *para*-position to the carbinol carbon atom, react easily and smoothly with amines or their salts, with the elimination of sulphurous acid and formation of substituted *p*-aminotriarylmethane dyes. Since the *p*-sulphonated dyes are readily obtained by sulphonation and oxidation of the corresponding leuco-bases, a cheap technical method for the preparation of the amino-dyes is thus available.—G. F. M.

Triarylmethane series; Preparation of chrome-mordant dyes of the —— from their leuco-bases. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,004, July 22, 1914.

THE salts of the triarylmethanehydroxycarboxylic acids or their substitution products are treated with oxidising agents such as chlorine, lead peroxide, manganese dioxide, and particularly oxygen or air in alkaline medium, either in presence or absence of an oxygen carrier, when, contrary to statements in Ger. Pat. 189,938, good yields of the corresponding dyestuffs are obtained.—G.F.M.

Dyestuffs of the anthracene series; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,615, June 11, 1914.

4-AMINO-3-SULPHO-2.1-ANTHRACRIDONES are either heated alone or treated with acids, alkalis, or reducing agents, whereby the sulphonic group in the *ortho*-position to the acridone carbonyl group is readily removed with the formation of dyestuffs. The products are mostly vat dyes, but by sulphonation, or by the use of more highly sulphonated starting materials, valuable wool dyes are obtained.—G. F. M.

Wool dyestuffs of the anthraquinone series; Preparation of green ——. Badische Anilin u. Soda Fabr. Ger. Pat. 287,614, June 11, 1914.

THE 4-amino-1-arylidoanthraquinone-3-sulpho-2′-carboxylic acids or their derivatives are treated with condensing agents in such a way that the 3-sulphonic group remains intact. The resulting 4-amino-2.1-anthracridone-3-sulphonic acids, which, if necessary, may be further sulphonated, furnish green shades on wool, and may also be used for the preparation of other dyestuffs.
—G. F. M.

Safranine dyestuffs; Preparation of basic ——. Durand, Huguenin und Co. Ger. Pat. 287,271, Apr. 16, 1914. Addition to Ger. Pat. 282,346.

INSTEAD of allowing nitrosoalkyl-*o*-toluidines to react with alkyl-*m*-toluylenediamines as described in the chief patent (this J., 1915, 710), methyl- or ethyl-*p*-toluylenediamine and methyl- or ethyl-*m*-toluylenediamine are mixed and subjected to oxidation in aqueous solution, with alkali bichromate, ferric chloride, etc. This method has the advantage that only 1 mol. of diamine is required in place of 1½ mols. of the nitroso-compound, and that the reaction does not require to be carried out in alcoholic solution as in the case of the earlier patent.—G. F. M.

Carrying out alkali fusions or alkali condensations in the anthracene series. Ger. Pat. 287,270. *See* III.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Textiles : Analysis of ——. Pontio. Comptes rend., 1916, **162**, 81—83.

THE identification of textile fibres, *e.g.*, the differentiation of hemp from flax or of true hemp from sunn hemp, etc., is much facilitated by a preliminary purification or chemical retting of the fibres. Portions of the samples are boiled for 15 mins. in a 2% solution of caustic soda, the liquid is poured off, and the boiling repeated under the same conditions. After thorough washing, the boiled fibre is heated with a solution of sodium hypochlorite of sp.gr. 1·002 and the liquid boiled for exactly 2 mins. ; after removing the hypochlorite, the sample is treated with a dilute solution of sodium bisulphite and thoroughly washed. Such a treatment cleans the fibres, facilitates their separation from one another, and enhances the structural details for microscopical examination with the iodine stain. A small quantity of the purified material is pressed with blotting paper and treated for 2 mins. with a solution containing 3 grms. of potassium iodide per 100 c.c. and saturated with iodine. The excess of liquid is pressed out and the fibres are mounted in sulphuric acid. This solution is made by mixing 24 grms. of pure sulphuric acid (sp.gr. 1·767) with 16 grms. of water, cooling and adding 16 grms. of glycerin (sp.gr. 1·169). The microscopic preparation may be photographed, using colour-sensitive plates, and the dimensions of the fibres and other elements measured.—J. F. B.

Sulphite-cellulose manufacture : Sugar-formation and production of dark-coloured liquor in ——. E. Oman. Vierte allgem. schwed. Chemikerversammlung, Stockholm, May 28—29, 1915. Chem.-Zeit., 1915, **39**, 820.

THE production of dark-coloured lye in the sulphite-cellulose process is due to hydrogen ions and proceeds more rapidly the higher the hydrogen ion concentration. Under normal working conditions the production of a dark colour depends upon the concentration of sulphur dioxide in excess of that necessary to form bisulphite and is independent of the quantity of lime present. The Mitscherlich test is of no value for ascertaining the risk of formation of dark-coloured lye. Sodium bisulphite solution removes 7·5—8% of sugars from pine wood. This is probably present in the wood as a hexotriose, which, when the wood is digested with bisulphite at 140°—145° C., is hydrolysed to a monose (*i*-galactose) and a biose containing no free carbonyl groups. Under the same conditions the pine wood yields 57—58% of cellulose, of which a portion is readily hydrolysed by "sulphite-acid" (acid bisulphite solution). In the ordinary digestion process nearly one-half of the sugar present in the solution is derived from this easily hydrolysed cellulose ; pentoses are probably formed in the hydrolysis.—A. S.

Sulphite wood pulp waste lyes ; Neutralisation and fermentation of ——. E. Oman. Papierfab., 1915, **13**, 534—537, 553—554. Z. angew. Chem., 1915, **28**, Ref., 561.

THE author considers that for the fermentation of the sulphite lye a specially cultivated yeast is not necessary, also that aeration is of significance only in so far as it is capable of modifying the acidity of the liquor. The neutralisation of the sulphite lye is not a very simple matter. Complete neutralisation is not possible with calcium carbonate alone ; a small degree of acidity always remains, equivalent to 0·05—0·06 *N*, varying with different lyes but constant for the same lye. When lime is used for neutralising, it exerts only 40—50% of its theoretical neutralising power, apparently because some of the lime is precipitated in combination with organic matter. Fermentation proceeds most favourably in presence of an acidity equivalent to 0·02—0·03 *N*. The best method, therefore, consists in adding an excess of calcium carbonate and then determining the residual acidity. If this exceeds 0·03 *N*, the calculated quantity of milk of lime is added to reduce the acidity to that equivalent. Effective fermentation depends to an extraordinary degree on the correct acidity.—J. F. B.

Paper pulp ; Standard tests for ——. Paper Making, 1916, **35**, 10—11.

A JOINT Committee of the American Paper and Pulp Association and the Association of Wood Pulp Importers has agreed on the following rules for standard tests of paper pulp :—

Not less than 5%, nor more than 10%, of the entire shipment, but not less than ten bales, shall be sampled. Samples to be drawn only from sound and intact bales, from different sections of the entire shipment, and analysts shall be careful to observe that no unusual conditions prevail in the selection of the bales. The accurate weight of all bales sampled to be ascertained, and no other bales than those weighed to be sampled.

The sample shall be taken by boring into a bale to a depth of 3 in. (7·62 cm.) with a special auger which cuts a disc about 4 in. (10·16 cm.) in diameter. The disc shall be removed and ten of them taken as a sample, these to be selected as follows :—1 disc 2nd sheet from the wrapper, 2 discs 1 in. (2·54 cm.) deep, 3 discs 2 in. (5·08 cm.) deep, 4 discs 3 in. (7·62 cm.) deep. The holes to be bored shall be so located that in five successive bales they will represent a portion extending diagonally across the bale. Each bale to be bored but once. The first hole to be bored at the corner, the edges of the cut being at a distance of 1 inch from the edges of the bale. The second cut shall then be made half way between the location of the first cut and the centre of the bale, the third bale shall be cut at the centre, the fourth bale half way between the centre and corner, and the fifth bale in the opposite corner in a position corresponding to the first. All samples must be either weighed immediately after being drawn from the bales by accurate scales, or, where this is impracticable, must be put into air-tight vessels, made of metal or glass with ground glass or metal stoppers, and due care must be used in the transportation of such samples until they can be properly weighed at the laboratory. The entire bulk of samples selected from the bales must be dried out for the test. The temperature in the drying oven shall not exceed 212° F.

Manufacture of alcohol from sulphite lyes in Sweden. *See* XVIII.

Preservation of solutions of sodium aluminate by refrigeration. Le Roy. *See* VII.

PATENTS.

Wool and other textile fibres and textile or other materials ; Machines for washing ——. F. B. Petrie, Rochdale. Eng. Pats. (A) 23,837 and (B) 23,838, Dec. 10, 1914.

(A) In washing machines in which the material is carried by rakes or other devices through the upper part of an elongated liquor-bowl, a trough is formed in the bottom of the bowl in which are mounted one or more screw conveyors, which may be formed with a right and a left handed thread adapted to convey the foreign matters to outlets situated either at each end or at the middle of the trough and controlled by valves opened periodically by automatic means. (B) The liquor which is discharged by the periodical opening of the valves is automatically replaced by liquor from the next following bowl in succession or, if there be no subsequent bowl, from a reserve of fresh liquor. For this purpose each bowl is provided with a reserve tank and with an overflow pipe leading to the tank, and a pump forces liquor from the tank to the bowl. A ball-tap in the reserve tank controls a pipe leading from the next following bowl, through which liquor passes when the ball falls in consequence of the discharge of liquor from the former bowl.—J. F. B.

Fibre and fabric treating machine ; Vacuo-centrifugal ——. H. P. Jefferson, Boston, Mass. U.S. Pat. 1,164,619. Dec. 14, 1915. Date of appl., Aug. 7, 1914.

The machine comprises a fixed horizontal shell having its lower portion extended to form a trough, with means for sealing the shell, a fixed perforated hollow shaft in the shell with a perforated cylinder mounted so that it can be rotated on the shaft, and also oscillated, and a number of perforated partitions in the cylinder, having curved portions conformed to the hollow shaft.—J. F. B.

Vegetable fibres of all kinds ; Preparation of ——. C. Melhardt, Starnberg. Ger. Pat. 286,270. Oct. 1, 1914.

To prepare vegetable fibres for spinning and weaving, the incrusting substances soluble in water are first removed, under such conditions that no fermentation takes place, and then substances soluble in alkali carbonate or equivalent solution are removed. For example the fibres are boiled with water and then for 12—18 hours in a 1% solution of sodium or potassium carbonate. Any remaining incrusting substances may be removed by means of soap solution or the like.—A. S.

Packing cord and the like from hard fibres, such as Manila fibre ; Manufacture of ——. J. Funke, Goslar. Ger. Pat. 286,651, Dec. 17, 1914.

The cord prepared from the raw fibre is boiled in a solution of alkali, bleaching powder, or the like, and then rinsed in water. The fibres, especially the outer fibres, are rendered pliable by this treatment, and can then be sized and finished in the same way as hemp fibres.—A. S.

Sacking impervious to dust ; Preparation of ——. T. Nitsch, Herzberg. Ger. Pat. 286,739, Apr. 25, 1914.

Sacking in which paper yarn has been used as weft, is impregnated with a mixture of glue, dextrin, fatty material, and water.—F. W. A.

Impregnating balloon envelopes and aeroplane fabrics ; Process for ——. A. Stefanowski, Berlin. Ger. Pat. 286,740, May. 2, 1914.

A filling material of Iceland moss to which magnesia and common salt have been added is used ; it remains elastic when cold, imparts to the fabric a certain resistance to fire, and prevents the penetration into the fabric of the varnish with which it is subsequently treated. —F. W. A.

Cellulose ; Manufacture of —— *by digestion of wood, with circulation of the liquor.* E. Morterud, Torderöd, Norway. Ger. Pat. 286,071, Dec. 28, 1913.

The liquor is made to circulate through a series of digesters in succession, and liquor at another temperature and containing other chemicals is added to the original liquor whilst it is flowing from one digester to another. For example, in the sulphate process, lime or other base may be added to combine with organic acids and thus prevent the formation of dark-coloured substances. The liquor finally discharged has a much higher concentration than that obtained by the usual method.—A. S.

Cellulose digestion process in which the liquor is heated outside the digester, and digester for same. F. Voltz Sohn, Kupferschmiede und Apparatebauanstalt, Frankfort. Ger. Pat. 287,387, Nov. 11, 1914.

The digester liquor, after being heated in a preheater outside the digester, is raised to the required temperature (136° C. or higher) by the direct introduction of steam through a steam injector pump inserted in the conduit leading from the preheater to the top of the digester.—J. F. B.

Cellulose digestion liquors ; Process for facilitating the removal of incrustations on the heating surfaces in the heating of ——. Aktieselskapet Cellulosepatenter, Torderöd, Norway. Ger. Pat. 287,730, May 29, 1914.

The heating surfaces are coated with a deposit of soluble or carbonisable matter before being used for heating the liquor which forms the hard incrustations. A suitable deposit is obtained by heating spent digestion liquors containing ligneous matter in solution ; this deposit consists mainly of organic matter in combination with calcium. When a sufficient thickness of organic matter is deposited, the regular heating of fresh liquors may be proceeded with. The incrustation of mineral matter, which forms in course of use, takes place on the top of the first deposit of organic matter ; the latter is gradually carbonised by the high temperature employed, so that the whole is easily removed.—J. F. B.

Cellulose ; Digester plant for the preparation of —— *by the indirect boiling process.* E. Morterud, Torderöd, Norway. Ger. Pat. 287,775, Mar. 23, 1915. Addition to Ger. Pat. 273,860, (this J., 1914, 746).

The central heating arrangement is connected not only with the digesters but also with the liquor storage tanks which supply them, so that it may be used alternately for heating one of the digesters and for the preliminary heating of the liquor. —J. F. B.

Cellulose articles [threads, etc.] ; Preparation of —— *from cuprammonium solutions of cellulose.* Glanzfäden-A.-G., Berlin. Ger. Pat. 286,297. Aug. 17, 1913.

Precipitation of the cellulose is effected by means of a bath containing alkali hydroxide and cupric carbonate. The cupric carbonate may be produced in the bath itself by the interaction of cupric hydroxide and alkali carbonate, and when the process is in operation, it is sufficient to add alkali carbonate at intervals ; this reacts with the cupric hydroxide, introduced into the bath by the copper-cellulose complex, to form cupric carbonate. By the interaction of the cupric hydroxide present in the precipitated cellulose and the cupric carbonate of the bath, a basic cupric carbonate, insoluble in the alkaline bath, is formed. This is readily removed by treating the precipitated cellulose with an acid bath. The product is softer, whiter, and more elastic than that produced by other methods.—A. S.

Viscose; Preparation of lustrous threads, ribbons, films, or sheets from ——. Verein. Glanzstoff-Fabriken A.-G., Elberfeld. Ger. Pat. 287,955, Feb. 15, 1912.

The coagulating bath contains sulphuric acid in which a salt, preferably a sulphate, is dissolved, the acid being in excess of the quantity which would permit of the formation of a coagulated product soluble in water and the salt being in excess of the quantity required to form a bisulphate with the acid. *Example*: Viscose of medium "ripeness" is coagulated in a bath at 45°—50° C., containing about 160 grms. of sulphuric acid monohydrate per litre and more than 240 grms. (*e.g.*, about 320 grms.) of sodium sulphate. The coagulated thread is subsequently treated with a bath containing 3—4% of sulphuric acid more or less saturated with normal sodium sulphate.—J. F. B.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

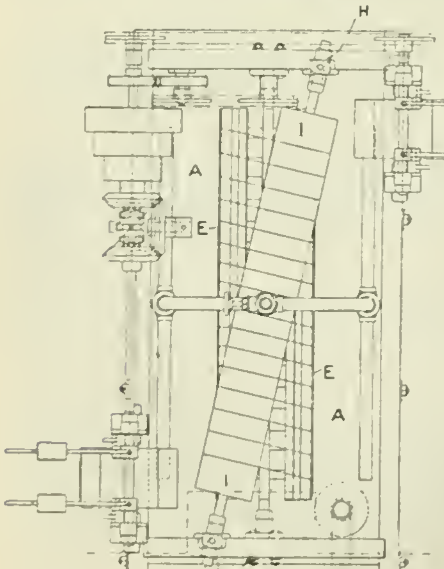
Patents.

Bleaching of cotton and other vegetable fibres; Process for the fractional ——. J. Korselt, Zittau. Ger. Pat. 287,240, Nov. 21, 1913.

Bleaching is carried out with hypochlorite solution of gradually increasing concentration. The process leads to great improvement in the fibre, retention of the spinning properties, and a very small loss in weight, and an excellent white is obtained. It prevents irregularities causing the formation of oxycellulose, noticeable when hypochlorite solutions of gradually decreasing concentration are used.—F. W. A.

Dyeing and analogous processes; Machinery for use in ——. A. Seeley, Rochdale. Eng. Pats. 4957, Mar. 31, and 6024, Apr. 22, 1915.

In a machine for dyeing or sizing small warps, etc., shown in plan in the figure, A is the dye-tank, E is a barrel formed of staves, H, H, are swivel bearings in which the roller, I, is mounted so that it can be revolved but cannot be moved lengthwise. The roller is oblique to the barrel, E, so that a warp led from a fixed position near one end of the tank and passed round the barrel and roller to another fixed position near the other end of the tank, will pass round the barrel when it is revolved, without one part of the warp rubbing against another. To ensure equal dyeing from end to end of a warp, it is passed round the barrel the same number of times in each direction.—F. W. A.



Weighting of silk; Process for the ——. Gebr. Schmid, Basle. Ger. Pat. 287,751, Nov. 1, 1914.

The fibre is repeatedly treated alternately in stannic chloride and alkali phosphate baths and finally in an alkali silicate bath, one or more of the baths being in the form of froth produced by the alkali introduced by addition of the extract of the cocoons, etc. The new process effects a saving of plant, as it only takes 4 to 5 mins. in place of 3 hrs. formerly necessary; an increase of 10 to 15% in the amount of weighting introduced is also noted.—F. W. A.

Ice colours; Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,752, July 28, 1914.

The fibre is padded with solutions of the monosulphonic acids or carboxylic acids of *bis-β*-hydroxynaphthoyl derivatives of aromatic diamines, and then treated with diazo-solutions. The new diamines used are prepared by the action of 2 mols. of carbomethoxy-β-hydroxynaphthoyl chloride (Fischer, Annalen, **391**, 355) on 1 mol. of an aromatic diamine sulphonic or carboxylic acid, and saponifying the product by boiling with sodium carbonate. The new substances in the form of the sodium salts are readily soluble in boiling water, and possess the important property that, after coupling, any uncombined substance may be removed readily from the fibre by soaping. The dyeings are fast to washing and to boiling.

—F. W. A.

Aniline Black; Production of ungreenable ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 287,791, Aug. 28, 1914. Addition to Ger. Pat. 285,955 (this J., 1915, 1140).

Potassium ferrocyanide is added to the chlorates of aniline and its homologues claimed in the main patent.—F. W. A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sodium aluminate; Preservation of solutions of —— *by refrigeration.* G. A. Le Roy. Comptes rend., 1916, 162, 74—75.

Solutions of sodium aluminate, particularly concentrated solutions, are extremely unstable at the ordinary temperature. In the process of proofing textiles with sodium aluminate, it is desirable to keep a stock solution ready for use, and it is found that the tendency to spontaneous decomposition is entirely avoided by storing the liquid in a refrigerator at a temperature a few degrees below 0° C. The strong commercial solution of sodium aluminate, containing 21·9 grms. Al_2O_3 per 100 c.c. and having an alkalinity of 30·0 to phenolphthalein and 54·2 to methyl orange, expressed as grms. of H_2SO_4 per 100 c.c., does not freeze even at —20° C. It may be stored in closed bottles in a refrigerator maintained at —1° to —2° C. for a month or more without the slightest change, whereas at 20° C., the solution becomes cloudy after storage for a few days. In the course of a month at 20° C. the dissolved alumina had fallen from 21·9 grms. to 7·4 grms. per 100 c.c.—J. F. B.

Potassium bitartrate; Determination of —— by the reduction of potassium iodate and iodide. Kantor. Monit. Scient., 1915, **59**, 273.

The method, which may be used for the estimation of potassium bitartrate, either pure or in the form of commercial tartrates, is based on the following reaction, where RH represents an acid substance:—

$$6RH + 5KI + KIO_3 = 6RK + 3I_2 + 3H_2O.$$

The iodine liberated is titrated with a standard solution of sodium thiosulphate from which the content of acid is calculated. If the iodine is titrated in the vessel in which the three substances react, a sharp end point is not obtained. The difficulty is overcome by distilling over the iodine into a small flask containing a 10% solution of potassium iodide.—W. C. H.

Sodium uranate; Experiments on the separation of vanadium from crude ——. H. H. Barker and H. Schlundt. Met. and Chem. Eng., 1916, **14**, 18—23.

The crude sodium uranate, obtained as a by-product in the extraction of radium from carnotite ores, generally contains 5—10% V_2O_5, of which only about one-half is removed by solution in acid and re-precipitation with sodium hydroxide. The present investigation was made, on a laboratory scale, with the object of discovering a direct method for removing the vanadium and means for converting the purified uranate (which should contain less than 0·5% V_2O_5 to be marketable) into uranium oxide. (1) By the action of gaseous hydrochloric acid, the vanadium was completely volatilised and a residue obtained consisting of sodium uranate, sodium chloride, and uranyl chloride, from which 59 to 64% of the total uranium was recovered, as pure oxide, by either boiling with excess of ammonium chloride, or dissolving in dilute acid and precipitating the solution with ammonia, and igniting the ammonium uranate produced. It is probable that, by proper regulation of temperature, gaseous hydrochloric acid might effect the quantitative removal of vanadium from carnotite ores direct. (2) By heating a mixture of the crude uranate with twice its weight of ammonium chloride and sufficient water to make a thick paste, the vanadium content of the original material was reduced from 8·5 to less than 0·5% and the uranium partly converted into oxide; the highest recovery of uranium oxide was obtained at a temperature not exceeding that necessary to volatilise the ammonium chloride and vanadium compounds. (3) By dissolving the crude uranate in the least possible quantity of dilute hydrochloric or nitric acid, or, in some cases, sulphuric acid, and boiling the solution, the vanadium was completely co-precipitated with about 13% of the uranium; pure uranium oxide was obtained by adding ammonia to the filtrate and igniting the ammonium uranate produced. From 58 to 79% of the total uranium was recovered, as pure oxide, by this method when dilute hydrochloric or nitric acid was employed.—W. E. F. P.

Radium; The life of ——. E. Gleditsch. Amer. J. Sci., 1916, **41**, 112—124.

Experiments were made with solutions of ionium preparations separated from the uranium minerals, uraninite, cleveite, and bröggerite. The two most carefully prepared solutions, both obtained from bröggerite, gave the values, $4{\cdot}22 \times 10$_^{4} year)_^{1} and $4{\cdot}14 \times 10^{-4}$ (year)$^{-1}$, for the disintegration constant of radium; the corresponding half-value periods of radium are 1612 and 1671 years respectively, results agreeing very closely with the value found by Rutherford.—B. N.

Hydrogen sulphide: Oxidation of —— by ozone in presence of steam at 120° C. U. Bresciani. Annali Chim. Appl., 1915, **4**, 313—316.

Steam superheated to 120° C. was passed at the rate of 2685 litres per hour through an asbestos-covered tin coil. 2m. long, and then condensed in a second tin coil. After half an hour ozonised oxygen (prepared by decomposing ammonium persulphate with nitric acid; see Malaquin, this J., 1911, 487) and hydrogen sulphide were added to the steam as it entered the first coil, in proportions such that the mixture contained 0·21% of ozonised oxygen and 0·02% of hydrogen sulphide by volume. The addition was continued for ½ hour and then steam alone was passed for another ½ hour. Examination of the condensed liquid showed that under these conditions less than one-twentieth of the hydrogen sulphide was oxidised to sulphuric acid.—A. S.

Hydrogen peroxide: New reaction of ——. K. Spiro. Z. anal. Chem., 1915, **54**, 345—347.

If a dilute phenol solution is treated with a few drops of $N/10$ hydrogen peroxide solution and a freshly-prepared $N/100$ ferrous sulphate solution is added, an intense green coloration is obtained. The colour changes to reddish violet on addition of dilute alkali solution but the green colour reappears when the mixture is acidified. The reaction is very sensitive; the green coloration may be obtained with 1 c.c. of $N/1000$ hydrogen peroxide solution, that is, with 0·017 mgrm. of the peroxide; it depends on the simultaneous oxidation of the ferrous salt and the phenol, the resulting catechol giving a green coloration with the ferric salt. Certain other monohydroxy derivatives of benzene may be used in place of phenol, but not salicylic acid owing to the coloration which it gives with ferric salts; other substances, which yield complex salts with ferrous sulphate, should not be present.—W. P. S.

Antiseptics from sea water. *See* XIXb.

Patents.

Glover, Gay Lussac, or like towers. J. Harris, Sheffield, and D. H. Thomas, Morriston. Eng. Pat. 7055, May 11, 1915.

The towers are packed with spaced rows of stepped bricks, some of which rest on inward projections of the lining or wall bricks; these projections form grooves for receiving the ends or sides of the packing bricks, so that lining and packing mutually support one another. The packing bricks are stepped at the sides only or also at the ends, and in the latter case have tongues at their upper ends to engage the projections of the lining bricks, these bricks being recessed below the projections to take the end steps of the packing bricks. Alternate rows of the packing bricks may be inverted, and the bricks are then made hollow and provided with distance pieces. For a circular tower, the lining bricks are arc-shaped.—F. Sodn.

Sulphuric acid; Method of making ——. E. Taylor, New York, and F. P. Bergh, Yonkers, N.Y. U.S.Pat. 1,157,455, Oct. 19, 1915. Date of appl., Dec. 31, 1913.

A finely-divided catalytic agent, such as iron oxide, is projected as a cloud into a mixture of sulphur dioxide and air, and the temperature of the reaction is controlled by injecting a stream of cold air, or other cooling medium, into the gases.

The iron oxide is collected, either by settling or by an electric dust collector, and is used again in the process.—B. N.

Sulphuric acid compounds obtained in the purification of hydrocarbons; Decomposition of —— by heat. F. A. Bühler, Berlin-Lichterfelde West. Ger. Pat. 287,755, Mar. 10, 1914.

The lower part of a rotating drum dips into the waste acid, which collects on its surface and is decomposed, at a temperature of 273° C. or above, by flames, free from oxygen, which impinge upon it. The apparatus is in an enclosure with one outlet for the escape of gases which receive subsequent treatment. The coke residue left on the drum is removed by a scraper and also recovered. —E. H. T.

Magnesia; Process of obtaining ——. J. A. Bradburn, Syracuse, N.Y. U.S. Pat. 1,156,662, Oct. 12, 1915. Date of appl., Nov. 28, 1914.

Dolomite is calcined at a temperature not higher than is necessary to form the oxides, and the product is stirred with water to form hydroxides of the metals. The milky liquid is mixed with a solution of sodium and ammonium chlorides, and distilled to expel ammonia and form a solution containing calcium and magnesium chlorides. The solution is mixed with calcined dolomite to convert the magnesium chloride into hydroxide, the magnesium oxide in the calcined dolomite being also precipitated. By passing the mixture through a series of settling tanks, the heavier magnesium oxide and the lighter magnesium hydroxide are deposited and recovered separately from the liquid, and the hydroxide is calcined to form magnesia.—B. N.

Sulphate of ammonia; Process of producing ——. A. F. Hilleke, Ensley, Ala., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat. 1,163,752, Dec. 14, 1915. Date of appl., Feb. 2, 1915.

Water of condensation from the gas is continuously cooled and circulated in contact with the gas to remove tar and fixed ammonium compounds. The gas is then washed with the surplus water of condensation, which is independently heated, so as to vaporise and restore to the gas the condensed water and free ammonia; finally, it is passed through an acid bath, to form ammonium sulphate, and the water condensed in the bath is vaporised and returned to the gas. —F. Sodn.

Ammonia saturator. A. F. Hilleke, Ensley, Ala., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat. 1,163,753, Dec. 14, 1915. Date of appl., Apr. 10, 1915.

The saturator is provided with a cylindrical baffle, to the upper part of which is attached a circular acid-supply trough, to deliver acid upon its surface. —F. Sodn.

Potassium chloride; Continuous crystallisation of ——. J. Schnitzler, Bochum. Ger. Pat. 286,910, Dec. 15, 1914.

The hot solution flows successively through a series of cooling vessels, each provided with a set of narrow cooling boxes. In addition to the cooling vessels the installation comprises corresponding series of auxiliary vessels and mixing vessels with the necessary connections and pumps. The cooling water flows first through an auxiliary vessel to a mixing vessel and thence to the corresponding cooling vessel, then through the next set of auxiliary, mixing, and cooling vessels respectively, and so on through the series of cooling vessels in the opposite direction to the potassium chloride solution. Each mixing vessel is connected with both the corresponding auxiliary vessel and the adjacent auxiliary vessel containing water at a higher temperature, so that the temperature of the water in the mixing vessel may be increased to the extent necessary to compensate for loss of heat by radiation, etc., and thus maintain a condition of equilibrium in the apparatus.—A. S.

Alkali chlorides; Process and apparatus for the electrolysis of ——. Siemens und Halske A.-G., Siemensstadt. Ger. Pat. 286,918, Nov. 9, 1913.

In electrolysers with horizontal diaphragms, the space above the diaphragm is divided into a large number of small compartments by partitions or hollow pieces of alkali-resistant insulating material, *e.g.*, glass or porcelain; or both partitions and hollow pieces may be used. The partitions or hollow pieces may rest on a network of asbestos rope placed on the diaphragm; preferably several layers of such network, not in register, are used. With the arrangement mentioned, the formation of hypochlorite is reduced to a minimum without notably increasing the resistance.—A. S.

Hydrazine or the like; Process of reduction [of metallic compounds] by means of ——. N. Sulzberger, New York. U.S. Pat. 1,164,141, Dec. 14, 1915. Date of appl., Dec. 10, 1914.

Reducible metallic compounds are treated with compounds of nitrogen and hydrogen having reducing properties, *e.g.*, hydrazine, in the presence of a metallic catalyst, preferably a metal of the platinum group.—F. Sodn.

Hydrogen sulphide and alkali or alkaline-earth sulphides; Manufacture of ——. Sarvarer Kunstseidenfabrik A.-G., Sarvar, Hungary. Ger. Pat. 286,947, Nov. 24, 1914. Under Int. Conv., Jan. 12, 1914.

Waste substances containing sulphur are mixed with alkali or alkaline-earth hydroxides or carbonates and heated, either alone or in presence of an organic substance capable of acting as a reducing agent. Saturation mud from sugar refining may be used as a source of both alkali and reducing agent. —A. S.

Nitrides; Manufacture of coherent masses of ——. E. Podszus, Neukölln. Ger. Pat. 286,992, Dec. 25, 1913. Addition to Ger. Pat. 282,748 (this J., 1915, 717).

Coherent masses of boron, titanium, or the like are converted slowly into nitride by heating in an atmosphere of ammonia or nitrogen.—A. S.

Mixtures developing cyanogen and hydrocyanic acid, prepared in cartridge form. A. Lang, Karlsruhe. Ger. Pat. 287,006, Feb. 8, 1914.

Mixtures are prepared which react exothermically, when the reaction is started by local heating, with formation of cyanogen or hydrocyanic acid. Two examples are given. (1) 87 parts of barium nitrate and 32 parts of carbon. The interaction produces carbon monoxide, barium oxide, and nitrogen, and if a part of the cartridge is enclosed in a metallic cover, local overheating produces a further action and formation of cyanogen; this is liberated as such if the supply of oxygen is restricted, as in caves, etc. (2) 1 part of aluminium, 2 parts of iron, 5 parts of barium nitrate, and about 0·8 part of ammonium oxalate. The first three form the exothermic mixture, the heat of the reaction being sufficient to decompose the oxalate with formation of hydrocyanic acid, etc.—B. V. S.

Salts; Apparatus for the continuous preparation of ——. H. Pappée, Samswegen. Ger. Pat. 287,862, June 22, 1913.

In the preparation of potassium sulphate by the interaction of potassium magnesium sulphate and potassium chloride, and in similar processes, the space below the main stirrer in the reaction vessel contains an auxiliary stirrer with large, vertical blades, which, when the stirrer is at rest, serve as baffles for the circulating liquor, and, together with the containing walls, form receptacles for the separated salt. The auxiliary stirrer is independent of the main stirrer, and separated therefrom by a perforated partition.—E. H. T.

Oxides and hydroxides of heavy metals; Process for obtaining —— practically free from basic salts. F. Cochlovius, Frankfort. Ger. Pat. 288,159, Apr. 5, 1914. Under Int. Conv., Aug. 27, 1913. Addition to Ger. Pat. 272,182 (this J., 1914, 550).

To precipitate the metallic hydroxide, just sufficient basic substance is added to ensure a complete precipitation, and additional basic material, which need not be identical with the first, is added subsequently. Thus calcium or magnesium carbonate may be used to precipitate the copper from a copper-zinc chloride solution, as the zinc remains dissolved at the temperature employed (50°—60° C.); but for the subsequent heating in the autoclave as described in the chief patent, calcium hydroxide, which cannot be used for the separation, is most suitable.—E. H. T.

Carbon monoxide; Method of producing —— from carbon dioxide. C. B. Hillhouse, New York. U.S. Pat. 1,163,922, Dec. 14, 1915. Date of appl., June 29, 1915.

Powdered carbon is sprayed with a whirling motion by a gas under pressure into a stream of carbon dioxide, and the mixture heated to a reducing temperature.—W. F. F.

Hydrogen; Production of —— from steam and metals. W. Näher and M. Nöding, Pforzheim. Ger. Pat. 286,960, June 13, 1914. Addition to Ger. Pat. 279,726.

In carrying out the process described in the chief patent (this J., 1915, 355), the metals are heated to at least 400° C. and the steam to at least 200° C. The metallic oxides produced are again reduced to metal at a temperature of at least 400° C. In the production of the reducing gases, coal, wood charcoal, metallurgical coke, gas coke, soot, or graphite may be used as source of carbon, and small quantities of air, carbon dioxide, producer gas, water-gas, or illuminating gas may be added to the steam; the reducing gases are produced at a temperature of at least 400° C.—A. S.

Hydrogen; Manufacture of ——. Chem. Fabr. A.-G. vorm. Moritz Milch und Co., Posen, and F. Bergius, Hannover. Ger. Pat. 286,961, Nov. 21, 1913. Addition to Ger. Pat. 254,593 (this J., 1913, 195).

In the production of hydrogen by the action of water on metals in a closed vessel, the water is used in the form of steam, and the reaction is effected at a temperature below the sintering point of the metal or the solid reaction products, preferably below 500° C. Pure hydrogen is thus obtained in a highly compressed condition, and the yield is nearly quantitative. The addition of electrolytically conducting salts, such as sodium chloride or ferric chloride, is advantageous, just as in the process described in the chief patent. —A. S.

Apparatus for the continuous solution of solid substances, especially for slaking lime with sugar juice or water. Ger. Pats. 286,824 and 286,825. *See* I.

Process of treating coal and similar substances to obtain oils, ammonia, and other products. Eng. Pat. 18,232. *See* IIa.

Anticorrosive material to withstand water, acid gases, and liquid acids. Ger. Pat. 288,263. *See* IX.

VIII.—GLASS; CERAMICS.

Glasses: Special —— and their constituents. A. Granger. Monit. Scient., 1915, 82, 274—285.

Glasses with baryta. Baryta, usually introduced into the mix as carbonate, increases the specific gravity, index of refraction, brilliance, elasticity, and viscosity of glass, but diminishes the specific heat. Baryta glasses are chemically less resistant than lime glasses, and the barium silicate melts more easily than the calcium silicate. Barium also tends to cause striæ in the metal and favours devitrification, which may be overcome by adding zinc oxide. Baryta glasses are specially useful for pressed ware. Baryta, always introduced as carbonate, may replace lead oxide, and does not affect the coefficient of expansion. The high price of barium compounds, however, prevents their use in cheap ware.

Glasses with zinc oxide. The index of refraction of these glasses is slightly higher than that of lime glasses, but lower than that of lead or barium glasses. Zinc oxide gives a lower coefficient of expansion than basic oxides, even magnesia, the glasses have a high resistance to tension, compression, and chemical action, and a large quantity of zinc does not cause devitrification. Zinc oxide can be obtained pure more easily than lead oxide. In glass it replaces lime, and fusion can be effected in a shorter time but at a higher temperature, and any slight yellow colour developed by long heating can be masked by adding a trace of nickel oxide. Zinc glasses are valued mainly for their special physical properties (*e.g.*, Jena thermometer glass 16 III., which contains 7% ZnO).

Magnesia in glasses. Opinions of various authorities vary enormously as to the desirability of incorporating magnesia in glasses, and research is needed to say what content of magnesia is objectionable from the point of view of fusibility, devitrification, and chemical resistance.

Alumina in glasses. Contradictory views are held as to the effect of alumina. Generally it was considered that alumina raised the fusion point, made the glass hard and difficult to work, and favoured devitrification, but Thuringian glass which can be heated, re-heated, blown, and softened without devitrifying is made from Martinroda sand which contains 3·66% Al_2O_3. Aluminous glasses are particularly resistant to the action of alkalis, and alumina is said to facilitate the fusion of the soda, lime, and silica in glass mixtures. It may be introduced in the form of kaolin, aluminous sands containing felspar, calcined or, preferably, hydrated alumina; cryolite makes glass cloudy. Common glass may be made with rocks, such as granite, syenite, porphyry, basalt, etc. Jena borosilicate thermometer glass 59 III. contains 5% Al_2O_3.

Boric acid, phosphoric acid, antimony, and arsenic in glasses. Boron is introduced either as the crystallised acid or as borax. Up to 20% it raises the refractive index of a silicate glass, but beyond that the effect is reversed. It behaves in the opposite way to fluorine, potassium, and sodium, and has the property of diminishing the part of the spectrum from blue to red. A proper combination of boric flint glass with phosphoric crown gives sharply defined images free from coloured edges. The coefficient of expansion decreases as the content of boric anhydride increases, consequently such glasses resist sudden changes of temperature, also atmospheric influences and acids, but not alkalis. Boric anhydride hinders devitrification and facilitates fusion, so that the content of alkalis can be reduced even though boric anhydride may replace silica, *e.g.*, one of Schott's glasses consists of Al_2O_3 12, PbO 32, and B_2O_3 56%. Phosphoric acid is important in optical glass but makes it soluble; boro-phosphate glasses are more stable than silico-phosphate glasses. Arsenic and antimony are chiefly used to colour or decolorise glass; the former is almost completely vaporised during fusion.—W. C. H.

Porcelain; Technical properties of —— with special reference to its use as insulator. E. Rosenthal. Techn. Studien No. 17. 35 pages. (Verlag G. Stalling, Berlin-Oldenburg.) Z. angew. Chem., 1915, 28, Ref., 598.

IN the determination of sillimanite in porcelain, relatively accurate results can be obtained only when finely powdered materials, and not whole pieces, are treated with the hydrofluoric acid, and when equal amounts are treated for the same time with the same quantity of acid. Sillimanite has no influence on the valuable technical properties of porcelain; its amount increases with the time of heating, when the temperature is constant. The insulating power of different samples was tested, flat electrodes with rounded edges, immersed in oil, being employed. Experiments on the material made in the Berlin factories showed that the best insulating porcelain is obtained at the temperature indicated by cone 16. With plates 2·5 mm. thick, the insulation was broken down at 40,000 volts, and the porcelain was not improved in this respect by repeated firing, although more sillimanite was formed. The insulating power is not seriously affected by change in chemical composition; it is only reduced when relatively very great amounts of felspar are used, and the reduction is due to the presence of microscopic bubbles. Porcelain that has been perfectly sintered and fired has the best mechanical properties; the product obtained by rapid burning in electric furnaces is inferior. The maximum compression strength is attained when silica and felspar are used in approximately equal amounts. When the clay content is constant, the resistance to heat diminishes with increasing felspar and with decreasing silica. Economy could be effected without sacrificing the valuable electrical and mechanical properties, by using less felspar and cheaper clay.—E. H. T.

Crystalline glazes. C. Kabus. Keram. Rundsch., 1915, 23, 139—140, 165—166, 178—179, 183—184. Z. angew. Chem., 1915, 28, Ref., 598—599.

IN the production of crystalline zinc silicate glazes the cooling period should be long, in order to obtain fine crystals, but with rutile the period should be short: hence the former method is best suited for ordinary industrial ovens, the latter for muffle furnaces. A glaze batch has been prepared which gives good and safe results in common glost ovens at cones 8—10; it is applied over another glaze. An oxidising atmosphere in the oven is much the best for making crystalline glazes. Using copper oxide in an oven where both oxidising and reducing zones obtained, a surface glaze of dark Chinese red containing cornflower blue crystals was produced. Titanium oxide (rutile) crystals gave a more subdued tone than crystals of zinc silicate (willemite) and the crystalline glaze penetrated well beneath the surface. The best body for these glazes is that recommended by Pukall (this J., 1910, 213). Crystallisation is much facilitated by the addition of ammonium vanadate, and of molybdic and tungstic anhydrides. Oxides of manganese, chromium, iron, etc., can be used for crystalline glazes; the proportion of these should be about half that of the total bases in Seger's formula.—E. H. T.

PATENTS.

Glass-melting furnaces; Method of heating ——. Bunzlauer Werke Lengersdorff und Co. Ger. Pat. 287,159, June 18, 1913.

THE furnace is provided with means for regulating independently the heat supplied to each melting pot or group of melting pots, and the waste gases from the heating of each pot or group of pots are passed to a regenerator or recuperator corresponding to such group. By adopting this mode of operation it is possible to melt refractory glass in one pot and soft glass in another pot in the same furnace. Moreover the temperature of a defective pot may be reduced sufficiently to allow it to be replaced without interfering with the working of the remainder of the furnace. The same principle may be applied to tank furnaces with several tanks.—A. S.

Glass objects; Process for decorating ——. H. Fritsch, Carlsbad. Ger. Pat. 288,062, May 18, 1913. Under Int. Conv., Aug. 13, 1912.

THE glass object, before being cooled, is placed in a revolving drum maintained at a white heat, in order that the more fusible glass forming the decorative design may melt and become uniformly distributed. In consequence of the rotation the melted glass does not drop off, and the object can be heated for a considerable time without losing shape. Cooling must be very slow, *e.g.*, in an oven completely closed. When cold the framework of the design is worked on an iron wheel with sand, then on a grindstone, polished, and glazed in a muffle.—E. H. T.

Quartz; Process for melting ——. H. Helberger, Munich. Ger. Pat. 288,417, Jan. 10, 1914.

QUARTZ is melted whilst in contact with powdered silicon carbide or other inert and refractory powder, with the object of purifying the melt and preventing it from cracking when it cools. The quartz is melted in a fire-proof, trough-shaped vessel containing the carbide at the bottom. Electrical heating is preferred.—E. H. T.

Slimes or the like; Treatment of —— in rotary drum separators. [*Separation of "mica" from clay.*] W. Feldenheimer, London. Eng. Pat. 24,179, Dec. 16, 1914.

AN aqueous suspension of china-clay, or the like, is fed into a rotary cylindrical drum separator which is rotated, with all its parts, at such a speed that the "mica," or heavier or coarser material, is retained in the separator, whilst the clay, or lighter or finer material, is discharged in suspension. The drum is mounted axially on a vertical spindle, around which, at the top, is an inlet aperture, and a discharge outlet for liquid and fine material is formed by the hollow interior of the lower end of the spindle, which communicates by lateral openings with the interior of the drum; a coned plate, carried on a sleeve sliding axially on the spindle, rests on flanges projecting inwards from the bottom of the drum, and provides, when lifted, a peripheral discharge for heavy or coarse material which escapes between the plate and the flange, at the same time that the discharge apertures for fine material are covered by the sleeve. —F. SODN.

Manufacture of coherent objects from nitrides. Ger. Pat. 286,992. *See* VII.

Manufacture of zinc muffles. Ger. Pat. 287,122. *See* X.

IX.—BUILDING MATERIALS.

Materials for road construction; Progress report of the Special Committee on —— and on standards for their test and use. Proc. Amer. Soc. Civ. Eng., 1915. **41**, 2721—2746.

In this, the Committee's semi-final report on non-bituminous materials, broken stone, slag, and gravel for the construction of roadways, and cement-concrete and blocks of brick, slag, stone, and wood for the construction of pavements are considered. Wood blocks for paving need not be of long-leaf Georgia pine (*P. palustris*), and should contain between 15 and 20 lb. of preservative per cub. ft. In addition to the tests for cement, prescribed by the Society's Special Committee on concrete and reinforced concrete (Trans. Amer. Soc. Civ. Eng., **77**, 427—430), it is recommended that the following methods for testing other non-bituminous materials be adopted as standards:—*Apparent sp.gr. of rock*: An approximately cubical sample (29—31 grms.) is dried for 1 hr. at 110° C., cooled in a desiccator for 1 hr., and then rapidly weighed in air. Trial weighings, in air and water, of another sample of approximately the same size having been made to determine the approximate loss in weight on immersion, the balance is set at the estimated weight and the first sample weighed as quickly as practicable in distilled water at 25° C. The apparent sp.gr. of the rock is taken as the average of determinations made on three different samples. *Apparent sp.gr. of sand, stone screenings, or other fine highway material*: A Jackson direct-reading apparatus is used in accordance with the manufacturer's instructions; kerosene is employed as the liquid for displacement, and 50 grms. of the dried sample is taken for the test. *Absorption of water per cub. ft. of rock*: The cubical sample employed for determining the apparent specific gravity is allowed to remain in distilled water at about 25° C. for 48 hrs. after the initial weighing, when, the water being brought to exactly 25°C., the sample is again weighed while immersed. The amount of water absorbed (lb. per cub. ft.) is calculated from the formula,

$$\frac{W_2-W_1}{W-W_1}\times 62\cdot24,$$

W, W_1, and W_2 being respectively the weight of the sample in air, in water just after immersion, and in water after 48 hours' immersion, and 62·24 the weight in pounds of a cub. ft. of distilled water at 25° C. Determinations are made on three different samples and the average result taken. *Voids in mineral aggregates*: The cone specific gravity method is employed, a truncated cone 10 in. high, 10 in. in external diameter at the bottom, and 3 in. in internal diameter at the open top being used. The aggregate, thoroughly mixed by rolling on paper, is charged into the cone and compacted therein by tapping opposite edges of the base alternately on a block of wood, 300—500 oscillations of the cone being required for this purpose; segregation during oscillation is prevented by pressing cotton waste against the surface of the charge. The percentage of voids (V) is calculated from the formula $V=100\left(1-\frac{C-A}{D(B-A)}\right)$ in which A is the weight (grms.) of the cone, B the weight of the cone filled with water, C the weight of the cone filled with the compacted aggregate, and D the apparent sp.gr. of the aggregate as determined in the cone. *Absorption of water by wood blocks after treatment*: 5 blocks are heated to 110° C. for 3 hrs. and weighed, then immersed in water for 3 hrs., wiped dry and weighed again, the increase being calculated on the dry weight. *Examination of wood block preservative*: The sp. gr. at 38° C. is determined by means of a standardised hydrometer; the solubility in benzol or chloroform by an ordinary method involving re-treatment of the insoluble residue in an extraction apparatus; and the water content by distillation in a copper still. The distillation (fractionation) test is made on 100 c.c. of the water-free material in a glass retort of 250—290 c.c. capacity, supported on a tripod over two sheets of 20-mesh gauze and surrounded by an asbestos shield. A mercurial thermometer, graduated from 0° to 400° C., and having the space above the mercury (including an expansion chamber) filled with carbon dioxide or nitrogen, is used, the dimensions being:—total length, 375 ± 10 mm.; length of bulb, 14 ± 1 mm.; zero mark to bottom of bulb, 30 ± 4 mm.; zero mark to 400° mark, 295 ± 5 mm.; diameter of stem, 7 ± 1 mm.; diameter of bulb, 6 ± 1 mm. The accuracy of standardisation required is 0·5° up to 200° C., 1·0° between 200° and 300° C., and 1·5° between 300° and 360° C. In the test, the bottom of the thermometer bulb is 0·5 in. above the surface of the oil, and the distance from the bulb to the outlet end of the condenser tube is between 20 and 24 in. The distillation is conducted at the rate of 1—2 drops per sec., the fractions, up to 170°, 170°—200°, 200°—210°, 210°—235°, 235°—270°, 270°—300°, 300°—315°, and 315°—355° C. being collected in weighed receivers, each of which is removed as the mercury passes the dividing temperature, so that drainage is not considered as part of the last fraction. No correction is made for the emergent stem of the thermometer. The following mechanical tests are also described:—Abrasion test for broken stone, broken slag, or gravel; toughness and hardness tests for rock or slag; cementation of rock, slag, and gravel powders; crushing strength of rock or slag; mechanical analysis of broken stone, broken slag, gravel, sand, etc.; and the "rattler" test for paving brick.

—W. E. F. P.

Portland cement; Rational production of ——. F. Ferrari. Annali Chim. Appl., 1915, **4**, 329—341.

In the author's view the hydraulic modulus, *i.e.*, the ratio $CaO : (SiO_2+Al_2O_3+Fe_2O_3)$, needs to be supplemented by the "clay index," *i.e.*, the ratio $SiO_2 : (Al_2O_3+Fe_2O_3)$, in order to serve as a criterion of the rational composition of a Portland cement. In 72 samples of Portland cement examined during the past three years, in which the hydraulic modulus varied between 1·839 and 2·193, the clay index varied between 2·007 and 3·634. A study of the quaternary system, $CaO—SiO_2—Al_2O_3—Fe_2O_3$, has shown that for mixtures in which the hydraulic modulus varies between 1·8 and 2, the most favourable results as regards clinker formation in a rotary kiln are given by mixtures with a clay index between 2·5 and 3. Assuming that to obtain Portland cement of proper composition, the clay index must be a function of the hydraulic modulus and that it decreases from 3 to 2 as the hydraulic modulus increases from 1·8 to 2·2, it is shown that $y=-2\cdot5x+7\cdot5$, where x = the hydraulic modulus and y = the clay index. To test this hypothesis experiments were made in a technical plant with five series of mixtures in which the hydraulic modulus was 1·8, 1·9, 2·0, 2·1, and 2·2 respectively; in each series one mixture had a clay index equal to that calculated from the formula given above, and four other mixtures had clay indices 0·25 and 0·5 respectively above and below the calculated value: in the mixtures used the alumina varied between 4·66 and 7·92% and the ferric oxide between 2·25 and 3·78%, and the ratio $Al_2O_3 : Fe_2O_3$ was kept practically constant. The composition of the resulting clinkers was determined, and the cements prepared from them were tested in regard to setting properties, volume constancy (Le Chatelier test), and tensile and crushing strength. In nearly all cases the best results were given by the mixtures in which the clay index had the calculated value, and it is concluded that within the accepted limits for the hydraulic modulus, the most advantageous equilibrium between the four essential constituents of Portland cement is represented by the expression:

$$\frac{SiO_2}{Al_2O_3+Fe_2O_3}-2\cdot5\quad\frac{CaO}{SiO_2+Al_2O_3+Fe_2O_3}+7\cdot5.$$

—A. S.

Patents.

Hydraulic cement: Manufacture of ——. J. Gresly, Kilchberg, Switzerland. Eng. Pat. 8551, June 9, 1915. Under Int. Conv., June 29, 1914.

To obtain a slow-setting, hydraulic cement practically free from alumina and suitable for constructions in sea-water or water containing calcium sulphate, gypsum is added, as sintering agent, to calcium silicate, silicious limestone, or a mixture of calcium carbonate (or quicklime) with silica, the mixture is heated until sintered, and the product pulverised as usual. The gypsum may be used either in the crude state or after heating and rapid cooling.—W. E. F. P.

Bricks for muffles, retorts, recuperators, etc.: Manufacture of ——. Dr. North Kommandit-Ges., Hannover. Ger. Pat. 286,206, Sept. 25, 1914.

A brick made from fireclay is provided with openings extending through it from one side to the other, and these openings are filled with refractory material of high thermal conductivity. The brick is also coated on both sides with this material. The size of the openings is such that their total volume is at least equal to the total volume of the coatings of refractory material on the faces of the brick. It is stated that a brick of this kind with carborundum coating and carborundum in the openings possesses a thermal conductivity nearly as high as that of a brick made entirely of carborundum.—A. S.

Lime and similar materials; Process for burning ——. F. K. Meiser, Nürnberg. Ger. Pat. 286,967, Mar. 12, 1914.

In burning lime and similar materials in annular, tunnel, or shaft furnaces, a portion of the air for combustion is preheated by using it to cool the burnt material, and the remainder is preheated in recuperators into which a portion of the waste gases from the furnace is led.—A. S.

Flooring plaster and stucco plaster: Production of —— in rotary kilns. F. M. Meyer, Saarbrücken. Ger. Pat. 287,301, Jan. 8, 1914.

Two rotary kilns are used, and the solid material and the heating gases move in the same direction through the kilns. The waste gases from the kiln in which flooring plaster is produced, are used to heat the other, larger kiln, and the latter is of such capacity that it furnishes not only sufficient material to charge the first kiln but also a considerable quantity of stucco plaster as end product.

—A. S.

Building blocks from peat; Manufacture of ——. W. Schütz, Königsberg. Ger. Pat. 287,701, June 5, 1914.

Peat is pressed to remove part of the water, then finely subdivided, intimately mixed with a hydraulic binding agent, moulded, and the blocks exposed to the air. Substances which would interfere with the setting of the binding agent are mostly removed with the water expressed from the peat. The bricks or blocks prepared in this way have a high crushing strength and resistance to atmospheric influences and a specific gravity about one-half that of ordinary building brick.

—A. S.

Sintered magnesite; Process for making —— from mixtures of magnesia with calcium oxide. Harburger Chem. Werke, Schön und Co., Harburg. Ger. Pat. 288,262, Oct. 23, 1914.

Magnesium chloride liquor is decomposed by excess of lime and, after separation, the pressed solid mass, containing up to about 3% of calcium chloride, is heated to a sintering temperature; no change in composition occurs during sintering. By increasing the calcium chloride content, a deficiency of calcium oxide can be made good.

—E. H. T.

Anti-corrosive material to withstand water, acid gases, and liquid acids. Superphosphatfabrik Nordenham A.-G., Nordenham. Ger. Pat. 288,263, June 30, 1914.

Asbestos powder, water glass, and silicic acid are mixed to a homogeneous mass and used both as a protective coating and as a cementing material. The silicic acid employed is a by-product of the superphosphate industry, formed by the action of the sulphuric acid upon mineral phosphate containing quartz and calcium fluoride, the silicon tetrafluoride thus formed being passed into water; it is extremely porous and contains traces of hydrofluoric and hydrofluosilicic acids.

—E. H. T.

Glazing natural and artificial stones and plastic materials: Process for ——. P. Fenaroli, Milan, Italy. U.S. Pat. 1,164,710, Dec. 21, 1915. Date of appl., Feb. 21, 1913.

See Eng. Pat. 2197 of 1913; this J., 1914, 422.

Method of heating furnaces for metallurgical and other purposes. Ger. Pat. 287,080. *See* X.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Cast iron; Malleable ——. F. Erbreich. Stahl u. Eisen, 1915, 35, 549—553, 652—658, 773—781. Z. angew. Chem., 1915, 28, Ref., 578.

The composition of the molten iron should be C not over 3%, Si, according to carbon content, 0·45 to 1·25%, Mn at most 0·4%, P at most 0·10%, S below 0·1%. The importance of composition makes chemical control extremely desirable. Melting in crucibles gives the best product, but it is only used for work on a small scale, and for castings required to be specially strong. Cupolas are chiefly used in Germany, reverberatory furnaces, contrary to American practice, being little utilised. On the other hand the Siemens-Martin furnace is quickly becoming more and more regarded, in Germany, as the most suitable furnace for the production of malleable cast iron. The author has observed in many samples of malleable cast iron a carbon-rich layer of varying extent lying between two decarburised layers, and the causes and disadvantages of the formation of such a shell are discussed at length. The judging of the finished product must be based primarily on physical tests; chemically, determinations of silicon, phosphorus, manganese, and particularly sulphur, are required.—T. St.

Iron-carbon alloys; The magnetic transformation in ——. G. Rümelin and R. Maire. Ferrum, 1915, 12, 141—151. Z. angew. Chem., 1915, 28, Ref., 577

The magnetic and thermal transformation points were determined on 13 very pure carbon steels containing from 0·11 to 1·54% C. Preliminary experiments were made to ascertain to what extent the temperature of the magnetic transformation is influenced by the conditions of experiment, as usually performed, so that the changes due to varying carbon content could be studied under the most favourable conditions. The results obtained are summarised as follows:— (1) Iron-carbon alloys with 0·11 to 0·43% C show with a weak field intensity, and with slow rates of heating and cooling, a sharply defined reversible magnetic change point at $Ar_2 = Ac_2$; above this temperature the alloys are still weakly ferromagnetic; this part of the magnetisation alters continuously and reversibly between A_2 and the arrest A_3, which depends for its position on the carbon content; magnetisation entirely disappears at the latter point. (2) The temperature-hysteresis increases as the carbon content increases from 0·4 to 0·8%, whilst the transformation temperature sinks to Ac_1 and Ar_1. With 0·4 to 0·8% C the magnetic transformation takes place in a temperature interval corresponding to the separation and solution of β-ferrite with alteration of temperature, as indicated by the iron-carbon diagram. (3) Eutectoid and hypereutectoid steels undergo an irreversible transformation at the sharply defined points Ac_1 and Ar_1. They all have the same transformation temperatures. (4) An explanation is given of the circumstance that the pearlite change taking place in alloys containing less than 0·8% C exercises no influence on the magnetic transformation; the failure of the first magnetic observations to accord with the generally accepted iron-carbon diagram is hereby accounted for.—T. St.

Platinum; Occurrence of —— in Spain. Domingo de Orueta and S. Pina de Rubies. Comptes rend., 1916, **162**, 45—46.

The Ronda range, in Andalusia, is composed of olivine rocks resembling those of the Urals. The alluvial deposits were found to contain platinum varying in quantity from a trace to 28 grms., average 3 grms., per cub. metre.—W. R. S.

Copper refining; Comparison of the multiple and series systems of electrolytic ——. P. L. Gill. Eng. and Min. J., 1916, **101**, 9—10.

In a comparison between the multiple and series systems of electrolytic copper refining, the figures have shown that, at present, the higher labour cost of the series system is compensated by the higher power cost of the multiple, the ultimate cost being about the same. The figures, however, have not been obtained from the same class of material, as the series system is favoured by a supply of exceptionally pure blister copper, whilst the multiple system is operating on, and is more adaptable to, impure coppers, and those running high in silver and gold values.—B. N.

Copper; A supposed allotropy of ——. G. K. Burgess and I. N. Kellberg. U.S. Bureau of Standards. J. Wash. Acad. Sci., 1915, **5**, 657—662.

Contrary to the conclusion of Cohen and Hulderman (this J., 1914, 597), that copper exists in two allotropic forms having a transition point between 71·7° and 69·2° C., no indication of allotropy was observed by measuring the electrical resistance of the metal between 0° and 100° C. by three different methods.—W. E. F. P.

Nickel; Occurrence and production of ——. Chamber of Comm. J., Feb., 1916.

About three-fourths of the output of nickel ore is mined at Sudbury in Ontario, Canada, but the greater part of the world's supplies of metal is refined in the United States, from imported matte. The following table shows the exports of nickel contained in ore, matte or speiss from Canada during 1913 and 1914:—

To	1913.		1914.	
	lb.	$	lb.	$
United Kingdom	4,826,783	718,141	6,479,250	960,621
United States	43,341,307	4,327,056	43,989,648	4,398,920
Other countries	—	—	111,638	15,197
Total	48,168,090	5,045,197	50,580,536	5,374,738

The exports of nickel, nickel oxide, and matte (but mainly the metal), from the United States during the years ended June 30th, 1913, and 1914, were:—

To	1913.		1914.	
	Quantity. lb.	Value. $	Quantity. lb.	Value. $
United Kingdom	9,213,109	3,300,500	7,604,592	2,702,000
Germany ...	2,346,325	441,447	11,084,366	3,007,786
France	4,197,110	1,577,500	4,419,663	1,583,830
Netherlands	9,164,012	2,812,300	2,376,216	840,269
Belgium ...	1,719,285	666,108	1,230,274	475,175
Italy	1,075,303	414,100	1,276,905	446,900
Other countries	166,133	63,759	903,226	347,749
Total exports	27,881,277	9,275,714	28,895,242	9,403,709

The imports of nickel and nickel matte into the United Kingdom are not recorded separately in the trade return of the United Kingdom. The imports of nickel oxide into the United Kingdom in 1914 were 25,264 cwt., value £125,754, wholly from the United States. Following are some particulars of the occurrence of nickel in various countries.

Canada.—The deposits of nickel-copper ore in the Sudbury district of Ontario are mined and treated by the Canadian Copper Company and the Mond Nickel Company. The Alexo Mine is being worked in Dundonald township, on the Temiskaming and North Ontario Railway. The ore is a pyrrhotite, similar to that of the Sudbury region. A number of claims have been staked for nickel on the north shore of Lake Athabasca, but no development work has been done.

In 1914, 1,000,364 metric tons of nickel ore was mined in Canada, 947,053 tons was smelted, and 46,396 tons of matte produced. The matte contained 22,759 metric tons of nickel and 14,448 metric tons of copper.

Newfoundland.—Nickel is known to occur in Newfoundland in association with the Tilt Cove copper deposits, and at one time a small quantity was extracted and marketed. Some 320 tons was produced between 1869 and 1876.

Union of South Africa.—Nickel ores have been found at Insizwa, Cape Province. Trial shipments of the ore were reported to contain 3½% Cu and 5% Ni and Co. If the ore is present in large quantities the occurrence may be of importance.

Tasmania.—The occurrence of nickel in Tasmania has been know for some time, but little has been done until recently in the direction of exploration and development. The two principal occurrences are in the west of the island, one in the Dundas mining district near Zeehan, and the other on the west coast at Trial Bay, 14 miles away.

Development work has been done on the Dundas deposit of high-grade copper-nickel ore. The ore is principally sulphide with 8 to 12% Ni and 4 to 6% Cu; lower grade ore occurs at a depth of 70 feet. The operations are burdened with heavy transport charges to Europe, which could be materially lessened by smelting to matte of 80% metal. The Trial Bay ore is of low grade, generally less than 1% of metal, but amenable to water concentration.

Egypt.—Nickel ore is known to occur in Egypt, but there is no production at present.

United Kingdom.—Nickel mining was started in Kirkcudbrightshire in the year 1897, when 300 tons of ore was raised, the value being estimated at £300. No output has been recorded since that year. Small quantities of asbolane, containing both nickel and cobalt, were obtained from a mine in Flintshire up to the year 1890. No production has been recorded since that date.

Cuba.—The occurrence of nickel in iron ores is common, the best known instance being the deposits of the Spanish-American Iron Co. in Cuba, where the average nickel content of the ores is a little over 1%. The steel plant of the Maryland Steel Co., near Baltimore, U.S.A., uses these ores and smelts many thousands of tons a year.

Germany is a comparatively small producer of nickel ores and a large importer of metal and ore. In the first half of 1914 Germany imported 1066 metric tons of nickel and 13,012 tons of nickel ore, as compared with 1189 tons and 6643 tons respectively in the corresponding period of the previous year. Exports for the first half of 1914 were 1145 tons of nickel, compared with 1018 tons in the same period of 1913. The production of nickel ore in Prussia in 1912 was 12,113 metric tons, valued at £12,799.

Greece.—An interesting nickel deposit on the island of Socris, east of Athens, has recently attracted attention and may prove to be of value. The mine was opened for hæmatite and has been worked as an iron mine, but below the iron ore a fairly rich ore of nickel is found containing 9% of nickel oxide. A shipment of the ore has been made to Norway for treatment at the Evje smelter.

Madagascar.—In 1912 a concession was granted for working nickel in the neighbourhood of Ambositra, 160 miles south of Antananarivo, and the property is stated to have been thoroughly prospected. No production or export appears to have been reported.

New Caledonia. The only important source of nickel ores, outside Canada, is New Caledonia. Owing to the nature of the deposits and their situation, the ores do not yield as large a profit as those of Sudbury, although they are richer. The following table shows the exports of nickel ore and nickel matte from New Caledonia during 1914:—

To	Ore.		Matte.	
	Tons.	£	Tons.	£
United Kingdom	42,125	50,520	2,523	70,160
Germany	10,205	12,240	—	—
Belgium	18,346	22,000	2,458	66,280
United States	—	—	305	8,520
France	23,379	28,000	—	—
Total	94,055	112,760	5,286	144,960

Norway.—Deposits of nickel ore exist in Norway at Hole, Saetersdal, and Torvestad. The output of the Flood mine, Saetersdal, in 1913, is stated to have been 28,000 tons of ore, which was sent to Evje (three miles away) for smelting. The refinery of the Evje Nickel Works, near Christiansand, produced 1,200,000 lb. of nickel during 1913, and the Ringerike plant, near Christiania, handled 19,000 tons of ore in the same year.

Russia.—Nickel ores associated with iron occur in the Ural region in Russia. It is stated that three such deposits containing 2 to 4% of metal have long been known, and their exploitation has recently been begun. Factories at Revdinsk are now smelting about 600 poods a year of crude nickel with 65% Ni.

Zinc and lead; Hydrometallurgy of —— in 1915. D. A. Lyon, O. C. Ralston, and J. F. Cullen. Met. and Chem. Eng., 1916, 14, 30—32.

Zinc. In Brunner, Mond and Co.'s plant (Northwich), zinc ores are leached with waste calcium chloride liquor in presence of carbon dioxide; the resulting zinc chloride solution on electrolysis gives a spelter of 99·96% purity, and chlorine gas, which is used in making bleaching powder. The same process is in operation at Duisburg, Germany. Two plants were erected in 1914 at Kristiania and Balestrand (Norway) for the treatment of Broken Hill flotation concentrates. The processes which are being tested in American plants are based on sulphuric acid leaching and subsequent electrolysis of the zinc solution, using lead anodes. The Anaconda Copper Co. is completing a 25-ton plant in which the roasted ore will be leached with barely sufficient acid to extract the zinc, the resulting liquor being purified by addition of zinc oxide. At the Bully Hill mine (Shasta Co., Cal.) the zinc sulphate liquor is precipitated with lime and the precipitate of zinc hydroxide and calcium sulphate is suspended in the electrolyte to neutralise the acid as fast as it is formed. For the same purpose, the Reed Zinc Co. (Palo Alto, Cal.), in the recovery of zinc from bag-house dust, use a sponge lead anode which is converted into sulphate. By reversing the current sulphuric acid and lead are regenerated. At Silverton, B.C., the ore is leached with bisulphate and electrolysis carried out with addition of manganese sulphate. The anode becomes coated with manganese dioxide, which is re-dissolved and used over again. *Lead.* Methods involving chloridising or sulphatising roasting, followed by leaching with saturated brine, ar mostly employed. Electrolysis of the liquor give spongy lead, but unlike copper or zinc spong this can easily be melted into bars by adding a small quantity of reducing agent. Experiment are being conducted on the leaching of lea carbonate ores by means of brine containin sufficient sulphuric acid to convert the lead int sulphate. (See also this J., 1915, 1059.)—W. R. S

Cadmium; The treatment of raw material, technic and economics of the metallurgical extraction o ——. F. Juretzka. Metall u. Erz, 1915, 12 235—241. Z. angew. Chem., 1915, 28, Ref., 575

The chief sources of cadmium are zinc blend and calamine. A large proportion of the cadmiu is lost, however, in the roasting of the ores. Th zinc chloride solutions used in the manufactur of lithopone contain considerable amounts cadmium chloride, which is separated eithe electrolytically or by means of zinc dust. In th dry way, cadmium is obtained chiefly from th zinc dust produced in the first 1½—2 hours distillation treatment of zinc ores. This produc which contains up to 6% Cd, is mixed wit 50% of coal, well dried, charged into zin muffles, and distilled for about 22 hours at a lo red heat. The distillate is condensed in shee iron cones 1 m. in length, and contains abou 75% Cd, the remainder consisting of cadmiu oxide, zinc, and zinc oxide; the residue in th muffles contains 45—50% Zn. The impu cadmium is mixed with 40% of charcoal, well dried, and heated in sharply inclined cast-iron retorts which are left empty in the front for the reception of the molten cadmium. Under normal conditions, the extraction of cadmium is only profitable at prices higher than M. 7·50 per kilo. (about 3s. 3d. per lb.), and when the zinc dust cannot profitably be disposed of direct without further treatment.—T. St.

Mercury; British imports and exports of ——. A. H. Pickering, London, Jan., 1916.

	Imports. Bottles.	Exports. Bottles.	Price. Highest. £ s. d.	Price. Lowest. £ s. d.
1906 ..	38,823	27,712	7 7 6	6 17 0
1908 ..	43,605	22,348	8 10 6	7 12 6
1910 ..	44,595	24,748	9 15 0	7 9 0
1911 ..	46,547	31,438	10 0 0	7 10 0
1912 ..	47,261	32,240	8 12 6	7 3 6
1913 ..	45,348	26,815	7 15 0	7 0 0
1914 ..	37,568	22,975	11 5 0	6 10 0
1915 ..	40,579	13,020	18 10 0	11 0 0

The estimated consumption in the United Kingdom is 15,000 bottles per annum. (A bottle of mercury weighs 75 lb.)

Tungsten [in ores]; Reduction test for ——. M. L. Hartmann. Min. and Eng. World, 1915, **43**, 1021—1022.

At least 0·2 grm. of the finely divided ore is boiled in a small test tube with hydrochloric acid until about half of the latter is evaporated; the solution is diluted with an equal volume of water, a piece of tin ("mossy") added, and the liquid warmed if necessary. If a negative result (no blue colour) is obtained, 0·5 grm. of the sample is fused with sodium carbonate (4 grms.), the melt dissolved in water, an equal volume of hydrochloric acid added, and the solution treated with tin as before. The final volume should not exceed 20 c.c., and, in either case, the blue colour is changed to brown by prolonged reduction. By this method, tungsten may be detected in materials containing as little as 2% WO_3. Interfering metals are columbium, which gives a blue colour unaffected by prolonged reduction; vanadium, which also yields a blue compound on reduction in tartaric acid solution (distinction from tungsten); molybdenum, the reduction of which yields a series of colour changes from violet to blue and then to black; and titanium, which gives a violet colour on reduction.—W. E. F. P.

Flotation process; Theory of the ——. J. M. Callow. Amer. Inst. Min. Eng., 1915. Met. and Chem. Eng., 1916, **14**, 49—51.

Observations on the electrostatic properties of ore particles showed that floatable minerals seemed to have positive, and gangue particles negative, charges. Some gangues were found to have positive charges, but these had a tendency to rise with the froth. On the other hand, the oil and air contact films of the froth have both been proved to have negative charges. The theory is advanced that oil flotation is an electrostatic process, the negatively charged froth attracting the positively charged (*i.e.*, floatable) minerals and repelling the gangue particles.—W. R. S.

Mineral and metal production in the United States. Eng. and Min. J., Jan. 8, 1916.

In the table given below, the production of the more important metals and minerals in the United States is summarised. The figures given for 1915 are mostly based on official figures for the first 10 months of the year, the remainder being estimated:—

Metals.

Metal.	Unit.	1913.	1914.	1915.
Aluminium	lb.	49,601,500	(*g*) 45,000,000	(*g*) 80,000,000
Copper (*a*)	lb.	1,225,735,834	1,158,581,876	1,424,640,565
Ferromanganese	Long tons	229,834	185,118	232,210
Gold (*b*) ..	Dollars	88,884,400	94,531,800	98,891,100
Iron	Long tons	30,736,477	23,147,226	29,738,981
Lead (*c*) ..	Short tons	433,476	538,735	565,356
Nickel (*e*)	lb.	47,124,330	30,067,064	38,966,138
Quicksilver	Flasks	(*g*) 20,000	16,300	(*f*) 20,681
Silver (*b*)	Troy oz.	66,801,500	72,455,100	67,485,600
Zinc (*d*) ..	Short tons	358,262	362,361	492,495

(*a*) Production from ore originating in the United States. (*b*) The statistics for 1913 and 1914 are the final and those for 1915 are the preliminary statistics reported jointly by the directors of the Mint and the U.S. Geological Survey. (*c*) Production of refined lead from ore and scrap originating in the United States: antimonial lead is included. (*d*) Total production of smelters, except those treating dross and junk exclusively; includes spelter derived from imported ore. (*e*) Imports; for 1915, first 9 months only. This nickel is refined in the United States for the production of metal, oxide and salts. (*f*) As reported by .U.S. Geological Survey. (*g*) Estimated.

Mineral and Chemical Substances.

Substance.	Unit.	1913.	1914.	1915.
Coal, anth. (*a*)	Short tons	91,626,825	(*b*) 90,821,507	89,000,000
Coal, bitu. (*a*)	Short tons	478,688,867	(*b*)422,703,970	428,371,921
Coke (*a*)	Short tons	45,953,808	(*b*) 34,555,914	40,462,027
Copper sulphate	lb.	54,339,000	31,776,670	41,032,000
Iron ore	Long tons	61,847,116	42,911,897	58,843,804
Petroleum	Barrels.	(*b*)248,446,230	(*b*)265,762,535	(*b*)267,400,000

(*a*) Estimates of "Coal Age." (*b*) As reported by U.S. Geological Survey.

Separation of vanadium from crude sodium uranate. Barker and Schlundt. *See* VII.

Patents.

Case-hardening and other surface treatment of iron and steel articles. G. Stolle and A. Hocks, Kiel, Germany. Eng. Pat. 8889, June 16, 1915.

The article is heated locally and simultaneously sprayed with carbon or other hardening material, using the flame as a carrier for the material to be sprayed. In a similar manner, metals or alloys low in carbon or free from carbon may be sprayed on to the surface of iron containing a high percentage of carbon.—W. R. S.

Case-hardening of calibrated and engraved rollers, standard rollers, and the like. Façoneisenwalzwerk L. Mannstaedt und Co. A.-G., Köln-Kalk. Ger. Pat. 286,464, Nov. 24, 1912.

The article to be case-hardened is supported so that it can be rotated whilst the carburising powder is being distributed over it, the holder for the article being mounted on a bearing in the cover of the case-hardening chamber. Gases from which carbon is deposited may be introduced into the case-hardening chamber.—A. S.

Steel, cast iron, and alloy castings; Process for strengthening ——. H. E. Field and F. C. T. Daniels, Wheeling, W. Va. U.S. Pat. 1,164,487, Dec. 14, 1915. Date of appl., Oct. 7, 1914.

The casting is packed with inert material in a container, which is heated in a furnace to 1250° F. (680° C.) for a period of 5 to 72 hours, then cooled gradually in the furnace to 850° F. (450° C.), the heat supply shut off, the furnace closed, and cooled to atmospheric temperature gradually but more rapidly than in the first stage.—B. N.

Ore concentration [by the agitation-froth process]. A. H. Higgins, and Minerals Separation, Ltd., London. Eng. Pat. 19,855, Sept. 16, 1914.

THE product obtained by treating an organic substance, such as an oil, fat, alcohol, or phenol, with sulphuric acid is employed as the frothing agent.—W. E. F. P.

Ores; Concentration of —— [by the agitation-froth process]. Minerals Separation Ltd., London. From E. H. Nutter, San Francisco, U.S.A. Eng. Pat. 19,856, Sept. 16, 1914.

THE frothing agent employed consists of the acid sludge produced by treating a hydrocarbon (preferably unsaturated) or a mixture of hydrocarbons, such as a petroleum distillate, with sulphuric acid.—W. E. F. P.

Separating or classifying ores: Apparatus for ——. H. E. Wetherbee, Assignor to Wetherbee Concentrator Co., Cleveland, Ohio. U.S. Pat. 1,163,876, Dec. 14, 1915. Date of appl., Mar. 3, 1915.

A STATIONARY hydraulic-classifying receptacle, open at the top, and provided with discharge openings near the bottom, has its upper end surrounded by a launder. A buoyant drum, tapering towards its open top and having discharge openings near the bottom, is rotated within the receptacle. The receptacle is provided with a removable lining in the plane of the discharge openings of the drum. —W. H. C.

Gold and silver ores; Flotation method for the concentration of poor ——. S. Michaelis, Aranyida, Hungary. Ger. Pat. 287,831, Apr. 18, 1913.

THE ore, previously treated with oil, is led into the upper half of a double-walled vertical cylindrical vessel, into which acid in excess is supplied in a tangential stream at about the middle height. The levers controlling the ore and acid inlets and the gangue outlet are actuated by a common lever so that the ore inlet and the gangue outlet are alternately opened and closed, and the acid inlet is half closed when the gangue outlet is open. —T. St.

Precious metals; Apparatus for the recovery of ——. B. R. Koering, Assignor to Koering Cyaniding Process Co., Detroit, Mich. U.S. Pat. 1,163,828, Dec. 14, 1915. Date of appl., July 27, 1914.

A PERFORATED cylinder lined with a filtering medium, is mounted concentrically within a closed horizontal, rotating drum, and ore and solvent are introduced into the inner cylinder through the end plates. The filtered solution is withdrawn from the annular compartment, into which air under pressure may be forced, to facilitate removal of ore residue from the filter.—W. E. F. P.

Precipitation device [for gold and silver from cyanide solutions]. B. R. Koering, Assignor to Koering Cyaniding Process Co., Detroit, Mich. U.S. Pat. 1,163,829, Dec. 14, 1915. Date of appl., July 27, 1914; renewed Aug. 2, 1915.

CONICAL basins are arranged concentrically one within the other and spaced apart so as to form a series of compartments, communicating successively at their upper and lower parts, each of which is charged with precipitant. The solution, introduced into the innermost vessel from below by means of a vertical pipe, traverses each compartment in succession and is discharged by peripheral overflow from the outer vessel; the bottom of the latter is provided with a valved outlet through which the precipitate is removed without interrupting the flow of solution through the apparatus.—W. E. F. P.

Hardening of compositions of nickel and copper. P. J. A. Douglass, Dartmouth, Nova Scotia. U.S. Pat. 1,163,813, Dec. 14, 1915. Date of appl., Feb. 9, 1914.

AN alloy containing Ni, 67 parts by weight; Cu, 33 parts; ferrosilicon, 10 parts; Cr, 2 parts, is claimed.—B. N.

Metal-spraying process. R. W. E. Moore, Swissvale, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,164,008, Dec. 14, 1915. Date of appl., Mar. 13, 1911.

A JET of compressed air or gas, previously heated, is projected at a high velocity into contact with a stream, or a thin annular film, of molten metal, or a fine jet of molten metal only may be used, and projected at a high velocity, and at an angle, against a heated deflecting surface.—B. N.

Roasting-furnaces; Stirrer for ——. L. B. Skinner, Denver, Colo. U.S. Pat. 1,164,130, Dec. 14, 1915. Date of appl., Oct. 19, 1914.

THE stirrer comprises a hollow vertical shaft with a central vertical partition, carrying rabble arms, each divided into two compartments by a vertical partition extending throughout the greater part of the length of the arm. The arms are locked in tapering sockets on diametrically opposite sides of the shaft; the central partition of the shaft is in line and abuts against those of the arms.—W. R. S.

Ore-furnace. L. B. Skinner, Denver, Colo. U.S. Pats. (A) 1,164,131 and (B) 1,164,132, Dec. 14, 1915. Date of appl., Mar. 25, 1915.

(A) THE cylindrical multiple-hearth furnace has air inlets at the bottom and middle parts, and gas outlet openings at the middle and upper parts, communicating through the outer casing directly with the air supply and flues respectively, each conduit being provided with an adjustable damper. (B) The furnace-casing has openings at intervals into which water-cooled plates or blocks of heat-conducting material are removably inserted. —W. R. S.

Roasting furnace; Mechanical ——. Akt.-Ges. f. Zink-Industrie vorm. W. Grillo, and W. Schefzik, Hamborn. Ger. Pat. 287,078, Sept. 26, 1913.

THE furnace is provided with horizontal muffles made in one piece and forming an integral part of the furnace. The bottoms of the muffles are curved and the roofs are slightly arched. The heating gas is introduced at one end and passes through flues beneath the muffles, and each heating flue is connected with independent air flues, the size of the cross-section of which can be varied. Longitudinal cooling channels beneath and between the muffles are also provided to allow of a finer adjustment of temperature in different parts of the furnace. Along one side of each muffle is an opening closed by loose bricks.—A. S.

Furnaces for metallurgical and other purposes; Method of heating ——. G. Polysius, Eisengiesserei und Maschinenfabr., Dessau. Ger. Pat. 287,080, Jan. 10, 1913.

THE claim is for the use of a current of gas, *e.g.*, air, heated by passing it through one or more electric arcs, as the sole source of heat. The method is specially advantageous in processes where it is undesirable to introduce impurities into the material being heated, *e.g.*, in the roasting of zinc blende and the like, and in cement burning. —A. S.

Ores and other material: Apparatus for treating ——. H. B. Hovland, Duluth, Minn. U.S. Pats. 1,164,187—1,164,189, Dec. 14, 1915. Dates of appl., (A) May 27, (B) June 3, (C) June 17, 1915.

(A) An apparatus for treating materials under pressure consists of an outer shell, capable of withstanding pressure and enclosing a container of suitable resisting material, inlet and outlet tubes for the materials to be treated, and an agitator for bringing them into intimate contact. (B) Apparatus similar in principle to that described above and suitable for treating the contents with a gas under pressure, the gas being introduced through the stem of the agitator. (C) Apparatus consisting of an inclosed container, feed bins, and receiving bins, all connected by passages for equalising the pressure and for advancing the materials to be treated through the system, and provided with inlet and outlet tubes for fluid reagents.—W. R. S.

Zinc; Apparatus for the manufacture of ——*, using a bath of molten slag.* F. Tharaldsen, Drontheim, Norway. Ger. Pats. (A) 286,228, Mar. 28, and (B) 286,229, Mar. 31, 1914. Addition to Ger. Pat. 261,188.

(A) To prevent, as far as possible, contamination of the zinc vapour by lead, in the production of zinc by introducing the ore beneath a bath of molten slag in an electric furnace, as described in the chief patent (this J., 1913, 832), there is provided, in the hearth of the furnace, a network of channels communicating with receptacles at the side, from which the lead which accumulates is tapped off at intervals. (B) The slag is tapped off periodically from the furnace into suitable receptacles, wherein it is treated with reducing agents. The receptacles are provided with hoods connected with a common chamber for condensing the zinc vapour.—A. S.

Zinc bath; Process and apparatus for cleaning the surface of a —— *in an electric furnace for refining zinc by distillation.* A/S Metalforedling, Drontheim, Norway. Ger. Pat. 286,557, Apr. 9, 1914.

During the cleaning operation an atmosphere of an inert gas is maintained within the furnace, and the cleaning tool is introduced in such a manner that admission of air is prevented as far as possible. A hood hinged to the side of the furnace forms a gas-tight cover for a receptacle, and is provided with adjustable slots through which a scraper can be introduced into the furnace to clean the surface of the zinc bath. When distillation is stopped, the residual impure zinc can be tapped off through the hood into the receptacle without coming in contact with the air.—A. S.

Zinc muffles; Manufacture of ——. Celludin Co. m.b.H., Berlin. Ger. Pat. 287,122, Sept. 15, 1913.

The muffle is made from a mixture containing an amount of zirconia equal to from 1 to 10% of the whole. A suitable mixture is composed of 33·3% of clay, 1—10% of zirconia, and "grog" (burnt fireclay).—A. S.

Muffles; Method and apparatus for removing hot residues from ——. E. Gellbach and M. Matt, Hohenlohehütte. Ger. Pat. 286,535, May 11, 1913.

The residues are removed by jets of air and water, assisted by scrapers attached to the outer tube of the device through which the water and air are introduced.—A. S.

Fine ore, flue dust, and the like mixed with fuel; Process for agglomerating —— *by fusion.* A. Kroll, sen., Luxemburg. Ger. Pat. 286,607, Feb. 6, 1914.

A shaft furnace is filled with a mixture of the fine ore or the like and fuel, and air is blown through the charge so as to fuse it. A large excess of air is used, so that lower oxides of iron formed at first are oxidised and formation of metallic iron is restricted. The proportion of fuel is so adjusted that the charge is fused as a whole, the process being intermediate between the sintering of the mixture of ore and fuel, and the production of metal and iron-free slag.—A. S.

Sulphatising roasting of ores and metallurgical products. W. Buddéus. Ger. Pat. 286,620, Sept. 7, 1913.

Sulphide ores are roasted in the usual way and then treated with hot roaster-gases in a shaft-furnace, converter, rotary kiln, or other suitable furnace. Nearly all of the sulphide-sulphur is removed in the preliminary roasting, and hence in the sulphatising operation the heat developed (*i.e.*, the heat of combustion of sulphur dioxide to the trioxide *plus* the heat of formation of the sulphates) is not sufficient to cause decomposition of the sulphates formed.—A. S.

Salt-bath, preheating, and tempering furnace; Combined ——. Gebr. Pierburg, Berlin. Ger. Pat. 286,647, July 8, 1914.

A tempering furnace connected with a chimney communicates with a salt-bath furnace by a conduit provided with a damper, and between this damper and the salt-bath furnace, a branch conduit, also provided with a damper, leads to a preheating furnace. When the salt-bath furnace is being heated, the damper in the conduit leading to the tempering furnace is closed and that in the branch conduit is open, so that the waste gases serve to heat the preheating furnace. When the latter attains the desired temperature, the other damper is opened gradually, so that a portion of the waste gases passes to the tempering furnace. By suitably regulating the damper in the main conduit, it is possible to control the temperatures in the tempering and preheating furnaces whilst keeping the temperature of the salt-bath furnace constant.—A. S.

Blast-furnace gas; Utilisation of ——. E. Hofmann, Duisburg-Meiderich. Ger. Pat. 287,664, Jan. 3, 1915.

The blast-furnace gas is wholly burnt in stoves which serve both to heat the blast and also to heat air which is circulated for heating boilers. Some of the circulating air is taken for burning the gas and is constantly replaced either by fresh air or by hot blast-air.—T. St.

Process for increasing the citric-acid solubility of phosphatic slags. Ger. Pat. 286,125. *See* XVI.

XI.—ELECTRO-CHEMISTRY.

Antiseptics from sea water. See XIXb.

Patents.

Insulating composition. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., New York. U.S. Pat. 1,156,452, Oct. 12, 1915. Date of appl., Oct. 24, 1911.

The insulating composition, for impregnating coils or the like, is prepared from a phenolic condensation product, obtained from phenols and formaldehyde, dissolved in a solvent, such as nitrobenzene, nitrotoluene, etc., not miscible with water, possessing high dielectric properties, and boiling above 120° C. This solvent is mixed with a solid hydrocarbon, such as naphthalene, and a suitable cyclic hydrocarbon, such as toluene, xylene, cumene, etc., together with an inert filler, such as china clay, etc. The proportions of the condensation product and the solvent are arranged so that the mass is at first fluid at normal or somewhat higher temperatures, but is transformed by heat, without substantial evaporation, into an infusible gelatinous mass, which softens on heating. By employing a soluble fusible condensation product and a compound such as hexamethylenetetramine, the condensation product which is transformed by heat into an infusible substance may be formed indirectly in the mass.—B. N.

Electrolysis [*of zinc solutions*]. C. A. Hall, Mount Airy, Pa. U.S. Pat. 1,163,911, Dec. 14, 1915. Date of appl., Mar. 6, 1913 ; renewed Sept. 8, 1915.

The free anion concentration of a zinc electrolyte is maintained constant during electrolysis, by means of a finely-divided substance, which is insoluble in the absence of the current, but which combines with the liberated anions when the current is passed, forming a compound electrically inert in the electrolyte. The finely-divided substance and electrolyte are continually and thoroughly agitated during electrolysis.—B. N.

Storage-battery plates : Treatment of ——. C. C. Carpenter, Buffalo, N.Y., Assignor to Guaranty Trust Co. of New York. U.S. Pat. 1,164,461, Dec. 14, 1915. Date of appl., Mar. 8, 1910.

Negative lead battery plates, after being formed, are subjected to the action of solutions of persulphates of the alkaline earths to oxidise the metal, forming, at the same time, a compound which is insoluble, remains diffused throughout the plate, and is unaffected by charging and discharging the battery.—B. N.

Ozone-generator. Allgem. Elektricitäts-Ges., Berlin. Ger. Pat. 286,989, Apr. 4, 1914.

The electrodes are in the form of hollow plates made in sections constructed entirely or partly of electrically non-conducting material. The inner surface of the electrode is provided with a conducting layer, to which current is conveyed by means of the cooling liquid circulated through the electrode. The electrodes are supported by tubes which serve as inlets and outlets for the cooling liquid.—A. S.

Process and apparatus for the electrolysis of alkali chlorides. Ger. Pat. 286,918. *See* VII.

XII.—FATS ; OILS ; WAXES.

Marine animal oils, fish-oils, and waste products in the soap, stearine, and fatty acid industry ; The treatment of ——. C. K. Keutgen. Seifensiederzeit, 1915, 42, 552—553, 573—574, 594—595, 617—618. Z. angew. Chem., 1915, 28, Ref., 561.

The majority of the processes proposed for the preparation of odourless products from marine animal oils and fish oils are ineffective for the purpose, but the following treatment ensures a satisfactory result :—The oil is thoroughly purified both by mechanical and chemical means, and subjected to a preliminary deodorisation by treatment with sulphuric acid of sp. gr. 1·49—1·65, or aluminium sulphate, and then hydrolysed to the highest possible degree. The fatty acids are carefully dried, treated with concentrated sulphuric acid, and boiled with water to convert the resulting sulphonated fatty acids into hydroxy-acids. The crude fatty acids are filtered after the addition of fullers' earth and then distilled. The distillate is washed with highly dilute acid and lastly with water. The solid and liquid fatty acids are separated by pressing. The residue in the still is treated with acid, decomposed by water, thoroughly washed, and again subjected to distillation. The fatty acids and the soaps prepared from them are permanently odourless. Odourless neutral fats may be prepared by treating the previously purified oils with a current of carbon dioxide or other indifferent gas at 125°—250° C. They present more or less the appearance and properties of boiled or polymerised oils. The malodorous bodies are carried over with the carbon dioxide and may be recovered by cooling ; they constitute a yellowish-white product, having a solidifying point (titer test) between 22° and 33° C.—J. F. B.

Marine animal oils and products obtained from them by hydrogenation : Detection of ——. J. Davidsohn. Seifensieder-Zeit., 1915, 42, 657—659, 678—679. Z. angew. Chem., 1915, 28, Ref., 560.

The bromine reaction of Tortelli and Jaffe (this J., 1911, 1061) is stated to be of little value for the detection of marine animal oils, for many of such oils fail to give a green coloration in the test. Hydrogenation products of marine animal oils give an intense green colour, but so also do hydrogenised vegetable oils, such as linseed oil and soya bean oil. The octobromide test of Marcusson and Huber fails with marine animal oils which have been hydrogenised or strongly heated, but is to be preferred to Tortelli and Jaffe's test, because its indications are trustworthy when a positive result is obtained.—A. S.

Patents.

Lubricating oil ; Composite ——. W. T. Rice, Chicago, Ill. U.S. Pat. 1,163,856, Dec. 14, 1915. Date of appl., Aug. 16, 1915.

The claim is for a mixture of about 60 parts of castor oil, 15 of rape oil, and 25 of paraffin oil. —W. H. C.

Oil from seed-kernels : Process of extraction of ——. W. M. Neale, Greenville, S.C. U.S. Pat. 1,164,383, Dec. 14, 1915. Date of appl., Mar. 4, 1914.

The crushed kernels are passed through a closed chamber heated by a current of steam and air which travels in the opposite direction, and are meanwhile agitated or beaten to prevent agglomeration during the cooking. Part of the oil is extracted from the mass as it is forced from the chamber, and the residue is formed into cakes, which are pressed.—C. A. M.

Palm oil : Manufacture of edible —— *suitable for the preparation of margarine.* L. Bernegau, Berlin-Halensee. Ger. Pat. 288,209, Mar. 4, 1914.

The pulp of the fresh palm fruit is heated with alcohol *in vacuo*. The difficultly digestible fatty acids having an irritating action on the mucous membrane, the dark brown colouring matter, and the pulp-water are thus removed, and edible palm oil is extracted from the residual pulp by pressing, purified by filtration, and pasteurised, with or without addition of common salt. The alcoholic liquid is distilled to recover the alcohol, the residual oil is separated from the aqueous layer, and refined by melting to give a product similar to commercial palm oil.—A. S.

Soap ; Method of solidifying ——. W. D. Richardson, Chicago, Ill. U.S. Pat. 1,161,397, Dec. 14, 1915. Date of appl., Mar. 3, 1915.

The plastic soap is forced through a contracted orifice into a cold fluid of greater density than its own, so that it is suddenly chilled and solidified without losing its shape.—C. A. M.

Froth-producing and washing agents ; Preparation of ——. A. Kaufmann und Co., and R. Mandelbaum, Asperg. Ger. Pat. 287,241, July 22, 1914.

Froth-producing agents prepared by melting or heating carbohydrates (*e.g.*, cane sugar) are mixed with small quantities of a natural froth-producing agent, such as gum-arabic or other colloid. The frothing power of such a mixture is stated to be several times that of the components used separately.—J. F. B.

Drying and deodorising residues separated from effluents, with simultaneous recovery of the fat. Ger. Pat. 286,664. *See* XIXb.

Method of adding the elements of water to unsaturated organic acids. Ger. Pat. 287,660. *See* XX.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Patents.

Encaustic pigments ; Process of manufacturing ——. K. Ferber, Haardt. Ger. Pat. 288,006, May 31, 1914.

Melted wax is mixed with pigments and the mixture treated with alcohol, until a granular mass is obtained. This is mixed with phenol, ground in a mill or otherwise, and freed from the bulk of the phenol by filtration and washing with alcohol. Coats of this paint are allowed to dry in the air, and may then be rendered more permanent and brilliant by the application of heat. —C. A. M.

Linoleum, lincrusta, and similar fabrics ; Preparation of non-inflammable ——. A. Maschke, Bonn. Ger. Pat. 286,690, May 9, 1913. Addition to Ger. Pat. 267,407.

An ester or mixed ester of phosphoric acid with phenol or its substitution products, or a mixture of such esters as are described in the chief patent (this J., 1914, 138), is added to a linoleum mass containing linseed or other drying oil, to render the linoleum non-inflammable. —C. A. M.

Coating and impregnating purposes ; Material for ——. M. Buchner, Mannheim, Assignor to C. F. Boehringer und Söhne, Mannheim-Waldhof, Germany. U.S. Pat. 1,165,222, Dec. 21, 1915. Date of appl., Aug. 17, 1911.

See Ger. Pat. 256,856 of 1910 ; this J., 1913, 499.

Manufacture of carbon powder [*from pitch*]. Eng. Pats. 24,313 and 8901. *See* III.

Preparation of colour lakes from 1-arylsulphamino-4-aminoanthraquinone-3-carboxylic acids. Ger. Pat. 287,013. *See* IV.

Process of manufacturing floor coverings of the nature of linoleum [*from rubber*]. Ger. Pat. 286,741. *See* XIV.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

Patents.

Floor coverings of the nature of linoleum ; Process of manufacturing —— [*from rubber*]. W. Golombek, Spandau. Ger. Pat. 286,741, Nov. 16, 1913.

Linoleum of great strength and elasticity is obtained by coating the fabric with the residue left on evaporating the solvent from a solution of vulcanised rubber by means of steam.—C. A. M.

Latex ; Apparatus for treating —— and sheeting the coagulated product. L. Norzagaray, London. U.S. Pat. 1,164,850, Dec. 21, 1915. Date of appl., Dec. 17, 1913.

See Eng. Pat. 29,369 of 1912 ; this J., 1914, 151.

XV.—LEATHER ; BONE ; HORN ; GLUE.

Tanning materials ; Nitrogen in ——. H. G. Bennett. Collegium (London), 1916, 1—4.

Tanning materials contain small but characteristic quantities of nitrogen, varying from 0·17% in quebracho wood to 1·18% in lentisco. All this nitrogen is not extracted in leaching, and the percentage of nitrogen in the extract depends upon the concentration, but a characteristic figure is obtained by calculating the nitrogen in mgrms. per grm. of tannin.

Extract.	Nitrogen. %	Mgrms. nitrogen per 1 grm. tannin.
Quebracho (solid	0·126	1·9
,, (liquid 1)	0·105	2·5
,, (liquid 2)	0·080	2·6
,, (bleach 2)	0·088	2·2
,, (bleach 3)	0·092	2·4
Myrabolans 1	0·204	8·4
,, 3	0·202	7·8
Chestnut	0·079	3·0
Hemlock	0·177	6·3
Gambier (cube)	0·450	10·8
,, (block)	0·435	16·4

The values for gambier are high and variable, owing to the very variable amount of insoluble and unextracted matter found in this extract. It is hoped that the nitrogen figure will aid the detection of wood pulp liquor in extracts and of lentisco in sumac.—F. C. T.

Tannin ; A new gravimetric method of determining ——. A. Gawalowski. Ledertech. Rundschau, 1915, 7, 337—338. J. Amer. Leather Chem. Assoc., 1916, 11, 30—31.

The tanning material is extracted with alcohol and ether, which brings tannin and resins into solution, but not pectins. The alcohol-ether extract is evaporated at 40° C. and the residue treated with cold water to separate resinous matter. In an aliquot portion of the filtrate the tannin is precipitated with basic copper acetate, and the precipitate collected on a tared filter and weighed. The precipitate is heated in a current of air or oxygen until converted into oxide, and is then reduced in hydrogen. The difference between the weight of copper and that of the precipitate gives the tannin content. It is impossible to calculate the amount of tannin from the amount of copper or copper oxide, as different materials have widely different factors (see Dott, this J., 1915, 1124).—F. C. T.

Colour tests with skivers. O. Riethof. J. Amer. Leather Chem. Assoc., 1916, 11, 2—15.

Lack of uniformity in results of colour tests obtained by different chemists has led the author to give attention to the following points :—(1) The kind of hide or skin used for the tests, its manner of preparation and preservation, the most suitable part for use, and the thickness of the test-piece, (2) the strength and quantity of tanning solution, the time allowed for tanning, the question of agitation as against laying-away, and (3) the washing, oiling, and drying of the test-piece. Skivers take too light a colour and calf skin is too liable to variation. The use of split hide is therefore recommended. A thickness of 0·5 mm. is suitable, but small deviations from this cause only slight variations in shade. Borophenol is an excellent preservative for the hides but should be thoroughly washed out before using the hide, using warm water in the case of skivers. The amount of tannin employed in the test is much more important than the strength of the liquor, which may vary considerably without causing much alteration in shade, provided the hide split be well tanned. A quantity of liquor (conveniently of analytical strength) containing tannin to the extent of 80% on the dry weight of the hide, should be used, and drumming continued for six hours, when the hide will be well tanned, and most of the tannin taken up, thus avoiding danger of selective absorption. Skivers and sheep skins were found to tan much more slowly than hide splits and to yield much less regular results. Hide splits take the same shade if allowed to lie in the liquor instead of being drummed, but occasional shaking and longer time are needed. After tannage the test-pieces should be squeezed by hand, washed by shaking for fifteen minutes with distilled water, tacked out on boards, and dried slowly in a dark place. If liquor of analytical strength has been used, oiling is not necessary. —F. C. T.

Leather: Changes in skins during their conversion into ——. A. A. Schlichte. J. Amer. Leather Chem. Assoc., 1915, **10**, 585—612. (See also this J., 1915, 1218.)

Further attempts were made to fill loose flanks of calf skin with glue or gelatin and with combinations of blood and glue, and blood and gelatin. No satisfactory results were obtained; finishing was rendered difficult, and bacterial action could not always be prevented when blood was used. Experiments were carried out showing that sterile hides can be unhaired by sterile lime liquors with or without arsenic sulphide or sodium sulphide. For sterilising the hide the Seymour-Jones method (this J., 1912, 35) was found quite effective, as no growths could be obtained from hide so treated, under conditions which allowed the growth of *B. tetanus* or *B. acidi lactici*. Sterile hide was treated with lime liquor previously heated in an autoclave and quite sterile; after thirteen days the hair was quite loose, and no bacterial cultures could be obtained from the liquor or the hair, though check experiments with *B. tetanus* and *B. acidi lactici* tried under anaerobic and aerobic conditions respectively, always gave positive results. In further experiments, lime, lime and arsenic sulphide, lime and arsenic sulphide and hair, and lime and hair were boiled vigorously for 45 mins. before the sterile calf skin was added. These solutions remained sterile for several months. In each case unhairing took place after some days, and when sulphide was present the corium had almost all disappeared in six months when the materials were still sterile. Confirmatory experiments were made, and large pieces of cow hide unhaired under sterile conditions yielded fairly satisfactory leather.—F. C. T.

Japanese white leather. M. Ray. J. Amer. Leather Chem. Assoc., 1916, **11**, 22—25.

The so-called Japanese white leather is not strictly leather, but merely cured hide of remarkable toughness, and is spoilt by wetting. The raw hides are depilated by soaking in the river until the hair is loose (3—12 days according to the season), when they are scraped with a blunt knife, washed and fleshed. The hides are then dressed by treading for several hours in brine containing about 3¾ lb. of salt per hide, and are then left for one or two days in the tub, after which they are taken out and dried. After this dressing has been repeated, the hides are softened and soaked before oiling. Rape seed oil is used (2¾ to 4 oz. per hide) and spread over the flesh side. The hides are then alternately exposed to the sun, and softened, the operations being repeated two or three times, when the leather is in what is called the half-bleached condition. After this, the treatment varies according to the season. In the summer, the hides are first bleached for six hours and then piled for a few days, these operations being repeated until the tannage is complete, which in summer takes about a month. Finally, the hides are washed in the river and dried in the sun. The leather is much tougher than European leather prepared with alum and salt.—F. C. T.

Patents.

Soft [imitation reindeer] leathers and process for manufacturing the same. R. Parker and A. H. Patten, Yeovil. Eng. Pat. 14,543, Oct. 14, 1915.

Skins of relatively inferior quality, such as Cape sheepskins, are treated to remove the first grain (*e.g.*, by soaking in lime water and scraping), and are then soaked in a solution of potassium carbonate (say 3 lb. in 60 galls.), preferably at about 90° F. (32° C.), until the second grain is sufficiently loosened to be removed by scraping. The raw skins need only be soaked in water for 3 days instead of the usual 7 days. After removal of the second grain the skins are dressed on the grain side by means of the following tawing mixture:—Aluminium sulphate or alum (say 18 lb.), salt, preferably a mixture of common salt (5½ lb.) and sodium sulphate (4½ lb.), flour (35 lb.), egg yolk (3 quarts), and glucose (2½ lb.), with or without tartar emetic (¼ lb.), tannic acid (2½ oz.), and glycerin (½ lb.). The salts and glucose are dissolved in 9 galls. of hot water, and the other ingredients added to the cold solution.—C. A. M.

Decolorising agent [for tanning extracts]. G. A. Kerr, Lynchburg, Va. U.S. Pat. 1,163,827, Dec. 14, 1915. Date of appl., Apr. 6, 1914.

A homogeneous paste of vegetable substances containing legumin.—W. E. F. P.

XVI.—SOILS; FERTILISERS.

Crop production: The principles of ——. E. J. Russell. Lecture delivered before the Chemical Society on Nov. 18, 1915. Chem. Soc. Trans., 1915, **107**, 1838—1858.

Up to 1840 farmyard manure held undisputed sway as a fertiliser. It was known that plants contained metallic constituents, and that certain metallic compounds were useful fertilisers, but inasmuch as organic matter was the chief constituent of plants, it was believed that organic manures must be the best. In 1840, Liebig taught that the true function of a manure was to provide mineral matter, the nature of which was to be deduced from the composition of the plant ashes. His prescriptions failed completely in practice; and the Rothamsted experiments showed that he had overlooked the rôle of nitrogen, and that the composition of the ash of the plant was no guide to the soil amendment required in any specific case. When artificial fertilisers were first introduced, it was maintained that the fertilising effect would not endure; but experience disproved this, and experiments for over 60 years at Rothamsted have shown that good crops can be grown almost indefinitely by supplying sufficient nitrogen, phosphorus, and potash. Plot experiments by Ville in the 'sixties disclosed the nature of the fertilising elements required by a given soil, but his work was purely empirical, and scientific agriculture marked time till Schloesing and Müntz discovered that the nitrification of the ammonia in sewage was due to specific bacteria. This discovery opened up the highly important hinterland of soil bacteriology. Weathered subsoil contains little plant food, but supports a certain flora which when it decomposes yields nitrates, humus, lime, etc., as end-products: and these furnish the conditions necessary for the existence of bacterial life and for soil fertility. Scientific agriculture controls the decomposition by adjusting the air supply, water, temperature, etc., by securing the presence of beneficent organisms, and by maintaining the supply of plant residues. Fallowing and ploughing-in are almost prehistoric operations; in modern practice a special crop, *e.g.*, clover, mustard, lupines, vetches, is grown and ploughed-in, or brought back to the land as farmyard manure. The loss of nitrogen due to denitrification, which occurs particularly on prairie land and in soil intensively cultivated, has been traced to the hydrolysis of proteins by bacterial agency. In well-covered manure heaps the anäerobic conditions prevent loss of nitrogen, but so soon as air is admitted the loss proceeds apace, not as ammonia, but probably as free nitrogen. In the farmyard the loss is increased by leaching, and altogether millions of pounds sterling are lost annually from these causes. Such biochemical changes are affected by minerals, *e.g.*, lime, by the physical texture of the soil, and by the crop; the growing plant apparently retards nitrification, since more nitrate is formed in fallow than in cropped land, even after allowing for the nitrogen assimilated by the crop. Whitney, in his studies of tobacco culture in the United States, traced the connection between good growth and "soil climate," (*i.e.*, moisture, temperature, etc.), by correlating these factors with the sizes of the soil particles: hence the value of the mechanical analysis of soils. The factors which favour plant growth are so related that the good effect of any one of them ensues only when every other factor is operative. The failure of one factor affects the growth, even when the others are present in increased measure; and a stage is finally reached when the superabundance of that factor does direct harm. When tomatoes were grown under favourable conditions in four pots, to which successively increasing doses of sodium nitrate were added, there was an increase in growth from pots 1 to 2, but a decrease from pots 2 to 4, because in 3 and 4 moisture was deficient: water was thus the "limiting factor." Most soil problems are to be approached from the standpoint of the limiting factor and its counteraction. Thus dryness and acidity are counteracted by irrigation and organic manuring, and by liming respectively. Laboratory experiments often fail when applied to field practice because in the latter case it is not possible to eliminate the whole of the limiting factors and make every other condition, except the one under investigation, as favourable as in the laboratory. The three main principles of crop production are accordingly: (1) The maintenance of an adequate supply of nutrients, chiefly nitrogen, potash, and phosphorus. (2) The biochemical decompositions in the soil must proceed smoothly and quickly. (3) The occurrence of limiting factors must be prevented by ensuring that all the requirements of the plant are satisfied. It is possible that the existence of plant accessories, or hormones, as agents directing and regulating the vital activities of the plant, may have to be included. The simple fact that phosphates increase plant growth is very complex in practice. Laboratory experiments on the effect of phosphates on plants in sand-cultures are vitiated by the unsurmounted difficulty of reproducing the factor of the active phosphate inherent in the soil itself. Phosphates may be superabundant in a soil, yet the plant may starve for lack of added phosphate. Determinations of the "available" phosphate in soils by extracting with 1% citric acid led to results useful in practice but practically useless as a guide to the amount of available phosphate present. The reaction between a dilute acid and a phosphate in the soil is reversible, the direct solvent action being accompanied by the removal of dissolved phosphoric acid from the solution by the soil. When the reverse action is eliminated by using a diffusion method of extraction, all dilute acids are found to exert approximately the same solvent effect. When the direct action is rendered negligible by adding sodium phosphate to the soil, acids fail to remove all the added phosphate, *i.e.*, some of it is adsorbed by the soil particles. The curve showing the distribution of added phosphate between the soil and the solution is the ordinary adsorption isotherm, similar to that obtained with charcoal and dilute acids. The curves for a clay and a sandy soil show that the former adsorbs far more phosphate than the latter, bearing out the well-known fact that clay soils require heavier phosphate dressings than sandy soils. The effects of phosphatic manuring are: promotion of early growth, early ripening, and root development, and they are especially marked in clay soils, in wet regions, on shallow-rooting and quick growing plants. The factors of fertility are so many and so complex that first principles have not yet been formulated, and consequently accurate prediction is not possible: but soil surveying, joined with chemical, physical, and bacteriological studies, materially assists the existing empirical methods. The Rothamsted work on the partial sterilisation of soils has revealed another limiting factor in crop production, *viz.*, the activity in the soil of organisms inimical to beneficent bacteria, and though the problem is yet young, good practical results have been achieved in the curing of "sick" greenhouse soils by steaming.—E. H. T.

Soil protozoa; Activity of ——. G. P. Koch. J. Agric. Res., 1915, **5**, 477—488. (See also this J., 1915, 1063.)

To determine the number of active protozoa in a soil sample, a drop of sterile water was placed on a slide and a small portion of soil stirred into it; the film was then examined under the low power (16 mm. lens) of the microscope for a period of two minutes. Such an examination of twenty different greenhouse soils disclosed that active protozoa were present only in six, and these were all loose soils with a high moisture content; the organisms found were small ciliates, flagellates were present in one soil, and amœbæ in another. Fourteen field soils were examined for ½ hour each, a new sample being taken every 2 minutes; as no active protozoa were seen even when the moisture content was slightly above the normal, it is inferred that they cannot act as a factor limiting soil fertility. Inactive forms, however, are apparently present in all field soils, and they excyst under favourable conditions, *e.g.*, when the soil becomes water-logged. The most important factor determining excystment is the moisture content; temperature, organic matter, and physical state of the soil are of secondary importance. Under normal favourable conditions, encysted protozoa do not become active in 2 minutes; small ciliates excyst in 1—2 hours, flagellates in 6—8 hours, and large ciliates in 40 hours, when the temperature is 22°—24° C.—E. H. T.

Arsenic applied as a spray for weeds. McGeorge. *See* XIXb.

PATENTS.

Phosphatic slags ; Process for increasing the citric acid-solubility of ——. Hasper Eisen- und Stahlwerke. Ger. Pat. 286,125, Jan. 13, 1915.

SAND is added by means of a sand blast, to the molten slag flowing from the converter. The sand melts, and an intimate mixture of slag and sand is thus obtained. The addition of 5 % of sand increases the citric acid-solubility of the phosphoric acid of basic slag to 98·5 %.—A. S.

Fertilisers ; Manufacture of —— from silicates containing potash. Kaliwerke Grossherzog von Sachsen A.-G., Dietlas, and K. Hepke, Dorndorf, Ger. Pat. 286,187, Feb. 17, 1914.

A MIXTURE of the silicate and dry magnesium oxychloride, both finely-ground, is heated to dull redness.—A. S.

Fertilisers. Badische Anilin und Soda Fabrik. Ger. Pat. 286,491, May 24, 1914.

THE use of phosphates of ureas as fertilisers is claimed.—A. S.

Anticorrosive material to withstand water, acid gases, and liquid acids. Ger. Pat. 288,263. *See* IX.

Drying and deodorising residues separated from effluents, with simultaneous recovery of the fat. Ger. Pat. 286,661. *See* XIXB.

XVII.—SUGARS ; STARCHES ; GUMS.

Beetroots attacked by Cercospora beticola sacc. E. Saillard. Comptes rend., 1916, **162**, 47—49.

IN several parts of France the beets of last season were seriously attacked by a fungus, *Cercospora beticola sacc.* The crop was in consequence poor in quantity and quality, though in most cases the sugar-content of the roots was almost normal. The working of the beets showed anomalies similar to those observed in the dry season, 1911, viz., low purity and high mineral-content of juices, loss of alkalinity during heating of juices, and abnormal production of molasses (cp. Pillhardt, this J., 1911, 1326). The author found that the three classes of nitrogenous substances distinguished by Andrlik, viz., albuminoid (precipitated by cupric hydroxide), ammoniacal and amide (eliminated by heating first with acids and then with magnesia), and melassegenic (by difference), were all present in larger amounts than usual, and in most cases in larger amounts than in 1911. In the determination of sucrose in the roots, direct polarisation of extracts obtained by cold aqueous digestion (Degener-Saillard) gave values higher, in some cases by 0·4 %, than those obtained by inversion whether by acid or invertase. Hence the roots contained other dextro-rotatory substances not precipitable by basic lead acetate, but these disappeared during the factory operations (cp. Andrlik and Stanek, this J., 1910, 582 ; 1911, 299 ; Herles, 1911, 1325). Experiments showed that aspartic and glutamic acids, heated in alkaline solutions, slowly lose their rotatory power and evolve ammonia.—J. H. L.

Sugar beets ; Decrease in sugar-content of —— during storage. Foth. Z. Spiritusind., 1915, **38**, 247. Z. angew. Chem., 1915, **28**, Ref., 562.

SUGAR beets were put into store on Jan. 30, showing on test 14·9 % of sugar and yielding 4·5 litres of rectified spirit per 100 kilos. On May 13, the sugar content had fallen to 13·4 %, and the yield of alcohol to 4 litres. On July 6, tests showed a further decrease to 9·8 % of sugar and 3 litres of alcohol. The latter numbers are calculated on the weight of beets when taken out of store, which would be much less than their original weight.—J. F. B.

Vacuum pans [in sugar-houses] ; Factors affecting economy in ——. E. W. Kerr. Intern. Sugar J., 1916, **18**, 21—29.

FROM results obtained with vacuum pans operated in sugar-houses in Louisiana and Porto Rico, it is concluded that the coefficient of heat transmission is the only true measure of the heat transmitting capacity of the heating surface. For coil pans the average coefficient of heat transmission with straight (unmixed) strikes was 110, the three best results being 124·3, 134·5, and 174·8, without which the average would have been only 95. These three high values were all obtained with pans having short coils, which were well drained, and in which the heating surface was clean. Calandria (" Express ") pans gave coefficients of heat transmission which were about 40 % higher than the average obtained for coil pans, while the rise in temperature of boiling due to hydrostatic head, density, and purity was less. This was due to the more rapid circulation and the more efficient removal of condensed water, the latter being effected by the sloping tube sheets and inclined tubes.—J. P. O.

Dextrose : Rôle of atmospheric oxygen in the oxidation of —— with potassium permanganate in the presence of varying amounts of alkali. The products of the oxidation. E. J. Witzemann. J. Amer. Chem. Soc., 1916, **38**, 150—161.

WHEN dextrose is oxidised completely by permanganate in the presence of varying amounts of alkali, the calculated quantity of permanganate is not consumed. The deficit occurs to a slight extent even in the absence of alkali, but increases rapidly on the addition of small quantities of alkali up to a concentration of about $N/10$, and then diminishes. This is due to the action of atmospheric oxygen, which either oxidises the sugar directly in alkaline solution or oxidises the manganous salts formed. The sole products of the complete oxidation of dextrose are carbon dioxide and oxalic acid. The quantity of the latter formed increases from nil to 42 % within a small range of change in alkalinity ; this is not solely a question of the initial concentration of the alkali, but is also dependent on the degree to which the initial concentration is maintained. Oxalic acid, or potassium hydrogen oxalate, is not stable in permanganate solution, so that any oxalic acid which is formed cannot persist until the amount of alkali present is sufficient to convert it into normal potassium oxalate, which is stable in permanganate solution. The mechanism of the formation of oxalic acid is discussed.—W.P.S.

Lævulose ; The diphenylamine reaction of ——. L. Radlberger. Oesterr.-ung. Zeits. Zuckerind. u. Landw., 1915, **44**, 261—264. Z. angew. Chem., 1915, **28**, Ref., 592.

THE reaction between diphenylamine and lævulose (see Pinoff and Gude, this J., 1914, 657) consists of two phases ; the diphenylamine is first converted by the sulphuric acid into diphenylbenzidine and this is oxidised by the lævulose to form the N-phenylated di-imine of *p*-diphenoquinone, an indamine. The diphenylamine reaction (blue coloration) of carbohydrates in general depends on the fact that all carbohydrates, when inverted at 68° C., yield lævulose or dextrose and that both these sugars react with diphenylbenzidine.—W.P.S.

Sugar-formation and production of dark-coloured liquor in sulphite-cellulose manufacture. Oman. *See* V.

PATENTS.

Apparatus for the continuous solution of solid substances, especially for slaking lime with sugar juice or water. Ger. Pats. 286,821 and 286,825. *See* I.

Manufacture of hydrogen sulphide and alkali or alkaline-earth sulphides. Ger. Pat. 286,947. *See* VII.

XVIII.—FERMENTATION INDUSTRIES.

Hops; Determination of moisture and bitter resins in ——. O. Winge. Woch. Brau., 1915, 32, 376—380.

WIEGMANN (Allgem. Brauer- u. Hopfenz., 1915, 1315—1318) has criticised the methods recently published by the author and others (this J., 1915, 43). He found that samples of hops lost only about half as much weight at 35° C. *in vacuo* as at 100° C. in air. The author points out that the results obtained under the former conditions are confirmed by drying to constant weight over sulphuric acid *in vacuo* at the ordinary temperature, and that samples dried at 35° C. can be used for the determination of resins, whilst at higher temperatures decomposition occurs and at 80° or 100° C. the hops become dark brown and resemble burnt straw. The tasting tests with the α-, β-, and γ-resins, in beer wort (*ibid.*), cannot be regarded as very exact, but the results confirm the view, which Wiegmann shares, that the bitterness of the resins is closely related to their acidity. For the determination of the bitter substances ether is recommended in preference to carbon tetrachloride only because it extracts the resins more rapidly than the latter; the results of duplicate determinations are as concordant as the variable nature of hop samples permits.—J. H. L.

Alcoholic fermentation: Action of ultraviolet rays on ——. R. de Fazi. Annali Chim. Appl., 1915, 4, 301—329.

A SOLUTION of dextrose inoculated with beer yeast was exposed, at a distance of 20 cm., to the light from a 1200 candle-power Cooper-Hewitt mercury vapour lamp operating at 110 volts and 4 ampères. The rate of fermentation, as measured by the volume of carbon dioxide produced, was about double that of a similar mixture not exposed to ultra-violet rays. When the fermented solutions were kept in vessels closed with plugs of cotton-wool, the solution which had been exposed to ultra-violet rays remained unaltered even after 20 days and gave the same yield of alcohol on distillation as immediately after fermentation, whereas in the other solution the development of moulds was observed after 5 days and the solution acquired a pronounced acetic odour. A similar acceleration of fermentation was observed when a suspension of yeast in water was exposed to ultra-violet rays and then used for fermentation under normal conditions. The author's results show that yeast is not destroyed by exposure to ultra-violet rays, even for 14 hours, but that its activity is increased, owing to the bactericidal action of the rays on organisms injurious to alcoholic fermentation. It thus becomes possible to cultivate selectively, by exposure to ultra-violet rays, yeast more active than that grown under ordinary conditions (see also Eng. Pat. 1335 of 1914; this J., 1914, 936).—A. S.

Fermentation vats. P. Rohland. Z. ges. Brauw., 1915, 38, 203—205.

ALUMINIUM vats embedded in or supported by ferro-concrete may corrode owing to liberation of lime from the concrete in a moist atmosphere, unless the metal is completely insulated from the concrete. Paraffin and insulating materials containing saponifiable matters have proved unsatisfactory for this purpose. The relatively slow subsidence of yeast in "Ebon" vats and others with very smooth surfaces is attributed to electrical phenomena or changes in surface energy of the cells.—J. H. L.

Beers; Separation of exceptionally large quantities of calcium oxalate in ——. H. Will. Z. ges. Brauw., 1915, 38, 105—106, 115—116. (See also this J., 1913, 708.)

SOME particulars are given relating to observed cases of the formation of deposits of calcium oxalate in beers. The wort from a brewery where such deposits had been observed was employed as culture medium in tests with 79 different organisms. Certain wild yeasts were found to give rise to the formation of calcium oxalate crystals in this wort but not in others. The author concludes that the formation of oxalate deposits depends primarily on the composition of the wort, that oxalic acid occurs in beers much more frequently than is generally supposed, but that the conditions are not always favourable to its separation as calcium salt. The separation has been observed in sterile wort left standing for a long time.—J. H. L.

Cider and perry; Disorders of ——. B. T. P. Barker and O. Grove. J. Board Agric., 1916, 22, 939—949. (See also this J., 1911, 915; 1912, 1048; 1913, 443.)

THE commonest disorder of cider and perry is acetification produced by *Bacterium xylinum* and other organisms; in slight cases the effect of acetic fermentation on the general character of the liquid is not very marked, but in extreme cases the beverage becomes undrinkable. Acetification may take place during storage of the fruit, particularly if the fruit is wet and stored in heaps, during maceration of the pomace, and during keeping. Owing to the carbon dioxide given off during alcoholic fermentation, acetification has little chance of taking place at this stage, since air cannot come into contact with the surface of the liquid. After alcoholic fermentation has ceased, the liquid is again particularly liable to acetification. The best means of preventing the trouble are storage of the fruit under satisfactory conditions, exclusion of air as far as practicable from the juice during and after fermentation, and storage of the finished cider at as low a temperature as possible. The cider or perry should be kept in a cellar at a temperature below 50° F. (10° C.), the casks should be completely filled and tightly bunged, and any loss by evaporation or leakage should be made up every fortnight. Cider sickness is a common disorder in some districts; the first sign generally noticed is a violent evolution of gas, the liquid then becomes turbid, loses its flavour, and is unsaleable. The disease is caused by a bacterium, and is very contagious. It rarely occurs if the cider is kept at a low temperature or when the amount of malic acid present is not less than 0·5%. Prevention of the sickness may be attained by blending, the aim being to produce a mixture which shall ferment rapidly and which has a degree of acidity as high as considerations of palatability will allow. Ciders which are liable to sickness are also liable to become oily or ropy and the same means of prevention may be employed. Oily or ropy cider may to some extent be clarified with gelatin and tannin and rendered fit for consumption. The presence of iron in the cider, whether contained naturally in the apples or introduced by contact of the juice with iron vessels, renders the cider liable to blackening when exposed to the air; the blackening takes place particularly after the dissolved carbon dioxide has escaped from the liquid, the iron-tannin compound being then oxidised by atmospheric oxygen and exhibiting a greenish-black colour.—W. P. S.

Alcohol; Manufacture of —— from sulphite lyes in Sweden. Board of Trade J., Jan. 27, 1916.

The Swedish Board of Trade has submitted to the Swedish Government a report on the manufacture of sulphite spirit, and has brought forward proposals for the encouragement of its use and the development of its manufacture in Sweden. The principle is laid down that the manufacture and sale of denatured spirit for the propulsion of motors and other technical purposes should be reserved as far as possible to the sulphite spirit factories, whereas the manufacture of spirits for consumption is to be left to factories hitherto engaged in that manufacture. It is proposed that the manufacture of denatured spirit shall be restricted and made subject to licence in the case of distilleries and refineries of spirits, whereas sulphite spirit factories shall be permitted to manufacture denatured spirit without restriction, and shall moreover have the exclusive right of denaturing with benzol. It is further proposed to protect the sulphite spirit industry by levying on benzine a Customs duty of 14 öre per litre (or 20 öre per kilo.). At present benzine is allowed to be imported into Sweden duty free.

Neutralisation and fermentation of sulphite wood pulp waste lyes. Oman. *See* V.

Determination of potassium bitartrate by the reduction of potassium iodide and iodate. Kantor. *See* VII.

New reaction of picric acid and its applications. [*Detection of picric acid in urine and beer.*] Castets. *See* XX.

Source of error in the determination of protein. Wüst. *See* XXIII.

Patents.

Potatoes [*for distilleries*]*; Process for the preservation of* ——. Verein der Spiritusfabrikanten in Deutschland, Berlin. Ger. Pats. (A) 286,106, May 30, 1914, and (B) 286,107, June 7, 1913.

(A) Grated raw potatoes are inoculated in a watertight receptacle with a pure culture of lactic acid bacilli at a temperature favourable to the action of the latter. Substances containing sugar, such as grated or sliced sugar beets, or beet molasses, may be added to the potatoes. An acid mash as prepared and used in distilleries may be used for inoculating. (B) Hot spent distillery wash is used for warming the potato pulp to the desired temperature, and spent wash, with addition of sweet wort or other saccharine material, is used for preparing the acid mash used for inoculating.
—A. S.

Unfermented beverage. Beverage. U.S. Pats. 1,161,193 and 1,161,287. *See* XIXa.

XIXa.—FOODS.

Benzoic acid in animal foodstuffs; Detection and determination of ——. K. Baumann and J. Grossfeld. Z. Unters. Nahr. Genussm., 1915, 29, 397—409, 465—472. Z. angew. Chem., 1915, 28, Ref., 497.

For the determination of benzoic acid in milk, butter, margarine, etc., it is converted into its potassium salt, potassium soaps are removed by precipitation with calcium chloride, and proteins by means of phosphotungstic acid, the benzoic acid is extracted by percolation with carbon tetrachloride, and titrated with $N/10$ alkali. In the case of products, such as cheese, etc., containing considerable quantities of water-soluble fatty acids, the isolation of the benzoic acid is exceedingly difficult. For meat, sausages, and the like, 100 grms. is boiled with 100 c.c. of 5% sodium hydroxide solution, the aqueous solution is removed, the fat treated with 50 c.c. of benzene and extracted with water, and the united aqueous extracts are acidified with dilute sulphuric acid, an equal volume of sulphuric acid added to the solution so as to form a lower layer, and the liquid distilled with steam. The distillate (500 c.c.) is made faintly alkaline, warmed to dissolve the fatty acids, neutralised with sulphuric acid, concentrated to 50 c.c., treated with 2 c.c. of calcium chloride solution, the precipitate washed with 40 c.c. of hot water, the solution treated with 5 c.c. of dilute sulphuric acid, the benzoic acid extracted by percolating with carbon tetrachloride for 6 hours, and titrated.—A. S.

Pepsin; Adsorption of aqueous solutions of —— by alumina. M. A. Rakuzin and E. M. Braudo. J. Russ. Phys.-Chem. Soc., 1915, 47, 1055—1056. J. Chem. Soc., 1915, 108, i., 1018—1019.

Whereas trypsin is optically inactive and is not adsorbed from its solutions by alumina, pepsin exhibits the specific rotation, $[\alpha]_D = +68{\cdot}0°$, and is adsorbed by alumina. From 100 grms. of a 5% aqueous pepsin solution (sp.gr. 1·0222 at 15° C.), 10 grms. of alumina adsorbs, in twenty four hours at the ordinary temperature, 12·4% of the pepsin present, the fraction thus removed having $[\alpha]_D = +68{\cdot}0°$. If the liquid is then freed from alumina by centrifuging and treated with a second portion of alumina, both the concentration and optical rotation of the solution remain unchanged. Removal of the liquid by pressure from the alumina containing the adsorbed pepsin, and treatment of the residue with water yield a neutral liquid which is proteolytically inactive, and leaves no solid residue on evaporation. Adsorption of pepsin from its aqueous solution by means of alumina is, therefore, an irreversible process. (See also this J., 1916, 60, 66.)

Source of error in the determination of protein. Wüst. *See* XXIII.

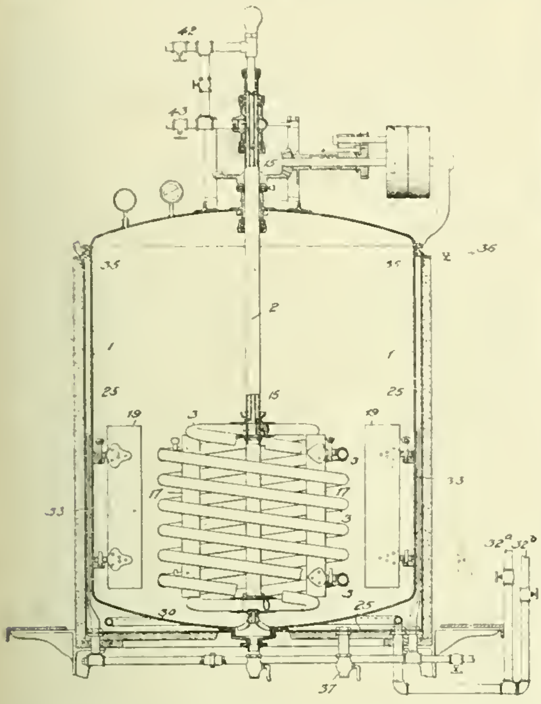
Patents.

Coffee substitute or coffee cereal. J. L. Kellogg, Assignor to Kellogg Toasted Corn Flake Co., Battle Creek, Mich. U.S. Pat. 1,163,932, Dec. 14, 1915. Date of appl., Sept. 16, 1912.

A mixture of 16 lb. of starch and 14 lb. of molasses is baked in shallow tins at 250°—300° C. for 5 hrs. until the moisture is driven off, the sugar caramelised, and the starch dextrinised. The baked mass is reduced to coarse granules and roasted in a rotary drum at 300°—330° C. for 30 min. until of a dark brown colour, moisture being removed by suction. The product is finely ground.—J. H. J.

Liquids [*milk, cream, etc.*]*; Apparatus for treating* [*pasteurising, ripening, churning*] ——. A. Jensen, San Francisco, Cal. U.S. Pat. 1,156,361, Oct. 12, 1915. Date of appl., July 31, 1914.

The container, 1, constructed to withstand internal pressure or a vacuum, is approximately half-filled with the liquid to be pasteurised, ripened, fermented, or churned, and the liquid is agitated by the rotation of the double helical coil, 3. The coil and the inner surface of the container are provided with hinged vanes, 17 and 19, so that the blades may be fixed either in a radial position, or substantially parallel to the path of rotation of the agitator. The container is surrounded by a felt-covered jacket, 25, and steam and water are passed through the tubes,



32*a* and 32*b*, to the perforated heating coil, 30, the heating liquid overflowing through the outlet pipes, 33. The upper part of the jacket is heated to a higher temperature by steam passed through the valved pipe, 36, to an annular pipe, 35. After the heating process has been completed, the jacket is drained by the tap, 37, and cold water is passed in through the pipe, 30, overflowing through the pipe, 33. The liquid is further cooled by passing a cooling brine solution through the pipe, 42, to an inner pipe, 15, within the tubular shaft, 2, carrying the coils, and the liquid, after circulating through the helical coil, 3, is passed through the tubular shaft, 2, to the exit pipe, 43.—B. N.

Beverage; Unfermented ——. *Beverage.* W. O. Kaiser and G. F. Stroebel, Burlington, Iowa. U.S. Pats. (A) 1,164,193 and (B) 1,164,287, Dec. 14, 1915. Dates of appl., Sept. 27 and Aug. 6, 1915.

(A) A MASH of raw grain, made with water containing 2% of wort from a peptonised malt lautermash, is maintained for about 25 mins. at 37° C. for peptonisation, boiled for about 50 mins., and then saccharified after addition of the spent grains from the lautermash. The separated wort is mixed with the remainder of the lautermash wort after the latter has been boiled with mineral acid to convert the carbohydrates into dextrose, and neutralised. The mixed worts are boiled for about 4 hours with 2 lb. of washed yeast per barrel, then for about 50 mins. with $\frac{1}{6}$ lb. of hops per barrel, and again for about 10 mins. with a further $\frac{1}{6}$ lb. of hops. The liquid is cooled, treated with a mixture of beer acids to produce the acidity usual in beers, digested for 24 hours, cooled, carbonated, and filtered. (B) In the preparation of an unfermented beverage a mash of raw grain is heated, saccharified by a portion of (the wort from) a peptonised malt mash, then treated with the remainder of the latter and heated to stop further diastatic action, and afterwards mixed with the residue of the malt mash and raised to the temperature of saccharification. The separated wort is boiled, first alone, then with commercial yeast (2 lb. per barrel), next with hops ($\frac{1}{8}$ lb. per barrel), and again with a further quantity ($\frac{1}{8}$ lb.) of hops, after which it is cooled, matured, filtered, and carbonated.—J. H. L.

Baking powder: Manufacture of ——. W. Esch, Hamburg. Ger. Pat. 286,914, Nov. 17, 1914.

SECONDARY sodium phosphate is "weathered" artificially by treating it with carbon dioxide at a moderate temperature. The product yields 21% of carbon dioxide when used as a baking powder.—A. S.

Manufacture of edible palm oil suitable for the preparation of margarine. Ger. Pat. 288,209. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Sewage: Value of the constituents of ——. E. R. Besemfelder. Chem.-Zeit., 1915, **39**, 813—815.

THE problem of recovering fat from sewage sludge has been solved in an experimental installation at Elberfeld-Barmen. After removal of the fat, the sludge, still containing 50% of water, is mixed with one-third of its weight of coal and burnt as fuel. Since by this method the whole of the nitrogen contained in the sludge is lost, the author recommends that the fat-free sludge be dried and coked, in a rotary kiln (or vertical furnace), by means of the gases from two water-gas generators: the hot coke would be discharged directly from the rotary kiln into the water-gas generators, and the mixed lighting gas and water-gas from the kiln would be treated by the methods used in gas-works for the recovery of ammonia. The heat of the water-gas would be sufficient to dry the sludge, but to furnish the heat required for coking it would be necessary to mix some coal with the sludge. Based on the actual results obtained in the recovery of fat at the Elberfeld-Barmen installation and on the nitrogen content and calorific value of the dry sludge, it is estimated that the sewage sludge obtained in Germany with its 67 million inhabitants has a value of 121 million marks (£5,922,000), the value of the crude fat separated from the sludge being 59 million marks (£2,888,000), whilst 34 million marks (£1,664,000) worth of ammonium sulphate could be prepared from the sludge. In addition, the sludge would yield gas worth 28 million marks (£1,370,000). The clear effluent after the removal of the sludge is valuable as a fertiliser and might be used for irrigation.—W. P. S.

Disinfectants: Action of —— *on pus.* P. Delbet. Comptes rend., 1916, **162**, 36—38.

PUS, rendered as homogeneous as possible, was filled into a series of tubes and mixed with twice its volume of the disinfectant solution to be studied. The tubes, with a control tube of pus alone, were incubated for 24 hrs. and then broth tubes inoculated from them. The best result was given by 2% phenol solution, which effected sterilisation 6 times out of 15, whereas ether was only effective twice out of 8 times, mercuric chloride twice out of 9 times, hydrogen peroxide once out of 6 times, and Dakin's solution (this J., 1915, 919) twice out of 12 times. In many cases the growth in cultures from the control tube was less abundant than that given by cultures from the tubes containing disinfectant. These facts could be explained by the hypothesis that the disinfectant combines with certain elements of the pus to form substances which are favourable to bacterial growth. Although eggs alone are not good medium for the growth of streptococci, it

was found that with the addition of a proportion of a hypochlorite solution they formed a medium specially suitable for the growth of streptococci but not for aerobic cultures of vibrion and perfringens bacilli, all of which are wound organisms. If the medium already had a growth of streptococci on it and was then inoculated with *B. perfringens* and kept in the air, a growth was obtained of a bacillus not morphologically the same as *B. perfringens* but which killed a guinea-pig in 20 hrs. with production of gas. The author concludes that some chemical change is produced in the medium by the hypochlorite which makes it suitable for the growth of organisms. This explains why the treatment of wounds with a disinfectant sometimes leads to an increased bacterial growth.
—J. H. J.

Antiseptics from sea water. Times, Feb. 1, 1916.

An electrolytic cell for the preparation of hypochlorite from sea-water has recently been installed on the R.M.S. Aquitania. Using a current of 60—75 amps. at 110 volts, a solution containing 0·2 % of available chlorine is obtained in 5 minutes at a cost of 3d. per 100 gallons. The cost of the cell is about £50.

Insecticides: Report on [analysis of]——. R. C. Roark. J. Assoc. Off. Agric. Chem., 1915, 1, 435—457.

The report deals with the methods of determining quantitatively the chief constituents of Paris green, Bordeaux mixture, Bordeaux-lead arsenate, and mixtures of these; also of estimating nicotine. Unless otherwise stated the methods described below are now recommended for official adoption.

Arsenic. Total arsenic in Paris green. (1) An amount of the sample is weighed out such that when dissolved and the solution diluted to a definite volume, 50 c.c. of the solution will contain a quantity of Paris green equal to the amount of arsenious oxide equivalent to 100 c.c. of the iodine solution (approx. $N/20$) used in the titration. The weighed sample is transferred to a measuring flask with the aid of about 100 c.c. of a 2% caustic soda solution, and the mixture is boiled until no green particles are visible. The volume is made up after cooling, and the liquid passed through a dry filter. 50 c.c. is diluted with about 100 c.c. of water, treated with 3—4 c.c. of concentrated sulphuric acid and 1 grm. of potassium iodide, and the whole evaporated to 40 c.c. After cooling, approx. $N/20$ thiosulphate solution is added drop by drop until the liquid clarifies; then excess of sodium bicarbonate is added and the titration with standard iodine solution performed. The volume of iodine solution in c.c. gives the percentage of arsenic as arsenious oxide. (2) A similar weight of the sample is washed into a distilling flask with 100 c.c. of concentrated hydrochloric acid, and distilled with about 5 grms. of ferrous sulphate, a well-cooled condenser and an adapter being used; a large conical flask containing 50—100 c.c. of water is used as the receiver. When the volume of liquid in the distilling flask is reduced to about 40 c.c., 50 c.c. of hydrochloric acid is added, and the distillation is re-commenced. This procedure is repeated until the distillate fails to give the arsenic reaction when treated with iodine and starch after neutralisation with bicarbonate. The distillates are nearly neutralised with 25% caustic soda, in presence of methyl orange, keeping the solution well cooled, and then titrated with iodine.

Total arsenic as As_2O_3 only. (3) (*a*) A like amount of the Paris green is washed into a conical flask with 25—30 c.c. hydrochloric acid (1 : 1), 100 c.c. of water is added, and the whole heated at not above 60° C., on a water-bath, until solution is complete. An excess of bicarbonate is added to the cold liquid, and then enough ammonium chloride to dissolve the precipitated copper salt. The iodine titration is performed after diluting with water, the starch being added towards the end of the reaction. (*b*) As above, sulphuric acid (1 : 4) being used instead of hydrochloric acid. In this case the solution may be heated to boiling. By these methods, the iodine titration numbers give the percentage of As_2O_3. The arsenic present as As_2O_5 is obtained by subtracting the result of (3) from (1) or (2).

Total arsenic in Bordeaux-Paris green. (4) 0·5 grm. of the dry powder is weighed out into a distilling flask, and about 10 grms. of ferrous sulphate and 100 c.c. of concentrated hydrochloric acid added. The determination is continued as described in (2). Methods (3) (*a*) and (*b*) are recommended as optional official methods for estimating total As_2O_3 in Bordeaux-Paris green; and a provisional method for determining water-soluble As_2O_3 in the same mixture and in Bordeaux-lead arsenate is also given.

The iodine solution is standardised against chemically pure arsenious oxide dissolved in caustic alkali (4—5 grms. to 1 grm. As_2O_3), or in 12—15% solution of sodium bicarbonate (6 grms. to 1 of oxide), or in boiling water containing 4—5 grms. H_2SO_4 per grm. of oxide, or in 10% HCl by heating on the water-bath at not above 60° C. The strength of the starch solution is about 0·5 grm. in 100 c.c.; and from the volume of iodine solution used, the number of c.c. required to produce the same coloration with the same materials, excluding the arsenic, is subtracted.

Copper in Bordeaux mixture. 2 grms. of the dried, powdered sample is treated with 20 c.c. of water and 5 c.c. of concentrated nitric acid, diluted to 100 c.c., and transferred to a weighed platinum dish of about 150 c.c. capacity. The liquid is then electrolysed with a current of about 3 amps. and 3—4 volts, a rotating spiral anode being employed. The copper is washed, dried, and weighed as usual. The copper in Bordeaux-Paris green and in Bordeaux-lead arsenate is determined by adding 20 c.c. of water and 5—6 c.c. of concentrated nitric acid to 1 grm. of the dry sample, boiling and cooling, treating with a slight excess of concentrated ammonia, washing both liquid and precipitate into the platinum dish and electrolysing. The deposited copper is washed, re-dissolved in nitric acid, the solution diluted to 100 c.c., and then re-electrolysed. The volumetric method, using potassium iodide and thiosulphate, is recommended as an optional official method for determining copper in Bordeaux-Paris green and in Bordeaux mixture alone. In the latter case, 2 grms. is dissolved in 50—100 c.c. of 10% nitric acid, and excess of ammonia is added to precipitate any iron present. The precipitate is washed, the filtrate boiled, treated with 5—10 c.c. of acetic acid, cooled, and 3 grms. of potassium iodide added before titrating. The Bordeaux-Paris green is dissolved in concentrated nitric acid, heated on the water-bath to expel brown fumes, diluted and again boiled, oxidised with bromine water and the excess of halogen expelled. Acetic acid and iodide are then added and the titration performed.

Carbon dioxide in all three preparations is to be determined by the method of Fresenius (Quant. Chem. Anal., 1911, p. 1180), using 2 grms. of dry substance or 10 grms. of paste.

Moisture is determined by heating 2 grms. at 105—110° C., till the weight is constant. (Provisional method.)

Lead oxide in Bordeaux-lead arsenate. The lead peroxide which separates at the anode in the electrolytic method for copper is dissolved in dilute nitric acid with addition of a little hydrogen peroxide, and added to the washings from both electrolyses. Any separated lead sulphate is dissolved by adding ammonium chloride, and the solution is made up to 1000 c.c. 200 c.c. is pipetted into a 400 c.c. beaker, diluted to about 300 c.c., and the lead precipitated as lead chromate.

Nicotine is estimated by distilling with alkali in a current of steam, and precipitating the alkaloid in an aliquot portion of the distillate with silicotungstic acid, $4H_2O.SiO_2.12WO_3.22H_2O$. The nicotine silicotungstate is collected on a quantitative filter paper, washed with cold water containing 1 c.c. of hydrochloric acid to the litre, dried, and ignited in a platinum crucible. The weight of residue ×0·114 gives the weight of nicotine.—E. H. T.

Arsenic applied as a spray for weeds. W. T. McGeorge. J. Agric. Res., 1915, **5**, 459—463.

Of the different sprays which have been recommended, sodium arsenite is the most effective weed-killer, and it has been used to great advantage in Hawaii for the past five years. Small amounts of arsenic stimulate growth, but excessive quantities ultimately kill the vegetation. It has no harmful effects upon the organisms which promote ammonification and nitrification; the former process was stimulated in one soil which contained as much as 1% As_2O_3. Pot experiments with three different soil types treated with sodium arsenite spray of usual strength, showed that the arsenic became fixed in the surface soil and remained there in spite of leaching; and a field experiment on a porous soil, to which the spray had been applied for 5 years at the rate of 5 lb. As_2O_3 per acre per annum, indicated that all the arsenic was present in the top 4 inches. This fixation, and the fact that plants gradually tend to become immune to arsenical poisoning, is due to the formation of insoluble or difficultly soluble arsenites or arsenates of iron, calcium, and magnesium; humus is also removed from the soil by the action of the arsenite. —E. H. T.

Sewage sludge for gas making. Snyders. *See* IIa.

Risk of acetylene-air explosions in mines. Burrell and Oberfell. *See* IIa.

Patents.

Sewage and analogous liquids; Purification of ——. W. Jones, and Jones and Attwood, Ltd., Stourbridge. Eng. Pat. 22,736, Nov. 19, 1914.

Sewage is admitted gradually to a tank containing a residuum of active sludge from a preceding operation, and air is blown through it from the bottom of the tank at the same time, the operation taking 1—6 hrs. When the tank is full, aeration is stopped, the sewage allowed to remain quiescent for 1—2 hrs., and the clear liquid is drawn off from the top down to the level of the sludge layer in about half-an-hour. If through any cause the sludge should get less active, it may be drawn off into side tanks for aeration, and afterwards returned to the main tank. Cultures of organisms may be added to the tank to assist in the purification process. Several tanks may be worked in combination.—J. H. J.

Sewage and analogous liquids; Purification of ——. W. Jones, and Jones and Attwood, Ltd., Stourbridge. Eng. Pat. 22,737, Nov. 19, 1914.

A tank of continuous channel form with semicircular ends is used, the space enclosed by the inner wall of the channel forming an inner tank. Air diffusers are placed along the bottom of the tank, and just behind these, baffle-plates are let down from the surface. The mixture of sewage and air passes under the bottom and rises up the side of the baffle, and thus produces a forward movement of the sewage along the tank. A weir leads from one part of the channel into the inner tank, and some distance in front of this weir the introduction of air is stopped, so that there is time for some sedimentation of sludge to take place before the sewage passes into the inner tank, which constitutes a settling tank and from the upper part of which the purified sewage is continuously drawn off. The sludge deposited in the inner tank is lifted back by an air-lift into the treatment tank. An annular treatment tank or one in the form of a zig-zag channel may also be used.—J. H. J.

Sewage and analogous liquids; Apparatus for the purification of ——. W. Jones, and Jones and Attwood, Ltd., Stourbridge. Eng. Pat. 24,630, Dec. 24, 1914.

A tank has a discharge pipe practically flush with the bottom, and over the pipe, and fitting on to it, is a superposed series of rings or cylinders reaching above the surface of the liquid in the tank, all the joints being water-tight; when all the rings are in position the series forms a closed tube. Each ring is connected with the one below it by sliding links which permit of the rings being lifted in succession from the top and which leave a considerable space between the lifted ring and the one below it. As each ring is lifted, liquid flows into the mouth of the next lower ring, and in this way the tank is emptied in successive layers from the surface. The rings are lifted by means of a pulley chain connected with a bucket which is filled from a cistern through a regulated tap, the cistern being filled with liquid from the tank by a pipe near the surface with a regulating tap. When all the rings have been lifted a percussion valve in the bottom of the pulley bucket is opened automatically and the bucket is emptied; the empty bucket is raised again by the rings in the tank subsiding into their places. In an alternative form of the apparatus, part of the discharge end of the tank is formed of wooden slats working in grooves, the top slat being connected at each end to a pair of pulley chains and lifting those below it by links; the discharge thus takes place through the end of the tank. The pulley bucket works inside the tank. Another method of effecting the discharge is by a float carrying a siphon discharge pipe which empties into the tank discharge pipe, the float being counterbalanced by a weight acting over a pulley. The short legs of the siphon are trapped by cups just below the surface of the liquid. Sludge is discharged from the tank, when desired, by valves in the bottom. The discharge apparatus may be arranged to open and close the sewage inlet valves of the tank and to actuate the air-supply valve.—J. H. J.

Sewage; Purification of ——. G. W. and J. F. Naylor, Denby Dale, Yorks. Eng. Pat. 24,386, Dec. 21, 1914.

A tank is divided into compartments by vertical baffles and is provided with an air supply from tubes entering the pipes by which the sewage flowing over the baffles is led to the lower portion of the next compartment. In an alternative form, air is supplied to rows of boxes with perforated or permeable faces fixed to one or each side of the baffles; the boxes may be arranged checker-wise, with the permeable faces delivering horizontally; or obliquely overlapping, with inclined permeable faces alternately directed upwards and downwards. Agitators may be used to mix the sludge at the bottom of the tank with the incoming sewage, and may also deliver air into the sewage.—J. H. J.

Effluents: Drying and deodorising residues separated from —— with simultaneous recovery of the fat. W. Wurl, Berlin-Weissensee. Ger. Pat. 286,664, Feb. 15, 1912.

The material is freed from as much of the water as possible by treatment on gratings or the like, and dried sufficiently to enable it to be extracted with a volatile fat solvent in the usual form of apparatus. After extraction of the fat, the solvent is expelled from the residue, which is then obtained in the form of a dry, odourless product, suitable for use as a fertiliser.—A. S.

Pressure-filter [for water]. H. Reisert, Cologne, Germany, Assignor to Reisert Automatic Water Purifying Co. U.S. Pat. 1,165,124, Dec. 21, 1915. Date of appl., Apr. 11, 1914.

Unfiltered water enters at the top of a closed chamber and passes downwards through primary and secondary filters to the outlet at the bottom. To clean the filter beds, filtered water is forced upwards through the secondary bed and unfiltered water through the primary bed, both being discharged through a central vertical tube with its inlet end above the primary bed and having a valved outlet. A perforated pipe is provided in the space between the beds, through which unfiltered water and air are alternately directed against the surface of the secondary bed.—W. F. F.

Water [in wells]: Apparatus for removing iron from —— by atmospheric oxygen. J. Zöllner, Militsch. Ger. Pat. 286,295, July 30, 1913.

The well reservoir is provided with a float, and when water is withdrawn, this float opens a valve, whereby raw water is allowed to flow through a series of concentric channels surrounding the well reservoir: the opening of the valve is so regulated that the water flows through the channels in the form of a shallow stream. The channels contain gravel, the air entrapped by which oxidises the iron compounds present in the water. The water, carrying most of the precipitated ferric hydroxide in suspension, flows into a sludge chamber, where the precipitate is deposited, and then passes upwards through a sand filter into a channel leading to the well reservoir.—A. S.

Iron from water: Process and apparatus for the supply and distribution of air in closed apparatus for removing ——. A. Kannenberg, Berlin-Halensee. Ger. Pat. 286,913, Nov. 13, 1913.

The air is led through glass vessels filled with water, so that its flow can be observed, and then passes to the oxidation apparatus through valved pipes. The glass vessels may be graduated and provided with discharge pipes for the water, so that at intervals the velocity of the air current may be ascertained by measuring the water displaced by it from the glass vessels.—A. S.

Manganese oxides, with or without colloids; Process for treating —— for removing iron, manganese, and germs from liquids. J. D. Riedel Akt.-Ges., Berlin. Ger. Pat. 288,154, July 7, 1912.

Natural or artificial oxides of manganese are treated with a mixture of a manganous and an alkali salt, and then with an oxidising agent such as permanganate. The manganese oxides may be mixed with natural or artificial substances, *e.g.*, zeolites, either of inorganic or organic origin, and the treatment with the oxidising salt may be followed by one with alkali or with alkaline salts of alkali metals. The presence of colloids imparts a spongy texture to the mass and thus hastens filtration. This open texture is lost when manganese salt alone is used, and the object of the alkali salt, *e.g.*, sodium chloride, is to preserve it. —E. H. T.

Mixtures developing cyanogen and hydrocyanic acid prepared in cartridge form. Ger. Pat. 287,006. *See* VII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Distilled waters; Alteration in colour of —— in general, and of orange-flower water in particular. Green orange flower water. R. Guyot. J. Pharm. Chim., 1916, **13**, 37—46.

The alteration of orange flower and other distilled waters on keeping is usually accompanied by the growth of species of *Mucor*, but samples of orange flower water were also examined which showed a yellowish-green colour, which was associated with the production of a species of bacillus, 4—5μ in length, which could not be identified as any of the common fluorescent green bacilli of waters. The bacillus could live without secreting the green pigment; oxygen and oxidising agents favoured its production, reducing agents on the other hand caused decolorisation. Light was favourable for the generation of the colour, whilst antiseptics paralysed the development of the bacillus and with it the colour. Whilst the *mucor* flourished best in an acid medium, the colour-producing bacillus was favoured by a neutral or alkaline medium. Waters which manifested this phenomenon had been collected in glass vessels, whereas those collected in vessels of zinc or other metals did not become green, owing to the inhibiting action of the metal on the colour formation. The source of these growths probably lies in the condensing worm, and hence this and the collecting vessels should previously be sterilised with high-pressure steam. The above-mentioned green colouring matter is insoluble in alcohol or chloroform. It appears to be of the nature of a leuco-base which becomes red and soluble in alcohol with acids, and green and soluble in water with alkalis.—G. F. M.

Salicylic acid; Melting point of ——, and a test for the presence of p-hydroxybenzoic acid. H. L. Smith. Analyst, 1916, **41**, 3—6.

Specimens of salicylic acid prepared by different methods, and dried *in vacuo* over sulphuric acid, melted at 158·5° C. (corr.). The presence of 1% of *p*-hydroxybenzoic acid lowered the m.pt. to 155°—156° C. The m.pt. required by the British Pharmacopœia is 156°—157° C. The following test for *p*-hydroxybenzoic acid in salicylic acid will detect smaller quantities of the former than the test based on the relative insolubility of the *p*-acid in chloroform:—A small quantity of the sample, mixed with an excess of calcium hydroxide and water, is evaporated to dryness, heated for an hour at 110° C., and when cold extracted with a little water. The calcium salt of the *p*-acid dissolves together with some calcium salicylate. The aqueous solution is acidified and extracted with ether and the ethereal extract is filtered and evaporated to dryness. A solution of the dry residue in dry ether, allowed to evaporate on a microscope slide, leaves feathery and leaf-like crystals of salicylic acid together with small dense crystalline tufts of the *p*-acid. These are readily distinguished against a dark background, under a magnification of 60. If the salicylic acid contained only 1% of *p*-hydroxybenzoic acid, the crystalline tufts of the latter will predominate on the slide.—J. H. L.

Picric acid; New reaction of —— and its applications. [Detection of picric acid in urine and beer.] J. Castets. J. Pharm. Chim., 1916, **13**, 46—49.

The formation of 2-bromo-4,6-dinitrophenol when picric acid is treated with bromine water forms the basis of a convenient analytical reaction for this substance. 5—10 c.c. of the solution is boiled for a moment with one-twentieth of the volume of bromine water, the cooled product is extracted with ether, and the presence of the bromodinitrophenol is rendered evident by the colour reactions it gives with ammonia or potassium cyanide. The ethereal solution may, for example, be evaporated to dryness and the residue exposed to ammoniacal fumes, when a reddish tint is obtained, or it may be allowed to evaporate on filter paper, and the latter, when dry, gives with ammonia vapour a carmine-red, or with a drop of 2% potassium cyanide solution a red ring on drying. To detect picric acid in urine the test is applied to an aqueous solution of the chloroform extract of the acidified urine. In the case of beer 100—200 c.c. is evaporated to one-fifth, the residue is twice extracted with alcohol, the alcoholic extracts are evaporated to about 20 c.c., treated with 40 c.c. of water, the rest of the alcohol boiled off, and the test performed on the aqueous residue. (See also Rodillon, this J., 1915, 1005.) —G. F. M.

Organic acids; Distribution coefficients and velocity of extraction of some ——. J. Pinnow. Z. anal. Chem., 1915, **54**, 321—345.

The author has determined the distribution coefficients between water and ether for acetic acid at 15° C., succinic acid at 15°, 20°, and 25·5° C., for citric, tartaric, lactic, and oxalic acids at 15°, 25·5°, and 27·5° C., and also the velocity of extraction of these acids from their aqueous solution by means of ether in the Parthiel-Rose apparatus (this J., 1901, 1244). The extraction practically follows the formula for monomolecular reactions; it is, within certain limits, inversely proportional to the volume of liquid extracted and also to the distribution coefficient at 27° C. The distribution coefficients found are, at 27° C., citric acid, 153; succinic acid, 7·58; malic acid, 70·9; lactic acid, 11·28; oxalic acid, 13·9. If the distribution coefficients of the acids mentioned, at 27° C., be divided by 0·04, the time (in minutes) required for the approximately complete (99%) extraction of the acid from 30 c.c. of solution is obtained. Addition of a quantity of sulphuric acid up to ¼ grm.-mol. per litre is recommended in the case of oxalic acid solutions, and a small addition of sulphuric acid is advantageous also in the other cases.—W. P. S.

Report on [analysis of] insecticides. [Determination of nicotine.] Roark. *See* XIXb.

Patents.

Benziminazoles containing an ethylamino-group [which act as pressors]; Process for manufacturing ——. D. Maron. Geneva, Switzerland. Eng. Pat. 1752. Feb. 3, 1915.

p-Nitrophenylethylacylamines,

$$NO_2.C_6H_4.C_2H_4.NH.COR,$$

are reduced to the corresponding amino-compounds, the amino-group acylated, and the acylated products nitrated to introduce a nitro-group in the *ortho*-position to the acylamino-group; by direct reduction of the nitro-compounds in presence of mineral acids, or by reducing to the corresponding amine, splitting off water, and hydrolysing, ethylaminobenziminazoles are obtained, which possess the property of increasing the blood-pressure. The preparation of 5-ethylamino-2-methylbenziminazole (m.pt. 299°—300 C.), and of 2-(*p*-aminophenyl)-5-ethylaminobenziminazole is described.—F. W. A.

Acetylsalicylic acid and its nuclear homologues; Preparation of alkali salts of ——. J. A. Wülfing, Berlin. Ger. Pat. 286,691. Apr. 6, 1913. Addition to Ger. Pat. 270,326 (this J., 1914, 439).

Acetylsalicylic acid or one of its homologues is mixed with an equivalent quantity of an anhydrous alkali carbonate, in presence of a small quantity of an anhydrous aliphatic alcohol (methyl or ethyl alcohol) or ketone (acetone or methyl-ethyl-ketone) insufficient to dissolve the alkali salt which is formed, and the mixture is allowed to stand at the ordinary temperature until a test-portion dissolves completely in water without evolution of carbon dioxide. (See also Ger. Pat. 276,668; this J., 1914, 1036.)—A. S.

Alkaloids of the morphine series; Preparation of derivatives of —— *containing no methyl groups attached to nitrogen.* F. Hoffmann-La Roche und Co. Ger. Pat. 286,743, Mar. 4, 1914.

Derivatives of alkaloids of the morphine series or of their substitution products or hydro-derivatives, in which the free hydroxyl groups have been acidylated, are treated with cyanogen bromide, and the resulting norcyano-compounds are saponified. By the action of cyanogen bromide the methyl groups attached to nitrogen are replaced by cyanogen. The norcyano-compounds and the secondary bases obtained from them by saponification are of value as pharmaceutical products or for the preparation of such products.—A. S.

Acidylbromodiethylacetylureas; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 286,760, Dec. 6, 1913.

Acidylbromodiethylacetylureas of the general formula, $R.NH.CO.NH.CO.CBr(C_2H_5)_2$, are prepared by the action of acid amides on bromodiethylacetyl isocyanate or bromodiethylacetylcarbamic acid halides, or of bromodiethylacetamide on acidyl isocyanates or acidylcarbamic acid halides. They are sparingly soluble and possess sedative and soporific properties. (See also Eng. Pats. 2888 of 1910, 18,812 of 1911, and 1170 of 1912; this J., 1910, 1332; 1912, 256, 900.)—A. S.

Unsaturated organic acids; Method of adding the elements of water to ——. G. Schicht A.-G., and A. Grün, Aussig. Ger. Pat. 287,660, July 16, 1914. Under Int. Conv., May 30, 1914.

A salt of the acid, *e.g.*, linolic acid, is heated, under pressure, with water, in presence of a small quantity of an alkaline substance.—A. S.

Nitro-compounds of phenylantimonic acids and their derivatives; Preparation of ——. Chem. Fabr. von Heyden A.-G. Ger. Pat. 287,709, Dec. 24, 1911.

Nitro-compounds of phenylantimonic acids and their derivatives, which form intermediate products in the preparation of medicinal compounds, are prepared by treating phenylantimonic acids, their derivatives and substitution products, with nitric acid. *m*-Nitrophenylantimonic acid and *m*-nitro-acet-*p*-aminopheny antimonic acid are described.—F. Sp.

Preparations soluble in water and in dilute alcohol containing the ingredients of lecithin; Manufacture of ——. A. Buchholz, Grünberg. Ger. Pat. 287,743, Oct. 29, 1911.

Preparations containing the ingredients of lecithin, but soluble in water and in dilute alcohol, are obtained by treating buttermilk successively with ammonia, caustic soda solution, and quicklime, cooling to as low a temperature as possible, filtering, evaporating the filtrate to dryness, extracting the residue with 50% alcohol, and concentrating the extract.—F. Sp.

Norcamphor and its derivatives ; Process for preparing ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,796, Apr. 24, 1914.

KETOPINIC acid or a derivative is heated in an acid medium. *Example* : 10 parts of ketopinic acid is heated with a mixture of 180 parts of sulphuric acid (sp.gr. 1·767) and 120 of water, or with 300 parts of phosphoric acid (sp.gr. 1·72), with the simultaneous admission of superheated steam, so that the temperature in the boiling liquid is 137°—140° C. or 165°—175° C. respectively. The new norcamphor ($C_9H_{14}O$) is obtained from the aqueous distillate : it is a substitute for camphor and distils at 105° C. under 13 mm. pressure. Boric acid may also be used as the acid medium. —J. F. B.

Silver salts of fatty acids and their derivatives containing sulphur ; Preparation of aqueous solutions of ——. Chem. u. Pharm. Fabr. Dr. G. Henning, Berlin. Ger. Pat. 287,797, Jan. 17, 1914.

THE silver salts of certain fatty acid derivatives containing sulphur, *e.g.*, those prepared according to Ger. Pat. 239,074, have a pronounced destructive action on gonococci. Stable aqueous solutions may be obtained by treating a solution of the free fatty acid in weak ammonia with the required amount of silver oxide, or by precipitating a soluble alkali salt of the acid with silver nitrate, separating the insoluble silver salt, and dissolving it in ammonia.—F. SP.

Organic compound of arsenic acid : Preparation of an ——. F. Hoffmann-La Roche und Co. Ger. Pat. 287,798, Mar. 14, 1914.

DISTEARIN is warmed with arsenic acid, and the white crystalline compound formed is extracted by an organic solvent. The product is particularly adapted for therapeutic application on account of its solubility in lipoids.—F. SP.

Organic selenium compounds : Preparation of ——. J. D. Riedel A.-G., Berlin-Britz. Ger. Pat. 287,800, July 16, 1913. Addition to Ger. Pat. 276,976 (this J., 1914, 1172).

BY treating the compounds (*e.g.*, chloroselenolinolic acid) obtained by the process claimed in the principal patent, with excess of alkali, selenofatty acids free from halogen are obtained, the halogen being probably replaced by hydroxyl or oxygen. The products obtained are particularly suitable, on account of their stability, for the preparation of injecting liquids in cases where the presence of the halogen would be of no advantage.—F. SP.

Salt-like double compounds of purine derivatives and the ω-methylsulphonic acid of the p-aminophenyl ester of salicylic acid ; Preparation of ——. I. Abelin, E. Bürgi, and M. Perelstein, Berne, Switzerland. Ger. Pat. 287,801, Dec. 12, 1914. Addition to Ger. Pat. 285,579 (this J., 1915, 1167).

SALT-LIKE double compounds of purine derivatives and the ω-methylsulphonic acid of the *p*-aminophenyl ester of salicylic acid are produced either by treating an alkali or alkaline-earth salt of the ω-methylsulphonic acid of the *p*-aminophenyl ester of salicylic acid with a basic derivative of purine, *e.g.*, 1.3.7-trimethyl-2.6-dioxypurine or 1.3-dimethyl-2.6-dioxypurine, or by treating the alkali compound of the purine derivative with the free ω-methylsulphonic acid of the *p*-aminophenyl ester of salicylic acid, in the presence of an organic solvent, *e.g.*, chloroform, acetone, alcohol. The products are purer and more soluble than those prepared by the process claimed in the principal patent.—F. SP.

N-Methyl derivatives of organic bases ; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,802, Dec. 19, 1913.

N-METHYL derivatives of organic bases are produced by heating primary or secondary amines to a high temperature with oxidisable organic compounds (other than formic acid or formaldehyde) and at least one molecule of formaldehyde for each methyl group to be introduced. If the amine itself contains an easily oxidisable substituent, *e.g.*, an alcohol radical, it may be heated alone with formaldehyde. Simultaneous oxidation and methylation occur. For example, α-N-methylpyrrolidylpropan-(1)-one is obtained from diacetonemethylamine, diethylmethylamine, methylpiperidine, etc. From α-pyrrolidylpropan-(2)-ol a methylated ketone is produced which is probably the racemic form of the alkaloid hygrine. —F. SP.

Amino derivatives of 2-phenylquinoline-4-carboxylic acid : Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 287,804, July 23, 1914.

AMINO derivatives of 2-phenylquinoline-4-carboxylic acid are obtained either by condensing nitroisatin with acetophenone and reducing the nitro group, or by condensing isatin with acidylamino-acetophenones and saponifying the products. They are of therapeutic value because, unlike phenylquinolinecarboxylic acid, they do not cause separation of uric acid in the system.—F. SP.

Alkamine esters of phenylcarbonic acid containing an amino group in the nucleus ; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 287,805, Feb. 17, 1914.

ALKAMINE esters of phenylcarbonic acid containing an amino group in the nucleus are obtained by treating nitrophenols with carbonyl chloride, condensing the carbonic acid chloride obtained with basic alcohols, and reducing the nitro group. They have anæsthetic properties.—F. SP.

Condensation [of ketone-alcohols] ; Process of ——. H. Hibbert, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,164,647, Dec. 21, 1915. Date of appl., Aug. 13, 1913.

SEE Eng. Pat. 5408 of 1914 ; this J., 1914, 984.

Preparation of dyestuffs containing selenium or tellurium. Ger. Pat. 286,950. *See* IV.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Retardation of development by sodium phosphate. Lüppo-Cramer. Phot. Korr., 1915, 35. Z. angew. Chem., 1915, 28, Ref., 533.

SECONDARY sodium phosphate acts as an accelerator to a developer containing only pyrogallol and sulphite, but as a strong restrainer in a developer containing potassium carbonate with pyrogallol or quinol. In the latter case, however, about ten times as much phosphate is required as potassium carbonate.—B. V. S.

Silver salts ; Accelerating effect of acids on the reduction of —— *by ferrous sulphate.* Lüppo-Cramer. Phot. Korr., 1915, 35. Z. angew. Chem., 1915, 28, Ref., 533.

THE addition of acetic acid increases the rate of reduction of silver nitrate by ferrous sulphate. The explanation advanced is on the same lines as Abegg's explanation of the stronger reducing power of ferrous oxalate as compared with ferrous sulphate; on addition of oxalate in the one case, and of acetate in the other, the ferri-ions show a much greater tendency than ferro-ions to form complex ions, and hence the ratio of ferro- to ferri-ions in the solution increases, and the reducing action is accelerated.—B. V. S.

Photographic printing; Continuation of —— under a yellow screen. Lüppo-Cramer. Phot. Ind., 1915, Heft 16. Z. angew. Chem., 1915, 28, Ref., 533.

If a faint print, obtained by a short exposure under a negative in the usual way, is further exposed under a yellow filter, without the negative, there is not only an increase of density but also an appearance of detail not previously visible. The method has a practical value only for very hard negatives, and it is necessary to make the first exposure under the negative long enough to get full density in the shadows; otherwise the longer exposure required under the yellow screen may be sufficient to produce "fog" in the whites. It is suggested that the first exposure under the negative produces traces of colloidal silver which act as a sensitiser for yellow light.—B. V. S.

Patents.

Multi-coloured photographs by superimposed coloured part-pictures; Preparation of ——. M. Holfert, Warnsdorf. Ger. Pat. 286,657, Mar. 1, 1913.

The positives necessary for the preparation of a coloured photograph are printed over one another on unexposed and uncoloured films which have been prepared with the same silver halide emulsion of uniform light-sensitiveness.—B. V. S.

Ferrous developer in solid form; Preparation of a photographic ——. Elektrochem. Werke G.m.b.H., Berlin. O. Dreibrodt and H. Röhler, Bitterfeld. Ger. Pat. 286,727, Oct. 4, 1914.

Neutral potassium oxalate, ferrous sulphate, and a neutral salt of a mono- or poly-basic mono- or poly-hydroxycarboxylic acid are separately powdered, mixed, and at once warmed *in vacuo*. The solid developer so formed is a yellow powder, very easily soluble in water.—B. V. S.

Ferrous developer; Preparation of a stable photographic ——. Elektrochem. Werke G.m.b.H., Berlin, O. Dreibrodt and H. Röhler, Bitterfeld. Ger. Pat. 286,775, Jan. 14, 1915.

To a neutral solution of potassium oxalate and ferrous sulphate is added a solution of a neutral salt of a mono-basic, mono- or poly-hydroxycarboxylic acid. After exhaustion of the developer its reducing power may be restored by addition of small quantities of metallic iron.—B. V. S.

Drying photographic plates, films, and the like: Process for ——. W. Hommel, Frankfort. Ger. Pat. 286,933, May 13, 1914.

Drying is effected under reduced pressure, for example, in a closed room provided with heated shelves and connected with a vacuum pump.
—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Patents.

Trinitrotoluene; Manufacture of ——. D. C. Roberts and O. Stuart, Liverpool. Eng. Pats. (A) 7047, May 11, 1915, and (B) 9466, June 29, 1915.

(A) Mononitrotoluene, or (B) nitrobenzene is used as solvent for recrystallising trinitrotoluene. *Example:* 2000 lb. of crude trinitrotoluene is heated with 750 lb. of nitrobenzene at 70° C.; the solution is filtered and cooled to about the ordinary temperature; the crystals are separated by a centrifuge or press and washed with 40% alcohol. The product (m.pt. 80°—81·5° C.) is of light colour, and the yield is excellent. By using ordinary mononitrotoluene (*e.g.*, 42% *para*, 55% *ortho*, and 3% *meta*) a yield of 90 to 95 parts of pure trinitrotoluene is obtained in place of 85 parts obtained when alcohol is used as solvent. The solvent is purified by steam distillation for further use.—F. W. A.

Organic compounds insoluble in water; Process for nitrating liquid or easily fusible ——. K. Kubierschky, Eisenach. Ger. Pat. 287,799, Mar. 31, 1914.

Nitration is effected as a continuous operation by feeding fresh nitrating acid at one end of the apparatus and the substance to be nitrated at the other end and passing them in intimate contact in counter current. The process may be applied to benzene and its homologues, naphthalene, and aliphatic hydrocarbons, in a column lined with resistant material. The column may be filled with nitrating acid and benzene introduced as a finely divided spray at the bottom, nitrobenzene being discharged at the top, after passing through the fresh nitrating acid which enters at that point. Conversely, the tower may be filled with benzene and the acid sprayed into it at the top. The heat of the reaction is controlled by cooling coils. The method is only applicable in cases where both the original and the nitrated compounds are fluid at the temperature of the reaction, insoluble in the medium, and heavier or lighter than the nitrating acid. (Compare Borrmann, this J., 1915, 1232.)—J. F. B.

XXIII.—ANALYSIS.

Iron in presence of organic matter; Rapid determination of ——. F. Ferrari. Annali Chim. Appl., 1915, 4, 341—343.

Iron is precipitated quantitatively from acid solution, even in presence of considerable quantities of organic compounds (citric, tartaric, and malic acids, glycerol), by the ammonium compound of nitrosophenylhydroxylamine (cupferron; see Baudisch, this J., 1910, 115). The solution containing iron (150 c.c. containing 10—15 c.c. of concentrated hydrochloric acid) is treated with a slight excess of chlorine water to oxidise ferrous iron, and a 6% solution of cupferron added, drop by drop, with agitation, an excess of one-fifth of the quantity necessary for the complete precipitation of the iron being added. After 15—20 mins. the precipitate is collected on a filter, with the aid of the pump, washed twice with water acidulated with hydrochloric acid and then with water, treated on the filter with ammonia, washed with water, dried, and ignited to ferric oxide. The method is not applicable in presence of copper, silver, lead, mercury, tin, bismuth, titanium, and zirconium, all of which give insoluble compounds with cupferron.—A. S.

Nickel; Determination of —— with dimethylglyoxime. K. Wagemann. Ferrum, 1915, 12, 126—129. Z. angew. Chem., 1915, 28, Ref., 590.

This method of determining nickel may be accelerated by precipitating the metal with an aqueous dimethylglyoxime solution, dissolving the precipitate in dilute sulphuric acid, and boiling the solution with the addition of hydrochloric acid and hydrogen peroxide in order to destroy the dimethylglyoxime; the solution is then rendered ammoniacal, and the nickel deposited electrolytically and weighed.—W. P. S.

Protein ; Source of error in the determination of ——. W. Wüst. Spezialmonats. Brau.-u. Malzereibetriebeskontrolle, 1915, 1, 173, 193. Z. ges. Brauw., 1915, 38, 244.

In oxidising the material with sulphuric acid, potassium sulphate, and copper sulphate, low results may be obtained if the digestion is not continued for an hour after the liquid has become bright green. Oxidation is most rapid when sulphuric acid, potassium sulphate, and mercuric oxide are used, and the results are accurate provided the heating is continued until the liquid is quite colourless. The liquid should boil vigorously, but loss of ammonia may occur if it becomes so concentrated as to solidify on cooling. —J. H. L.

Method of distinguishing benzine and benzol. Mix. *See* IIa.

Analysis of textiles. Pontio. *See* V.

Determination of potassium bitartrate by the reduction of potassium iodide and iodate. Kantor. *See* VII.

New reaction of hydrogen peroxide. Spiro. *See* VII.

Report on materials for road construction and on standards for their test and use. See IX.

Reduction test for tungsten [in ores]. Hartmann. *See* X.

Detection of marine animal oils and products obtained from them by hydrogenation. Davidsohn. *See* XII.

New gravimetric method of determining tannin. Gawalowski. *See* XV.

Colour tests with skivers. Riethof. *See* XV.

Diphenylamine reaction of lævulose. Radlberger. *See* XVII.

Determination of moisture and bitter resins in hops. Winge. *See* XVIII.

Detection and determination of benzoic acid in animal foodstuffs. Baumann and Grossfeld. *See* XIXa.

Report on [analysis of] insecticides. Roark. *See* XIXb.

Melting point of salicylic acid and a test for the presence of p-hydroxybenzoic acid. Smith. *See* XX.

New reaction of picric acid and its applications. [Detection of picric acid in urine and beer.] Castets. *See* XX.

Distribution coefficients and velocity of extraction of some organic acids. Pinnow. *See* XX.

PATENTS.

Drying and extracting apparatus [for analysis]. A. Seidenberg, New York. U.S. Pat. 1,164,667, Dec. 21, 1915. Date of appl., Jan. 26, 1915.

A corrugated and perforated wire sheet adapted to hold a liquid is contained in a ribbed tray which may be rolled up with it (see this J., 1915, 1108).—W. F. F.

Sulphuretted hydrogen recorder. Eng. Pat. 379. *See* IIa.

Trade Report.

German chemical industry in 1915. Engineering, Jan. 21, 1916.

During 1915 the dividends of all the great German chemical manufactories went down considerably, from 28 % (in the previous year) to 19 % in the case both of the Badische Anilin und Soda Fabrik and the Elberfeld Farbenfabriken, and from 30 to 20 % in the case of the Höchster Farbwerke ; the Chemische Fabrik E. Schering paid 10 % instead of 15 %. Th. Goldschmidt-Essen 8 % instead of 12%. Many chemical-trade firms did not pay any dividend at all. The same applies to one-third of the twenty-five cement works, to five out of ten big paper and cellulose works, and to many glass, porcelain, and earthenware works. Potash firms also did badly. On the other hand, the lignite and gas industries, also the starch and linoleum industries had little ground for complaint. In many works, no doubt, the profits—held over for the present and not yet noticed in the balance-sheets made in the departments engaged in war supply balanced the losses of the other departments ; but the general outlook was not a favourable one.

Books Received.

Petroleum and Natural Gas Resources of Canada. Vol. I. By F. G. Clapp and others. Canada Department of Mines, Mines Branch, Report No. 291. xviii. +378 pages, 9¾ × 5½ in.*

In this volume, no attempt has been made to discuss exhaustively the individual oil and gas fields of Canada. A brief general description is given of the geological and geographical occurrence, production, properties, and uses of petroleum and natural gas, with special reference to the conditions met with in the Dominion.

The Salt Deposits of Canada and the Salt Industry. By L. Heber Cole. Canada Department of Mines, Mines Branch, Report No. 325. 152+viii. pages, 9¾ × 5½ in.*

The first part of this report contains chapters on the composition, properties, and origin of salt. and its occurrence in the various provinces of Canada. The second part contains statistics of Canadian salt production, and an account of the technology of salt manufacture, outlining the various methods of extraction, concentration, evaporation, and refining. A chapter on alkali, hydrochloric acid, and chlorine industries and a bibliography conclude a most useful report, which is fully illustrated throughout with maps, photographs, and diagrams.

Summary Report of the Mines Branch of the Department of Mines, 1913. Report No. 285. x. +214 pages, 9¾ × 5½ in. Price 15 cents.

Coal Fields of British Columbia. Canadian Geological Survey, Memoir 69. 350 pages, 9¾ × 5½ in. Illustrated by a map and 23 diagrams.*

Economic Minerals, and Mining Industries of Canada. Canada Dept. of Mines, Mines Branch, Report No. 322. 78 pages, 9¾ × 5½ in.*

This report, which is illustrated by 19 plates and a mineral map of Canada, presents in popular form a brief sketch of the more important minerals and of the mining and metallurgical industries of the Dominion.

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* A limited supply of the publications marked * is available for free distribution.

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Official Notice.

THE EXEMPTION FROM ENLISTMENT OF ANALYTICAL, CONSULTING, OR RESEARCH CHEMISTS.

In order to clear up any misunderstanding that may arise in consequence of recent legislation concerning Reserved Occupations, the Royal Society desire to point out that an unmarried chemist of military age entitled to exemption as an "analytical, consulting, or research chemist" should, unless he has been attested *before* 2nd March, lodge a claim for exemption with the Local Tribunal before that date.

Men who have been attested should lodge their claims for exemption with the Recruiting Officer or Local Tribunal when called up for enlistment; and if such claims be not admitted, a communication, stating all material facts in favour of the disputed claim, should be addressed at once to the Secretaries, The Royal Society, Burlington House, Piccadilly, London, W.

Edinburgh Section.

Meeting held at Edinburgh on Wednesday, January 19th, 1916.

MR. D. B. DOTT IN THE CHAIR.

A NOTE ON THE FAT OF NUX VOMICA.

BY HENRY E. WATT, D.SC., F.I.C., AND GEORGE B. ANGUS.

The fruit of *Strychnos Nux Vomica*, Linné, is a round berry, about the size of an orange, with a smooth, yellow or orange-coloured, hard, fragile rind, and containing many seeds in a juicy pulp. The seeds, which alone are used in medicine, are about ¾ inch in diameter, and about ⅛ in. thick, flat or slightly convex on one side, and concave on the other, with a slight ridge extending from the centre of one side to the edge.

Nux vomica is characterised by an exceedingly bitter taste, due to the presence of strychnine and brucine, two alkaloids which were discovered early in the last century by Pelletier and Caventou.

Nux vomica contains from one to two per cent. of a concrete oil or fat which has been investigated by F. Meyer (Inaug. Diss., St. Petersburg, 1815) and found to consist principally of the glycerides of capric, caprylic, caproic, butyric, and palmitic acids. More recently (Arch. Pharm., 1912, **250**, 398—402, and 1915, **253**, 202—213) Heiduschka and Wallenreuter have made a careful examination of the unsaponifiable matter, from which they have isolated a phytosterol, a saturated alcohol, $C_{35}H_{57}OH$, or $C_{35}H_{59}OH$, and an unsaturated alcohol, $C_{32}H_{54}O,\frac{1}{2}H_2O$, which behaved like syroceryl alcohol.

A sample of oil which has recently come to our notice is dark-brown in colour and possesses a somewhat unpleasant odour. The subjoined table gives the results of its examination:—

Specific gravity 100°/15·5°	0·892
Solidifying point	60° C.
Saponification value	152
Iodine value (Hübl)	54
Reichert-Wollny value	1·0
Acetyl value	31·2
Acid value	33·7

This work was conducted in the Research Laboratories of Messrs. T. and H. Smith, Ltd., to whom we are indebted for permission to publish the above results.

Discussion.

Mr. J. Rutherford Hill said that he had detected copper in some commercial samples of *Nux vomica* and later in samples of the wild seed obtained direct from Burmah, so that copper would appear to be a natural constituent and not introduced accidentally. In most text-books it was stated that the fat content was 3%. In making the fluid extract the liquid was heated with hard paraffin (about 15 grms. to the litre), which removed the fat. The world's supply of liquid extract must involve the use of a very large quantity of hard paraffin, and he wondered whether it was discarded as waste or whether any attempt was made to recover the paraffin or the fat and utilise them.

London Section.

Meeting held at Burlington House on Monday, February 7th, 1916.

MR. A. R. LING IN THE CHAIR.

THE USE OF ENZYMES AND SPECIAL YEASTS IN CARBOHYDRATE ANALYSIS.

BY WILLIAM A. DAVIS.

In the course of an investigation of the carbohydrates present in different plants, carried out at Rothamsted during the past four years, several sources of error in the processes of analysis hitherto adopted in such cases have been detected. In the present paper an account will be given of these and of methods which have been devised to eliminate them. It has been found necessary largely to discard purely chemical methods and to adopt processes based on the use of special enzymes or selective yeasts. There is no doubt that operations of this kind will in the future become more and more widely used both in industrial and purely scientific research, as they make it possible to estimate the individual constituents of a complex mixture of carbohydrates in stages, each of which is perfectly specific in character. The general principles of such methods can best be illustrated by considering in turn the estimation of saccharose, raffinose, maltose, and starch.

Estimation of saccharose.

It was found in a series of experiments carried out on mangold leaves (Davis and Daish, J. Agric. Sci., 1913, **5**, 437) that the amount of saccharose in the extracts (which had been previously treated with basic lead acetate and sodium carbonate) was far less by inversion with 2%[1] citric acid than by inversion with invertase, although with pure solutions of saccharose identical results were obtained by the two methods. The difference was due to the presence in the solution of a relatively large proportion of sodium acetate; this salt was found in a series of experiments made with solutions of pure saccharose, containing about 1 % of sodium acetate, very largely to inhibit the inversion of the sugar by 2 % citric acid. In the mangold extracts the sodium acetate was formed owing to the necessity of using relatively large quantities of basic lead acetate to precipitate the tannins, etc.; when sodium carbonate was added subsequently to eliminate the slight excess of lead present, the whole of the acetic acid originally present in the lead acetate was converted into sodium acetate. In such cases, with a concentration of only about 1 to 2 % of sodium acetate, complete inversion could only be effected by increasing the citric acid present to 10%; with acid of this concentration our experience has shown that hydrolysis of the saccharose is always complete after 10 minutes boiling and identical results to those given by invertase are obtained even when very large quantities of basic lead acetate have been used to purify the sugar solutions dealt with.[2]

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[1] When maltose is likely to be present in the solution analysed it is preferable to use citric acid, rather than hydrochloric acid at 70° under Herzfeld conditions, to effect inversion. As shown by the writer (J. Agric. Sci., 1914, **6**, 413) hydrochloric acid under these conditions brings about appreciable hydrolysis of the maltose, so that high results for saccharose are obtained. On the other hand 10% citric acid, under the conditions prescribed in the text (10 minutes boiling), does not hydrolyse maltose, so that it can be safely used to estimate the saccharose.

In the analysis of ordinary sugar works materials and products the quantity of basic lead acetate used is generally small; as much as 5 c.c. of the lead solution can be present without causing incomplete inversion under Herzfeld conditions (compare Pellet, Dosage du Sucre par Inversion, *Sucrerie Indigène*, 1913). On the other hand, in working with plant extracts or sap, when much larger quantities of basic lead acetate have to be used, the proportion of lead remaining unprecipitated may be so great as to cause incomplete inversion when only the usual quantity of acid is used in the Herzfeld method. Even if the lead is precipitated by sodium carbonate or sulphate, sodium acetate is formed, which limits the inversion by hydrochloric acid just as it does inversion by citric acid. In such cases serious error may arise. M. Pellet (private communication) has met with an instance in which 6% of raffinose was returned as being present in a wild beet from this cause. Care should always be taken in such cases to make the solution faintly acid to methyl orange by the addition of sulphuric acid before adding the 5 c.c. of hydrochloric acid required under Herzfeld conditions. Pellet (*loc. cit.*) has recommended that duplicate experiments should be made in which the heating is prolonged to 10 or 15 minutes. He shows that under the Herzfeld conditions (at 70°) the time of heating can be increased to 20 minutes without affecting the accuracy of the results; on the other hand it is not desirable to use more than 5 c.c. of hydrochloric acid, as any increase of the acid sensibly modifies the rotatory power of the invert sugar formed. When maltose is present there is always the danger that slight hydrolysis of this sugar to dextrose may occur even under Herzfeld conditions (see footnote [1], p. 201), a risk which is increased by lengthening the time of heating; in such cases, it is preferable to use 10 per cent. citric acid for the inversion, as stated above.

It is a striking fact that although sodium acetate when present to the extent of only 1 or 2 % largely affects the inversion of saccharose by dilute citric acid (2 %) and may lead to incomplete inversion even by hydrochloric acid at 70°, it does not in the least interfere with the activity of invertase. This shows the advantage of using invertase, in many cases, to check the results obtained by acid hydrolysis. The writer invariably uses two methods to estimate saccharose in plant material: (1) hydrolysis with 10 % citric acid, (2) hydrolysis during 24 hours at 38° C. with 1 c.c. of autolysed yeast. The two methods should give identical results if inversion is complete and serve mutually to check each other.

Use of invertase in estimating saccharose.

Preparation of the invertase.

O'Sullivan in 1891 (Trans. Chem. Soc., **59**, 46) suggested the use of ordinary yeast as hydrolytic agent in estimating saccharose, and Brown and Morris in 1893 (Trans. Chem. Soc., **63**, 663) made use of a precipitated preparation of invertase in their work on the carbohydrates of the leaf. Ling and Baker (this J., 1898, **17**, 111) proposed a modification of Clerget's process in which hydrolysis of the saccharose was effected by treating the half-normal solution, slightly acidified with acetic acid, with 0·5 grm. of fresh pressed yeast for 5 hours at 55°. J. P. Ogilvie (this J., 1911, **30**, 62) has applied this process to the analysis of molasses, using basic lead acetate and then sulphur dioxide to clarify the solution, and has shown (Int. Sugar J., 1912, **14**, 89 and 624) that in the case of cane and beet molasses it gives results practically identical with those obtained by Pellet's sulphurous acid method and by Andrlik's method of inversion with hydrochloric acid in which urea is used to arrest the invertive action of the acid in taking the direct reading.

O'Sullivan and Tompson (Trans. Chem. Soc., 1886, 64) described the preparation of an active invertase solution by the autolysis of yeast, and in 1910 Hudson (U.S. Dept. Agriculture, Bureau Chem., 1910, Circular No. 50; this J., 1910, **29**, 443) introduced what he considered to be an improvement in this process, in which the digestion of the yeast was accelerated by adding chloroform. In a later paper Hudson (J. Amer. Chem. Soc., 1914, **36**, 1566; see also Bull. Assoc. Chim. Sucr., 1915, **32**, 207) states that toluene is preferable to chloroform for this purpose. As the writer has pointed out (Int. Sugar J., 1915, **17**, 522) the use of chloroform, as suggested originally by Hudson, was no real improvement because it introduced an additional complication by making it necessary to subject the product of inversion to a special treatment to expel the chloroform before measuring the reducing power by Fehling's solution; ordinary chloroform has a strong reducing action. Four years before Hudson suggested toluene as a means of accelerating the autolysis of yeast the writer had used it for this purpose; we have always prepared very active invertase solutions by the following method (see Int. Sugar J., *loc. cit.*).

The fresh, pressed beer yeast after thoroughly washing with water on a Buchner funnel to remove any adhering wort, is packed into a large wide-mouthed bottle, until the latter is nearly full. About 30 to 50 c.c. of toluene is then poured over it and allowed to percolate through the mass. The mouth of the bottle is covered with a sheet of paper, and the bottle left in a warm place at a temperature of 25°—30° C. Autolysis takes place very rapidly, and in about a fortnight nearly the whole of the yeast is liquefied. It is only necessary to filter on a Buchner funnel to obtain a clear and highly active solution of invertase. This preparation is quite free from maltase and zymase.

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[2] The method of carrying out the hydrolysis by 10% citric acid is as follows: 50 c.c. of the solution to be analysed (which has had the excess of lead removed by means of sodium carbonate) is treated with a few drops of concentrated sulphuric acid until it just shows the faintest indication of pink to methyl orange. Solid citric acid is then added so as to make a 10% solution (5 grms. solid citric acid to 50 c.c. of solution) and the mixture raised to the boil; it is kept actively boiling over a small flame for 10 minutes, under a reflux condenser, and the solution is then cooled to the ordinary temperature and exactly neutralised (using phenolphthalein as indicator) by adding a 10 or 15% solution of sodium hydroxide. It is diluted to 100 c.c. at 15° (or 20° according to the temperature at which the flask is graduated) and is then ready for the polarisation or for measuring the reducing power by means of Fehling's solution.

Hudson's method of treatment with neutral lead acetate, etc., followed by dialysis, is quite unnecessary for ordinary purposes of analysis. The object aimed at by Hudson was apparently to purify the invertase and so diminish its liability to lose activity on keeping. Such purification is, however, superfluous, as the autolysed yeast prepared as described above is extremely stable, and even after several years' keeping shows very little falling-off of activity. There are preparations in the writer's possession which, after three years, gave the following values:—

1 c.c. of the autolysed yeast when added to 50 c.c. of a 10% solution of sucrose inverted 20% of the sugar in 15 minutes at 38°. Inversion was complete in four hours (100·0%).

5 c.c. of the same preparation inverted 78% of the sugar under similar conditions (15 minutes at 38°).

The method adopted by Hudson of adding a large volume of water (10 litres of water to 10 kilograms of pressed yeast) during autolysis serves no useful purpose, and has the effect only of diminishing the activity of the invertase preparation to about one-half the value it would have without such dilution.

Method of inversion.

The method of inversion adopted by the writer in the case of plant material is exceedingly simple (Davis and Daish, J. Agric. Sci., 1913, **5**, 437). The original solution after treatment with a very slight excess of basic lead acetate (see below) is mixed with just sufficient sodium carbonate to precipitate the excess of lead, and is then diluted to a known volume (say 500 c.c. = solution A); 25 c.c. of this solution is used to determine the direct reduction and polarisation; the reduction is due to dextrose, lævulose, maltose (if present), and pentoses. To estimate the saccharose by inversion, 50 c.c. of solution A is neutralised in a 100 c.c. flask, by adding a few drops of sulphuric acid, using methyl orange as indicator; 1 c.c. of autolysed yeast is added together with a few drops of toluene, and the solution is left 24 hours at 38°. After this period 5 to 10 c.c. of alumina cream is added and the volume made up to 100 c.c. (solution B). After filtering, the reducing power of 50 c.c. of B (= 25 c.c. of A) is determined and the rotatory power measured, preferably in a 400 mm. tube. The reducing power can be determined gravimetrically under Brown, Morris, and Millar's conditions, or volumetrically by Ling's method. The saccharose is calculated from the change of rotatory or reducing power as usual. The writer has made a series of determinations with pure saccharose and finds that under the conditions given the Clerget constant holds strictly after allowance has been made, by Herzfeld's table, for the concentration. It is usually not necessary to introduce any correction for the optical activity or reducing power of the invertase solution added, as when only 1 c.c. of this is used, these values are quite inappreciable. If larger quantities are used it is, however, desirable to make a control experiment under exactly the same conditions as those of the actual sugar inversion. The writer generally works with a polarimeter graduated in angular degrees, and the following table gives the values of the constant used with such an instrument, in comparison with the ordinary Clerget constant at different concentrations.

When raffinose is present, the autolysed yeast prepared from top fermentation yeasts, usually converts this sugar into lævulose and melibiose only; but the preparation from bottom yeasts, containing the enzyme melibiase in addition to invertase, converts the raffinose into lævulose, galactose, and dextrose. When the raffinose has been determined (see below) it is possible to allow for this sugar, according as one or other kind of yeast has been employed. Usually raffinose is absent and no such correction is necessary.

TABLE I.

Grms. saccharose per 100 c.c.	Clerget constant.	Change in angular degrees per grm. of saccharose inverted in 100 c.c. of solution measured in a 200 mm. tube at 20° (sodium flame).
1	141·85	1·745°
2	141·91	1·747
5	142·12	1·748
10	142·46	1·752
13	142·66	1·755
15	142·79	1·756
20	143·13	1·760

The supposed precipitation of reducing sugars by basic lead acetate.

It has been generally considered since the work of Gill,[3] Pellet,[4] Edson,[5] and Geerligs[6] that when basic lead acetate is used in purifying and decolorising solutions containing reducing sugar, a considerable proportion of the latter is thrown out of solution; this action is most marked in the case of lævulose, and Pellet has stated that in some cases 23% of the lævulose present is precipitated at the ordinary temperature, whilst at 50° C. the lævulose is totally removed. Whilst the experimental results recorded by the above authors are perfectly correct, the writer, from a series of experiments as yet unpublished, has reason to doubt the correctness of the view that lævulose is precipitated under the conditions named above. It has been found that, at least in dilute solutions, lævulose is not precipitated at all by basic lead acetate, even in presence of impurities such as sodium sulphate or organic acids, and that no loss occurs unless the solution of the lævulose is left in contact with the basic lead acetate for some time. If to the solution containing the lævulose, basic lead acetate is added in not too large excess (5 c.c. or 10 c.c.) and then the lead is immediately precipitated by sodium sulphate or sodium carbonate, practically 100% of the lævulose is recovered. On the other hand, if the lævulose is left with the basic lead acetate for various lengths of time, for example, 1 hour, 24 hours, 48 hours, and the lead is subsequently precipitated by the same reagents, different proportions of lævulose are found to have disappeared; the amount apparently lost increases with the time that the solution has been in contact with the basic lead acetate. At the same time the solution progressively becomes more and more yellow in colour, without, however, any precipitation becoming visible. Instead of the lævulose being precipitated in the form of an insoluble lead compound, as has been generally supposed to be the case, what happens is that the lævulose is either destroyed by the basic lead acetate (possibly by an oxidising action which occurs in the alkaline solution) or it is transformed into another carbohydrate with a different specific rotatory power and a smaller reducing power. Lobry de Bruyn and van Ekenstein[7] by the action of lead hydroxide on lævulose isolated a hexose, $C_6H_{12}O_6$, to which they gave the name glutose; it has practically no action on the plane of polarised light, has a reducing power half that of dextrose, and is not fermentable by yeast.

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[3] J. Chem. Soc., 1871, **24**, 91.

[4] Bull. Assoc. Chim. Sucr., 1891. **9**, 439.

[5] Zeitsch. Ver. Zuckerind., **40**, 1037.

[6] D. Zuckerind., **23**, 1753.

[7] Rec. Trav. Chim., **16**, 262.

The higher the temperature the more rapid is the disappearance of lævulose, so that heating a solution containing reducing sugars with basic lead acetate must always be avoided.

It is well known that Pellet[8] advocates the use of normal lead acetate in place of the basic lead acetate in clarifying liquors which contain reducing sugars, owing to the supposed precipitating effect of the basic salt on the lævulose. But in the majority of cases the normal lead acetate is far less effective as a clarifying agent and, in the case of plant material, frequently leaves in solution optically active substances (for example gums) which are thrown down by the basic salt and therefore prevented from interfering with the analysis. From the results obtained by the writer it would appear that if the basic lead acetate is added carefully in small quantities at a time until the precipitation of the impurities is just complete,[9] and if the actual excess of basic lead acetate is not allowed to exceed about 5 c.c. on 300 to 500 c.c. of solution, there is practically no loss whatever of lævulose, or other reducing sugars. Direct experiment with mixtures of pure reducing sugars and tannin have shown that if care be taken to avoid any considerable excess of basic lead acetate during the precipitation, there is no loss of reducing sugars when the tannin is precipitated in this way. Parkin[10] cites a case of this kind when the following results were obtained in a test analysis :—

	Tannin added and precipitated by 5 c.c. basic lead acetate.	Control in distilled water.
Saccharose	0·487	0·489
Dextrose	0·204	0·201
Lævulose	0·244	0·244
Total sugar .	0·935	0·934

In this case tannin was added to the solution just to the extent that it was all carried down in the precipitate caused by the addition of 5 c.c. of the basic lead solution; the excess of lead was not removed, and it is seen that this slight excess has had no influence on the result.

In agreement with the view the writer puts forward that no loss of lævulose ever occurs by actual precipitation, but that when such appears to take place it is caused by a transformation of the sugar by the alkaline lead solution, are the facts recently recorded by Le Docte.[11] The latter shows that whereas in carrying out the various hot aqueous digestion processes of extracting sugars in presence of basic lead acetate the polarisation due to lævulose (which was purposely added) disappears entirely, it is not changed at all or changed only very slightly when the digestion is effected in the cold. Similarly when the hot digestion is carried out in the absence of basic lead acetate, and the latter is then added after cooling, the polarisation due to lævulose (or dextrose) is not in the least changed. It is concluded that, as stated above, basic lead acetate should never be added to the hot solution when reducing sugars are present.

Lævulose is far more sensitive to the action of basic lead acetate in the cold than dextrose or other sugars just as it is in general far more easily decomposed than these (compare below, p. 206, action of hydrochloric acid). The writer finds that dextrose and maltose remain practically unchanged in presence of considerable excess of basic lead acetate and Le Docte also states that in presence of dextrose, the hot digestion with basic lead acetate can be carried out without loss of this sugar. The fact that no precipitation or loss of either dextrose or maltose occurs in presence of basic lead acetate greatly simplifies the analysis in the case of solutions containing these substances. The writer has shown, for example,[12] that basic lead acetate can be used in removing impurities in the estimation of starch by means of taka-diastase (see page 208), which converts the starch quantitatively into a mixture of maltose and dextrose, without any loss whatever occurring of either of these sugars.

In sugar analysis any considerable excess of basic lead acetate should always be avoided; and, in the majority of cases, any such excess should be removed before taking the actual polarisation readings, either by means of sulphurous acid as recommended by Pellet or by sodium carbonate, sodium sulphate, etc. If any excess of basic lead acetate is left it combines with the reducing sugars (dextrose, lævulose, maltose) forming soluble lead compounds which have an entirely different rotation from the sugars themselves; this is particularly the case with lævulose (or invert sugar) the negative rotation of which may become positive in presence of excess of basic lead acetate.

Estimation of raffinose.

It is now becoming generally recognised that the process of estimating raffinose polarimetrically gives in most cases quite untrustworthy results. This method assumes that no optically active substances are present other than saccharose and raffinose, whereas in most cases when the latter has to be estimated, this is not the case. Pellet (Dosage du Sucre, p. 63) has given data showing that the presence of glutamic and aspartic acids and their amides in crude beet sugars makes it impossible to estimate raffinose owing to the change of optical activity that these substances undergo when the sugar is inverted by acid. He gives an example of a crude sugar showing a direct polarisation of 91·10 (in presence of basic lead acetate) which appeared to contain 0·5% of raffinose by the ordinary process; when, however, the direct polarisation was taken in presence of acid, the value found was 91·55, and the conclusion was drawn that no raffinose was actually present. Other sources of error in estimating raffinose may be incomplete inversion of the saccharose owing to the presence of basic lead or sodium acetates; as stated above, M. H. Pellet has informed the writer of a case in which 6% of raffinose was returned for a wild beet from this cause when none was actually present. Error may also arise in the case of vegetable extracts from the presence of reducing sugars, not only dextrose and lævulose but also pentoses, which the writer has shown occur in most plant extracts and probably also in molasses (Davis and Sawyer, J. Agric. Sci., 1914, 6, 406). When reducing sugars are present in quantity the use of methods such as that of Baumann (Zeit. Ver. Deut. Zuckerind., 1898, 779) to allow for these is liable to error in the case of vegetable material because the reducing sugars may consist of dextrose and lævulose in quite different proportions from those forming invert sugar. In such cases there are generally present large quantities of optically active substances other than sugars, which cannot be eliminated by treatment with basic lead acetate and make it impossible to determine even the exact proportions of dextrose and lævulose. The writer gives in recent papers (J. Agric. Sci., 1916, 7, No. 3) a large number of instances of this kind.

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[8] J. Fab. Sucre., 1899, **40**, No. 15; Bull. Assoc. Chim. Sucr., 1897, **15**, 605; 1899, **16**, 1007 and 1147; 1904, **22**, 744; 1913, **31**, 205; 1914, **32**, 909.

[9] It is usually quite easy by making tests of small portions of the filtrate to hit off the point at which this occurs within 1 or 2 c.c., even when relatively large quantities (for example 100 to 300 c.c.) of basic lead acetate have to be employed.

[10] Biochem J., 1911, **6**, 12.

[11] Sucrerie Belge, 1912, 275.

[12] J. Agric. Sci., 1914, **6**, 152.

It is therefore of the greatest importance to have a method of estimating raffinose which shall be independent of the errors inherent in the ordinary polarimetric process. In 1894 Bau (Chem.-Zeit., 1894, **18**, 1791; see also 1897, **21**, 188) suggested a practical method based on the well-known fact that whereas bottom yeasts completely ferment raffinose to alcohol, the majority of top yeasts only hydrolyse the raffinose to melibiose and lævulose, the latter being fermented, leaving the melibiose, which can be estimated. This is due to the fact that the top yeasts contain only the enzyme invertase which hydrolyses raffinose according to the equation :

$$C_{18}H_{32}O_{16}+H_2O=\underset{\text{lævulose}}{C_6H_{12}O_6}+\underset{\text{melibiose}}{C_{12}H_{22}O_{11}}$$

The bottom yeasts contain in addition to invertase, the enzyme melibiase ; this hydrolyses the melibiose to dextrose and galactose, which are then fermented. Bau's method consisted in fermenting duplicate quantities of the solution to be analysed, after suitable sterilisation, with pure cultures of top and bottom yeasts at 25° for at least 10 to 14 days ; the fermented solutions are then made up to a known volume and the reducing and rotatory powers determined. The difference between the values found with the top and bottom yeasts represents the melibiose ; this multiplied by 1·737 gives the crystalline raffinose ($C_{18}H_{32}O_{16}+5H_2O$).

Kluyver (Biochemische Suikerbepalingen, 1914, Boekhandel E. J. Brill, Leiden) has recently applied the same principle to the estimation of raffinose in complex mixtures of sugars. He measures the volume of carbon dioxide evolved by the action of the different yeasts in a small eudiometer specially designed for the purpose. In this way the raffinose can be estimated, using extremely small quantities of material and far more rapidly than by Bau's method ; the fermentation is complete in 60 hours. Kluyver shows that top yeast (press yeast of the Delft distillery), *Torula dattila*,[13] *Schizosaccharomyces Pombe*, and a lactose yeast all break down raffinose only to the stage of melibiose and lævulose, the latter of which is fermented, giving carbon dioxide. The bottom yeast employed (Bottom-yeast U of the Berlin collection) fermented raffinose completely. With the former set of organisms :

1 c.c. of carbon dioxide evolved at 0° and 760 mm. corresponds on the average with 10·5 mgrms. of raffinose, whilst with the bottom yeast U, 1 c.c. of carbon dioxide (0° and 760 mm.) represents only 3·8 mgrms. of raffinose.

From the difference between the quantities of CO_2 evolved by the action of bottom yeast U and the distillery yeast (top yeast) (or, in some cases, *Schizos. Pombe*[14]) the quantity of raffinose present can easily be calculated.

Kluyver has applied this method successfully in a large number of cases and suggests that, like Bau's method, it could be used to estimate raffinose in molasses and similar products. M. Pellet (private communication) informs me that whilst Bau's method gives satisfactory results in the case of mixtures of pure sugars, it does not do so with materials like molasses which contain relatively small quantities of raffinose, as the latter may be fermented completely, even by the top yeast. It must be remembered, however, that Lindner has shown that certain races of top yeast undoubtedly contain melibiase so that they are able completely to ferment raffinose. In the cases Pellet cites, the complete fermentation may have been caused by the use of an impure culture which contained cells of a melibiase-forming variety ; this would gradually increase in the sugar solution and finally destroy the raffinose. It remains to be seen whether a pure culture of a melibiase-free yeast ever acquire the power, by growth on other sugars, of developing melibiase and so fermenting raffinose completely. From the writer's experience with maltase-free and invertase-free yeasts which never develop the power of elaborating the enzymes they lack, even when grown in large quantities on other sugars in presence of the sugars they cannot ferment, the possibility of a melibiase-free yeast ever producing this enzyme under cultural conditions seems highly unlikely.

It is interesting to note that, according to Kluyver, the volume of carbon dioxide evolved by the top-yeasts and other melibiase-free organisms is always slightly greater than one-third of that evolved by the bottom yeast. Kluyver suggests that this is possibly due to the presence of small quantities of emulsin in these organisms (compare Henry and Auld, Proc. Roy. Soc., 1905, **76B**, 568) which, according to Neuberg (Biochem. Zeit., 1907, **3**, 519) resolves raffinose into saccharose and galactose, these sugars being then fermentable. The fact that slightly more than one-third of the complete hydrolysis occurs with the top yeast does not interfere with the accuracy of the determination of raffinose by the two kinds of yeast, as this depends only on the difference between the results with the different yeasts having a constant value, which appears to be the case.

Hudson and Harding (J. Amer. Chem. Soc., 1915, **37**, 2193), without mentioning the earlier work given above, have adopted the same principle as that of the foregoing methods, namely, the difference in the enzymes of top and bottom yeasts, but use preparations of autolysed yeast for the transformations. The preparation from top yeast, obtained by using toluene (see above), contains invertase only, but that from bottom yeast contains melibiase also ; it is free from enzymes which hydrolyse glucosides and from maltase, cellase, lactase, trehalase, inulase, and diastase. To estimate raffinose the difference between the two changes I. and II. in the following equations is measured polarimetrically :—

I. Raffinose → melibiose + lævulose (autolysed top yeast).

II. Melibiose → galactose + dextrose (autolysed bottom yeast).

The sugar solution is clarified with normal lead acetate, and the excess of lead removed as oxalate or sulphide ; the resulting solution is neutralised, then acidified with a few drops of acetic acid, diluted to 100 c.c., and 95 c.c. is treated with 5 c.c. of the invertase solution from top yeast, in presence of toluene, for 18 to 21 hours; the saccharose is completely inverted and the raffinose hydrolysed according to Equation 1. The polarimeter readings are taken at 20° C. To 95 c.c. of the hydrolysed solution 5 c.c. of autolysed bottom yeast is added and the rotatory power again determined: this should correspond with that calculated from the readings of the solution and of the yeast extract added. The mixture is kept at the ordinary temperature and its rotatory power measured each day until constant. Since $[\alpha]_D$ of melibiose is +143° and since 1 grm. of it yields 0·527 grm. of dextrose ($[\alpha]_D = 52·5°$) and the same quantity of galactose ($[\alpha]_D = +81°$) the specific rotatory power changes from +143° to +70·4° on hydrolysis. If the readings are taken in a 200 mm. tube, a 1% solution of melibiose will change in rotation during hydrolysis by 1·45 angular degrees or 4·18° V. A change of 1° V. is therefore equivalent to 0·239 grm. of melibiose per 100 c.c. of the solution or to 0·352 grm. of anhydrous raffinose. Results were obtained with raffinose in admixture with saccharose, dextrose, lævulose, invert sugar, lactose, maltose, cellose, and trehalose. When 1·5% of raffinose was present values ranging from 1·43 to 1·53% were found, so that the method seems quite reliable and applicable to the estimation of raffinose in such materials as low grade beet sugars and molasses.

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[13] *Torula dattila* contains only invertase and no melibiase; it is also free from maltase and hence does not ferment maltose. It ferments only the hexoses (dextrose, lævulose, mannose) and saccharose. *Torula monosa* does not contain even invertase and hence ferments the hexoses only ; it is completely without action on saccharose and maltose. The fact that it does not even break down raffinose to melibiose is important because it tends to prove that it is the same enzyme, invertase, which hydrolyses raffinose to melibiose and saccharose to invert sugar. Dr. A. J. Kluyver has kindly sent me pure cultures of *Torula dattila* and *Torula monosa* and Dr. H. Limbosch has tested these in my laboratory by our own methods. We can confirm Kluyver's statements as to the specific action of these organisms, which should prove of considerable service in the analysis of complex mixtures of sugars.

[14] In the presence of galactose *Schizos. Pombe* cannot be used as it differs from the bottom yeast in not fermenting galactose, so that the difference observed in the volume of CO_2 is not due to raffinose alone. *Schizos. Pombe* is interesting in that it has the power of fermenting malic acid, liberating carbon dioxide (Kluyver, *loc. cit.*).

Estimation of maltose.

It has been frequently proposed to estimate maltose by hydrolysis with dilute hydrochloric or sulphuric acid at 100°, noting the change of cupric reducing or specific rotatory power of the solution after allowing for the inversion of saccharose present. Under carefully regulated conditions this method gives approximate results in the case of pure maltose or a mixture of maltose and dextrose (cf. Baker and Dick[15]), but, as shown by Davis and Daish,[16] it is quite useless when saccharose or lævulose is also present, owing to the large amount of decomposition of the latter sugar which is caused by the prolonged heating with dilute acids. In the paper cited, it is shown that it is impossible to effect complete hydrolysis of maltose by dilute acid at 100°, without at the same time destroying a large proportion of the lævulose; thus 31% of the lævulose present in a 1% solution is destroyed when it is heated with a 2·4% hydrochloric acid during 2 hours, this being the time necessary to effect 98% of complete hydrolysis of maltose in a 1% solution of this sugar. Even at 70° it is impossible completely to invert maltose in presence of saccharose or lævulose without at the same time destroying considerable quantities of lævulose; thus in 1% solution, even after 24 hours' heating with a 2·4% solution of hydrochloric acid only 94% of the maltose is hydrolysed, whilst more than 5% of the lævulose is destroyed.

It is therefore impossible to estimate maltose with any degree of accuracy by acid hydrolysis when saccharose or lævulose is also present. In such cases it is necessary to employ a biochemical method, involving the use of maltase-free yeasts. Davis and Daish (*loc. cit.*) have suggested the following process, which has been thoroughly tested and found to give quite accurate results; it was shown that it is possible to ferment away every trace of dextrose, lævulose, or saccharose by means of any one of three special yeasts, *Saccharomyces marxianus*, *S. exiguus*, or *S. anomalus* and to recover every trace of maltose, which can then be estimated by measuring the residual reducing power[17].

To 50 c.c. of the solution containing the sugars (previously purified by means of basic lead acetate and freed from lead as described below) which must be very faintly acid to litmus paper, 5 c.c. of yeast water is added; the solution is then sterilised in a flask closed with a cotton-wool stopper by heating during 20 minutes in the autoclave at 115°—120°. It is inoculated with a trace of the pure maltase-free yeast and incubated at 25° for 3 to 4 weeks. When the fermentation is complete[18] 5 c.c. of alumina cream is added and the solution well boiled; it is then filtered and the precipitate well washed until the filtrate has a volume of 100 c.c. An aliquot portion (50 c.c.) can then be used to measure the reducing power.

For the yeasts to grow satisfactorily it is necessary to make sure that every trace of lead has been removed from the solution. The best method to effect this is to throw down the excess of lead by adding sodium carbonate, little by little, until no further precipitate is produced, then to make the filtrate slightly acid with hydrochloric acid and to precipitate the traces of lead remaining in solution by hydrogen sulphide. The lead can also be removed directly from the solution by using hydrogen sulphide without the prior employment of sodium carbonate, but in such cases the solution usually becomes strongly acid if much lead acetate is present (owing to the liberation of acetic acid) and this acidity must be very nearly neutralised by adding sodium carbonate before sterilising and inoculating with the yeast. In all cases, hydrogen sulphide is expelled by sucking air through the solution obtained after filtering from the lead sulphide; the solution used for the fermentations should show a faint but distinct acid indication to litmus.

When small quantities of pentoses are present in the solutions to be analysed (as is frequently the case in dealing with plant extracts), it is necessary to introduce a correction for these; the pentoses are very slowly, if at all, fermented by the maltase-free yeasts and consequently, like maltose itself, exercise a reducing effect on the Fehling solution. The correction is obtained by carrying out fermentations with a pure culture of ordinary distillery or brewers' yeast which ferments away the maltose but leaves the pentoses; the slight residual reducing power found after carrying out a fermentation with such yeast is indeed a measure of the pentoses present, and can be used as a means of verifying the presence of these substances or of estimating them in cases when the ordinary pentose method is likely to give incorrect results owing to the presence of other sugars (Davis and Sawyer; J. Agric. Sci., 1914, 6, 406). On subtracting the value found for the reducing power remaining after fermentation with ordinary yeast from the value given by the maltase-free yeast, the cupric reduction due to the maltose alone is obtained.

During the past 3 years the writer has used this method of estimating maltose in more than 600 analyses of various kinds of plant material (plant extracts, germinated and ungerminated grain, starch conversions, etc.). It has been our custom to carry out five fermentations with each solution to be analysed, viz., one each with *S. anomalus*, *S. exiguus*, and *S. marxianus*, and two with distillery yeast. The agreement between the results with the different special yeasts has generally been entirely satisfactory. *S. anomalus* does not lend itself quite so well to quantatitive experiments as the other maltase-free yeasts, as it is slower in its acton and is less efficient as a sugar-remover—that is, a greater growth of yeast is necessary to remove a certain weight of sugar. Moreover, the Fehling solution in the subsequent reductions often filters very slowly; the cuprous oxide is also generally somewhat contaminated by traces of copper compounds formed by the action of the Fehling solution on substances elaborated during the growth of the yeast. It is therefore best to make use of *S. exiguus* and *S. marxianus* only.

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[15] Analyst, 1905, **30**, 79.

[16] J. Agric. Sci., 1913, **5**, 453.

[17] Baker and Dick (Analyst, 1905, **30**, 79) suggested the use of *S. marxianus* to detect maltose in presence of dextrose by the increase of specific rotation and drop in reducing power which occur on fermenting the mixed sugars with this yeast; they fermented, however, only for a relatively short time, and did not completely remove the dextrose as we have done, so as to make the method a quantitative one.

[18] 0·2 to 0·5 grm. of saccharose is invariably completely fermented under the above conditions after 3 weeks.

The following results are typical of those obtained by this method:—

TABLE II.

Sugars taken: 0·3704 *grm. maltose* + 0 2000 *grm. saccharose.*

Yeast.	Time of fermentation.	CuO from 50 c.c. grm.	Maltose found, grm.	% Maltose found.
S. exiguus	31 days	0·2535	0·3712	100·2
S. marxianus ...	31 days	0·2548	0·3736	100·8
S. marxianus ...	31 days	0·2547	0·3734	100·7

It is our practice to purify the original culture of yeast used by plating out and then from the separate colonies so obtained to inoculate a number of agar yeast-water-saccharose tubes; these tubes are then plugged and left in an incubator at 25° for a few days. Each batch of tubes is tested by making quantitative experiments with a mixture of pure maltose and saccharose; the maltose solution is standardised by means of its reducing and rotatory powers. In actual work, the same culture can be used over and over again until the yeast is all consumed, provided that care be taken not to infect it whilst removing each portion during inoculation. There is no difficulty in this if one works in a fairly dust-free room and observes the ordinary precautions. In this work we must acknowledge our great indebtedness to Dr. H. B. Hutchinson who has been good enough specially to purify the yeasts for us and to keep us supplied with new cultures.

For our scheme of analysis of plant materials reference should be made to J. Agric. Science, 1913, 5, 437; here details are given of the estimation of saccharose, maltose, pentoses, dextrose, and lævulose. In recent papers (J. Agric. Science, 1916, Vol. 7, and Biochemical J., 1916, Vol. 10) we give a number of examples of the application of these methods to special problems, for example, the proof of the invariable presence of the enzyme maltase in germinated barley.

Other biochemical methods of estimating sugars.

The estimation of maltose in presence of other sugars as described above is an instance in which ordinary chemical methods are quite useless and biochemical methods give good results. Kluyver in the important monograph already cited has independently applied similar principles with considerable success. Kluyver makes use of a gasometric method, measuring the volume of carbon dioxide evolved by the action of a series of special yeasts and torulæ upon the solution dealt with; this method has the advantage that approximately accurate results are obtained with exceedingly small quantities of the solutions or sugars dealt with. A special case may be cited to illustrate the principle of applying this process, the sugars present, for example, being raffinose, cane sugar, and monoses; the ferments used were *S. cerevisiæ* (bottom yeast U), ordinary press yeast, *Torula dattila*, and *Torula monosa*. The difference between the results with the first two yeasts gives the raffinose; the cane sugar can then be calculated from the volume of gas given by *Torula dattila*, after allowing for the raffinose present, whilst the gas evolved by *Torula monosa* is a measure of the hexoses present (dextrose, lævulose, or mannose), as only these sugars are fermented by this organism. The process is relatively rapid and gives approximately accurate results in cases where other methods are inapplicable. Biochemical methods have been applied by Kluyver to the analysis of food materials such as jams, starch syrups, and to other cases of technical importance.

The experiments of Bertrand and Weisweiller[19] and Bertrand and Ducháček[20] have shown that the Bulgarian bacillus (*Bacillus acidi lactici Massol*) is capable of converting hexoses such as *d*-glucose, fructose, mannose, and galactose into lactic acid, but acts upon only one of the disaccharides in this way, namely, lactose. Saccharose and maltose are not attacked by this organism, and Margaillan suggested that it should be used as a means of separating cane sugar from lactose and *d*-glucose. Testoni[21] has worked out a process of estimating cane sugar in condensed milk and similar materials based on this principle. He also shows that Jolles' method (Zeit. Nahr. und Genussm., 1910, 20, 631) based on the destruction of all sugars except saccharose by heating with *N*/10 sodium hydroxide, gives the same results for saccharose in sweetened wines, condensed milk, and marmalades as the fermentation process above described, so that in most cases Jolles' method is preferable as it is far more rapid.

The method of estimating lactose in presence of other sugars by taking advantage of the fact that it is not fermentable by ordinary yeasts, is preferable in many cases to polarimetric methods such as those of Harrison (Analyst., 1904, 29, 248) and Dubois (J. Amer. Chem. Soc., 29, 556). It has been investigated by Baker and Hulton (Analyst, 35, 512).

Estimation of starch.

The writer showed (Davis and Daish, J. Agric. Sci., 1914, 6, 152; also Davis, J. Soc. Dyers and Col., 1914, 30, 249) that the existing methods of estimating starch were quite unreliable and proposed a method based on the use of the enzyme taka-diastase, prepared from *Aspergillus oryzæ*; this converts starch quantitatively into a mixture of two sugars only—viz., maltose and dextrose—which can readly be estimated by measuring the reducing and rotatory powers of the product of conversion.

The modified Sachsse method,[22] which is official in the United States of America and is based on the hydrolysis of the starch present with boiling dilute acid, is valueless in the majority of cases when dealing with plant material, because of the presence of pentosans, "hemi-celluloses," and other substances which yield reducing sugars that count as dextrose; even when such substances are absent the method gives results which are more than 5 per cent. low, owing to the destruction of dextrose that occurs during the prolonged treatment with acid which is a feature of this method.[23] The destruction of dextrose is a source of error in all the methods which make use of hydrochloric acid to effect hydrolysis, such as that of Märcker and Morgen, even when the primary conversion of the starch has been carried out with diastase.

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[19] Ann. Inst. Pasteur, 1906, **20**, 977.
[20] Ann. Inst. Pasteur, 1909, **23**, 402.
[21] Ann. Lab. Centr. delle Gabelle, 1912, page 581.
[22] Bureau of Chemistry, Bulletin 107, Revised, 1912.
[23] Compare J. Agric. Sci., 1913, **5**, 437.

Although ordinary diastase gives with purified starch results by O'Sullivan's method which are approximately correct, values 15 to 20% lower than the actual starch content may be obtained when it is applied to plant material owing to the loss of dextrin. In the majority of cases, plant material, which has been previously deprived of sugar by prolonged extraction with alcohol, still contains tannins, amino-acids, proteins, etc.; during the hydrolysis by diastase these pass into solution and exercise a very marked effect on the reducing power and optical activity of the solution. These substances have therefore to be removed by the addition of basic lead acetate, which almost invariably produces a heavy precipitate in the filtered solution obtained from the diastase conversion. Although basic lead acetate does not of itself precipitate dextrin, when dextrin is present in solutions in which a precipitate is produced, as in the purification of the solutions obtained from the diastase conversions, it is carried down with this and is thus lost to the analysis.[24]

Use of taka-diastase in estimating starch.

In a series of experiments in which 2 grms. of anhydrous starch was gelatinised in 200 c.c. of water and, after cooling, subjected to the action of 0·1 grm. of taka-diastase during different periods at 38°, it was found that so long as the time of conversion exceeds 6 hours, maltose and dextrose are the only products formed; up to the sixth hour some dextrin is present, which interferes with the calculations, but when the conversion is prolonged to say 12 or 24 hours, the whole of the starch is found in the solution as maltose and dextrose and can be accurately estimated. The curve given in Fig. 1 shows that the dextrose arises solely from pre-formed maltose; as time goes on, the dextrose increases whilst the maltose proportionately falls. The curves of dextrose and maltose (calculated as starch) are strictly complementary. In this action, the starch is first converted into maltose by the ordinary diastatic enzymes, and this sugar is then transformed into dextrose by the maltase, which is the special feature of the taka-diastase. The maltase comes into action comparatively slowly, so that after 6 hours only one-tenth of the original starch is present as dextrose. Subsequently, however, the rate at which dextrose is formed increases, following very nearly a straight line curve between 6 hours and 28 hours, when about 60% of the starch is present as dextrose; the rate of formation of dextrose then rapidly slows down until a nearly constant value is reached in the neighbourhood of 84%.

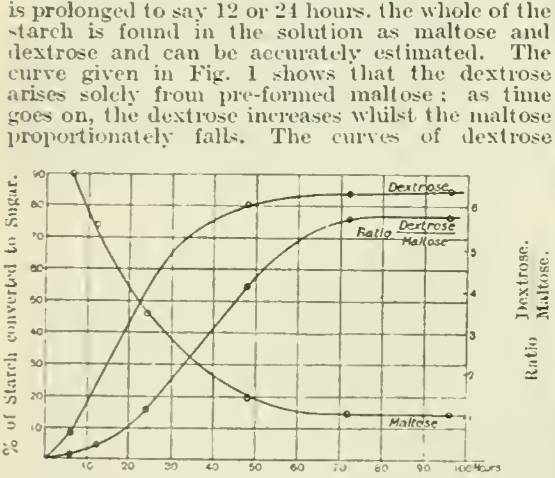

FIG. 1.

The view that has recently been put forward by Kita[25] that when taka-diastase acts on starch the dextrose is split off directly from the starch and is therefore not formed through the intermediary of maltose, is highly improbable in view of the above results. Davis and Daish give actual analyses with maltase-free yeasts confirming the view, that the actual product of the conversion throughout is a mixture of maltose and dextrose only; after 6 hours every trace of dextrin has disappeared under the conditions employed.

At 55°, the optimum temperature for the action of ordinary diastase, the action of taka-diastase, at least as regards the transformation of maltose into dextrose, is very much restricted, owing to the fact that the enzyme maltase is gradually destroyed at the higher temperature. In working with taka-diastase, therefore, a temperature of 38° to 40° should not be exceeded. It is noteworthy that the average value for the starch present in the purified potato starch found on using taka-diastase in the conversions of 6 to 48 hours is 99·65, whereas with ordinary diastase a value generally 0·5% higher was obtained. It is probable that the numbers obtained with taka-diastase more nearly represent the true starch values, as the calculations are based on the constants for two pure sugars only; they do not involve any assumption with regard to the specific rotatory power of the "dextrin" existing in solution, which is generally taken at 202°, although some doubt may still be entertained as to the exactness of this value. It is probable too that the purified potato starch contains a small proportion of foreign material; hence the low value of 99·6%.

In our method the use of precipitating agents such as alumina cream or basic lead acetate, accompanied by subsequent precipitation of the lead with sodium carbonate, does not in the least interfere with the accuracy of the results. We have applied this method to estimate starch in a large number of vegetable materials and tissues such as leaves, and found that it gives satisfactory results. Revis and Burnett (Analyst, 1915, 40, 429) have also successfully used it to estimate starch in cocoa; all other methods had proved quite worthless in this case.

The following is a brief description of the details of carrying out an analysis.

To estimate starch, the dry material (free from sugars[26] and, if necessary, previously extracted with water to remove gums, amylans, etc., is gelatinised with 200 c.c. of water in a 250 c.c. beaker flask heated for ½ hour in a water-bath at 100°. The solution is cooled to 38°, 0·1 grm. taka-diastase[27] added, together with 2 c.c. of toluene and the mixture left 24 hours in order that the conversion may take place; it is then heated in a boiling water-bath to destroy the diastase and the clear solution above the residual material is filtered through a fluted filter paper into a 500 c.c. measuring flask; the residue is thoroughly washed several times by decantation, the washings being passed through the filter paper until the volume of liquid in the flask amounts to about 475 c.c. The necessary quantity of basic lead acetate is then added to precipitate the tannins, etc., present in the solution; the amount required varies considerably with different materials, generally ranging from 5 c.c. to 25 c.c. A large excess of lead should be avoided and tests should be made after each small addition of lead acetate in order to ascertain when the precipitation is complete. When this is the case the solution is made up to 500 c.c. at 15°, and filtered; 100 c.c. of the filtrate is placed in a 110 c.c. measuring flask, the slight excess of lead precipitated by adding solid sodium carbonate and the volume adjusted to 110 c.c. at 15°. 50 c.c. of the filtrate from the lead carbonate is used for the reduction and another portion polarised in a 400 mm. tube. The following example shows the method of calculation:—

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[24] When basic lead acetate is added to the solution obtained by the diastase conversion of purified starch not the slightest precipitate is produced with the dextrin existing in solution; but results obtained in a series of special experiments showed that if sodium carbonate is subsequently added, or hydrogen sulphide is passed so as to precipitate the lead, a greater or smaller proportion of the dextrin is removed by co-precipitation.

[25] J. Ind. Eng. Chem., 1913, **5**, 220.

[26] To remove sugars the material should be thoroughly extracted by boiling 80% alcohol in a Soxhlet extractor. For the details in the case of leaf material and other vegetable tissue, see Davis and Daish (*loc. cit.*); precautions should be taken in such cases to ensure that all enzymes present are destroyed at the moment the sample is taken.

[27] We have used the commercial article prepared by Messrs. Parke, Davis & Co., which can be kept for many months without undergoing any change.

Weight of extracted leaf material (*Tropæolum majus*) after drying in steam oven .... = 10·4122 grm.
Weight of leaf material dried *in vacuo* at 100° .... = 9·4059 grm.
CuO from 50 c.c. of the final 110 c.c. .... = 0·4492 grm.
Polarisation of this solution in 400 mm. tube at 20·00° .... = 1·995°

If x = grm. dextrose in 50 c.c. of this solution,
y = grm. maltose in 50 c.c. of this solution.

we have, using the values of CuO corresponding to 1 grm. of dextrose and maltose for the weight 0·4492 CuO in the tables of Brown, Morris, and Millar:—

$$2{\cdot}369x + 1{\cdot}362y = 0{\cdot}4492 \quad (1)$$

For the 400 mm. tube, employing the values $[\alpha]_D^{20^\circ}$ 137·6 and $[\alpha]_D^{20^\circ} = 52{\cdot}7$ for maltose and dextrose we have also

$$4{\cdot}216x + 11{\cdot}008y = 1{\cdot}995^\circ \quad (2)$$

solving equations 1 and 2 for x and y

$x = 0{\cdot}1095$ grm. dextrose in 50 c.c.
$y = 0{\cdot}1394$ grm. maltose in 50 c.c.

Total dextrose in 500 c.c. original solution =

$$0{\cdot}1095 \times \frac{110}{50} \times \frac{500}{100} = 1{\cdot}2045 \text{ grm.}$$

Total maltose in 500 c.c. original solution =

$$0{\cdot}1394 \times \frac{110}{50} \times \frac{500}{100} = 1{\cdot}5334 \text{ grm.}$$

Starch corresponding to dextrose = 0·90 1·2045 = 1·0840 grm.
Starch corresponding to maltose = 1·5334—1·055 = 1·4535 grm.

Total starch = 2·5375 grm.

∴ % of starch in vacuum dried extracted leaf material

$$2{\cdot}5375 \times \frac{100}{9{\cdot}4059} = 26{\cdot}97\ \%.$$

One of the principal difficulties in estimating starch in plant material is due to the presence of gummy substances, tannins, proteins, etc., which pass into solution during the hydrolysis and exercise an effect on the rotatory and reducing power of the solution. These substances are very largely removed by the use of basic lead acetate, but sufficient impurity often remains, even after this treatment, to falsify the analyses. Thus in the case of mangold leaf a lævorotatory gum is present, which gives an error of nearly 10% in the rotation actually measured.

In the case of leaf and plant material it is generally possible to extract the disturbing gummy material prior to the starch conversion by a preliminary treatment with water.[28] Thus with mangold leaf, by adding 200 c.c. of water and 5 c.c. of toluene to the leaf material and extracting for 24 hours at 38°, decanting and washing with a little water and subsequently converting with taka-diastase, in the ordinary way, a solution is finally obtained (after the usual treatment with basic lead and sodium carbonate) which in a 400 mm. tube shows a lævorotation of not more than 0·01°. It is noteworthy that the preliminary treatment with water fails to remove the greater part of the material precipitable by basic lead acetate, so that this treatment is necessary even after the preliminary extraction with water.

In the case of plant material from which gummy matter is extracted with extreme difficulty, it would probably be sufficient to introduce a correction for any active substances present by carrying out a control experiment or "blank" in which the diastase is omitted but the material otherwise treated exactly as in the actual estimation of starch.

Ewers' method[29] *of estimating starch.*

This is a method which has come into considerable use especially in dealing with brewers' materials (barley, grains, etc.). It is a modification of Lintner's polarimetric method based on the substitution of hot dilute hydrochloric acid for the cold acid used in this process.

Whilst it may be useful in certain cases for giving comparative results, it is very doubtful whether the values obtained represent the true starch present, owing to the fact that the treatment with hydrochloric acid breaks down pentosans and hemicelluloses, substances with a dextrorotation passing into solution which count as starch; thus the writer found that a sample of mangold leaf, which was absolutely free from starch, when subjected to Ewers' method gave a solution having a strong dextrorotation, which corresponded with the apparent presence of 16·5% of starch. Far higher values, too, are obtained by this method for the starch present in grain, such as wheat, than are given by the diastase method, so that there is no doubt that the results obtained by it are quite untrustworthy so far as the true starch is concerned.

DISCUSSION.

Mr. **JULIAN L. BAKER** said that the completion of the fermentations required a month and it was obvious that a modification would be necessary if such methods were adopted in commercial laboratories. With regard to the use of *Saccharomyces marxianus* in estimating maltose and dextrose, he (the speaker) had worked out the conditions for a more rapid method than Mr. Davis had described (this Journal, 1905, **24**, 352). The analysis of a mixture of maltose and dextrose could be completed in three or four days with an accuracy of 95%. The observation which Mr. Davis had made on the effect of basic lead acetate on lævulose was in harmony with the work of Lobry de Bruyn. With regard to the estimation of starch, he (the speaker) had applied Lintner's polarimetric method to materials in which it existed in a considerable proportion, and had found that it yielded most satisfactory results.

Professor **H. E. ARMSTRONG** said that Mr. Davis's work was undoubtedly of first-class importance, especially in connection with the analysis of living plant tissues. It had been impossible hitherto to make any determinations which gave trustworthy results by the conventional methods available; and he believed that for the first time Mr. Davis had put on record, and had used methods which had given them a true picture of the carbohydrate contents, particularly of the mangold leaves. The methods he had made use of were, of course, not novel in principle, but he had developed a technique by the aid of which accurate information could be obtained about these problems. As to whether they were satisfactory for technical purposes, such as Mr. Baker had referred to, was another matter. They were now gradually coming within sight of a field of analytical inquiry which in the past appeared almost hopeless, and was certainly hopeless so long as one resorted to the ordinary laboratory chemical methods.

Dr. **L. T. THORNE** said that he was afraid that methods involving the use of enzymes would not, in practice, take the place of the purely chemical determinations, on account of the time occupied; but a description of them would be of very great help in comparing the results, so as to strengthen one's views on the estimations made by the chemical methods. For the ordinary technologist, the chemical methods would probably still hold the field. In his own case, the products dealt with were mixtures of comparatively few substances, where the starch or the saccharose, or the other material to be determined was present in a large proportion. With regard to the estimation of starch, he had found, for instance, that the cold hydrochloric acid method gave exceedingly valuable results for technical purposes. It was not an absolutely accurate method, but in the large number of cases that came into the hands of the technologist, where the determination was made of a substance in which the starch was present as the main constituent, he found that it gave very good results, and results that would give the information that was wanted in technical work.

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[28] Compare Brown and Millar, Trans. Guinness Lab., Vol. I, 79.

[29] Zeit. ges. Brauw., 1908, **31**, 250.

Mr. H. F. E. Hulton asked why the fermentation with the special yeast took such an extraordinarily long time. A fermentation by *Cerevisiæ* or ordinary yeast could be completed at the end of three days, if sufficient of the yeast were used. If the time of fermentation could be reduced the method would be very much more valuable. He quite agreed that the citric acid method was very useful, but he had found that considerable hydrolysis of maltose occurred with 10% citric acid.

Mr. Davis said that there was no hydrolysis under his conditions of working.

The Chairman said that Mr. Davis had stated that for the clarification of plant materials, unlike technical sugar products, a large excess of lead was necessary. That was not quite the case, *e.g.*, in dealing with molasses where a large amount of lead must be used for clarification, there was certainly an effect on the lævulose. Whether that effect was due to precipitation of lævulose, or whether it was due to the transformation of that sugar into another one, did not matter. It was probable that Mr. Davis was correct in assuming the latter, which followed from the work of Lobry de Bruyn. He thought that Ogilvie had solved the problem of the use of invertase in the analysis of molasses. He clarified the molasses with basic lead acetate, removed the lead with sulphurous acid, and then applied invertase. He agreed with Mr. Davis that the ordinary methods for the estimation of raffinose were untrustworthy. They could not be as accurate as the methods Mr. Davis had worked out. The differential behaviour of top and bottom yeasts towards raffinose had long been known; certainly more than 20 years before Bau's paper it had been pointed out by Loiseau. The official Sachs method was quite unreliable for the estimation of starch. He could not understand how the Americans and Germans had continued with it so long. The method of Ewers was the one he had used for many products in which starch was present in large quantities, and it gave very useful results, although, perhaps, not absolute ones. There was every reason why it should; because, with starch itself it gave a rotary power of $[\alpha]_D =$ 178—180°, and there was nothing present having a rotation of the same order of magnitude, whilst other substances were perhaps present to the extent of 5 to 10%. Their rotatory power was therefore practically negligible.

Mr. Davis, in reply, admitted that Ewers' method was accurate in dealing with pure starch, or anything which approximated to starch purity. Under those conditions there were other substances which gave rise to other products. The Chairman had stated that, generally speaking, they did not have substances present which gave a rotatory power anything like that of starch. As a matter of fact, some pentosans yielded arabinose on hydrolysis and that sugar had a rotatory power of $[\alpha]_D = 106°$, more than half the rotation of starch and one could not correct for pentoses without knowing which one was produced. He had made a number of comparative experiments with wheat, and had found invariably that Ewers' method gave results 15 to 20% higher than the diastase method, and that would generally be found to be the case with plant material. The great advantage of Ewers' method was, that it gave results which agreed very closely. But hitherto there had been no criterion testing its accuracy. Mr. Baker had said that it gave excellent results; but on what basis did he judge the percentage of starch in the material he dealt with? It was perfectly accurate if they were dealing with pure starches.

Mr. Baker said he had made up mixtures.

Mr. Davis continuing, said that for comparative purposes Ewers' method was useful, but it was unsuitable for the analysis of plant material. The reason why the fermentations took so long, was that a mere trace of the pure culture was used for inoculation, and it took some time for the race to grow and get up speed. If a large quantity of yeast were used the fermentations would probably be complete in a couple of days. If a large growth of yeast were used it was probably not a pure culture. In the kind of work they had been doing, that delay did not much matter, but for practical purposes it was impracticable. On the other hand, in estimations by means of invertase and diastase, the process was complete in one day, so that the method was perfectly satisfactory particularly for the estimation of starch. With regard to the question of citric acid, he had shown absolutely beyond doubt that, under their conditions of working, dealing with 10% citric acid and 1% solution, there was no hydrolysis of pure maltose.

The Chairman said that the time taken up by enzymic methods was not of great moment, if the methods required practically no attention.

ACETIC ANHYDRIDE.

BY J. T. HEWITT, F.R.S., AND C. H. LUMSDEN, B.SC., A.I.C.

Acetic anhydride has acquired such technical importance that a review of the methods available for the preparation of this and similar compounds seemed desirable. We have examined several processes already in use and have made further experiments on apparently possible processes. Where these have been unsuccessful a brief record seems desirable in order to save the time of other investigators, who might, like ourselves, be attracted by reactions which appear probable on paper but fail when put to the practical test.

Dibasic acids, such as succinic acid, in which two carbonyl groups are attached to adjacent carbon atoms, were found at an early date (D'Arcet, Ann. Chim. phys., 1835, ii, **58**, 282) to give anhydrides, the dehydration being effected by distillation or by heating with phosphorus pentoxide. The removal of a molecule of water from two molecules of a monobasic acid necessitates indirect means. Gerhardt (Ann. Chim. phys., 1853, iii, **37**, 288) first obtained acetic anhydride by the action of acetyl chloride on anhydrous sodium acetate,

$$CH_3COCl + CH_3COONa = NaCl + (CH_3CO)_2O,$$

and further showed that the operations of preparing acetyl chloride and acetic anhydride might be combined in one by distilling a chloride or oxychloride of phosphorus with an excess of a metallic acetate. The method has remained a standard one, and it will be again referred to. In addition to processes depending on the use of halide compounds of non-metals (usually acid chlorides), direct dehydration of acetic acid by the anhydrides of sparingly volatile inorganic acids (*e.g.*, SO_3, P_4O_{10}, etc.), and the decomposition of acetates of weak bases must be taken into consideration.

Three chief points must be considered before applying any process technically, viz. :—(i) The cost of the product as determined by the cost of the materials employed and the yield obtainable. (ii) Ease of technical applicability as determined by simplicity of plant, time of working and extent to which a process is " fool-proof." (iii) Purity of product.

The value of acetic anhydride depends largely on the actual anhydride content, *i.e.*, freedom from acetic acid. If a boiling point determination is to be the only check, it should be remembered that the presence of acetic acid amounting to several per cent. in a sample of acetic anhydride has very little effect on the temperature of ebullition as found with an ordinary distilling bulb (cf. Pickering, Chem. Soc. Trans., 1893, **63**, 1000). Methods of finding the actual percentage of acetic acid and anhydride in a mixture have been given by Menschutkin and Vasilieff (J. Russ. Phys. Chem. Soc., 1889, **21**, 190), Treadwell (Analytical Chemistry, 1914, Vol. II.), and Edwards and Orton (Chem. Soc. Trans., 1911, **99**, 1181). Menschutkin and Vasilieff treat with aniline and water, and determine the acidity after the reaction

$$C_6H_5NH_2 + (CH_3CO)_2O = C_6H_5{\cdot}NHCOCH_3 + CH_3COOH$$

has taken place. Treadwell recommends treatment with barium hydroxide solution and titration of excess of the latter, whilst Edwards and Orton convert the anhydride into acetanilide, the latter into phenylacetylchloro-amine, and then determine the chloro-amine volumetrically. We have employed Treadwell's method, all necessary precautions being taken.

Inorganic anhydrides.—The direct action of anhydrides of inorganic acids on fatty acids or their salts in accordance with equations such as

$$4CH_3COOH + P_4O_{10} = 4HPO_3 + 2(CH_3CO)_2O \quad \text{or}$$

$$2CH_3COONa + SO_3 = Na_2SO_4 + (CH_3CO)_2O$$

has but limited application. The anhydride of chloro-acetic acid has been obtained by the direct action of phosphorus pentoxide on chloracetic acid (Bischoff and Walden, Ber., 1894, **27**, 2949).

Sulphur trioxide.—This anhydride may be used indirectly. Franchimont (Comptes rendus, 1881, **92**, 1054) considered it probable that the first product of the action of acetic anhydride on sulphuric acid was acetylsulphuric acid, $CH_3CO.SO_4H$; the isolation of this substance has been effected by A. J. van Peski (Proc. K. Akad. Wetensch. Amsterdam, 1914, **16**, 969) who allowed acetic anhydride and sulphur trioxide to react below 0° C. Addition of sodium acetate gives a sodium salt from which acetic anhydride is produced either by heating alone or suspended in toluene or acetic acid or by heating with sodium acetate in acetic acid.

$$2CH_3CO.SO_4Na = (CH_3CO)_2O + Na_2S_2O_7.$$

$$CH_3CO{\cdot}SO_4Na + CH_3CO.ONa = Na_2SO_4 + (CH_3CO)_2O.$$

Van Peski finds that the bulky sodium pyrosulphate produced in the first reaction gives acetic anhydride when distilled with sodium acetate and acetic acid, whilst ordinary sodium pyrosulphate will not enter into the reaction

$$Na_2S_2O_7 + 2CH_3COONa = 2Na_2SO_4 + (CH_3CO)_2O.$$

Acetylsulphuric acid and sodium chloride give acetyl chloride on distillation.

We can confirm van Peski's statement as to ordinary sodium pyrosulphate not acting in the desired sense. Sodium pyrosulphate containing 58% $Na_2S_2O_7$ was obtained by heating sodium hydrogen sulphate under reduced pressure (abt. 200 mm.) in a current of dry air at 260° C. slowly rising to 320° C. 222 grms. of this product was mixed with 95 grms. of fused sodium acetate and distilled from an oil bath at 190°—200° C., under 70 mm. pressure. 8 grms. of acetic acid resulting from the action of residual sodium hydrogen sulphate was obtained. On distilling the residue in a slow current of dry air over a naked flame, an offensively smelling distillate containing much sulphur was obtained, the contents of the flask charring considerably. No acetic anhydride was recovered from this distillate.

An attempted acetylation of salicylic acid in accordance with the equation

$$C_6H_4(OH)(COOH) + CH_3COOH + Na_2S_2O_7 = 2NaHSO_4 + C_6H_4(OCOCH_3)(COOH)$$

proved unsuccessful, unchanged salicylic acid being recovered after boiling for two hours with two parts of anhydrous acetic acid and three parts of sodium pyrosulphate (58%).

Nitrogen pentoxide, etc.—Acetic anhydride appears to be produced when the vapour of nitrogen pentoxide or a mixture of oxides of nitrogen and air or oxygen are passed over dry sodium acetate or calcium acetate (R. Muller and the Deutsche Celluloid Fabrik, Fr. Pat. 468,963 of 26 Feb., 1914; this Journal, 1914, **33**, 985). This process may offer a profitable method for recovery of nitrous fumes from the preparation of metallic nitrates.

Non-metallic chlorides and oxychlorides.

Phosphorus compounds.—The original method of Gerhardt (*loc. cit.*) is so well known as hardly to need description. Acetyl chloride may be first isolated and then allowed to react with anhydrous acetate, or by taking an excess of the latter with a phosphorus halogen compound, acetic anhydride may be directly obtained. Gerhardt overestimated the yields obtainable, assuming that one molecule of phosphoryl chloride reacts with three molecules of sodium acetate.

$$POCl_3 + 3CH_3CO.ONa = Na_3PO_4 + 3CH_3COCl.$$

Geuther (Annalen 1862, **123**, 114) showed definitely that only two molecules of sodium acetate react, the sodium being converted into chloride and *meta-* (not *ortho-*) phosphate.

$$2CH_3COONa + POCl_3 = 2CH_3CO.Cl + NaCl + NaPO_3.$$

Hence one molecule of phosphoryl chloride reacts with four equivalents of an acetate to give two molecules of acetic anhydride

$$4CH_3COONa + POCl_3 = 2(CH_3CO)_2O + 3NaCl + NaPO_3.$$

Yields are satisfactory and that the method is in use technically is shown by examination of commercial products. The products of two German firms were examined qualitatively and found to contain chloride and phosphorus. The latter element was detected by careful heating and ultimate fusion with a mixture of soda lime and potassium nitrate, solution in dilute nitric acid, and treatment with ammonium molybdate. The specimens contained 90·84 and 88·35% acetic anhydride respectively; similar contents of anhydride have been obtained by Treadwell (Analytical Chemistry, vol. ii., 584), whilst Orton and Jones (Chem. Soc. Trans., 1912, **101**, 1721) state that ordinary specimens of acetic anhydride usually contain 8—10% of acetic acid and that if a still head is not employed, distillation begins at 134°—135° C. Orton and Jones further found that "acetic acid free from homologues" distils completely at a temperature not exceeding 139·5°; with most commercial anhydrides the temperature may rise to 142° C.

Various other methods are known by which an acid chloride (produced by the action of a phosphorus halogen compound) may be converted into the corresponding anhydride. Linnemann (Annalen, 1872, **161**, 169) obtained butyric anhydride from butyryl chloride and butyric acid. The reaction

$$R.COOH + R.COCl = HCl + (RCO)_2O$$

is, however, probably reversible, since Colson (Bull. Soc. Chim., 1897, (iii), **17**, 58) obtained acetic acid and acetyl chloride from acetic anhydride and hydrogen chloride.

Other methods of converting acid chlorides into the corresponding anhydrides depend on the use of lead nitrate (Lachowicz, Ber., 1884, **17**, 1281; 1885, **18**, 2890).

$$2CH_3COCl + Pb(NO_3)_2 = (CH_3CO)_2O + PbCl_2 + N_2O_4 + O$$

and sodium nitrite (Minnuni and Carbetti, Gazzetta, 1890, **20**, 655).

$$2C_6H_5COCl + 2NaNO_2 = (C_6H_5CO)_2O + 2NaCl + N_2O_3.$$

These apparently offer no technical advantages.

Carbon compounds.—Carbonyl chloride and other carbon compounds containing chloride have been used in the preparation of anhydrides. Hentschel (Ber., 1884, **17**, 1285, and the Chem. Fabrikswerk Hofmann and Schoetensack, Ger. Pat. 29,669, April 4, 1884) obtained acetic anhydride by leading carbonyl chloride over heated sodium acetate.

$$2CH_3COONa + COCl_2 = (CH_3CO)_2O + 2NaCl + CO_2.$$

Benzotrichloride has been used by F. Jenson (Ger. Pat. 6685, Oct. 30, 1878), who found that the reaction,

$$C_6H_5CCl_3 + 2CH_3COOH = C_6H_5COOH + 2CH_3COCl + HCl$$

took place in the presence of one per cent. of zinc chloride. Loss of acetyl chloride with the escaping hydrogen chloride may be avoided by the addition of zinc acetate, whilst if two molecular proportions of zinc acetate are employed, a violent reaction occurs, and acetic anhydride is produced.

$$2C_6H_5CCl_3 + 4(CH_3COO)_2Zn = (C_6H_5COO)_2Zn + 3ZnCl_2 + 4(CH_3CO)_2O.$$

A. Béhal (Comptes rendus, 1909, **148**, 179) finds that acetic anhydride is formed on boiling acetic acid with benzal chloride.

$$C_6H_5CHCl_2 + 2CH_3COOH = C_6H_5CHO + (CH_3CO)_2O + 2HCl.$$

He has also examined the reaction between benzotrichloride and acetic acid (*ibid.* p. 648).

Silicon compounds.—Rudolph Sommer (Ger. Pat. 171,146, May 25, 1905) finds that silicon tetrafluoride is rapidly absorbed by fused sodium acetate at 200°—220° C.; as the absorption ceases, acetic anhydride begins to distil over.

Sulphur compounds.—Compounds containing sulphur and chlorine have engaged the attention of many investigators and our own work leads us to the conclusion that such substances are most suitable for giving a product containing a high percentage of acetic anhydride and not otherwise largely contaminated.

Heintz (Jahresb. Chem., 1856, 569) allowed "Chlorschwefel"—apparently SCl_2—to react with salts of organic acids, and obtained benzoyl chloride from sodium benzoate.

$$4C_6H_5COONa + 3SCl_2 = 2S + Na_2SO_4 + 2NaCl + 4C_6H_5COCl.$$

He proposed a method for the preparation of benzoic anhydride which naturally results by employing an excess of sodium benzoate.

The use of the cheap and easily obtainable sulphur monochloride, S_2Cl_2, was protected by Kessler (Ger. Pat. 132,605, Nov. 11, 1900). According to W. S. Denham (Trans. Chem. Soc., 1909, **95**, 1235) and Denham and H. Woodhouse (*ibid.* 1913, **103**, 1861) the mechanism of the reaction is explained in the following manner:—

$$2C_6H_5COONa + Cl_2S_2 = (C_6H_5COO)_2S_2 + 2NaCl$$

$$2(C_6H_5COO)_2S_2 = 2(C_6H_5CO)_2O + SO_2 + 3S.$$

Kessler states that acetic anhydride boils at 56° C. at 25 mm., and that if one distils off acetic anhydride from the reaction product of sulphur chloride on sodium acetate at this pressure, no sulphurous acid is formed. He gives the following directions for carrying out his process.

500 kilograms of sulphur chloride is gradually added to 805 kilograms of anhydrous sodium acetate contained in a good iron vessel provided with stirring apparatus and steam jacket. Thorough mixing is essential. After addition of the chloride, the mixture is cautiously warmed under reflux and the pressure gradually diminished. After some 5 or 6 hours all the acetyl chloride and sodium acetate will have reacted to form acetic anhydride which distils off on further reducing the pressure.

We have examined this process thoroughly and find it is very satisfactory. The following is an account of a typical laboratory experiment.

Quantities used:—190 grams fused and powdered sodium acetate and 120 grams of sulphur chloride. About one-quarter of the acetate was placed in a 500 c.c. R.B. flask and about 20 c.c. of sulphur chloride added. The mixture was well stirred, alternate additions were made of the two ingredients, and care exercised that the mixing was thoroughly effected. Heat was evolved during mixing and the reaction was completed by heating in an oil bath at 90°. On subsequently gradually reducing the pressure to 60 mm. and raising the temperature of the bath to 140°, acetic anhydride passed over, the thermometer in the anhydride vapour showing 70° C. In two different experiments 190 grms. of fused sodium acetate (excess of theoretical amount required to react with sulphur chloride) gave respectively 80 and 82 grms. of anhydride.

The acetic anhydride as directly obtained contained 83·5 % of actual anhydride, 0·024 % of sulphur, and merely a trace of chlorine. By careful rectification an anhydride of 99·7 % was obtained but the sulphur was not entirely removed. The form in which the sulphur occurs in the distillate is unknown, but the fact that the anhydride gradually gives a black precipitate with silver nitrate renders it probable that the impurity present is an acetic anhydride in which some of the oxygen is replaced by sulphur, *e.g.*, $(CH_3CO)_2S$.

Instead of using a chloride of sulphur directly, various proposals have been made to use sulphur and chlorine with the object of converting all the sulphur into sulphate. Goldschmidt (Ger. Pat. 222,236, Nov. 21, 1908) takes a well dried mixture of sulphur and sodium acetate, cools this to —24° C. or even lower and introduces chlorine under continual stirring. When the reaction is complete the mixture is gently warmed for a few hours to convert acetyl chloride into anhydride, and the latter is then distilled off.

$$8CH_3COONa + S + 6Cl = 6NaCl + Na_2SO_4 + 4(CH_3CO)_2O.$$

A modification due to the Aktien-Gesellschaft für Anilin-Fabrikation (Ger. Pat. 273,101, Jan. 16, 1912) consists in using a sulphur chloride and chlorine with the acetate; the low temperature necessary in Goldschmidt's process is avoided and good yields are said to be obtained working at 20°.

$$16CH_3COONa + S_2Cl_2 + 5Cl_2 = 12NaCl + 2Na_2SO_4 + 8(CH_3CO)_2O, \text{ and}$$

$$8CH_3COONa + SCl_2 + 2Cl_2 = 6NaCl + Na_2SO_4 + 4(CH_3CO)_2O.$$

Respecting this latter process we think that good stirring during the introduction of the chlorine is probably essential. In experiments carried out under laboratory conditions, in which stirring was omitted, we found the yields of anhydride were much the same as if sulphur chloride had alone been employed. Further, we obtained no acetic anhydride by submitting a mixture of glacial acetic acid and sulphur chloride to the action of chlorine.

The acid chlorides of sulphur have been frequently used in manufacturing acetic anhydride. We have no experience of the use of thionyl chloride, so simply refer to Kopetschni and Karczag (French Patent 450,227) and W. S. Denham and H. Woodhouse (Chem. Soc. Trans., 1913, **103**, 1861).

Chlorosulphonic acid was found by the Badische Anilin und Soda Fabrik (Ger. Pat. 146,690, Oct. 1, 1902) to react with either acetic acid or its salts giving acetyl chloride which might, of course, be subsequently converted into anhydride.

$$CH_3COOH + ClSO_3H = CH_3COCl + H_2SO_4.$$

The same patentees have also protected the use of sodium chlorosulphonate which may be obtained by heating chlorosulphonic acid with sodium chloride.

In attempting the preparation of acetic anhydride according to the equation

$$ClSO_3Na + 2CH_3COONa = NaCl + Na_2SO_4 + (CH_3CO)_2O$$

we obtained bad yields of an impure product; whether the process is really a good one when good machinery is available we do not know, but under laboratory conditions we should not recommend the process. On the other hand the production of acetyl chloride by leading the vapour of glacial acetic acid over sodium chlorosulphonate is easily carried out and apparently gives good yields, but trouble owing to caking of the salt easily occurs.

The use of sulphuryl chloride according to the equation:

$$4CH_3COONa + SO_2Cl_2 = 2NaCl + Na_2SO_4 + 2(CH_3CO)_2O.$$

is obvious. According to the Farbenfabriken vormals F. Bayer (Ger. Pat. 127,350, June 26, 1900) two molecules of sulphuryl chloride convert six molecules of an alkali acetate into acetic anhydride, whilst by two molecules of sulphuryl chloride and a corresponding amount of chlorine, eight molecules of alkali acetate can be acted on. The simple equation given above evidently requires modifying.

Subsequent work has shown that ready formed sulphuryl chloride is not essential, A. Wohl (Ger. Pat. 151,864, Jan. 18, 1901) found that a mixture of sulphur dioxide and chlorine would effect the conversion. Modifications of this process have been patented. The Verein für Chemische Industrie (Ger. Pat. 161,882, March 30, 1902, and Ger. Pat. 167,304 of June 26, 1902) use sulphuryl chloride or a mixture of sulphur dioxide and chlorine on a mixture of sodium and calcium acetates. The Farbwerke vorm. Meister, Lucius, und Brüning (Ger. Pat. 210,805, Jan. 10, 1907) state that if the dry salts of organic acids are treated successively with sulphur dioxide, either gas or liquid, and then with chlorine, the corresponding acid chlorides are produced. The Aktien-Gesellschaft für Anilin-Fabrikation (Ger. Pat. 244,602, Dec. 20, 1909) lead 256 parts (4 mols.) of sulphur dioxide and 284 parts (4 mols.) of chlorine into 100 parts of acetic anhydride: the resulting solution of sulphuryl chloride in acetic anhydride is allowed to flow with cooling on to 1312 parts (16 mols.) of anhydrous sodium acetate, the mixture is stirred and, after completion of the reaction, the acetic anhydride is distilled off. It will be noted that the proportions used correspond to the equation:

$$4CH_3COONa + SO_2Cl_2 = Na_2SO_4 + 2NaCl + 2(CH_3CO)_2O.$$

We regret that we have not had time to examine this process, which is ingenious and promises well.

Other attempted methods.—Ferric and aluminium oxide being weak bases and acetic acid a weak acid, it seemed possible that ferric and aluminium acetates might decompose on heating in the following manner:

$$2Fe(C_2H_3O_2)_3 = Fe_2O_3 + 3(CH_3CO)_2O.$$

We tried to carry this reaction into practice by heating anhydrous sodium acetate with carefuly dehydrated aluminium sulphate or the basic ferric sulphate, $Fe_2O(SO_4)_2$. All our experiments in this direction were unsuccessful, and even in the case of acetates of such weak bases some acetone is produced and sulphur compounds are also found in the distillate.

In conclusion we think that the chlorides of phosphorus and sulphur are the most suitable reagents for use in the preparation of acetic anhydride, and whether a sulphur or a phosphorus chloride should be used is chiefly a matter of expense.

In a Discussion which followed Mr. C. F. Cross referred to the possibility of producing acetic anhydride from acetylene.

GRAPHIC METHODS IN CHEMICAL INDUSTRY.

BY EMIL HATSCHEK.

The Graphic Representation of Mixtures of Four Components.

It is well known that mixtures of four components having a constant sum can be represented by the four perpendiculars from a point inside a regular tetrahedron on its four faces, since the sum of these perpendiculars is constant (the height of the tetrahedron).[1] A system of points satisfying a further condition—*e.g.*, a constant specific gravity for the mixture—will form a surface lying inside the tetrahedron. Tetrahedral coordinates for representing such surfaces have been employed in some of the classical investigations in the literature.[2]

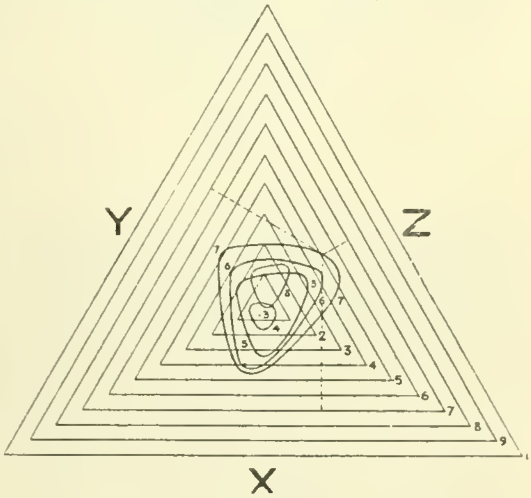

FIG. 1.

The problem of a convenient method of representation of such systems is of course the general problem of representing three-dimensional objects, complicated by the obliquity of the planes of reference. What is required in practice is evidently some method which permits the four coordinates to be measured directly and preferably to the same scale. The most complete solution is obviously a model, but the measuring of the perpendiculars from any point of a curved surface to the faces of the tetrahedron is by no means convenient. Another alternative is the representation of the surface and tetrahedron of reference by any of the familiar methods of projection, preferably orthographic or axonometric. This procedure, although perfectly simple, is tedious for a large number of points and has the further disadvantage that some of the coordinates become foreshortened, so that the use of at least two, and possibly three, scales becomes necessary.

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[1] R. Loewenherz, Zeits. physik. Chem., 1894, **13**, 463.

[2] Van't Hoff, Zur Bildung ozeanischer Salzablagerungen, I, p. 19 (Braunschweig, 1895).

The solution proposed by the author, which is believed to be novel, is a simple adaptation of the "contour" method to tetrahedral coordinates. The principle of this method, which is familiar to everybody from its use on maps, consists in taking a number of plane, parallel and equidistant sections through the surface and projecting them perpendicularly on one of the planes and at the same time marking them with a number denoting the distance of the particular section or contour from a plane of reference—such as "O.D." or sea level on maps.

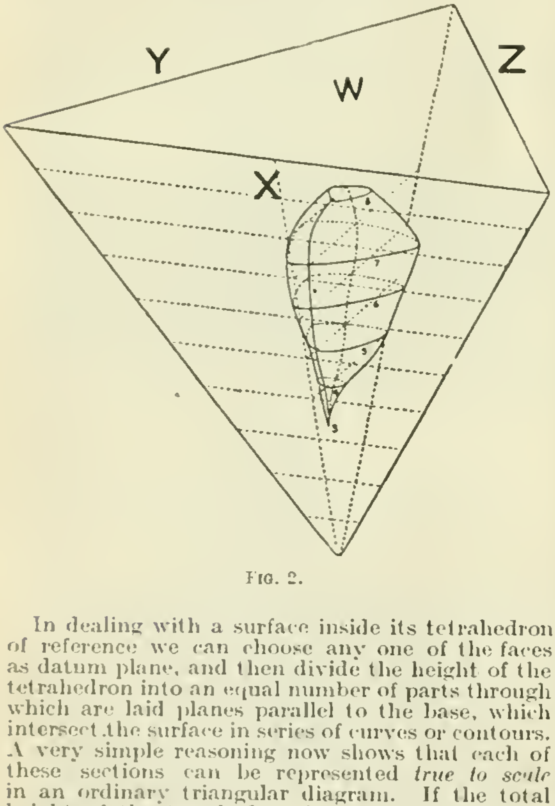

Fig. 2.

In dealing with a surface inside its tetrahedron of reference we can choose any one of the faces as datum plane, and then divide the height of the tetrahedron into an equal number of parts through which are laid planes parallel to the base, which intersect the surface in series of curves or contours. A very simple reasoning now shows that each of these sections can be represented *true to scale* in an ordinary triangular diagram. If the total height of the tetrahedron is h, and our contour is taken at a distance a from the base, the remaining three perpendiculars from any point in the contour on the three other surfaces, *i.e.*, the remaining three coordinates, will obviously have the sum $h—a$. We can therefore represent the contour, *true to scale*, in a triangular diagram, viz., in an equilateral triangle the height of which is $h—a$, the contour being marked a to denote its distance from the base.

If, as is generally the case, the coordinates are given in per cent., it will be convenient to refer them to a tetrahedron the height of which, in any convenient scale, is 100, and is divided into say ten parts. The contour 10 will then be represented true to scale in a triangular diagram having the height 90, contour 20 in a triangle with the height 80, etc. A complete contour diagram, in which the contours and triangles of reference have for convenience been numbered 1—10, is shown in Fig. 1. In this case the figures do not show the distances from the base, but the height of the triangle of reference, thus 7 is the triangle whose height is 7, and its distance from the base therefore 3, etc.

It need hardly be pointed out that the triangles of reference are not the triangles formed by the intersection of the contour planes with the faces of the tetrahedron. The latter cannot be used for scale-true representation, since the three remaining coordinates do not lie in them. A very simple consideration of the properties of the tetrahedron shows that the ratio, side of triangle of reference : side of triangular section, is

$$\frac{2}{\sqrt{3}} : \sqrt{\frac{3}{2}} = 1\cdot155 : 1\cdot226.$$

If therefore we use for reference a tetrahedron having the height 100, the side of the base is 122·6, while the triangle which gives in true scale the three other coordinates of any point in the base has a side = 115·5, and the same ratio will exist between any other cross section and the coordinated triangle of true scale.

Using this ratio, we can of course construct from the contours in the true scale diagram a model of the surface defined by them, or we can represent the latter in any of the usual systems of projection. Thus the surface defined by the contours 4 to 9 in the diagram (Fig. 1) is shown, with the tetrahedron of reference in axonometric projection (1 : 1 : ½) in Fig. 2. The outline of the surface, as it appears in this projection, is indicated, and also the section of the surface with the plane bisecting the angle between the face Y and Z; the points on this line therefore have the property that for all of them y = z.

A Simple Geometric Solution of an Engineering Problem Involving Three Variables.

By way of introduction it may be worth mentioning that a geometric solution of a problem—as distinct from the general case of a graphic solution—is one in which, once the scales for the variables have been fixed, the whole of the constructions required can be performed with set square and compasses. Such methods of course have long been familiar to engineers: graphic statics, the Zeuner slide valve diagram, etc., being familiar examples.

The present problem is to find by geometric methods the time in which a tank of constant cross section (*i.e.*, prismatic or cylindrical) empties itself when filled to a variable height and discharged through an outlet of variable cross section. The problem arose in a large vacuum filtering plant, in which a variable number of suction filters discharged the filtrate into a common receiver. The latter was therefore—since all the filters were running at the same rate—filled to variable heights in the same time, and had to be emptied in a given time, which was fixed by other factors in the whole process.

It is at once evident that we are dealing with three variables, the head of liquid, the time of discharge and a third one depending on the outlet area. The last named can, however, be introduced in two different ways, as appears from the following: if we call X the head of liquid in tank, S the cross section of the tank, s that of the outlet, and Y the time of discharge, the time of emptying is given by the formula:

$$Y = c\,\frac{S}{s}\sqrt{\frac{2X}{g}}$$

where c is a coefficient >1 (the reciprocal of the contraction coefficient) and g the gravity constant. Assuming c to be the same throughout, a condition which can be very nearly satisfied by using, not a literally variable outlet, but a variable number of outlets of equal size, we can combine all the constants into one. We now see that we can treat the right hand side of the equation in two ways: we can take as our third variable either the fraction $\frac{S}{s}$, or else s itself. Calling the third variable Z, we obtain respectively the two equations:

$$(1)\ Y = CZ\sqrt{X} \text{ and } (2)\ YZ = C'\sqrt{X}$$

in which Z has the meanings defined above, and the constants are of course different.

These equations, as all equations between three variables, define curved surfaces, (1) being of the third, and (2) of the fourth degree. If we made models of either, the three coordinates of any point would immediately give us the coordinated values of head, outlet area, and time of discharge. This course would however be somewhat inconvenient and it remains to find a simple method of representing either surface in two dimensions.

A discussion of equation (1) shows that the sections of the surface parallel to the plane of Y Z are pairs of straight lines, since

$$Y = \pm CZ\sqrt{X}$$

represents such a pair of straight lines. It therefore follows that we can reduce our whole graph to one consisting of straight lines in the following simple manner.

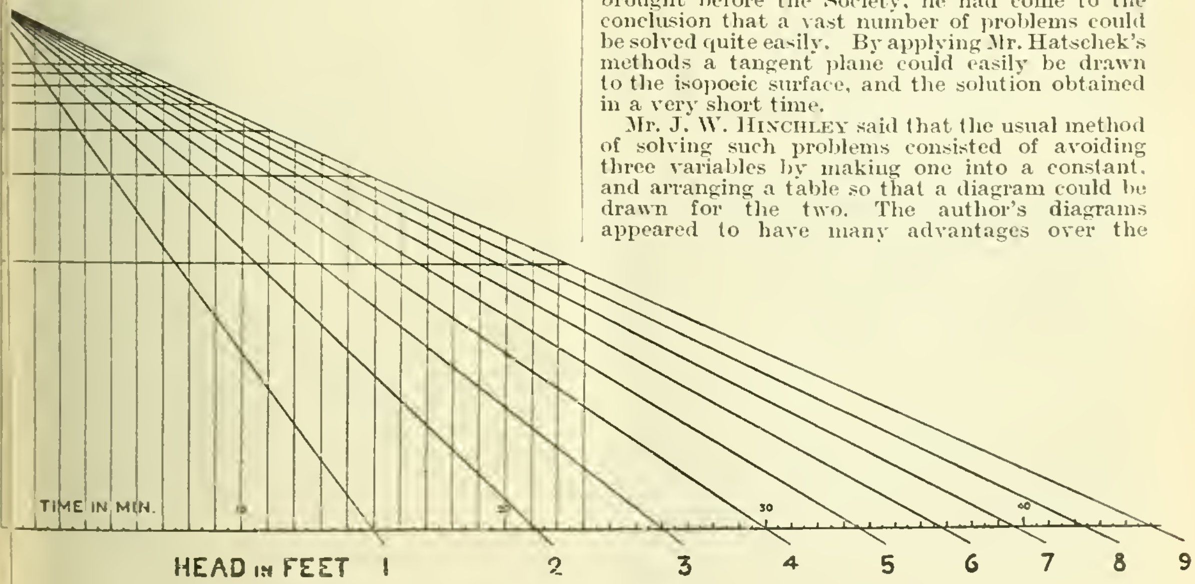

Fig. 3.

Tank 9' 9" diam.
8 outlets 2" diam.

We calculate the time of emptying for the smallest head, say one foot, and one outlet, allowing a suitable contraction. The time in minutes so obtained we mark on the base line of the diagram (Fig. 3) in any convenient scale. It is at once obvious that the times required to empty the tank with the same outlet, but with 2, 3 ...... feet head will be as $\sqrt{2}$, $\sqrt{3}$ ...... We therefore mark these square roots, taking the time for 1 ft. as unity; it is hardly necessary to remark that this can be done purely geometrically by constructing successive rectangular triangles. We now erect a perpendicular on the base in O, and from a pole selected in it at a convenient height draw rays to the divisions obtained by plotting the square roots. If we now draw parallels to the base at distances from the pole equal to $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc., of the whole distance, it is clear that the intersections of these horizontals with the rays give the times necessary for emptying with 2, 3, 4, etc., outlets open at the same time, and with heads of 1, 2, 3, etc., ft., so that these two systems of lines give the complete solution of the problem. All vertical lines are isochrones, *i.e.*, they show what combination of heads and outlets makes it possible to empty the tank in that time: thus if the discharge is to take 6 mins., this can be accomplished with (approximately) 4 ft. head and 5 outlets, 6 ft. head and 6 outlets, and 8 ft. head and 7 outlets.

The practical interest of the problem here solved is limited and it is published only as a very striking instance of how simple the graphic solutions of apparently complicated problems may become.

Discussion.

Professor **Donnan** said that the author had extended the well known method, which he himself had been using, of equilateral triangles dealing with three components, in discussing the problem which he had brought before the Society dealing with one of the blending problems which occur in chemical industry. So far as he knew, Mr. Hatschek's method had not been applied in dealing with four components. The methods van't Hoff had used in 1896 or 1897 were very cumbersome. In considering the problem he had brought before the Society, he had come to the conclusion that a vast number of problems could be solved quite easily. By applying Mr. Hatschek's methods a tangent plane could easily be drawn to the isopoeic surface, and the solution obtained in a very short time.

Mr. J. W. **Hinchley** said that the usual method of solving such problems consisted of avoiding three variables by making one into a constant, and arranging a table so that a diagram could be drawn for the two. The author's diagrams appeared to have many advantages over the logarithmic diagrams generally used for such purposes.

Mr. **Hatschek**, in reply, said that Professor Donnan had given simple geometrical solutions of two problems which he called "simple blending" and "complex blending" for the case of three components. With four components the cases were exactly parallel: what was a tangent to the isopoeic curve became a tangent plane to the isopoeic surface. In "simple blending" this tangent plane was parallel to a given plane, while in "complex blending" it passed through the line of intersection of two given planes. Both these problems could be solved with the greatest ease with the aid of the triangular contour diagram. Mr. Hinchley had said that problems could be reduced to two variables by making the third a constant. Of course that was a recognised mathematical method, known as the introduction of a variable parameter. It was also the only way of finding out what a curved surface looked like, as, by doing it successively with the three variables, one obtained sections of it and could form a picture or construct a model of the surface.

Messrs. Adam Hilger, Ltd., and Messrs. Bellingham and Stanley sent exhibits of polarimeters, spectroscopes, and refractometers.

The Chairman drew attention to the fact that the particular form of polarimeter employed in the sugar industry, namely, the so-called quartz-compensating instrument, was now made for the first time in this country, by the two firms above mentioned. It was a remarkable fact, he said, that although there was such an extensive requirement for these instruments in all sugar-producing countries, up to the time of outbreak of war, the supply had been exclusively from German and Austrian firms.

Newcastle Section.

Meeting held at Bolbec Hall on Wednesday, January 12th, 1916.

PROF. P. P. BEDSON IN THE CHAIR.

THE INFLUENCE OF FLUORSPAR ON THE SOLUBILITY OF BASIC SLAG IN CITRIC ACID.

BY G. S. ROBERTSON, M.SC.

Until recently practically the whole of the phosphatic basic slag on the market contained phosphoric acid with a solubility according to the citric acid test* of from 70—95%. As the result of the work of Wagner it has been generally assumed in Germany, and to a certain extent in this country, that the agricultural value of basic slag is proportional to the solubility of the phosphate in 2% citric acid. The high solubility of the phosphate in citric acid was said to be due to the silica which combined with the phosphate. It was contended that the higher the percentage of silica in the slag the more soluble the phosphate is in citric acid, and that all that was necessary to obtain a highly citric soluble phosphate was a liberal supply of sand. Collins,† however, has been able to show that the reverse of this contention holds true.

During the past few years steel manufacturers, particularly those using the basic open hearth process, have been introducing fluorspar into the furnace. Fluorspar produces a much more fusible slag and greater quantities of lime can therefore be added without making the slag too thick.

The peculiarity of basic slag produced by the use of fluorspar is that the solubility of the phosphate, according to the citric acid test, varies from 20—50% instead of from 70—90%.

The citric solubility of two of these "fluorspar slags" produced respectively by Messrs. Dorman Long and Co., and Messrs. Bell Bros., is given in the following table. Five grams of each of these slags (fineness 80%) was submitted to five consecutive half-hour extractions with 500 c.c. of 2 per cent. citric acid.

Dorman, Long and Co.'s basic slag.

Citric extract.	P_2O_5 %	CaO %	% P_2O_5 of total.	Ratio P_2O_5:CaO
1st	1·61	33·24	17·50	—
2nd	2·04	5·27	22·17	1 : 2·58
3rd	1·75	3·63	19·02	1 : 2·07
4th	1·34	2·66	14·56	1 : 2·00
5th	1·01	2·02	10·98	1 : 2·00
Extract totals	7·75	46·82	84·23	—
Actual totals	9·20	52·75	100·00	—

Total SiO_2=17·10%

Bell Bros.' slag.

Citric extract.	P_2O_5 %	CaO %	SiO_2 %	% P_2O_5 of total.	Ratio P_2O_5 : CaO	Ratio SiO_2 : P_2O_5
1st	3·75	26·12	7·10	34·20	—	1 : 0·53
2nd	2·41	5·24	1·58	22·00	1 : 2·17	1 : 1·52
3rd	1·76	3·72	0·84	16·04	1 : 2·11	1 : 2·09
4th	1·10	2·35	—	10·00	1 : 2·13	—
5th	0·95	2·13	—	8·66	1 : 2·24	—
Extract totals	9·97	39·56	9·52	90·90	—	—
Actual totals	10·97	45·10	20·45	100·00	—	—

Obviously the citric acid test, as ordinarily performed, that is to say one extraction, affords no reliable indication of the solubility of these slags in citric acid. In the case of Dorman Long's slag more phosphoric acid is soluble in the second citric acid extraction than in the first. A glance at the ratios which the phosphoric acid and lime dissolving in the various extractions bear to one another, suffices to show that they are fairly constant, whilst the ratios of silica to phosphoric acid in the extractions made from Bell Bros' slag are so divergent as to suggest at once that the silica does not enter into the composition of the phosphate.

With the object of obtaining further information on these results, two 5-grm. portions of a highly citric soluble basic slag (92%) were calcined with fluorspar in a Fletcher muffle furnace and then submitted to consecutive extractions with 2% citric acid. Portion 1 was calcined for about 2 hours with 0·5 grm. of fluorspar, and portion 2 for about 4 hours with 0·1 grm. of fluorspar. The analysis of the basic slag used is as follows:—

	Total %	Citric soluble. %
P_2O_5	17·84	16·40
CaO	48·82	43·16
SiO_2	9·45	8·94

Solubility of phosphoric acid according to citric acid test 92·4%, fineness 88%.

Portion 1.

Citric extract.	P_2O_5 %	CaO %	SiO_2 %	% P_2O_5 of total.	Ratio P_2O_5 : CaO	Ratio SiO_2:P_2O_5
1st	5·30	22·56	6·00	29·71	—	1 : 0·88
2nd	6·31	11·44	0·72	35·37	1 : 1·81	1 : 8·76
3rd	1·31	7·48	—	24·20	1 : 1·73	—
4th	1·22	2·86	—	6·84	1 : 2·34	—
5th	0·42	0·96	—	2·35	1 : 2·30	—
Extract totals	17·56	45·30	6·72	98·47	—	—
Actual totals	17·81	48·82	9·45	100·00	—	—

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* To perform this test 5 grms. of the phosphate is placed in a litre flask containing 500 c.c. of 2% citric acid solution. The flask is shaken end over end for 30 minutes in an apparatus making 30 revolutions per minute.

† This Journal, 1915, **34**, 10.

Portion 2.

Citric extract.	P_2O_5 %	CaO %	SiO_2 %	% P_2O_5 of total.	Ratio P_2O_5:CaO	Ratio SiO_2:P_2O_5
1st	12·89	33·38	6·58	72·25	—	1 : 1·96
2nd	4·12	7·62	0·30	23·09	1 : 2·33	1 : 13·73
3rd	0·82	1·60	—	4·60	—	—
Extract totals	17·83	42·60	6·88	99·94	—	—
Actual totals	17·84	48·82	9·45	100·00	—	—

The solubility of Portion 1 has been reduced from 92 % to 29 % and of Portion 2 from 92 % to 72 %. The results secured with Portion 1 are very similar to those obtained with Bell Bros.' slag, and point to the conclusion that the silica in this portion is not in combination with the phosphate. When a highly citric soluble slag is calcined without fluorspar and extracted with $\frac{1}{4}$ % citric acid in order to get the phosphoric acid, lime, and silica gradually into solution, the phosphoric acid and silica dissolving in the various extracts bear a fairly constant relationship to each other, as the following results show.

Analysis of high citric soluble slag.

	Total. %	Citric soluble. %
P_2O_5	17·02	13·87
CaO	46·12	38·56
SiO_2	12·37	12·37

Solubility of phosphoric acid according to citric acid test, 81 % ; fineness, 82 %.

High citric soluble slag. Extracted with $\frac{1}{4}$ % citric acid.

	P_2O_5	CaO	SiO_2	Ratio P_2O_5 : CaO	Ratio SiO_2 : P_2O_5
Sugar extract					
*1st	—	1·34	—	—	—
*2nd	..	0·91	—	—	—
Citric extract					
1st	5·19	12·45	3·18	1 : 2·40	1 : 1·63
2nd	5·12	12·07	3·00	1 : 2·36	1 : 1·71
3rd	3·52	8·20	2·00	1 : 2·33	1 : 1·76
4th	1·26	3·10	0·72	1 : 2·46	1 : 1·75
5th	0·52	1·26	0·23	1 : 2·42	—
Extract totals	15·61	39·33	9·13	—	—
Actual totals	17·02	46·12	12·37	—	—

* Extracted for 4 hours with 500 c.c. of 10% cane sugar solution containing 10 c.c. of absolute alcohol, in order to remove any free lime.

It would thus appear that one of the effects of fluorspar is to cause the formation of a phosphate which does not contain silica in combination as is the case with high citric soluble slags.

Low citric soluble slags such as those dealt with have been used successfully as fertilisers in several parts of this country, and have produced results comparable with the highest citric soluble slags. There has never been brought forward a single reliable piece of evidence in support of the citric acid test. Wagner's work on which the citric acid test was founded has been severely criticised by Soxhlet, who alleged that a great deal of it had been falsified, and it is significant to note that Soxhlet was found not guilty in the libel action which ensued. Unfortunately every conceivable means is still being used by the German slag syndicate and certain agents in this country who sell a high citric soluble slag, to bolster up the citric acid test—a test which, to a certain extent, they initiated.

A very large proportion of the basic slag now produced in this country is of low citric solubility and it is evident that if ever the citric acid test had any significance, the alteration in the process of manufacture of the slag has destroyed it.

Many thousands of tons of the "fluorspar slag" are produced annually and form a waste product—one Teeside firm alone produces over 100,000 tons per annum. Certain firms even pay a few pence per ton to have the slag carried out to sea. It is certainly unfortunate that a worthless test should prove one of the obstacles to the extensive utilisation of this very valuable and enormous source of phosphoric acid.

It is worthy of note that in the United States "citric insoluble" rock phosphates are used even in preference to high citric soluble slags. In this connection the following table, contrasting the citric solubility of a "fluorspar slag" with a sample of Tunisian rock phosphate, is of interest:—

	"Fluorspar slag." Bell Bros. Fineness 80%			Tunisian rock phosphate. Fineness 100%		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
Citric extract.						
1st..........	3·75	26·13	34·20	4·83	14·37	18·48
2nd	2·41	5·24	22·00	7·81	11·84	29·88
3rd	1·76	3·72	16·04	5·83	8·84	22·31
4th	1·10	2·35	10·00	4·49	6·62	16·84
5th	0·95	2·13	8·66	2·93	4·30	11·17
Extract totals	9·97	39·56	90·90	25·80	45·97	98·68
Actual totals	10·97	45·10	100·00	26·13	48·40	100·00

Conclusions.

1. The results clearly show that the citric acid test gives no true idea of the solubility of the phosphate in "fluorspar slags" and affords no guide to its value to the plant.
2. The use of fluorspar in the manufacture of steel by the open hearth process results in the production of a phosphatic slag with low citric solubility. Nevertheless the slag is completely soluble in citric acid if sufficient time is spent on the extraction.
3. The phosphate or phosphates which the slag contains do not appear to be in combination with silica and they seem to bear a very close resemblance to those contained in mineral phosphates.

At the present time there is a very big demand for phosphatic manures, and if temporary difficulties, such as lack of railway facilities and shortage of bags, could be to some extent mitigated there is no reason why these low citric soluble basic slags should not be placed on the agricultural market at a tempting price.

The author wishes to express his sincere thanks to Mr. S. Hoare Collins for his invaluable advice and suggestions.

THE SOLUBILITY OF MINERAL PHOSPHATES IN CITRIC ACID.

PART II.

BY G. S. ROBERTSON, M.SC.

Varying opinions have been held regarding the value of mineral phosphates as a phosphatic manure since their introduction some seventy years ago by Professor Daubeny and Captain Widdrington. The advent of superphosphate and basic slag has done much to keep the value of mineral phosphates in the background.

Ground mineral phosphate costs from 9d. to 11d. per unit of phosphate, whereas basic slag costs 2s. per unit. If the phosphates in rock phosphates are as efficient as those in basic slag, and there is every reason to suppose they are, their economical importance is obvious.

The advent of basic slag was followed by the introduction by Wagner of what is now known as the "citric acid test." Wagner showed that from 70 to 95% of the phosphate in basic slag was soluble in 2% citric acid in half an hour, and he brought forward the results of field experiments which demonstrated that the field returns from basic slag were proportional to the solubility of the phosphate as judged by the citric acid test.

The citric acid test has been semi-officially adopted in this country, and many British manufacturers of basic slag are following the trade practice of the German firms by selling slag according to the citric solubility of the phosphate.

Mineral phosphates are only slightly soluble in citric acid, and as many agriculturists have accepted the theory that phosphates insoluble in citric acid are of little value to the plant, any attempt to espouse the cause of rock phosphates is heavily handicapped. This is all the more remarkable as not a tittle of reliable evidence exists in support of this theory.

The manurial value of mineral phosphates, however, can only be definitely established by the experience of the farmer. In this respect experiments, carried out at Cockle Park, in 1911—1913, are interesting (see Cockle Park Guide, 1915, pp. 39-40). In these two experiments Belgian and Tunisian phosphates have given results strictly comparable with the highest citric soluble basic slag. In this connection it is interesting to note that in the U.S.A. mineral or rock phosphates are used almost to the exclusion of basic slag.

In a previous paper* the author was able to show that Belgian and Tunisian phosphates were completely soluble in 2% citric acid, provided sufficient time was spent on the extraction. As so much stress has been laid upon the "citric acid test" this work has been considerably extended. The citric solubility of several other classes of rock phosphates has been determined and also the effect, upon the solubility of the phosphate, of fineness of grinding and calcining.

The following table shows the total analysis of the various phosphates used :—

	Mineral phosphates.							
	Makatea Island.	Florida Pebble.	Algerian.	Gafsa.	Tunisian.	Belgian.	Apatite.	Bone meal.
Calcium oxide	52·38	47·10	46·13	43·30	48·40	50·55	55·45[2]	50·28
Phosphoric acid	38·24	31·50	27·27	25·35	26·13	19·80	39·49	36·49
Carbon dioxide	1·69	3·04	6·70	5·50	9·03	17·22	2·23	4·76
Moisture	1·46	1·00	0·72	3·26	0·98	—	—	—
Combined moisture and organic matter	3·39	2·41	3·28	4·39	3·21	3·60	—	6·82[3]
Ferric and aluminium oxides	1·01	1·60	2·59	4·98	4·25	1·09	—	—
Magnesium oxide	1·35	1·90	2·02	1·72	0·90	1·14	—	0·66
Sand	0·28	7·03	8·12	7·56	4·65	4·28	0·38	0·26
Undetermined	0·20	4·42	3·17	3·94	2·45	2·32[1]	2·45	0·73
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

[1] Including sulphate 1·02%. [2] Partly combined with fluorine and chlorine. [3] Organic matter.

Whenever the hardness of the phosphates permitted, it was ground and divided into several portions by means of the 1 mm. sieve and sieves with 30, 60, 90, and 100 holes to the linear inch. Each of the five portions was submitted to five consecutive half-hour extractions with 500 c.c. of 2% citric acid. The extract was filtered by means of a filter pump, a Hirch filter funnel, and a 7 cm. diameter filter paper. The filtration usually occupied less than five minutes.

Makatea Island phosphate.

	Refuses 1 mm. sieve.			Refuses "30" sieve.		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
1st Extraction	3·93	5·40	10·10	4·98	7·00	12·67
2nd do.	3·66	5·10	9·31	4·85	6·70	12·36
3rd do.	3·47	4·80	8·91	4·56	6·40	11·11
4th do.	3·28	4·55	8·43	3·84	5·33	9·71
5th do.	2·91	4·10	7·48	3·70	5·20	9·43
Extract totals	17·25	23·95	42·23	21·93	30·63	55·28
Actual totals	38·90	53·38	100·00	39·24	53·75	100·00

	Refuses "60" sieve.			Refuses "90" sieve.		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
1st Extraction	6·40	9·00	16·31	7·47	10·65	19·02
2nd do.	6·06	8·58	15·40	7·07	9·90	18·02
3rd do.	5·44	7·52	13·87	5·95	8·40	15·17
4th do.	4·77	6·72	12·13	5·46	7·50	13·92
5th do.	4·30	6·00	10·96	4·82	6·70	12·29
Extract totals	26·97	37·80	68·67	30·77	43·15	78·42
Actual totals	29·23	53·00	100·00	39·09	53·57	100·00

	Passes "100" sieve.			Passes "100" sieve. (Calcined).		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
1st Extraction	9·25	13·01	24·16	6·58	9·50	17·25
2nd do.	8·26	11·46	21·58	6·32	8·58	16·55
3rd do.	7·54	10·50	19·70	5·55	7·51	14·52
4th do.	6·03	8·55	15·75	4·63	6·29	12·10
5th do.	4·22	5·75	10·02	3·79	5·16	9·94
Extract totals	35·30	49·27	91·21	26·87	37·04	70·36
Actual totals	38·24	52·38	100·00	38·24	52·38	100·00

This phosphate is of a particularly hard nature, and it is therefore surprising that in the portion passing "100" sieve over 90% of the phosphoric acid is soluble in the 2% citric acid extracts. The figures clearly show, assuming citric solubility to be a test, that fine grinding, which aids even distribution in the soil, would have much to do with the value of the phosphate as a manure.

Five grams of the portion passing the "100" sieve was calcined* for four hours. Five consecutive extracts with 500 c.c. of 2% citric acid were made with the calcined phosphate. The calcining process decreased by 22% the total solubility of the phosphate, or judging by the citric acid test, by 7%.

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* This Journal, January 15th, 1914. No. 1, Vol. XXXIII.

* A Fletcher muffle furnace was used for calcining all the phosphates mentioned in this paper.

Florida pebble phosphate.—There appeared to be no calcium carbonate in this sample, and the effect of fineness of grinding was therefore determined.

Florida pebble phosphate.

	Refuses "30" sieve.			Refuses "60" sieve.		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
1st Extraction	4·00	5·98	12·02	4·36	6·62	13·37
2nd do.	3·81	5·74	11·45	4·48	6·66	13·74
3rd do.	3·63	5·38	10 91	4·25	6·32	13·03
4th do.	3·23	4·90	9·71	3·86	5·81	11·84
5th do.	3·00	4·63	9·02	3·69	5·40	11·32
Extract totals	17·67	26·63	53·11	20·64	30·81	63·30
Actual totals	33 27	49·13	100·00	32·61	47·90	100·00

	Refuses "100" sieve.			Passes "100" sieve.		
	P_2O_5 %	CaO %	% P_2O_5 of total.	P_2O_5 %	CaO %	% P_2O_5 of total.
1st Extraction	5·10	7·78	16·02	6·18	9·23	19·61
2nd do.	5·27	7·78	16·56	5·83	8·76	18·51
3rd do.	4·92	7·40	15·46	5·46	8·24	17·33
4th do.	4·52	6·60	14·20	5·14	7·72	16·31
5th do.	3·89	5·72	10·65	4·31	6·36	13 68
Extract totals	23·70	35·28	72·89	26·92	40·31	85·44
Actual totals	31·83	48·30	100·00	31·50	47·10	100·00

Calcined Florida pebble, passes "100" sieve.

	% P_2O_5	% CaO	% P_2O_5 of total.
1st Sugar extract	—	0·10	—
1st Citric do.	6·01	9·56	19·08
2nd do. do.	6·77	10·00	21·49
3rd do. do.	6·63	9·07	21·05
4th do. do.	5·49	7·58	17,43
5th do. do.	3·88	5·44	12·33
Extract totals	28·78	41·75	91·38
Actual totals	31·50	47·10	100·00

Of the mineral phosphates examined this is the only one which shows an increased solubility as the result of calcining. The noticeable rise in the phosphoric acid dissolving in the second extract is curious. This matter has been further investigated, and it would appear that the phosphate dissolving in the first citric extract is in combination with silica, whilst that dissolving in the 2nd, 3rd, 4th, and 5th citric extracts is precisely the same as the phosphate contained in Makatea Island phosphate—whose solubility is greater than Florida pebble phosphate.

The results with Algerian, Gafsa, Tunisian, and Belgian phosphates are given in the following table.

It is worthy of note that a comparatively small percentage of calcium carbonate greatly decreases the solubility of the phosphate as judged by the citric acid test, whilst upwards of 30% of calcium carbonate makes the phosphate practically insoluble judging by the citric acid test.

For purposes of comparison samples of bone meal* and apatite were submitted to consecutive extractions with 2% citric acid.

Portions passing "100" sieve.

	Portions passing "100" sieve.											
	Algerian.			Gafsa.			Tunisian.			Belgian.		
	P_2O_5 %	CaO %	P_2O_5 % of total.	P_2O_5 %	CaO %	P_2O_5 % of total.	P_2O_5 %	CaO %	P_2O_5 % of total.	P_2O_5 %	CaO %	P_2O_5 % of total.
1st Extract	6·65	12·92	24·40	10·15	17·94	40·00	4·83	14·37	18·48	1·95	17·30	9·75
2nd do.	6·98	11·04	25·53	8·18	13·14	31·99	7·81	11·84	29·39	5·65	11·73	28·25
3rd do.	5·35	8·60	19·60	5·60	8·80	21·54	5·83	8·84	21·97	5·78	10·14	28·90
4th do.	4·00	6·30	14·63	1·93	2·97	7·61	4·40	6·62	16·84	4·95	7·90	24·60
5th do.	2·47	3·94	9·08	—	—	—	2·93	4·30	11·06	1·99	3·13	9·65
Totals for 5 extracts	25·45	42·80	93·24	25·86	42·85	101·14	25·80	45·97	97·74	20·32	50·20	100·15
Actual totals	27·27	46·13	100·00	25·35	43·30	100·00	26·13	48·40	100·00	19·80	50·55	100·00

The results recorded closely agreed with those obtained with Makatea Island phosphate. It is interesting to note that the difference in solubility (judged by five extractions) between any two consecutive portions is approximately 10%. The slightly higher percentage of phosphoric acid dissolving in the second extracts of portions "refuses 60" and "refuses 100," is partly due to a slight disintegration of the phosphate in the shaker, and partly to the presence of a small amount of calcium carbonate in these portions.

Five grams of the phosphate was calcined as in previous cases. To remove any free lime the calcined portion was shaken for 4 hours with 500 c.c. of a 10% solution of cane sugar, containing 10 c.c. of absolute alcohol, before the citric extracts were made.

Passes "100" sieve.

	Bone meal.		Apatite.	
	P_2O_5 %	% of total	P_2O_5 %	% of total.
1st Extract	26·69	73·11	1·28	3·24
2nd do.	9·29	25·46	1·70	4·33
3rd do.	0·51	1·43	1·47	3·72
4th do.	—	—	1·47	3·72
5th do.	—	—	1·30	3·29
Extract totals	36·49	100·00	7·22	18·30
Actual totals	36·49	100·00	39·49	100·00

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* Owing to difficulty experienced in filtering the extracts the bone meal was first gently ignited to destroy most of the organic matter.

The results obtained after calcining the various phosphates are given in the following table:—

Calcined phosphates (passes 100 sieve).
(Free lime removed by sugar solution.)

	Algerian.		Gafsa.		Tunisian.	
	P_2O_5 %	% of total.	P_2O_5 %	% of total.	P_2O_5 %	% of total.
Citric extract						
1st	3·33	12·21	5·20	20·50	4·46	17·06
2nd	4·36	15·99	6·55	25·87	4·58	17·55
3rd	3·78	13·86	5·77	22·80	3·54	13·55
4th	3·10	11·37	4·49	17·75	2·56	9·81
5th	2·29	8·40	2·29	9·07	2·07	7·93
Extract totals	16·86	61·83	24·30	95·99	17·21	65·90
Actual totals	27·27	100·00	25·35	100·00	26·13	100·00

Calcined Algerian, Gafsa, and Tunisian phosphates show a very marked decrease in citric solubility due to calcining. The author has been able to show that the decrease in solubility in each case is due to the production of a small quantity of a citric soluble silicophosphate (with a higher lime content than the original phosphate) which goes into solution in the first citric extract, whilst the remaining extracts contain phosphates with a lower lime content than the original phosphate, and which are therefore less soluble in citric acid. But there is no reason to suppose that because the calcined phosphates are less soluble in citric acid they are of less value to the plant than the corresponding uncalcined phosphates.

Calcined Belgian phosphate.—Two 5-grm. portions of this phosphate were calcined, the first portion for about four hours in a furnace to which it was afterwards discovered the gas supply was partially choked. The second portion was calcined in a hotter furnace, it not being thought at the time that any difference in the composition of the two portions would be produced thereby. The object of the experiment was to discover to what extent the free lime produced by calcining interfered with the citric solubility of the phosphate. The second calcined portion was therefore extracted with sugar solutions before being submitted to the citric acid extractions.

Calcined Belgian phosphate.

	1st portion. (passes "100" sieve).			2nd portion. (passes "100" sieve).		
	P_2O_5 %	CaO %	% P_2O_5 of total	P_2O_5 %	CaO %	% P_2O_5 of total.
Sugar extract.						
1st	—	—	—	—	17·32	—
2nd	—	—	—	—	0·61	—
2% Citric extr.						
1st	0·56	20·04	2·80	3·57	7·80	17·85
2nd	6·15	9·68	30·75	4·73	6·98	23·65
3rd	5·61	8·42	28·05	4·28	6·20	21·40
4th	4·75	7·02	23·75	3·16	4·53	15·30
5th	2·52	3·80	12·60	2·14	3·08	10·70
Extract totals	19·59	48·96	97·95	17·88	46·52	88·90
Actual totals	19·80	50·55	100·00	19·80	50·55	100·00

A glance at the totals soluble in five citric extracts shows that the higher temperature to which portion 2 was raised has had an effect on that portion which was not produced on portion 1. It is obvious in the case of this Belgian phosphate that the higher the calcining temperature the more insoluble does the phosphate become. Portion 1, in spite of the fact that the first citric extract contains practically no phosphate, has more phosphate soluble in the five citric extracts than portion 2, which has had all the free lime removed before the citric acid extracts were made.

Although the figures do not accurately reflect the effect of free lime in decreasing the solubility of the calcined phosphate as judged by the ordinary citric acid test, they are of sufficient accuracy to show that the presence of about 18% of free lime in a calcined Belgian phosphate makes it practically insoluble in citric acid.

Conclusions.

The results undoubtedly show that mineral phosphates are completely soluble in 2% citric acid if a sufficient number of extracts are made. In the majority of the rock phosphates examined five extracts removed 90—100% of the phosphoric acid present.

Even a small amount of free lime or calcium carbonate decreases substantially the solubility of mineral phosphates as judged by the citric acid test. When a large amount of calcium carbonate or free lime is present, the citric acid test, as commonly practised, is a test for lime and not for phosphates. It is important in this respect to distinguish between free lime and calcium carbonate, and lime actually entering into the composition of the phosphate. The higher the percentage of lime actually entering into the phosphate compound, the higher the citric solubility of the phosphate.

Fineness of grinding affects the total citric solubility of the mineral phosphates (judged by 5 extracts) to the extent of approximately 10% decrease for each of the gradients, Passes "100" Refuses "100," Refuses "60," and Refuses "30" sieve.

With one exception calcining produces a marked decrease in the citric solubility of mineral phosphates. The longer the calcining continues the more insoluble does the phosphate become.

The results judged as a whole confirm the conclusion arrived at as the result of a previous investigation,* namely, the worthlessness of the citric acid test as a means of judging the relative value to the plant of phosphatic manures. Rock phosphates are quite as soluble in a ¼% hydrochloric acid solution as basic slag, and there is just as much reason in favour of using a weak solution of a mineral acid for a solvent as there is for using a 2% citric acid solution.

It would be absurd to consider basic slag as of no agricultural value because it is insoluble in water, and it is equally absurd to condemn mineral phosphates because they are not so soluble in citric acid as basic slag.

There can be little doubt that, as a source of phosphoric acid for the plant, rock or mineral phosphates are just as valuable as basic slag.

Meeting held at Neville Hall on Wednesday, February 16th, 1916.

DR. CHARLES CARPENTER IN THE CHAIR.

THE PROBLEMS OF COAL WITH REFERENCE TO THE COMPLETE AND PROVIDENT UTILISATION OF THE SUPPLIES AND OF FUELS GENERALLY: A PRELIMINARY DISCUSSION AND SCHEME.

BY HENRY E. ARMSTRONG.

The thoughtful organic chemist is ever conscious of coal; and constantly, necessarily, he thinks of it in connection with benzene, a truly magic substance the mere mention of which calls up in the instructed mind a flush of memories such as few other words can evoke. The philosophic chemist cannot contemplate it without being haunted by dim disturbing visions of the inwardness of the processes of combustion and of his ignorance thereof. Palæobotanist and geologist gaze at it with amazement and "wonder what it is!" The engineer fondly believes that he knows how to burn it efficiently but some of us wickedly question his powers of insight and still rank him with empirics. The industrial user grows daily more horrified at the constant increase in its cost. Lastly, if we wish to know to what extent science be a part of the soul of our nation, we have only to ask what number of us ever regard it from any other point of view than that of price per ton or even per bushel—in this respect Carlyle's characterisation of our millions as "mostly fools" is still an apt one. And yet it may almost be said that man lives by coal alone in these days: the elements of all the sciences might easily be taught through coal—no better central motive could well be found for such teaching. But the "cultured" pass it by. A well-known headmaster, several years ago, boasted that he was accustomed, in his leisure, to read Greek authors with his feet on the fender; he forgot to state that he could not construe a single line of the great epic modern science has composed concerning the coal burning in the fire, fronted by that fender, from which, in reality, his satisfaction was derived, the Greek author being merely the cover behind which he sought to shelter his love of warmth. At Belfast, in 1902, in my address to the Educational Section of the British Association, I remarked that a scuttle full of coal excites no emotion in the literary mind; at the smoking concert, in the evening, my point was driven home, by a humorous graph printed in the programme, but no one took me seriously.

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* This Journal, 1914, **33**, 9–11.

Everyone is aware that we waste coal profusely and that it is fast going up in price. As we now burn approximately 200 million tons per annum, it is unnecessary to dwell on the fact that, if we could double the efficiency of our methods of using fuels, we should be able to keep much money in our purse. We care little, it is true, for our ancestors, if possible less for posterity, yet there *is* a spirit of altruism growing up gradually which is more or less leading us to think that we must take effective steps to check the thoughtless squandering of natural resources which has been a dominant characteristic of civilisation of late years—not of fuel alone but of raw materials generally.

Ownership of coal and other fuels.

Exportation of coal.

My object, at present, is to direct attention to broad issues rather than to discuss details. The primary political issue, in connection with coal, to be considered some day in the not distant future, though not yet, I imagine, will be that of the ownership of our national fuel supplies. We should be prepared and prepare to deal with this grave problem in an absolutely philosophic and scientific manner, without tinge of political feeling; it will be a thorny one to attack but it is inevitable that it should be attacked.

The question of the exportation of coal should receive more immediate attention. I am not an economist and am fully aware of my incompetency to deal with such a problem. I venture to insist, however, that one of the great questions to be discussed to an issue, in the near future, will be the extent to which such raw material as coal should be allowed to leave a country which is admittedly a home of industrialism. To treat coal as mere stone—as dirt of but moderate value, chiefly of use as return freight and therefore indirectly as the means of cheapening freights on imports of other produce—if not a questionable policy, is at least one to be considered in all its bearings: maybe, we should be able, under scientific direction, to make far better use of it on the spot and in so doing find more remunerative occupation, at least for those whose labours as miners would be unnecessary, if the amount of coal exported were even considerably diminished. Hitherto, so little has been made of organised intelligence, in dealing with problems of this order: everything has been left to individual initiative and enterprise.

The problems of coal mining.

To pass to a third great subject, apparently it is desirable to submit the problems of mining to exhaustive study, without delay. Present methods of getting coal are far from perfect and much is left underground that will never be recovered: should not the delivery of all coal at the surface, not merely that which is easily won, be made obligatory? The old adage, "Waste not, want not," may well be remembered, in this connection. At least it would seem to be desirable, in such an industry, to pool intelligence and work all mines efficiently; under a system of uncontrolled private ownership this is not likely to happen.

Methods of cleaning coal should be more widely used; apparently there is much to be done in this direction, especially in the case of the poorer coals. In this connection, the utilisation of minerals associated with coal will need consideration. In view of the growing demand for sulphur, it may be desirable, in some cases, even to separate pyrites—a far less difficult task than formerly in view of the introduction of effective methods of concentrating heavy minerals—by lævigation in water, with the aid of oily substances—such as are used, at the Broken Hill mines and elsewhere, in dealing with zinc and other ores.

In connection with mining, the question of ventilation plays an all-important part, both as affecting the health of the miners, the depth to which the workings can be carried and the prevention of explosions. A complete discussion of the work done in this field is required: it is clear that the measures taken hitherto have been little short of perfunctory and that a far more representative body of workers should be engaged without delay to prosecute inquiry.

The question of the constant control, by chemical means especially, of the state of ventilation in mines is one that calls for immediate attention. Enough is known, I am informed, to indicate that such control might be made really effective, if properly conducted by persons who understood the work.

Carbonisation of coal.

Hard and soft coke.

In burning coal, in the ordinary way, either in raising power or for domestic purposes, not only is an unsatisfactory modicum of the heat energy utilised but everything else is sacrificed. When coal is coked, besides the gas that is given off, various volatile products, of commercial value, are produced and may be collected—notably ammonia, hydrogen cyanide, sundry sulphur compounds, various hydrocarbons (benzenes, naphthalene, and anthracene), phenol, a number of basic substances and pitch. Little short of 20 million tons of coal are carbonised by the gas industry; at least an equal quantity is coked for use in the iron and steel industry. The volatile products have long been saved by the gas industry but it is only quite recently that any considerable development of by-product recovery coking plant has been effected: now, however, fully two-thirds of the coal used in making blast furnace coke is produced in recovery ovens of various types and it is to be expected that the beehive oven will soon pass into oblivion—if not spontaneously, by public enactment.

It is desirable that the various methods of recovering by-products should be discussed and their efficiency contrasted; in this connection the unfortunate loss of the phenols under the Otto system may be referred to: in nearly all cases the sulphur escaping in the gas is not recovered.

As the volatile products obtained in coking coal are materials of value in various industries, it is essential to recognise that coal now counts not only as a fuel but in sundry other ways—in agriculture, owing to the large quantities of ammonia it furnishes; in gold mining, as not a little cyanide is prepared from gas liquors; in the dye-stuff industry, as the source of its raw materials; as a not unimportant source of sulphur; lastly, as affording liquid fuel for use in the internal combustion engine. At the moment, most of the material used formerly in the dyestuff industry is being diverted to the manufacture of explosives; in addition, for the same purpose, coal gas is being stripped of vaporous constituents from which much of its value was derived.

But at most about 20 per cent. of the coal we consume—about 200 million tons per annum—is so used that the volatile products are recovered: we are, therefore, guilty of a colossal waste of opportunity, it would seem. Ammonia made—in Germany—in the factory, by the direct interaction of nitrogen and hydrogen, is fast coming into competition with the natural product—for that derived from coal was laid down in the plant, in former distant ages, under solar influence; it may well happen that the victory gained over Nature in the case of madder-red and indigo blue will be repeated in the case of ammonia. It seems to be little short of criminal that we should be talking of making ammonia (and nitric acid) by synthetic methods, when we have such large quantities going to waste through our entirely improvident use of coal; it is astounding evidence, indeed, of our lack of forethought and insight, that we should be making the most refined use possible of our scientific knowledge to defeat Nature while scarcely giving a thought to the provident utilisation of the abundance she has provided for us. The same argument may be applied to the sulphur in coal—which is not only wasted but forced into the atmosphere to pollute it; at least 400,000 tons are thus squandered annually.

Prohibition of the use of raw coal.

The question I desire to raise—in my opinion, the question of questions to be considered forthwith, at least by all connected with chemical industry, if not by fuel users generally—is whether drastic action should not be taken to put an end to much of the waste involved in burning raw coal—at all events, in the case of that burnt by domestic users. *I would urge this Society to advocate an enactment forbidding the use of raw coal for domestic purposes—such enactment to come into force at latest* 10 *years hence.*

I do not believe that hard coke, such as is now produced, can ever be a satisfactory domestic fuel; a softer form of the Coalite type seems to be required. Such a conclusion, if accepted, must have most important consequences and may involve the complete reconstruction of the gas industry, as this will have cast upon it the double function of providing a suitable solid fuel as well as a suitable gaseous fuel; the whole question of power centres, possibly of heat distributing centres also, must be taken into consideration. There are many reasons why these problems should be fully discussed without further delay.

The gas industry, in my opinion, is rapidly approaching a second period of crisis and we may hope that all those connected with it will realise the importance of a broad-minded, dispassionate, scientific review of the situation before this be too late. The battle between electric and gas light must soon be fought to a finish. The advantage the electric light has over gas light for domestic use is unquestionable and the former must prevail in the end—may it not be greatly to the advantage of the gas industry that this should be recognised at an early date and the mains set free for the supply of heating and power gas? The rare materials used in making the Auer mantle will not always be forthcoming. Unless certain changes in gas are made at an early date, users will be driven into the arms of the purveyor of electric light: it must be both cheapened in price and improved in quality. The price, except in towns such as Sheffield and Widnes, is altogether disproportionate to value: this is because the capital locked up in the industry is excessive; it must be conducted so as to afford larger profits, comparable with those made in other chemical industries—for it is a chemical industry, though hitherto it has been all but entirely in the hands of men who know not chemistry. A disastrous step was taken by gas managers, a few years ago, when they secured the repeal of the sulphur restrictions: since then, our homes have been flooded with sulphurous fumes and we have suffered not a little in consequence—though most users of gas are too ignorant to appreciate the effects and many gas engineers probably are not alive to the nature of the policy they have accepted. On this account, to my mind, nothing that has happened of late years, is more satisfactory than the action taken by the technical staff of the South Metropolitan Gas Co., in London, in recognising the moral obligation that was cast upon the industry when thus granted free trade in sulphur. Much has been said of late of the neglect of science by industry in this country. We hear much also of the many years the German chemists served before they came into possession of indigo—they plume themselves particularly upon the achievement and regard the application and dogged perseverance they displayed as something peculiar to themselves, outside the power of other peoples, which must in future enable them to be supreme—one of their spokesmen, indeed, has told us that "for all the Englishman does he expects soon to be compensated in hard cash." The patience and ability displayed by an unassuming trinity at Greenwich, in developing a successful process of removing all but traces of sulphur compounds from gas, in my opinion, is worthy to rank with the best German work, bearing in mind the difficulties to be overcome. Seven long years were spent in working out the process and in carrying it into practice on the large scale. The inquiry was promoted by Dr. Carpenter, the Chief Engineer of the Company, now our President; but he has assigned the credit for the chemical and physical foundation of the process to the chief chemist of the Company, Mr. Evans, who, with Mr. Franks, one of the younger engineers, was also mainly responsible for translating the process to the large scale plants. The process has been fully described in our Journal and in a lecture given by Dr. Carpenter at Liverpool to the Institution of Gas Engineers in June, 1914. The invention and elaboration of such a process in a gas works marks the opening of a new era in the industry—the era of science. Science has been strangely neglected by the gas engineer and by boards of gas directors throughout the country, in the past—in view of the many problems which await solution and which must be solved at no distant date, we may hope therefore, that the example set by the South Metropolitan Gas Co., in maintaining a highly competent scientific staff, will not be lost upon the country. But one swallow does not make a summer. Now that an efficient process is available, the force of public opinion should compel all gas companies once more to concern themselves with the removal of sulphur. It was the policy of gas managers in the past to encourage the waste of gas and to pay little attention to quality beyond that required to satisfy statutory requirements; a few enlightened undertakings now see the folly of such a policy and it may be expected that when they are once more free to attend properly to public interests, they will seek to supply an article of standard quality calculated to satisfy requirements and thus set an example which must be followed: in no other way will the industry be able to maintain its position.

Provision of funds for an inquiry into coking processes.

A national commission of inquiry.

To return to the problem of coking coal so as to produce a solid fuel suitable for general use and also a sufficiency of gaseous fuel. My proposal involves a thorough experimental inquiry to determine the conditions best suited to produce cokes that will give satisfaction in practice, in the first place, to domestic users, though I contemplate the extension of the practice to all bituminous coals. Such inquiry cannot be carried out privately; it would be too costly, too extensive, too problematic. Nor should it be carried out at the expense of the country at large. Therefore I suggest to this Society, which is not only a body of coal-users but the only body that can properly understand all the problems involved in the use of fuels, that its members unite forthwith in memorialising Government to place a tax upon all the coal raised and that the funds so obtained shall be expended, under the competent direction of persons appointed by the Society, in developing suitable methods of coking coal so as to conserve, as far as possible, all valuable products and, at the same time, produce solid and gaseous fuels that are suited for public use. The inquiry should be extended in every necessary direction and should involve also the discussion of all questions of policy relating to coal and its uses: in other words, the study of fuel problems in general.

The services must be enlisted of all the men in the country who are really competent to take actual part in and have responsible charge of and direct such inquiry—and they must be properly paid for their services; such men are few in number. Necessarily, advice would be sought from every competent quarter; anyone having ideas on the subjects dealt with should be at liberty to know what was being done and invited to lay his views before the Commissioners; if he proved to be of use, he should be duly remunerated. Full reports of the work done should be published as often as possible and discussion invited. We need to put the whole talent of the nation into such an inquiry.

I make these points advisedly, in order that the Government and others may not be misled into thinking that they may expect to get something for nothing—as they are constantly doing in their dealings with learned Societies. It is essential that action should be taken at an early date in direct protection of public interests—as it is not unlikely that money will be asked for, ere long, for soft coke undertakings. I venture even to urge that it is the duty of this Society to come forward, in protection of the public against the company promoter, in this particular instance. At present there is certainly no money in such a quest—probably a very large sum will be spent before satisfactory and remunerative methods of effecting what is required will be devised. It cannot be gainsaid that the attempts hitherto made have not been in competent hands. Only too frequently in this country over-sanguine inventors induce sanguine investors to entrust them with funds to attempt enterprises which they are in no way fitted to conduct; and such inventors become the tools of designing company promoters, who are too often the curse of legitimate industry. In self-protection, scientific workers must, in future, intervene to prevent the public from being misled by interested expert opinion. I question whether it be not even desirable for this Society in some way to institute a tribunal —a responsible Watch Committee—charged with this duty and authorised to face the necessary risks. It may be argued that such action would tend to prevent flow of capital; it is certain, on the other hand, that it would often check evaporation of capital.

Attempts to produce soft coke.

It cannot be gainsaid that the attempts made hitherto to produce soft coke and to utilise the by-products properly have not always been in competent hands. I have been a student of the subject and interested in such problems all my life. I gave an account of the oil gas industry to this Society in 1884 and made a further communication on the subject to the Chemical Society in 1886. In 1885, in a brief note presented to the Iron and Steel Institute, discussing the methods proposed for coking coal and recovering volatile matters, I definitely urged that an inquiry should be undertaken of the kind I am now advocating. I again brought the subject under notice of the Iron and Steel Institute at the last Middlesbrough meeting. I may mention that I initiated discussions on the provident use of coal at the meetings of the British Association for the Advancement of Science at Sheffield (1910) and Birmingham (1913). Time after time, I have called attention to the neglect of science in gas works. Of late years I have made a point of studying the various processes of coking coal that have been put forward. Through the courtesy of the late Sir William Preece, the Chairman of the Coalite Company, I had full opportunity of forming an opinion of the process. The inventor, the late Mr. Elwell Parker, was an electrical engineer as was also the Chairman of the Company; that the work of reconstructing the fuel industry—for the attempt meant nothing less—should have been undertaken by such men is but one of the many proofs that may be given of our willingness to accept unknown responsibilities, in reliance on the proverb "where ignorance is bliss, 'tis folly to be wise." Complete absence of a saving grace of modesty which would lead us to say, "that is not my job," when asked to do something of which we have no expert knowledge, would seem to be one of our most characteristic qualities; the condition is in no way peculiar to industry, however—it appears to be specially characteristic of our politicians and the Government service. Such courage, no doubt, is magnificent but it is never war; if we are to win in the future, it must be damped down.

The Coalite process was based upon a perfectly sound proposition and was a sound process, as far as it went. But it was affected with two fundamental difficulties—in the first place, carbonisation was on too small a scale, as it was carried out only in small retorts; in the second place, the tar was altogether peculiar, one for which a market had to be but never was created. The gas is wasted.

Scarcely any benzene or homologous hydrocarbon was produced and neither naphthalene nor anthracene; in fact, the only constituent of coal tar that was obtained in fair quantity was phenol; this, however, was of exceptionally high quality.

It is unfortunate that no serious study of the Coalite tars or of the tars obtained by distilling coals under reduced pressure has been made. I have been favoured with samples, at various times, when I have asked for them; naturally I have only carried the work far enough to satisfy my own curiosity. A complete investigation would involve a large amount of work and would occupy much time, so it would be an expensive one. It is most unfortunate that proper advantage has never been taken of the opportunities afforded by the various vain attempts that have been made of late years to develop low temperature coking as a commercial enterprise—I say vain advisedly, because I am satisfied that the attempts have never been made under proper conditions.

The magnitude of the task to be undertaken will be apparent to all who are in any way conversant with the subject—but it is the great problem with which our nation is faced, one in comparison with which all others are of small importance.

The most luminous contribution to the subject is that briefly made by Dr. Beilby at the meeting of the British Association in Birmingham in 1913 as a contribution to the discussion which was opened by me on the proper utilisation of coal and fuels derived therefrom. His statements are so important that I may be allowed to reproduce them. Said Dr. Beilby:—

"A fairly extensive experience of low-temperature distillation as applied to coal as well as to oil shale led me from the outset to question whether the proposal to distil bituminous coal in long vertical tubes of small diameter would be industrially successful. With the assistance of Mr. H. N. Beilby and later also of Mr. G. Weller, an experimental inquiry into the possibilities of other methods of distilling coal at a low temperature was carried on in the works of the Cassel Cyanide Company in Glasgow.

"By freely exposing small cubes of coal to radiant heat, at a temperature of 450° C., it was found that the gases were driven off in about an hour. It seemed reasonable, therefore, to conclude that, under practical conditions, the time of exposure to heat need not exceed one and a half to two hours. It had been stated in published reports that the time of exposure to heat, in the small vertical tubes of Mr. Parker's apparatus, was four hours and at a later stage it was suggested that even this time was not long enough to complete the distillation in the centre of the mass. The object we now set before us was to devise a form of apparatus in which the coal could be exposed to the action of heat in thin layers. The first practical apparatus consisted of a column heated externally in a gas-fired oven and fitted internally with a series of sloping shelves. Mechanical arrangements were made for feeding the small coal in to the top of the column and for mechanically jolting the shelves so that the coal passed over the whole series from top to bottom in a sheet two to two and a half inches in thickness. The coke was mechanically withdrawn from the bottom of the column. The volatile products of distillation were removed by an exit pipe to suitable condensers and receivers. The performance of this apparatus fully justified our expectations as to the rate at which coal could be exhausted of its gases at 400° to 450° C. The time required did not exceed the one and a half hours of our estimate.

"The further evolution of the apparatus passed through various stages till a unit with a capacity of fifteen tons per day was reached. The mechanical difficulties to be overcome as the scale of operations was increased were serious and even in its present form we are not perfectly satisfied with the apparatus. We are now preparing designs for a further step in which we hope to profit by the experience of the last four years. We are, however, satisfied that the principle of exposing coal to heat in thin layers is sound. We are also satisfied that the production of a mechanically perfect apparatus into which small coal is automatically fed, passed through the distilling zone and finally passed out through a cooling chamber, only requires a little more patient step-by-step development. It is obvious that an apparatus which could be built in units with a capacity of fifteen to twenty tons per day, which would work automatically, no part of which need be exposed to a higher temperature than 450° to 500°, ought to provide an exceedingly economical means for the distillation of coal. But I must not omit to tell you the weakness as well as the strength of this type of apparatus. It will, in its present form, only work smoothly with non-caking coal. If the coal, on heating, passes through a fusible stage, it is apt to stick to the shelves and to accumulate on them. The working then becomes irregular and eventually stops. Further, the fact that the coal is frequently turned over and dropped from shelf to shelf tends to break it down into small stuff, a good deal of which is no larger than coke breeze. These are both serious but not fatal disadvantages.

"The greater part of the coke from this unit plant has been used in water-gas producers into which it could be passed while it was still warm and dry. It had thus an initial advantage over the gas-works coke, which usually contains ten to fifteen per cent. of water. The use of the low temperature coke for water-gas making proved quite satisfactory. Its light nature made it necessary to reduce the pressure of the air blast in the producer but its freedom from water and its ready inflammability fully compensated for the loss of capacity due to this reduction in the air blast.

"A good deal of the low-temperature coke has also been converted into briquettes for domestic fuel. These are easily kindled and kept alight in an ordinary grate and burn almost without smoke. The experience of numerous householders in Glasgow in the use of this fuel has been most encouraging and my colleagues are quite satisfied that a steady outlet for a moderately large output could at once be obtained.

"The hydrocarbon gases from the unit apparatus have hitherto been passed into the general fuel gas system of the works but regular laboratory tests have been made of the thermal value, petrol contents, etc. The thermal value of the gas reached the high figure of 850 B.T.U. per cubic foot. The liquid tar has been regularly collected and examined and the results generally confirm those of other observers.

"Our attention has, however, been mainly concentrated on the mechanical development of this method of distillation and on the production of a domestic or an industrial fuel from the coke. These, in my opinion, are the really fundamental points in the low-temperature scheme. If these are not right then even fancy prices and an unlimited outlet for fuel oil and motor-spirit will not save the scheme from failure.

"I must repeat that the really significant points are covered by the economic and engineering questions: can an outlet be found for the low-temperature coke? and can a satisfactory apparatus be devised?

"The apparatus must be in fairly large units and it must be automatic and must work with the smoothness and regularity of the best types of automatic stoking machinery and with the minimum of manual labour or of detailed supervision. The gases and vapours from the distillation must be carefully preserved from loss or damage in the apparatus either through leakage of gas outwards or of air inwards. The necessary heat must be so applied as to cause no deterioration of the material of which the apparatus is constructed and the heating must, of course, be economical."

It will be obvious that while much may be learnt from the work done by the Coalite Co. and by Dr. Beilby and his co-adjutors, a great field of inquiry still lies open before us. It will be necessary to deal with different coals in different ways; probably a variety of fuels will be required, each calculated to meet some special requirement. The character of liquid by-products to be produced will not be easily determined: this part of the problem, in particular, will be largely affected by economic considerations. Much will depend on the demand for products such as are present in coal tar as now made—whether the tar obtained in making hard coke will afford sufficient of these; if not, it will be necessary to submit at least a part of the distillate obtained in making low-temperature soft coke to a secondary heat treatment. The discovery that certain varieties of petroleum contain a large proportion of benzenes has introduced a new factor into the situation which must not be overlooked.

Finally, let me point out that the introduction of coking processes such as those under consideration may afford an opportuntiy of purifying fuels—for example, from sulphur—which must not be neglected; in certain cases also, it should be possible to introduce variations (*e.g.*, the addition of lime) which would lead to an increase in the amount of a by-product such as ammonia.

Such is the problem before us—let us deal with it earnestly and scientifically, not casually as heretofore.

One inquiry of special importance that should be instituted at an early date is a complete geological and chemical survey of our coals, to determine as far as possible their composition and the distribution and extent of the different varieties. It may be desirable to set aside some varieties and confine their use to certain special purposes—the Durham coal, for example, as a coking coal.

Economy in the use of fuel.

Coincidently with the inquiry into the production of suitable fuels, we must also carry out an inquiry into the use of fuels. The waste, under existing conditions of ignorance on the part of users, is known to be enormous. It is astounding that the subject has been all but neglected in schools and colleges—this mistake must be brought home to teachers generally and remedied. Work such as has been done by Professor Bone and his assistants, in particular, of late years, should be interpreted and brought down to the vulgar level, so that it may be rated at its full worth; the principles to which he has specially drawn attention, which I am satisfied are not yet sufficiently appreciated by engineers, await systematic development and application.

The provision of efficient heating appliances, whether for gaseous, liquid or solid fuel, should be made the subject of profound study—I suggest with the aid of funds raised in the manner I have indicated.

We need also to discuss freely and fully all questions relating to the use of fuels economically in our industries. Certain firms already have experience which may well be made public. Not only is it necessary to discuss the various appliances—water softeners, heat economisers, mechanical stoking machinery, boilers, etc. but also to consider broader questions, for example, the distribution of the load factor in works, not omitting that of co-operative systems of producing power.

Full discussions of gas producers and their efficiency, as well as of the methods of using liquid fuel, are of immediate importance. In fact, no question bearing on the production and provident use of fuels must be left out of consideration.

National Fuel Board.

Scientific control of industry.

To render a scheme such as I advocate operative, it will probably be necessary to establish a Central National Fuel Board and secondary boards to control certain specified areas. Coal would no longer be used as such but would be delivered at selected centres and there prepared to serve as fuel, everything being separated from it that could be put to higher use. The rich gas produced in the coking process would be raised to the necessary volume by dilution with non-illuminating power gas and supplied separately.

The gas works, as we now know it, should disappear and its place be taken by the fuel and power works. Great engineering problems will arise if such a scheme be brought into operation, among them that of the distribution of gas, probably under pressure, over long distances.

The industry at large and the use of fuel should be brought absolutely under scientific control: to this end, it will be necessary to establish one or more central laboratories at which the major problems can be studied. It is becoming clear also that, in the near future probably, the coking industry as well as the gas industry will be closely linked with manufacturing industry, especially with that of organic chemicals, including dyestuffs. It will probably be desirable, at some works, to produce intermediate products from the raw materials separated during the coking process, as the sale value of these raw materials, when very large quantities are produced, may in some cases be so low that a remunerative return will not be obtainable in any other way. It appears already desirable that those who have by-product recovery coking plants should co-operate from this point of view and that, without further delay, they should establish a central research department to serve the special purposes of the industry.

It is essential that all who have precise knowledge should come forward and state their views—so that the subject of the supply and use of fuel may be exhaustively discussed by the several Sections of the Society. If eventually the lessons taught by the various discussions can be extracted and reduced to practical propositions on which action can be taken, a great work will have been done. I venture to think that the Society not only now has an opportunity such as it has never before enjoyed but that a responsibility is cast upon it which cannot be set aside.

I ask not only for the immediate consideration of the problems indicated but for little short of instant action.

DISCUSSION.

The PRESIDENT said that the paper was almost entirely a constructive one. Prof. Armstrong was not so much finding fault with existing systems as pointing out the importance of future improvements. He had pointed out the importance of organisation of effort and effect of our work as a nation. We were having the severest lesson we could possibly have that the individualism to which we had been so accustomed, and upon which we so largely prided ourselves, had proved an insecure reed. The question raised by Prof.

Armstrong was how far, in what direction, and by what steps, organisation could be applied to the coal industry. He was sure that help would be given in devising means to deal with a problem concerning which there was no possible doubt that serious action would have to be taken.

Dr. J. T. **Dunn** endorsed heartily all that Prof. Armstrong had said on the question of co-operation in low temperature distillation of coal. He had had the opportunity to examine a good many of such processes, and had found the same state of things to which Prof. Armstrong had drawn attention. There was an enormous future for a smokeless fuel, such as the coke produced from any system of low temperature distillation. The difficulty in regard to these processes was twofold. First of all, most of them had been carried out on a very small scale by people with very little capital and very little technical knowledge, but who experimented more or less empirically. If some central body were to undertake the work, to which body inventors could bring their devices, valuable results would be obtained. He also corroborated Prof. Armstrong's remarks as to the sacrificing of good ideas of industrial processes, capable of being a real economic benefit to the community, by their getting into the hands of the financial adventurer. He was convinced that enormous harm had been done to industry in that way.

Mr. W. **Diamond** said that the coke industry, up to the present, had mainly confined itself to the production of good metallurgical coke and the recovery of by products. When the "patent" ovens were first introduced, the coke produced was of very poor quality. Now, however, they were getting better results from the patent coke than from the beehive product, and the beehive ovens were gradually being put out of action. When the first by-product ovens were started high temperatures were not used. At about 900° C., with 50 to 55 hours' carbonising, a very dense coke was produced and a more fluid tar than at present; now a very thick tar was obtained, rich in naphthalene and pitch.

Mr. T. **Hardie** said that while low-temperature carbonisation might have a future, it certainly had also a past which had not shown that the process could be made a commercial success, though it might be scientifically correct. He could not agree that gas as an illuminant was done for and that it must be further purified for fuel purposes. He had not learnt that gas for fuel should be further purified from sulphur than at present. As a result of the recent movement in that direction, the restrictions had been removed from a certain number of undertakings, but the larger number of undertakings in this country had not been under any restrictions whatever. If methods could be discovered whereby fuel supplies could be controlled and coal used more economically, it should be done. He believed that gas undertakings would be ready to alter their plants to meet any new system resulting in the more economical use of coal.

Dr. J. H. **Paterson** thought Prof. Armstrong had made a mistake in confining his arguments to the low-temperature distillation of coal. A better case could have been made out for national action with regard to the conversion of coal into coke—no matter what kind—and the various by-products. His experience of cokes of the Coalite type had been unsatisfactory, mainly on account of their friability, and to base an important step on the results of a process about which very little was known—and practically nothing about the by-products—was rather a serious matter. Northumberland and Durham had a very large coking industry, in which a type of coke for metallurgical purposes and extremely valuable by-products were made. It would make a much more satisfactory starting point to say that the use of coal as a household fuel was a mistake and that the possibility of using coke in its place was very important, and to leave the question as to how that coke was to be produced an open one. Their present knowledge of low-temperature distillation was insufficient to justify them in saying that it was an ideal process. A satisfactory solid household fuel which was quite smokeless could be made by adding to any type of coke refuse small proportions of the liquid substances obtained during distillation. There was, probably, a great deal to be said for the nationalisation of the gas and coke industries. Few manufacturers knew the resources of their own coalfields. The manufacturer bought coal without taking as much care as an ordinary housewife would take in buying meat. He ordered thousands of tons because he had had that grade of coal before and had been satisfied with it.

Mr. **Nesbit**, referring to the wastage of coal, said that in the Derbyshire district coal below a certain size, which in Northumberland would be considered a nice-sized coal, had no market value to speak of.

Mr. C. D. **Drury** said that the gas industry was quite prepared to adapt itself to any improvement that seemed desirable, provided that it would result in a financial as well as a scientific success. The quantity of sulphur fumes emitted from gas was so small that a little variation made practically no difference. By far the greater amount of sulphur compounds produced in the carbonisation of coal was extracted in the works.

Prof. P. P. **Bedson** said that one of the consequences of the cheapness of coal was that it was valued too lightly. In connection with the suggestion that it should be taxed to provide money for researches, that was already done in Westphalia, where the money was expended partly for the benefit of the working people and very largely for the education of the miners and others taking part in the coal industry. At Borkum, for example, they maintained a School of Mines for the training of under-officials and conducted work on the analysis of the gases of the air in the pit. Many other efforts were maintained out of money raised in that way. There was in Westphalia a co-operation in the use of the waste products from the manufacture of coke. Gas there was used as a fuel for the production of steam, and that steam was used for the generation of electricity which, produced at different collieries, was pooled and distributed over the district. The waste heat at Middlesbrough and from many of the coke-ovens and by-product plants, might be used to produce electricity which might be pooled for the benefit of the district. They might have electricity as cheap in that district as in any part of the world. If they could do so, they might set up, by its aid, a number of electro-chemical industries.

Mr. Gerald **Stoney** said that the Priestman Collieries had by-product ovens where the gas was put under boilers, and the power thus produced put into the general system of the Electric Supply Co. There were other local collieries at which similar things were done, At the new coke-ovens at Dunston, for example, a similar thing was done, and the power was distributed through the district.

Mr. Ernest F. **Hooper** expressed the opinion that Coalite had been very largely spoilt by financial methods. He had had a considerable sample of low temperature tar to deal with, and found it so hopeless, from the tar distiller's point of view for products, that it appeared only useful as a fuel oil. If scientific work had been done on the tar to find uses for certain ill-defined bodies for technical purposes, then it would have been of some use to them, but, when it was a question of dealing with a few tons of this product per week, with some thousand or more tons of ordinary tar, they could not risk the spoiling of their ordinary products by the introduction of that tar, so that they wanted it explained from the scientific point of view that a by-product of that particular character had some value from the technical side before it could be put on the market with the hope of doing any good to the company producing it.

The President said that the sulphur problem was a very interesting one. Livesey had been fully alive to the disadvantages of the sulphur and had spent a good deal of time and money in endeavouring to elucidate the problem, but had finally given it up. The ideal as to the combustion of coal gas was that it should not differ from the combustion which went on in the human body. If only carbon dioxide and water vapour were produced by the combustion of coal gas, there would be many more possibilities of its use than at present. The experiments which had been suggested with regard to a smokeless fuel deserved far more than a passing reference. He thought that the gist of Prof. Armstrong's paper was that the production of a smokeless fuel from the smoky one now used was so important that steps should be taken to utilise the best scientific knowledge, not only chemical, but engineering, to be devoted to the solution of the problem. Of late years the great anxiety of large buyers of coal, certainly in the South, had not been to get coal which would pass the proper physical and chemical tests, but to get supplies at all.

Replying on the discussion, Prof. Armstrong said his mind was entirely open as to the character of the fuel ultimately required. What he wanted was a full and complete inquiry into the whole question. The matter was of such enormous public importance that the inquiry should be made by some public body. As to what Dr. Dunn had said, he mentioned that three or four years ago he had met a tar distiller who expressed himself as quite satisfied with the tar from a soft coking process, but it appeared that his opinion was based on results he had obtained on distilling it mixed with ordinary tar. That was the kind of thing everywhere met with. He believed that more than a million sterling had been put into Coalite and there was nothing to show for it. Most severe remarks were made in financial circles against their profession because they did not come forward in the protection of the public, and the Society must do so if it were to be of any use. The inquiry must be on such a scale and of such a kind that it could not be carried out in the ordinary private way. There was no probability of an immediate result. It would be a sheer accident if a result of a satisfactory character were obtained quickly. It was necessary to look at the matter from an economical—as well as an economic—point of view as it was time that they began to look at these things from the point of view of future generations, and that they took steps to avoid waste. One great object was to avoid smoke. There was an immense amount to learn as to the waste of burning fuel as we now burned it, and from that point of view an inquiry was necessary. He trusted that the question would be discussed by the different Sections throughout the country, because he could not imagine a problem of greater importance to them, nor one which afforded them a greater opportunity of making themselves of value to the public and of acquiring public esteem.

Sydney Section.

Meeting held at Sydney on Wednesday, 15th September, 1915.

PROF. C. E. FAWSITT IN THE CHAIR.

FELLMONGERING AND TANNING SHEEP-SKINS IN NEW SOUTH WALES.

BY F. A. COOMBS, E. SWINBOURNE, AND G. W. GABB.

In the New South Wales fellmongering industry sheepskins are usualy described as Merino or Crossbred, the former denoting fine, and the latter coarse woolled skins which include pure-bred Lincoln and Leicester. The pelts from fine woolled skins are usually thin, with an open and irregular grain, and the pure bred Merinos, particularly the Vermonts, are covered with ridges on the grain side; such skins are usually called ribbies. These faults affect the quality of the resulting leather, and the pelts from fine woolled skins are usually only fit for the production of low grade leather. The pelts from coarse-woolled skins are usually stouter, and not so open, but more regular in the external features of the grain than those from fine woolled skins, and therefore the former can be used for the production of higher grades of leather.

Pelts vary considerably in area, substance, and external features of the grain, the variations being largely due to difference in age, breed, health of the animal, amount of wool on the skin, and to climatic conditions. The pelt begins to fill up and get stouter after the wool is shorn off the sheep. A skin with "good substance" might be described as being thick, and the internal growth of white fibres would be dense, which means a greater concentration of the leather-producing constituents of the pelt.

Australian squatters have been breeding merino sheep for a high class wool. These sheep are particularly hardy when exposed to changes common to a dry, semi-tropical climate, and therefore thrive well in Australia; but the merino pelt is poor, and fellmongers and tanners are agreed in the opinion that the sheep pelts of Australia, merino predominating, are not worth the amount of skilled labour that can be profitably employed on pelts from coarse-wooled skins.

In New Zealand the merino has been practically ousted by the more profitable crossbred sheep, which give such good results in the frozen mutton trade, and at the present time the proportion of crossbred sheep is increasing in Australia, and tanners already note a decided improvement in the pelts. The merino sheep produce the finest wool and the worst pelt, the wool generally returning considerably more money than the pelt. This difference in relative values reaches the maximum in long woolled merino skins, and the minimum in short coarse woolled skins (shorelings) taken from the animal just after the sheep has been shorn; but while the pelt of a coarse woolled shoreling is worth more than the wool, the number of these skins is proportionately small, and therefore the wool is the more important product in nearly all fellmongering centres.

Fellmongering is that process which involves the separation of wool and pelt, and for sheepskins is similar to the methods employed by the tanner for removing the hairs from various skins; but the tanner does not consider the hair when treating the hair skin, and unfortunately some fellmongers do not consider the pelt when treating woolled skins. However, the difference between the preparatory treatment of sheepskins and calfskins will not be found in the materials used, but more in the method of using them. For dehairing purposes, calfskins are immersed in solutions of alkaline sulphides and lime, but the same treatment would destroy the wool on sheepskins; therefore, when this method is used, the latter are painted on the flesh side with the sulphide mixture. But in New South Wales approximately all the skins are dewooled by the sweating process, and a great number of pelts are lost each year which would be saved under a chemical process.

The first process at the fellmongery or tannery is soaking. The skins are placed in large water vats and washed free from dung, dirt, and blood. The time allowed for this soaking depends entirely on the condition of the raw material. Fresh butcher's skins give the least trouble in the soaks; but the dry or dry salt-cured skins remain for a longer period, to allow the pelts to take up water and come back to that soft pliable state peculiar to the pelt of the fresh green skin. The soaks, which contain a number of putrefactive bacteria, are not sterilised by the fellmonger, and the green skins should not remain here more than twelve hours. It is the usual practice to have all the skins in the soak pits within twelve hours after they have been taken off the animal. Failing this, they should be treated with the object of preventing or delaying bacterial action, which is not desirable at this stage, because it would be uncontrollable; but unfortunately a great number of pelts are thus destroyed. The wool contains large numbers of putrefactive bacteria; and when the skins are passing from the butcher to the fellmonger, the inner, or flesh side, is exposed to the air and brushed by the wool, becoming inoculated with bacteria on a part of the skin which at this stage is often covered with blood, and is therefore an ideal medium for their growth, especially if the temperature of the fresh warm skin is not brought within reasonable bounds by allowing what the trade call the "animal heat" to escape.

Many examples could be given illustrating the damage done to all classes of skins, hides, and fur skins, by putrefactive bacteria attacking the raw material before it reaches the tanner or fellmonger, and it is a common sight to see parts of a skin completely destroyed, while other parts are perfectly sound.

Mechanical and chemical agents, by bruising and penetration, enable the dry pelt to take up water more quickly than would otherwise be the case; but the results from any softening process depend almost entirely on the method of curing the skin for the raw skin market. It will be readily understood that when a hygroscopic substance like common salt is used for curing skins the softening process will give less trouble. When salt is placed on the skin, it withdraws moisture from the pelt, and a portion of the salt is dissolved and retained by the water that still remains in the pelt. The skin is now dried out to a state called dry-salted, and the salt remains in the pelt. Any skin that is worth drying out for its pelt value is worth salting. Sheepskins that have to be railed to the market, or even held up for a few days for the sales, are always dried out without the addition of salt. An important condition when soaking dry skins is the temperature at which they are dried out, and this is not controlled by the tanner or fellmonger. Skins dried on fences, etc., at a high temperature by exposure to sun are useless for producing a leather of average quality, but if the drying be carried out at a low temperature good results can be obtained by the tanner. Collectors who wish to get the maximum market value for fur-skins, etc., should use salt on the green skins, and then dry them out at a low temperature.

After soaking, the skins pass through the burring machine, which removes a large amount of dirt and seeds from the wool, and when the skins are put in, flesh side up, the mechanical action assists to bring the dry skins back to their original pliable condition. The skins are sprayed with water when they are passing through the burring machine; and when the rollers are reversed, the skin comes out freed from all surplus water, and in a condition suitable for either sweating or painting.

The skins are removed, after burring, to the sweat house, where they are suspended on hooks and exposed under conditions favourable for the action of bacteria. This process, called sweating, aims at a result which may be described as a partial decomposition of the skin, and the end point is reached when the wool or hair can be removed from the skin by the puller. The decomposition required is the result of bacterial action on the epithelium cells of the epidermis, including the hair follicles and the roots of the hair or wool. After noting the histological structure of the skin, one can readily understand that any action, chemical or bacterial, which is capable of destroying the connective links, and breaking down epithelial cells, must leave the wool in such a state that it can be easily removed by the puller. Sections of the epidermis usually adhere to the roots of the wool, when the latter is pulled out of the pelt, so that it does not appear necessary for the cells to be decomposed, but it is rather a case of decomposing or rupturing that tissue which connects cell with cell, or the first layer of columnar epithelial cells to the papillary layer. If the wool be carefully removed from the pelt, the epidermis is seen adhering to the pelt as a white pasty mass of cells which have lost their original strong cohesive properties, and can be scraped off the pelt with one's finger nail.

Bacterial action is not confined to the epidermis; the fibrous tissue of the pelt is also decomposed, but the action is much more rapid on the former than on the latter. If the bacterial action proceeds at a uniform rate all over the skins, the results are good: but if it is patchy, the grain and fibrous tissue will be destroyed before the wool will pull freely from the less favoured patches. The weak point in the sweating process is that the bacterial action connected with it is difficult to control, a great number of pelts being damaged, and in some cases completely destroyed. As the action proceeds there is a corresponding rise in temperature, which becomes exceedingly dangerous if it is not controlled. Our local method for doing this leaves room for considerable improvement. When the temperature reaches the danger point, trap doors are opened on the top of the sweat house, and the hot moist ammoniacal vapour escapes, and is replaced by air which may be cold or hot according to atmospheric conditions. If the air be cold the temperature of the sweat house decreases, but if the hot dry westerly winds prevail the temperature is not lowered, and under present conditions some of the fellmongers have to choose between opening the trap doors and admitting dry air at a temperature of 90° F., which will dry the skins, or keeping the trap doors shut and finishing the sweating at a very high temperature. In Europe and America water is sprayed over the walls and floor to assist in the control, and we think that if the hot dry air were passed through sprays of water before admitting it through the floor of the sweat house, better results would follow during the hot season, by increasing the humidity and decreasing the temperature.

Given a first class sweating house, much trouble can occur when the skins are hung too close together, owing to imperfect circulation of air. During the sweating process a large amount of ammonia is produced at the expense of the various protein constituents of the skin. The ammonia certainly assists in the dewooling process, and Procter[1] states that ammoniacal vapours alone are capable of reducing a skin to that stage where the wool can be removed from the pelt. The temperature of local sweat houses ranges from 18° to 26° C., and the humidity is always over 90%. Villon states that 20° to 25° C. is a suitable temperature. He isolated a special micro-organism which he called *Bacterium pilline*, and states that it is aerobic, lives in the presence of various of the putrefactive organisms, and is chiefly concerned in the fermentation peculiar to the process of sweating.

Wood also examined bacteria from the roots of wool in a sweating store, and isolated several organisms, among which are the bacteria described in a paper in this Journal (1899, p. 990) as bacillus D and E, which separately have very little action on the skin, whereas mixed, and working together, the action is rapid and effective.

Pathological changes in the skins often interfere with successful sweating. If a portion of a skin were to show signs of inflammation without any open sore, one would expect uneven sweating, and in some cases probably a rupture or hole follows on the grain side of the pelt. Skin affections may be due to the fact that the food supplies of sheep are liable to undergo many changes. One month a drought is on, and the sheep are nearly starving, and the next month a good rainfall is followed by a bountiful supply of grass; or as in New Zealand, where the sheep in the winter are often fed on rape and turnips, and according to Seymour Jones[2] the rape has overheating properties. Another cause is the damage done to sheep when they are railed to certain centres in trucks. The sheep are bruised and overheated, and patches of the skin are often saturated with urine.

Painting is generally considered to be an easier process to control than sweating. Sodium, potassium, and calcium hydroxides are supposed to attack those constituents of the skin which effectively hold the wool or hair in its place; but under ordinary sterile conditions, and at normal temperatures, these substances do not give satisfaction as dewooling agents. Lamb[3] describes an English process carried out by painting the skins with a paint of slaked lime and then placing them in a sweat house for bacterial action to complete the work. To sweat and paint skins would mean a decided increase in labour costs, and the process does not appear to give compensating results. In Australasia the fellmongers either paint or sweat, and the mixed process is practically unknown.

In New Zealand the majority of fellmongers paint their skins with a solution made from sodium sulphide and lime. This is a simple process, and is not affected by the use of sterilising agents used to preserve the pelt during the soaking period, etc. For this process soaking is carried out in the same way as for sweating, and the skins are put through burring machines and trimmed, then placed in a heap, flesh side up, and painted, using a brush of vegetable fibre.

Procter[4] states that a 25% solution of sodium sulphide crystals thickened with lime will give a satisfactory result. Lamb thinks that a 20% solution should seldom be exceeded, and his ideal mixture for all classes of skins is made up in the following proportions:—60 lb. unslaked lime, 25 lb. sodium sulphide crystals, and 20 galls. of water. This is practically a 12½% solution thickened with lime. Seymour Jones recommends a mixture of 25 to 30% on the weight of the rock lime, and the whole reduced with water to the consistency of paint.

Lamb has been getting good results 12 hours after painting by using a weaker mixture containing approximately 10 oz. of concentrated sodium sulphide per gall., but the strength is probably not the most important factor in the removal of wool from the pelt; but what is of more importance is the amount of water and sodium sulphide on any single skin, and such amounts vary with the workmen and methods of painting the skin; therefore, one might get better results with a thick coat of a weak solution than with a thin coat of a strong solution. Fellmongers sometimes use a strong solution for painting the back or greasy section, and a weak solution for the rest of the skin, but as a rule the skins are painted with only one solution, the greasy backs receiving an excess of paint, which means an excess of sodium sulphide and water. The fellmonger should aim at supplying the skin with just sufficient to give the required result. Any excess will not improve but may have a destructive action on the pelt. Lambskins should be painted with weaker solutions. The early butchers' skins (suckers) will only require about 5 oz. of sodium sulphide (conc.) per gallon. A sodium sulphide paint will always contain caustic soda, which is capable of swelling the pelt considerably above the normal condition, and tender lambs' pelts, if they be exposed to the action of a strong solution, are excessively swollen. A mixture of lime and arsenic sulphide will produce a paint that gives excellent results as a dewooling agent. This paint is quite free from caustic soda, and in some cases, *e.g.*, with tender lambskins, will give better results than sodium sulphide paint.

Procter has suggested[5] a sodium sulphide paint that differs from what has been described by the addition of calcium chloride to remove sodium hydroxide from the paint solution, and states that the following are the correct proportions to employ: 60 lb. lime, 25 lb. sodium sulphide, 12·5 lb. calcium chloride, 20 galls. water. Calcium chloride is used in the Argentine, but appears to be entirely new to Australasian fellmongers.

Procter was the first to point out the probable reaction between the lime and sodium sulphide, resulting in the formation of caustic soda; and Blockey and Mehd, after carrying out experimental work, give the following equation, as showing the probable reaction between portions of these two substances when the proportion of sodium sulphide to lime does not reach higher than one of sulphide to two of lime:

$$Ca(OH)_2 + Na_2S + H_2O = Ca(OH)SH + 2NaOH.$$

Blockey and Mehd[6] also show that when sodium sulphide is added to a saturated solution of lime certain reactions take place, and the amount of calcium left in solution is lower than the amount in a saturated solution of lime water. They also show that the solubility of the calcium compounds decreases as the concentration of the sodium sulphide increases.

The amount of calcium compounds found when $N/5$ sodium sulphide is made up with a saturated lime solution is so small that apparently only a small portion of the sodium sulphide in these paint mixtures reacts with the lime, and the amount of calcium hydroxysulphydrate formed is decidedly low.

We carried out several experiments by painting one side of a skin with a 10% sodium sulphide solution thickened with lime; the other side was painted with a 10% solution thickened with kaolin. Three tests were carried out, and the lime paint proved to be the better in each case. Dry skins were used and the wool did not pull easily, but the lime and sulphide gave distinctly better results. Further tests were tried for comparative results between lime and sodium sulphide, kaolin and sodium sulphide, and kaolin, sodium sulphide and sodium hydroxide, and the results obtained were as follows: No. 1, 10% sodium sulphide, thickened with lime, gave the best results; No. 2. 10% sodium sulphide, 5% sodium hydroxide, thickened with kaolin, was slightly inferior; No. 3. 10% sodium sulphide, thickened with kaolin, was inferior to both.

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[1] Principles of Leather Manufacture, p. 120.

[2] The Sheep and its Skin, p. 209.

[3] Journal of the Leeds University Textile Students' Association.

[4] Manufacture of Leather (Procter).

[5] Journal of the Leeds University Textile Students' Association.

[6] This Journal, 1912, p. 369.

Sodium hydroxide was added to the kaolin paint (No. 2), and we thought that such an addition would replace the soluble calcium hydroxide in the lime paint, and give improved results. The results obtained after using No. 2 paint give the impression that further experiments in this direction may lead to the exclusion of lime from painting mixtures, and this would mean a skin wool absolutely free from lime.

Paint solution No. 3 should be an ideal mixture for lamb and light skins, and the amount of sodium sulphide should be adjusted to suit the age and substance of the skins. The addition of sodium hydroxide to the above painting solutions did not adversely affect the few pelts in our experiment, but we recognise that more experimental work is necessary.

The wool is generally, but not always, the more important product in fellmongering, the pelt taking second place, the exception being the short-wool skins, especially those from sheep other than merino. The various processes for the removal of wool may all adversely affect its quality. We have considered the pelt first, because any method for dewooling is based on methods capable of decomposing certain of its constituents.

Wool from fellmongered skins is usually known as skin wool, and apparently various writers differ as to the fellmongering process which gives the best results from the standpoint of the quality of the wool. One English scientific wool expert[7] states "that the sodium sulphide process is the best, as this agent has no influence on the wool fibre," and with the sweating process he states "that there is danger that the wool fat and yolk may be extracted from the fibre, leaving it lean, tender, and wasty; but in Mazamet, in France, where the sweating is well understood, wools of excellent colour and quality are available after passing through this sweating process." Part of this statement practically admits that under skilled control the sweating process returns good results.

Seymour Jones[8] states that in Mazamet 25,000,000 woolskins are fellmongered annually, and sweating is largely carried on, but the fellmongers are gradually turning their attention to the milk of lime and sodium sulphide process, because of the simplicity of the operation, less cost, and improvement in wool and pelt. He also states that the sweating process is good for the wool, but is objectionable on account of the injury it causes to the pelt. Lamb[9] writes that from the standpoint of the condition of the wool, the sweating process is one of the best.

In New South Wales the majority of the fellmongers and wool-buyers consider that sweating is superior to the chemical or painting process, so far as merino wool is concerned. The fine merino wools are used for the manufacture of the best woollen materials, and it is claimed that the wool from sweated skins is brighter, has a better colour, and gives better results after dyeing than wool from painted skins.

We quote an expert who states that sweated wool is liable to become tender, owing to the removal of fat and yolk from the fibre, and there is no doubt that excessive sweating at high temperatures in ammoniacal watery vapour, in the presence of a great number of various bacteria, would decompose those natural lubricants on and in the wool fibre, and would probably attack and slowly decompose some of the protein constituents of the wool fibre.

There is a theory which claims that if all the fat and yolk are removed from the fibre, the tensile strength of the wool is lowered, and any application of oil will not bring it back to its original condition; and we must consider the possibility of sweated wool reaching this undesirable stage. In New South Wales we have a number of men who have had considerable experience in the sale of wool from sweated skins, and they state that the same buyers come year after year and buy this class of wool, so that we have a certain amount of proof that it is not tender, but only careful experiments would show if it had been adversely affected by the process of sweating.

Bacteria are capable of decomposing hair keratin, but the action is decidedly slow under normal conditions. Pieces of trimmings off woolled skins are sometimes sweated in heaps, and as such a method is difficult to control, the material is often over-sweated, and the resulting wool is a bad colour, while the quality is adversely affected, as is usually noted by the lifeless "feel" when handled by the expert. In some cases the keratinous structure of the wool fibre is attacked in such a manner as to affect its quality, but even in the extreme cases of over-sweating, when the pelts are destroyed, we have never heard that the wool has been affected; so that we can say that sweating skins, as carried out in New South Wales, returns a wool which shows no variation in quality and price corresponding with the variations in the sweating process. As variations are known to exist in the sweat house, we must assume for the present that there is no relation between the quality and selling price of the wool and the process of sweating; but before this sweating process can be described as free from any injurious action, the wool must be followed through the various processes of manufacturing the woollen goods, when research work would show any relation between sweating and such properties as the tensile strength, felting, affinity for dyes, and the ability to give full, bright, clean colours, etc.

Some wool-buyers in New South Wales say that wool from painted skins always contains lime. All the buyers of skin-wool will apparently buy sweated wool, but quite a number, especially of foreign buyers, refuse to touch wool from painted skins. Here again we can find no direct evidence that the best process of painting under experienced control has any effect on the quality of the wool. The old English process of painting with lime only, and then sweating, means frequent handling, especially when flooding with water after painting; and one can easily grasp the fact that the wool on these skins is liable to receive a fair sprinkling of lime, which is probably capable of injuring the fibres, and will certainly give trouble during the process of scouring. There is no doubt that a large amount of skin wool from painted skins contains lime, and buyers are inclined to place this defect as common to all skin wools from painted skins.

Taking the lime and sodium sulphide process as the best example of painting mixtures, we will compare the resulting wool, after painting, with sweated wool. In all painting processes a certain amount of the painting mixture will get on the wool around the edge of the skin; but with skilled workmen the amount at any time is very small, and only on the inferior portion of the wool. Any wool splashed with paint should be thrown aside by the puller, or it will be the medium for introducing insoluble calcium soaps into the scouring vats. Leaving out the wool that is splashed with lime, we must consider what is the action of the sodium and calcium compounds in the paint after they penetrate the skin and attack the epithelium cells of the epidermis, hair follicle, and roots of the wool fibres. When the wool is pulled from painted skins, the roots are always alkaline, and this alkalinity shows that certain constituents of the painting solutions are retained by the roots of the wool fibres after the wool is removed from the pelt. Even the lime and arsenic sulphide paints show this alkalinity, and whenever lime is used in the paint it is reasonable to suppose that small portions of a soluble calcium compound will be left on the roots of the wool. Now there is not the slightest doubt that, during the process of scouring, wools from painted skins require more soap than wools from sweated skins.

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[7] The Wool Year Book, 1911, compiled by A. F. Barker, M.Sc.

[8] The Sheep and its Skin, p. 274.

[9] Journal of the Leeds University Textile Students' Association.

The favourable factors in the sweating process are :—(1) the skins are exposed for a longer time in the wet state from soak to pulling beam ; (2) during this time the wool is covered with a mass of mixed bacteria which are capable of decomposing the fatty matters in it ; (3) the sweat houses are maintained at a temperature above normal, the humidity is always high, and the skins give off a considerable amount of ammonia, so that one might say they are finished in a weak ammoniacal vapour. Hence the scouring of sweated wool is more economical as regards time and consumption of soap and alkali.

Points to be considered in connection with the painting process are : (1) A great number of pieces are always made, because it is impossible to paint the narrow strips of skin from the legs, and also the thick fleshy parts around the ears, which are cut off and sweated. (2) For a quick and regular turnover, the advantage lies with the painting process ; it is much easier to control, and if one paints skins at night, it is a sure thing that they will pull in the morning. When the skins to be sweated are hung up in the sweat house, one is never sure, under local conditions, when it will "pull." (3) The painting process gives the better pelt. (4) Under present conditions, and taking piece wool into consideration, it would appear as if the sweating process gives the best returns, so far as wool is concerned ; but, as we have shown, good authorities differ on this question, and we are inclined to think that the best possible painting process in view would not affect the quality of the wool. (5) From a sanitary standpoint painting is the better process, and if some cheap chemical method could be brought into practical existence, to deal with the de-wooling of pieces, the painting process would be an ideal one, especially in those freezing works which fellmonger their own skins. (6) Labour costs must vary in different countries, but under local conditions we would expect painting to be slightly dearer than sweating.

The painted wool will certainly require an excess of soap if it contains portions splashed with lime, but if these are picked out, it is improbable that the lime penetrates the skin and fixes on the roots of the wool fibre in sufficient quantity to prove troublesome during the process of scouring. We have experimented with painting solutions which contain no lime, and hope to carry out further investigations on this work.

The men pulling the wool from the skins usually pick out the wool affected by tar brands, etc., also the hair ; and the rest of the wool from each skin is usually divided into two qualities, first and second grades, the second grade consisting of burry wool from bellies and flanks. The skins are sorted before they go to the pullers, and the number of classes of wool varies considerably according to the judgment of the fellmonger, but broadly they make combing, clothing, and cross bred of various qualities.

One interesting point about skin wool is that the whole of the wool fibre is saved, while with the fleece wool, a small proportion is left on the skin ; it has been stated that skin wool losses are higher than fleece wool during the process of manufacturing woollen goods.

The wool is usually taken straight from the pullers' beams to the scouring machines. The scouring of the skin wool is done by a machine usually containing three bowls, or it may be described as three machines placed one in front of the other with heavy rollers between for wringing purposes. The common method does not include a steeping bath for the removal of soluble substances, such as the potash salts, which would be washed out when the skins were soaked for fellmongering. The skin wool goes without any delay to the first bowl, which contains the "scour," usually made up with an alkaline soap and sodium carbonate. The mode of propelling the wool through the water varies according to the theory of the man in charge of the scouring operations. Some machines have the forks all moving like a harrow, and the wool is pushed forward, while other machines have forks which work alternately one into the other. The object is to push the wool slowly forward to the end of the bowl when it passes through the rollers at the head of the first bowl, and drops into the second bowl, which also contains a certain amount of scour, when the same mechanical work goes on and the wool passes into the third bowl, which contains clean water, sometimes hot, and then it passes through rollers to the drying machine ; or, as in a number of fellmongeries, a good portion of the drying is done on the green.

The scour is usually made up with a soda soap containing free alkali, with a further addition of sodium carbonate. Potash soap and potassium carbonate are not in general use at the local wool-scouring factores, and while the theory is that potash scours are better than soda scours, the results obtained from the latter appear to give general satisfaction. However, this could only be settled by bringing our local wool-scourers into closer touch with those who handle and manufacture the wool into woollen goods, and the wool-scouring industry would be placed on a more solid foundation if practical research work were carried out in conjunction with some English experts to prepare a standard method of scouring. The majority of the wool-scourers are good practical men, and good judges of wool ; but the industry just lacks that scientific touch which, combined with practical experience, means solidity.

After the wool is pulled off the sweated skin, the pelts are removed with as little delay as possible and placed in lime water with a large excess of lime—about 1 to 2 lb. in 10 galls. of water. In some cases they are washed in clean water, and then they go into the lime vats, which are sometimes fitted with a tanner's paddle, to keep them in motion. These lime liquors are not sterile to all species of bacteria, but apparently they retard the action of those bacteria peculiar to the sweating process. At this stage a great number of fellmongers sell their pelts to the basil-tanner, and this preliminary liming in paddle vats is necessary after sweating, or the skins would soon be destroyed by the putrefactive bacteria. This liming process may only last from one to six hours, and the skins are then removed and placed in heaps, where they remain until they are sent to the tannery ; or they may be left for three or four days in lime pits, and in some cases two or three weeks. Prolonged agitation in a paddle vat is not desirable, as the continual friction between the pelts and undissolved lime is liable to injure the grain of the pelt.

The real liming process only starts at the tannery and here the pelts remain in lime liquor, without agitation, for four to eight days; when the temperature is low (winter), the skins receive one day extra in the lime. The usual method is to add fresh lime to an old lime liquor and then throw in the skins. Each day the skins are lifted, and the lime liquors are thoroughly agitated, and the skins go back to these liquors before the undissolved lime settles, so that a light sprinkling of lime is deposited on all the skins. The supplies of pelts are so irregular that any organised system of liming, such as the "three pit system" of working from an old lime to a new one, is in direct opposition to the chief aim of the managers of these basil-tanneries, and that is a "quick turnover"; so that when a rush is on these tanneries are overloaded with pelts, and the method of liming must be one to meet the congested state of the lime-yard, by sharpening up the old limes until they contain an excess of dirt and calcium carbonate. They are then cleaned out, and fresh limes made up with about three parts clean water and one part old lime liquor. This mellowing new lime with old lime liquor is rather the exception than the rule. Approximately the consumption of lime works out at 200 lb. per 1000 skins.

After the pelts have been in the lime liquors for a few hours they begin to swell or plump, and to reach this state the surface of the pelt must naturally decrease; so that well limed skins are usually drawn, and much stouter than the pelts in their normal state. The theory of the liming process is very complicated, but the practical tanner knows that if the pelts are not limed the resulting leather is hard and thin, and a well limed pelt gives a soft and stout leather. It is generally recognised that, chemically, the lime has a slow decomposing action on the protein molecular aggregates, and there appears to be an unstable chemical combination between the lime and certain groups in the protein molecules. This lime and skin-protein compound has a greater affinity for water than the skin-protein, and the natural result follows; the pelt absorbs more water and swells, as explained above. When the pelt swells, a number of cells are ruptured, and the bundles of white fibres are changed in such a manner that the individual fibres are separated and no longer exist as one compact mass. This is essential to the production of a soft leather, and is probably brought about as much by the decomposing action of lime on the cementing substance as the straining and rupturing action of the swollen pelt.

After liming, the skins are thrown up in heaps, and in this condition a considerable amount of water drains away, and varying amounts of the lime are changed to carbonate. After these changes the pelts are not so slippery or greasy to the hand or to the rollers of the fleshing machine, and consequently the workmen are able to flesh a greater number of skins per day. Three or four days are allowed for the skins to drain, but when the busy season is on the skins often remain in heaps for two or three weeks. Lifting the pelts from the lime liquors and placing them in heaps probably only slightly retards the action of the lime on the pelt protein, and pelts should not be exposed in this way for more than three or four days.

Probably the most popular fleshing machine is the Whitney. Here we have the usual cylinder with spiral knives, revolving at a high speed. The pelts are thrown on revolving rollers controlled by the workman's foot; the rollers lift the skin and hold it firmly against the cylinder, and the skin works out to the operator. Only one half of the skin is fleshed at first, and the skin must be turned and the operation carried out a second time before it is completely fleshed. The unfleshed pelts, with butts all one way, are placed close to the operator, who takes each one singly, places it on the rollers, turns it, and then throws it on the heap for the trimmers, never taking his hands off until it is finished. We have seen one man flesh 1800 to 2300 sweated, well-limed and thoroughly drained skins in a day of 8¾ working hours.

As far as Australasia is concerned, New Zealand is the home of painted pelts; and while they have as raw material the best sheep pelts in the world, the treatment is faulty and leaves room for considerable improvement. New Zealand fellmongers must recognise that before they get the full market value for their pelts the standard of treatment must be raised, not so much by the individual freezing works or fellmongery, but rather by a united effort, keeping in view the fact that if a poor class of pelt were exported from, say, Southland, it affects the market value of those exported from Auckland. The chief faults are probably due to men controlling the painting, liming, etc., who have had no experience in the work of converting the pelts to the various leathers. If one does not see the results of painting, liming, etc., on the finished leather, then one falls short of the ideal practical experience. If one were to take green New Zealand sheepskins, paint, wash, and pickle them, they would then be in a condition to be exported as pickled pelts, and they would look all right, but perhaps to the experienced man they would feel a bit flat. When they are tanned the resulting leather is often hard and flat, or what the trade calls "tinny." Here the trouble is one of liming, and our experience is that a great number of New Zealand pelts are not thoroughly limed. It has been the practice in a number of cases to take the pelts after pulling, to wash, and then throw them into a pit with a little lime, and in some cases without any. Where no lime is used, the liquor becomes alkaline, owing to a certain amount of lime and sodium hydroxide bleeding from the pelts; and if the pelts remain long enough here, they are to a certain extent limed, but it is exceedingly hard to control such a method, and the results obtained are bad. The placing of these pelts in lime pits is too often looked upon merely as storing them, when the rush is on and the fleshing machines are blocked. In other cases liming is secondary to fleshing and getting the pelts in the sacks for export. A great number of New Zealand pelts have been shipped without ever being placed in a decent lime, and while we must admit that painted pelts, strongly alkaline with lime and sodium sulphide, and taking, say, five to ten days to get to the pickle, may reach the physical condition of limed goods without ever going into a lime, the process is too uncertain to give regular results. At the present time, tanners using New Zealand pelts for chrome and white leather do get casks of pelts which give the tinny leather already described, and they are likely to get these results until the New Zealand pelts are worked by a standard method based on their leather-producing properties. The sweated pelts, after being trimmed and fleshed, are treated for the removal of lime, which exists as calcium hydroxide combined with skin protein, and varying amounts of carbonate fixed on the fibres and grain. The pelts, after a thorough washing in a paddle with a constant overflow of cold water for about 20 minutes to 1 hour, receive the same treatment with warm water (105° F.). The results obtained from this treatment are (1) the skins are washed free from dirt; (2) a considerable amount of calcium hydroxide is washed out, but the fixed calcium carbonate still adheres to the fibres and grain; (3) the removal of calcium hydroxide lowers the affinity of the fibre for water, and the pelts fall or decrease in thickness and increase in area, but under present local conditions do not fall to their normal condition, because the insoluble calcium carbonate to a certain extent fixes the skin in its swollen state, and should be decomposed with an acid giving a soluble salt. Unfortunately New South Wales basil-tanners do not use the right acids, for after the washing described above, the pelts are placed in a pickle containing sulphuric acid, and the calcium sulphate remains fixed, affecting the quality of the finished leather.

The local pelts are not scudded, drenched, bated, or pulled down with organic acids or ammonium salts. They go straight from the hot water wash into the pickle, which contains sufficient sulphuric acid to neutralise all the lime, and leave them decidedly acid. The pelts worked under the above conditions do not return a first class sheep leather or basil. The process could be improved by removing surface lime with an acid giving a soluble calcium salt. Lactic, formic, or even hydrochloric acid could be used, by adding small quantities at a time, after the hot water wash, and using a paddle to keep the pelts in motion until they come down to the normal condition, when the small amount of lime left could be easily dealt with in the pickle.

Scudding has generally been looked upon as one of the most important parts of the process of preparing the pelts for the tan-liquors. Here, in New South Wales, it has been left out of the process, and, apparently, the tanners are satisfied with this change. Scudding is usually carried out by hand work, and the object in view is the removal of short hairs, grease, dirt, etc. If the pelt has been pulled down or neutralised, the scraping action of the scudding knife opens it out and removes the wrinkles. The class of pelts that we are describing contain no short hairs, and while a certain amount of grease could be removed from them, it is not probable that the results would pay for the extra labour on merino pelts. Cross-bred pelts may be improved by scudding, but after a fair amount of practical experience in dyeing basils that have never been scudded, we are inclined to think that hand-scudding could be left out of this process. At the same time, the skins require some mechanical action to stretch and remove wrinkles, and this work might be carried out by the aid of a machine or drum, after neutralising. If these pelts were neutralised in a drum with hot water, and, say, lactic acid, they would be bigger and give better results at the setting-out machines. However, the improvements we suggest here are, (1), the removal of surface lime after washing with acids giving a soluble calcium salt; (2), some mechanical action to stretch and remove wrinkles from the pelts before they enter the tan-liquors.

The pickling process is carried out by placing the pelts in a solution containing common salt and strong acids, such as sulphuric, hydrochloric, and formic. Our local tanners use sulphuric acid, and keep the pelts in motion with the usual paddle wheel. The pickling solution described by Procter is made up with salt to a Barkometer density of 65° (sp. gr. 1·065), and the salt solution should then receive enough sulphuric acid to make 100 c.c. of the pickling solution require 15 c.c. of $N/1$ sodium hydroxide to reach the neutral point. The pelts, when they come out of this pickling solution, are placed in a saturated salt solution, and are then ready to be exported as pickled pelts, or they may be tanned in the local tanneries.

Procter's formula gives satisfactory results if the pelts are free from excess of lime, and he probably proved his formula by working on English pelts which one would expect to reach the pickle after, say, scudding and drenching, almost free from lime, or slightly acid. As a rule the pelts in New South Wales are decidedly alkaline before going into the pickle, and they also contain a large amount of calcium carbonate, as already described; therefore a considerable portion of the acid may be neutralised with the production of the insoluble calcium sulphate. Under these conditions it is not surprising to find the local pickling solutions much stronger than the one outlined by Procter. We can give particulars of pickling solutions used at one tannery as follows:—

Table showing soda required to neutralise pickle.

No.	Fresh pickle.		Used pickle.	
	Density Barkometer.	100 c.c. require c.c. $N/1$ Soda.	Density Barkometer.	100 c.c. require c.c. $N/1$ Soda.
1	45	27·3	40	1·4
2	44	28·6	40	2·2
3	47	26·6	44	4·0
4	54	28·2	48	1·8
5	59	29·8	54	1·6

In the above example the acidity is high, but as the method of preparing the pelts does not remove the excess of lime, we may assume, with a few exceptions, that the acidity after neutralisation is not a great deal stronger than Procter's pickle. Pelts to be exported sometimes go into a saturated solution of salt after leaving the pickle; but for tanning, they are simply thrown upon a tray to drain before removing to the tan-liquors.

Pickling, under normal conditions, sterilises the pelts so far as putrefactive bacteria are concerned, and leaves them in a condition suitable for the export trade, or ready to enter the tan-liquors. It is not a hard and fast law that sheep pelts should be pickled before entering the tan-liquors if good leather results are to be obtained, but one advantage of it is that the pelts may be drained and left for several months when a boom is on in this particular industry, but the unpickled pelt would have to go at once to the tan-liquors to prevent decomposition. Procter states that pickled pelts do not consume as much tannin (sumach) as the unpickled. Another advantage of pickling is that the time required for tanning is much shorter.

The acid in the pickling solution is nearly all fixed by the pelt, and the outer solution retains only a small portion. The salt diffuses through the pelt and the outer solution shows no variation. Apparently no salt is fixed by the pelt, and the acid is generally supposed to be held by a weak chemical combination which is unstable unless there is weak acid in the outer solution. The pelt can be washed free from acid if it be suspended in running water.

The amount of acid used in pickling would destroy the pelts if no salt were used. The acid pelts have a great affinity for water, and when no salt is present they absorb water to such an extent that they are abnormally swollen, and the fibrous and cellular structure is partially destroyed, adversely affecting the quality of the resulting leather; so that pickled pelts, which retain a large amount of acid, should never be placed in water or tan-liquors that contain no salt, or the outer solution should contain a substance capable of exerting an osmotic pressure which successfully resists the osmotic pressure or affinity for water of the acid-proteins in the pelt, and abnormal swelling is then repressed.

The pickled pelts are tanned with tannin extracted from wattle bark of various kinds, and opinions vary as to which species gives the best colour. Adelaide bark (*Acacia pycnantha*) is supposed to give a slight reddish colour to the basils, and this is probably due to exposure, as this bark, when bagged, always shows more red than the New South Wales bark; so that we may say that Adelaide bark is more inclined to be affected by sunlight, or it is more exposed before reaching the tanneries than, say, the green wattle (*Acacia decurrens*) and its varieties. The bark to be leached is placed in large spenders and treated according to the theory of the man in charge of this work. Cold water is always used, and there is no system common to the majority of the tanneries, unless it be the one of using a salt solution for leaching. The tan-liquors all contain salt, and in the majority of cases these salt-liquors are pumped back on to the bark, and even the fresh bark at times receives salt water, so that the result is a large accumulation in both spenders (leaches) and tanyard liquors. Just what concentration of salt there is in the tan-liquors is beyond our knowledge, but we are probably right when we state that the majority contain sufficient to prevent the pickled pelts from swelling excessively in the first liquors. The apparently weak point in this system is the effect of the salt and faintly acid solution on the solubility of the tannins, and one would not expect to get the good results that are obtained when only water is used. The salt, by keeping out of solution the difficultly soluble red tannins, is probably the means of keeping the basils a good colour, and if one were to leach bark with water under the press-leach system, a higher percentage of tannin might be extracted, but it is quite possible that the colour of the basils would be adversely affected. However, this is another matter we hope to deal with in our research work.

Under local conditions the pelts are tanned with the aid of paddles. Each lot of pelts receives 4 to 8 liquors, and the paddles are running, in some cases, night and day. These pelts are thoroughly tanned in three days, using the paddles only in the working hours. The pelts go into a paddle box, and stay there until they are tanned, when they are thrown out to drain over-night, and then prepared for the setting-out machines. Sometimes sulphuric acid is added to the tan-liquors if the pelts show up a blue colour (iron stain), but in the majority of cases an excess of acid is added in the pickle.

The bark consumed averages about 1 ton (Adelaide) for 150 to 160 doz., costing about 1s. to 1s. 2d. per doz. basils. The basils or tanned sheep pelts are now drained, oiled, and set out. The setting-out machine stretches and lays the skin down flat. One operator can set out 900 basils per day, using a machine somewhat similar to the one described for fleshing, but differing in the set of knives. The skins are now dried, and pass through a staking machine, which stretches the dry basil, leaving it soft and pliable.

We have already dealt with several weak points and suggested improvements. Taking the average final products, we note that the ash (8%) is high, showing an excess of calcium sulphate and sodium sulphate and chloride. Leather exported to South Africa must not show more than 2% ash, and some New South Wales basils have been held up owing to their high percentage of ash. This trouble could be prevented by removing the lime from the pelts with an acid giving a soluble calcium salt, and the basils should also be thoroughly washed after they are tanned.

A number of finished basils after a few months show the effects of free sulphuric acid in the leather, becoming very red, with hard and brittle grain. This free sulphuric acid trouble can only be adjusted by controlling the pickling process, and no constant amount of acid will suit all tanneries. A hard water used for leaching bark would neutralise a large amount of acid and affect the concentration of the acid in the skin. Adding sulphuric acid to the tan-liquors is a bad practice.

We wish to thank those gentlemen who have assisted us to carry out the work of reviewing this important industry, and our thanks are especially due to the late Mr. McLaurin, and Messrs J. Swinbourne, Jas. Swinbourne, Hale, and H. Whiddon, for permission to examine their various plants, and also Messrs. Bradley, Nugent, W. Gabb, Monk, and Hannah for the generous manner in which they have always placed their practical experience at our disposal.

When pointing out the several weak links in this industry we also desire to acknowledge the valuable work of the pioneers who placed fellmongering, wool-scouring, and basil-tanning on a solid foundation, and although we advocate improved methods scientifically controlled, we yet recognise the valuable pioneering work which makes improvements possible.

DISCUSSION.

Mr. A. B. **HECTOR** inquired whether anything was done in New South Wales in the extraction of wool fat?

Mr. **GRIFFITHS** asked whether the authors had tried the use of lime-sulphur mixture in painting the skin, *i.e.*, the preparation obtained by boiling lime and sulphur together in water?

Mr. B. J. **SMART** said that in the plumping process, as practised in England, he understood that for some leathers the use of lactic acid did not have the tendency to rot the leather so much as sulphuric acid.

Mr. A. M. **WRIGHT** said that in New Zealand it was usual to wash the skins thoroughly in fresh water. Lime and sodium sulphide paint was used for something like 1½ million skins per annum, and this method was considered to give greater control than sweating. He thought that where results were erratic, this arose from underliming, from not adequately drenching the skins.

Dr. R. **GREIG-SMITH** said that skin substance was really a kind of gelatin, and that the action of lime seemed to be to loosen the fibre; but in the case of tripe, which is another kind of gelatin, its action is to harden the fibre. He would like to know the reason for the difference.

Mr. **COOMBS**, in reply, said that the fat was not usually recovered from the wool, except when it became necessary to prevent the contamination of a clean stream of water. With regard to the use of lime-sulphur preparation, he said the results were too variable. As regards the choice of acid to be used in plumping, lactic was fairly expensive, while sulphuric was cheap and removed iron stains more completely than lactic; and with regard to the action of lime on the skin substance, it at first made a very firm combination, and it was only after some days that the pelt became soft and pliable.

THE COMPOSITION AND NUTRITIVE VALUE OF MUTTON AND LAMB.

BY A. M. WRIGHT.

This investigation is a continuation of the work published in this Journal in 1912*; the present study covers the results of an investigation concerning the composition and nutritive value of the various retail cuts of mutton and lamb as sold in New Zealand.

Slaughter tests.—In connection with this investigation ten average quality sheep, and ten average quality lambs were taken from a line of stock received at the Christchurch Meat Company's Islington Works; these, after being fasted for twenty-four hours, were weighed alive and immediately slaughtered. In Table I. will be found the weights and percentages of the carcases and of the various by-products, based on the live weights.

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* This Journal, **31**, pp. 965—967.

TABLE I.

Results of slaughter tests.

	Pounds weight.		Per cent.	
	Ten Sheep.	Ten Lambs.	Sheep.	Lambs,
Live weight	1097·0	675·0	—	—
Dressed carcase (warm)	565·0	368·0	51·4	54·5
Dressed carcase (cold)	554·0	364·0	50·5	54·0
Wool	68·2	72·0	6·2	10·7
Pelt	51·8	30·0	4·7	4·4
Blood	47·0	24·5	4·3	3·6
Head	33·4	21·8	3·0	3·2
Feet	16·5	13·4	1·5	2·0
Fat (caul, kidney, and intestinal)	66·5	32·5	6·0	4·8
Diaphragm (skirt)	4·1	2·4	0·4	0·4
Tongue	4·0	2·9	0·4	0·4
Kidneys	2·7	1·7	0·3	0·3
Sweetbreads (thymus gland)	—	0·7	..	0·1
Brains	2·1	1·9	0·2	0·3
Heart	5·4	3·3	0·5	0·5
Lungs	12·4	8·2	1·1	1·2
Liver	16·9	8·3	1·8	1·2
Trachea (windpipe)	1·9	1·8	0·2	0·2
Spleen	1·9	1·0	0·2	0·1
Gall-bladder and contents	0·7	0·5	0·1	0·1
Small intestine	15·0	11·0	1·4	1·6
Large intestine	1·0	1·0	0·1	0·1
Other intestines	25·0	12·0	2·3	1·7
Stomach	37·0	18·0	3·4	2·7
Contents of stomach and intestines	104·5	35·5	9·5	5·5
Loss in dressing	14·0	2·6	1·3	0·4

Retail cuts. On the day following, a carcase of mutton weighing 55 lb. and a carcase of lamb weighing 35 lb. (cold weights) were selected from the twenty carcases from the slaughter test, for the purpose of the main investigation; these carcases were split and the left half of each, weighing 28 lb., and 18 lb. respectively, was cut into the joints usually offered for sale in the retail shops. In addition each cut was separated into lean meat, visible fat, and bone; in order to compare the various cuts as to their relative amounts of lean, fat, and bone the weights have been calculated to percentages; these figures which represent the untrimmed cuts are shown in Table II.

Relative cost of the retail cuts. Throughout New Zealand the prices of the various cuts differ considerably, and are liable to frequent fluctuation, so that absolute figures for the market retail price of the cuts would serve little purpose; it has been found, however, that by taking the cheapest cut as 1, the retail market prices bear relation to one another as follows:—Neck and breast of mutton, 1·00; shoulder of mutton, 1·50; fore quarter of lamb, 1·67; leg of mutton, 1·83; loin of mutton, 2·00; leg of lamb, 2·17; loin of lamb, 2·17. Thus, with the price of neck and breast of mutton at 3d. per lb., the other cuts in the above order will be 4½d., 5d., 5½d., 6d., 6½d., and 6½d. per lb.

TABLE II.

Average weight and percentage of lean, visible fat, and bone in the retail cuts.

	Weight in lb.				Per cent.		
	Lean.	Fat.	Bone.	Total.	Lean.	Fat.	Bone.
Mutton—							
Leg	5·4	1·3	1·2	7·9	68·4	16·4	15·2
Loin	4·7	2·4	1·5	8·6	54·8	27·8	17·4
Shoulder	5·2	0·9	1·0	7·1	73·2	12·7	14·1
Neck and Breast	2·0	0·6	1·8	4·4	45·5	13·5	41·0
Lamb—							
Leg	3·4	1·1	1·0	5·5	61·8	20·0	18·2
Loin	2·1	2·0	0·9	5·0	42·0	40·0	18·0
Fore-quarter	4·7	0·9	1·9	7·5	62·6	12·0	25·4

The chemical composition of the boneless meats. The right half of the carcases used in the previous determinations was sampled for chemical analysis, the total boneless meat (lean and fat) of each cut being used for this purpose.

Moisture. The moisture found in the various cuts ranged from 57·92% in the leg cut of the lamb to 40·12% in the loin cut of the same carcase, in general the higher percentage of fat being found associated with the lower moisture content.

Ash. The percentage of ash or mineral salts varied from 0·89% in the leg cut of the lamb to 0·49% in the loin cut of the same carcase; the ash is chiefly composed of the chlorides and phosphates of potash, soda, lime, and magnesia, which contribute largely towards the structure of the bone and other tissues; they also aid the digestive functions and increase the palatability of the cooked meats. There is no evident relation between market prices and the palatability of the different cuts as indicated by the amounts of mineral salts, the cheaper cuts shewing as much ash as the more expensive.

TABLE III.

Percentage chemical composition of the boneless meat of the retail cuts.

	Mutton.				Lamb.		
	Leg.	Loin.	Shoulder.	Neck and breast.	Leg.	Loin.	Fore-quarter.
Moisture	49·08	46·64	55·94	43·35	57·92	40·12	44·42
Ash	·87	·67	·76	·55	·89	·49	·64
Fat	22·60	37·48	27·66	42·56	24·08	48·38	40·54
Total nitrogen	2·956	2·394	2·495	2·112	2·742	1·688	2·283
Cold water extract							
Total solids	4·75	3·49	3·65	3·06	4·39	2·47	3·31
Ash	·75	·52	·56	·44	·71	·43	·51
Organic extractives	4·00	2·97	3·09	2·62	3·68	2·04	2·80
Nitrogen	·596	·430	·485	·375	·566	·311	·421
Coagulable proteins	1·72	1·31	1·36	1·18	1·66	·86	1·21
Non-coagulable proteins	·18	·12	·23	·11	·22	·11	·16
Total soluble proteins	1·90	1·43	1·59	1·29	1·88	·97	1·37
Meat bases	·92	·62	·72	·52	·78	·52	·63
Insoluble protein	14·74	12·24	12·55	10·79	14·87	8·59	11·62
Total determined protein	16·64	13·67	14·14	12·08	16·75	9·56	12·99
"Crude protein"*	18·48	14·94	15·56	13·18	17·11	10·56	14·27

* Nitrogen × 6·24.

Fat varies from 48·38% in the lamb loin cut to 22·60% in the mutton leg cut; as indicated above, it is noted that, in general, the higher the fat, the lower will be found the moisture content. The amounts of fat bear no relation to the market price of the meats.

Protein varies in the cuts from 16·75% in the lamb leg, to 9·56% in the lamb loin. The market prices charged for the cuts are not in proportion to the protein contents.

Meat bases, while possessing but slight food value, are of importance because of their influence on the palatability of the meat; they aid in giving cooked meat its flavour, and serve in part as stimuli to the digestive glands. No relation between the market price and the amount of meat bases seems to exist; indeed one of the highest priced joints, the lamb loin, contains 0·52%, while the lowest priced meat, the neck and breast of mutton, contains the same amount.

The results of the chemical analyses of the boneless meat of the various retail cuts are shown in Table 3.

Conclusion.

While some of the cuts are less tender and are therefore more difficult to prepare for use than others, yet the constituents (mineral salts and meat bases) which give flavour to cooked meats show little difference in the various cuts, and since the digestibility of the protein is independent of the cut, or the method of cooking,* it is evident from a study of the figures presented above that the retail market prices charged for the various cuts are not governed by the relative food values, or by the palatability of the meats.

For permission to publish these results the author desires to express his thanks to the Christchurch Meat Company (Limited), in whose laboratory the work has been carried out.

DISCUSSION.

Mr. T. U. WALTON questioned the accuracy of the opinion expressed that no relation existed between the market prices and the food values and palatableness of the different cuts. The lowest priced cut, the neck of mutton, contained (from Table 2) more than 10% of bone; while the fore-quarter of lamb had also a high proportion of bone. Owing to tenderness and delicacy of flavour, lamb fetched a higher price than mutton. Allowing for difference in percentage of bone, an equal quantity of boneless lamb cost nearly the same price from the different cuts. In the case of mutton also allowance for bone brings the prices nearer to one another, the higher price being paid for the fatter cut.

Mr. A. B. HECTOR thought that digestibility of meat depended on palatableness; that when the mouth was made to "water," hormones came into play and more digestive fluid was secreted.

Dr. R. GREIG-SMITH thought that to a large extent flavour was paid for in the different joints, and that some were more tasty because they contained more extractive matter than others.

Mr. T. STEEL was surprised to see that the leg contained so much fat, but he questioned the statement that the method of cooking made no difference to digestibility. He thought that ordinary experience was sufficient to convince anyone that there is a difference in digestibility of the same meat cooked in different ways.

Mr. F. A. COOMBS inquired whether there was any difference in the composition of meat from animals reared in a semi-tropical climate and in a colder climate.

The AUTHOR, in reply, admitted that there was a great deal in tenderness and palatability, but he said that the relative cost per pound of protein contents was much higher in the loin of lamb than in the shoulder of mutton. He agreed that the extractives were the stimuli which exercised the greatest influence on digestion; and for physiological reasons meals should be preceded by soups to give the stimulus to digestion. With regard to the climatic effect on the growth of the animal, he said that sheep from the South Island of New Zealand brought the highest price in the London market, though those in the North Island came very close to them.

Communication.

THE DETERMINATION OF TOLUENE, WITH A NOTE ON THE APPLICATION OF THE METHOD TO BENZENE AND XYLENE.

BY HUGH W. JAMES, A.R.C.SC. (LOND.).

The following method of determining toluene was devised in view of the extended nature of the Government requirement for coal tar distillates. It is hoped that this method may prove useful to those manufacturers and chemists whose work may necessitate the use of a rapid and accurate test.

The results given in Part II. have been found of considerable assistance in following the progressive changes in composition of the distillates obtained from benzol stills that are employed in the production of pure benzene and pure toluene.

DETERMINATION IN NAPHTHAS.

The Specification is divided into two parts. The object of Part I. is, by means of a fractional distillation, to obtain two fractions, I. and II., of which the former is substantially a mixture of toluene and benzene, and the latter a mixture of toluene and xylenes. In Part II. each of these fractions is submitted to a rapid distillation, from the results of which the percentage of toluene in each case can be determined by reference to the Tables provided.

A sample of one pint of the naphtha should be available. The top of the thermometer bulb should be ½ inch below the side tube of the flask or column. The thermometers used must be correct or their error known. Barometric correction should be made on the basis of 0·1° for each tenth of an inch above or below the standard. A round-bottom flask should be employed, as the fractions can then be distilled to a small residue.

Part I.

In which the naphtha is submitted to a series of three distillations referred to as stages A, B, and C. A fractionating column is necessary for all these distillations, one or other of the following being recommended:—Le Bel-Henninger, 6 bulbs; Young's "rod and disc," 20 discs; Young's "pear" still head, 12 bulbs; Young and Thomas' "evaporator" still-head.

Each stage, whether A, B, or C, should be started with a clean and dry flask, column, and condenser. The rate of distillation is to be maintained throughout at one drop per second from the end of the condenser. If the column is of such type that it retains liquid when in an upright position, it should be drained (by inverting or otherwise) into receiver No. 6 at the end of stages B and C.

Procedure.

A. Distil 250 c.c. to 140° C. A preliminary distillation of 100 c.c. may be made. If at least 95% distils below 140° C., distillation A is dispensed with, and the original 250 c.c. is at once submitted to B.

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* Grindley and Emmett, Bulletin 162, U.S.A. Dept. Agric., O.E.S.; also Grindley, Monjonnier, and Porter, Bulletin 193, U.S.A. Dept. Agric., O.E.S.

B. Re-distil the distillate obtained in A (or the original sample), collecting fractions in receivers numbered as under :—1. Below 90° C. 2. 90° to 100°. 3. 100° to 109°. 4. 109° to 112°. 5. 112° to 120°. 6. Residue at 120° C.

C. Re-distil the fractions 2, 3, 4, and 5 separately, receiving all the liquid that distils below 110·6° C. in each case in receiver No. 1, and adding all residues that remain undistilled in each case at 110·6° to that in receiver No. 6.

If on re-distilling No. 2 the residue in the flask becomes so small that distillation must be stopped before 110·6° C. is reached, the flask is allowed to cool. Fraction No. 3 is then added to the residue of No. 2, and the distillation continued. If the distillation of No. 3 or of No. 4 has similarly to be stopped before 110·6°, the same procedure is to be followed, No. 4 being added to the residue of No. 3, and No. 5 to the residue of No. 4.

Exceptions.

No. 1. Crude unwashed naphtha.

If a crude unwashed naphtha is under examination, it must be distilled to 150° in stage A. The distillate is washed with sulphuric acid in the usual way, and is then submitted to B, the following fractions being collected :—1. Below 90°. 2. 90° to 100°. 3. 100° to 109°. 4. 109° to 112°. 5. 112° to 120°. 6. 120° to 140° C. In stage C, all the above fractions are separately distilled to 110·6° into No. 1 ; and all the residues at that temperature are poured, when cold, into a vessel No. 7.

No. 2. Commercial benzol or toluol.

If a commercial benzol or toluol is under examination, it is at once submitted to B, as in this case stage A is not required.

Part II.

The sample now having been separated into three fractions, namely :—No. I. Distillate obtained below 110·6°, in vessel No. 1 ; No. II. Distillate from 110·6° to 140°, in vessel No. 6 (or 7) ; No. III. Residue at 140°, which, if any, is discarded, proceed as follows :—

Nos. I. and II. are measured, and the volumes corrected for loss due to the film of liquid remaining in the several receivers used in each case. The amount of this loss must be determined. This may be done by pouring a known volume of benzol or toluol from a graduated measure into each receiver, agitating it in order completely to moisten the interior of the vessel, and subsequently draining the liquid back into the measure, noting the loss in volume.

Precautions relative to Part II.

Before distilling, the flask and condenser tube should be moistened with the fraction to be distilled in each case, and allowed to drain. After distillation, and when cool, the residue is drained into the measure containing the distillate, and any loss added to the observed volume of distillate. The graduated vessel used in measuring out the liquid, should be employed, without drying, for collection of the distillate.

The flask used should have a neck about 5 inches long, with side tube at about the middle of the neck ; and the bulb should be of about 150—180 c.c. capacity.

Procedure.

No. I. Fraction.—This fraction (or 100 c.c., if there be sufficient of it) is distilled from a distillation flask, with side tube in neck, at the rate of two drops per second. The distillation is stopped at 85°, 90°, 95°, 100°, and 108° C., the total percentage of distillate, if any, at each temperature being noted. It will be found that one of the readings will be within or very near the range of one of the columns in Table I., from which the percentage of toluene in Fraction I. can be interpolated.

The distillation is finished when the total percentage of distillate at one of the above temperatures falls within the range of the corresponding column in Table I.

No. II. Fraction is similarly treated, the distillation being stopped at 115°, 120°, 125°, 130°, and 137° C., and the total percentage of distillate again noted for each temperature. Reference is then made to Table II.

From the resulting figures the total toluene in each fraction I. and II. is calculated, and the sum of these is the toluene in the original 250 c.c. of naphtha.

The following particulars of a commercial benzol illustrate the procedure: *Fraction I.* 234 c.c. giving 83% distillate at 85° C. Reference to Table I., column 1, indicates that it contains approximately 9% toluene = 21·1 c.c. *Fraction II.* 15 c.c. giving distillates as under :—115°, 27% ; 120°, 57% ; 125°, 65% ; 130°, 78%. Reference to Table II., column 2, shows that a distillate of 57% at 120° represents approximately 69% toluene = 10·3 c.c. ; total toluene, 31·4 c.c. ; toluene in original sample $\frac{31\cdot4}{250}\times100=12\cdot6\%$.

The method is available for determination of toluene in crude coal tar naphtha ; in the light oils resulting from the scrubbing of coal gas and of coke oven gas ; in commercial benzol, toluol, and solvent naphtha ; also for determination of toluene in "motor benzol" to which solvent naphtha has already been added.

The time required for carrying out a test averages about 3½ hours.

Trial of various mixtures of benzene, toluene, and xylenes.

The percentage of toluene indicated by the preceding test is placed against the known percentage of toluene in each case.

No.	Benzene %	Toluene %	Xylenes %	Heavy naphtha and creosote %	Toluene indicated by test. %
1	86	12	2	—	12·6
2	20	65	15	—	65·2
3	3	15	82	—	16·0
4	47	3	50	—	5·2
5	5	90	5	—	89·6
6	18	8	18	56	7·0
7	50	0	50	—	3·0

Considerable experience and practice with the above method have shown that, for naphthas containing not less than 30% of toluene, the amount of error should not reach 1%. In the case of naphthas containing less than 30%, the error may reach, or slightly exceed, 1%. The indications are unsatisfactory only when toluene is absent, or present in very small quantity. A more rigorous fractionation in the first part of the test would reduce this error, but it would be unwise to make the method more complicated and more lengthy in order to deal with such cases.

A course of procedure for naphthas of low toluene content would be to carry out the determination on a mixture consisting of 40% of pure toluene and 60% of the naphtha under examination. The results, after allowing for the added toluene, will then be satisfactory.

Correction for paraffinoid hydrocarbons.

Paraffinoid hydrocarbons are detected by a specific gravity determination, which should be made on fraction 11. at 15·5° C. The specific gravity of this fraction should lie between 0·865 and 0·870, as the toluene obtainable from such a naphtha would include, at most, only traces of paraffins, and would have a specific gravity above 0·868, and thus be of a quality suitable for those purposes for which pure toluene is required.

In actual determination of the paraffins it may be taken that the "pure" toluene obtainable from a naphtha would contain 1% of paraffinoid hydrocarbons for every 0·002 by which the specific gravity of fraction No. 11. at 15·5° C. falls short of 0·867.

For example, a naphtha shows, on analysis, 74·0% of toluene. The specific gravity of fraction No. 11. is 0·861—that is, 0·006 below 0·867. The "pure" toluene from this naphtha would contain 3% of paraffins. To correct the indicated per cent. of toluene for this, subtract from it 3% of its total, thus :—$74 \times 0·03 = 2·2$ (approximately). Toluene in the sample = 74·0—2·2 = 71·8%.

TABLE I.

Toluene. %	Mixtures of toluene and benzene.				
	85°	90°	95°	100°	108°
1	—				
2	—				
3	98·2				
4	94·5				
5	91·0				
6	89·2				
7	87·0				
8	85·0				
9	82·6				
10	80·0				
11	77·0				
12	74·2				
13	71·0				
14	68·0				
15	64·0				
16	60·0				
17	56·2				
18	52·4				
19	48·0				
20	42·5				
21	37·0				
22	32·0				
23	28·0				
24	23·0				
25	17·0	71·3			
26		69·5			
27		67·2			
28		65·0			
29		63·0			
30		60·7			
31		58·0			
32		55·6			
33		53·0			
34		50·5			
35		48·0			
36		45·0			
37		42·1			
38		39·5			
39		35·5			
40		33·2			
41		30·0			
42		26·8			
43		23·2			
44		19·5			
45		16·0	57·0		
46			55·3		
47			53·5		
48			51·5		
49			49·5		
50			47·2		
51			44·9		
52			43·0		
53			40·2		
54			38·0		
55			35·2		
56			32·8		
57			30·5		
58			28·0		
59			25·0		
60			22·0	56·5	
61				54·5	
62				52·3	
63				50·1	
64				47·9	
65				45·6	
66				43·2	
67				40·8	
68				38·2	
69				35·7	
70				33·0	
71				30·0	
72				27·0	
73				24·0	
74				21·0	
75				18·0	76·0
76					75·0
77					73·9
78					72·6
79					71·3
80					70·0
81					68·4
82					66·8
83					65·0
84					63·0
85					60·8
86					58·2
87					55·9
88					52·5
89					49·1
90					45·0
91					40·0
92					35·0
93					29·0
94					21·0
95					11·0
96					6·0
97					3·0
98					—
99					—
100					—

TABLE II.

Toluene. %	Mixtures of toluene and xylenes.				
	115°	120°	125°	130°	137°
1					—
2					—
3					4·0
4					6·5
5					11·0
6					17·0
7					23·0
8					28·0
9					32·3
10					37·0
11					41·0
12					45·0
13					48·5
14					51·2
15					53·5
16					55·8
17					58·0
18					59·8
19					61·5
20					63·3
21					65·0
22					66·1
23					67·8
24					69·2
25				21·7	70·5

Toluene. %	Mixtures of toluene and xylenes.				
	115°	120°	125°	130°	137°
26				24·7	
27				27·5	
28				30·3	
29				33·0	
30				35·7	
31				38·2	
32				40·7	
33				43·1	
34				45·4	
35				47·6	
36				49·8	
37				51·8	
38				53·5	
39				55·3	
40				57·2	
41				59·0	
42				60·7	
43				62·3	
44				63·8	
45			36·3	65·3	
46			38·8		
47			41·2		
48			43·4		
49			45·7		
50			48·0		
51			50·2		
52			52·3		
53			54·5		
54			56·6		
55		17·0	58·6		
56		20·0			
57		23·5			
58		26·5			
59		29·5			
60		32·7			
61		35·7			
62		38·7			
63		41·5			
64		44·0			
65		46·7			
66		49·5			
67		52·1			
68		54·9			
69		57·2			
70		59·6			
71		62·0			
72		64·5			
73		67·0			
74		69·4			
75		71·6			
76		73·7			
77		75·7			
78		77·5			
79		79·2			
80	41·5	80·9			
81	46·0				
82	50·0				
83	54·0				
84	58·0				
85	62·0				
86	66·0				
87	70·0				
88	73·5				
89	76·3				
90	79·3				
91	82·2				
92	85·0				
93	87·7				
94	90·4				
95	93·0				
96	95·5				
97	98·0				
98	—				
99	—				
100	—				

DETERMINATION IN COAL TAR.

For the purpose of determining the toluene in coal tar it is necessary to separate the crude naphtha from the tar by fractional distillation, and to wash this naphtha (which contains the whole of the toluene) with sulphuric acid before applying the test described above.

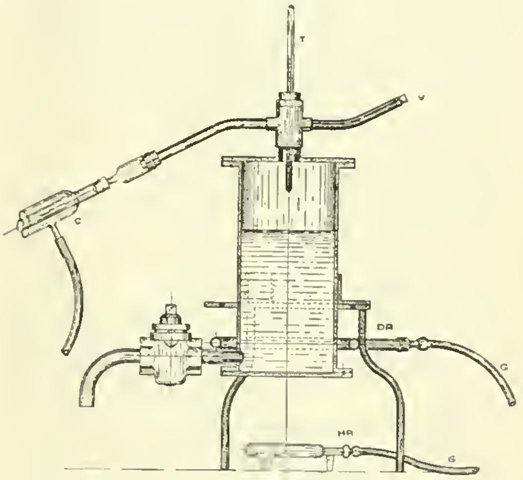
Sufficient of the tar is distilled to yield at least 250 c.c. of crude naphtha. Generally, 8000 c.c. of tar will be found ample. Some tars, however, contain so much naphtha that 4000 c.c., or even less, may be used.

Part I.

Distillation of the tar.

The tar is placed in a glass retort or an iron still, preferably the latter. A convenient and easily-constructed still is shown in the diagram.

Tar still for laboratory use.



T. Thermometer. V. Cork loosely inserted to act as safety valve. C. Water-cooled condenser. GG. Gas supplies. HR. Ring burner for preliminary heating. DR. Ring burner employed as additional source of heat when the water has been distilled off.

A thermometer is fitted in such a position that the bulb is surrounded by the vapour in the still. The delivery-pipe of the still is connected to a water-cooled condenser. Distillation is then started. The distillate is collected in a receiver which, when the thermometer indicates 220° C., is removed and a second receiver substituted for it. When this change of receivers is made, the supply of water to the condenser is shut off. The distillate is collected in the second receiver until the thermometer indicates 260° C., at which point the distillation is stopped.

During the time that the distillate is being collected in the first receiver, a sample, amounting to two or three drops of the distillate, should be taken periodically, and allowed to fall upon the surface of cold water contained in a beaker or other suitable vessel. When one of these samples becomes partly or wholly solid, the water supply to the condenser is shut off, and the water remaining in the condenser is allowed to become warm. The water supply is shut off in any case, as stated above, when the change of receivers is effected. This is done in order to avoid the risk of blockage by naphthalene, which would be very dangerous.

From the foregoing procedure two fractions are obtained, namely :—(*a*) Light oil and water up to 220° C. ; (*b*) creosote oil, 220° to 260° C.

Part II.

Distillation of the products obtained in Part I.

For this purpose a fractionating column is employed. A strip of cotton material is wound round the column in such a manner as completely to cover it except the side tube and the portion that projects within the neck of the flask containing the product to be distilled. This prevents the formation of too much liquid by undue condensation in the column. The top of the thermometer bulb should be ½ inch below the side tube of the column.

The light oil is separated from the water and is then distilled to 190° C. The water is measured. The creosote oil is similarly distilled to 190°. The distillate from the creosote oil is now added to that obtained from the light oil, and the mixture is thoroughly shaken. If any water settles out, it is separated and measured. The total quantity of water obtained from the tar is noted.

The mixture of distillates obtained from the light oil and the creosote oil now constitutes the crude naphtha of the tar. The crude naphtha is measured. 250 c.c. is then distilled to 150° C., and treated as described in "The determination in naphthas." (*Vide* Exception No. 1, *ante*.)

The following are particulars of an actual determination:—Tar taken, 7000 c.c.; less water, 300 c.c.; tar (anhydrous), 6700 c.c. Yield of crude naphtha, 400 c.c.

Determination of toluene in the crude naphtha.—Distillate to 150° (prior to washing with acid), 106 c.c.; loss on washing with acid, 8 c.c.; washed distillate = 98 c.c.

Fraction I.—49 c.c., giving 35 % distillate at 85° C. Reference to Table I., column 1, indicates that it contains 21·4 % toluene = 10·5 c.c. *Fraction II.*—29 c.c., giving 43 % distillate at 120° C. Reference to Table II., column 2, indicates that it contains 63·6 % toluene = 18·4 c.c. Toluene in 250 c.c. of naphtha, 28·9 c.c. The total amount of toluene in the 400 c.c. of naphtha, and, of course, in the tar from which this naphtha was distilled, is $\frac{28{\cdot}9 \times 400}{250} = 46{\cdot}2$ c.c. The amount of toluene in the anhydrous tar is therefore $\frac{46{\cdot}2 \times 100}{6700} = 0{\cdot}69\ \%$.

Assuming that 1 ton of coal yields 10 gallons of anhydrous tar, and taking the weight of 1 gallon of toluene as 8·7 lb., the amount of toluene obtained per ton of coal carbonised will be $0{\cdot}069 \times 8{\cdot}7 = 0{\cdot}60$ lb.

DETERMINATION OF BENZENE.

No. 1 Fraction, Part II., contains the benzene present in the original naphtha, and consequently its amount can be approximately ascertained by subtraction, from the total volume of this fraction, of the amount of toluene it contains. As determined in this manner, the figure found will include any carbon bisulphide and thiophen present.

DETERMINATION OF XYLOL (SOLVENT NAPHTHA).

The determination of the xylenes by fractional distillation is not satisfactory, owing to the probable presence of ethylbenzene and other hydrocarbons. For the approximate estimation of xylol (solvent naphtha) the following procedure, in the case of a crude naphtha, will demonstrate the method. Distil the naphtha to 190° C. (through a column), wash the distillate with sulphuric acid, etc., and submit the washed naphtha to stage A of the toluene determination (*vide* Exception No. 1—Crude Naphtha), collecting, however, an additional fraction distilling between 150° and 170° C. The amount of xylol will then be found by adding together the following three quantities:—(*a*) The fraction obtained in stage A between 150° and 170°; (*b*) the fraction obtained in stage B between 140° and 150°; (*c*) the difference between the quantity of toluene in fraction II. and the total amount of that fraction.

APPLICATION TO WORKS PRACTICE.

In the case of benzol stills employed in the production of pure benzene and pure toluene, the distillate obtained between the two pure products, though it may contain very small amounts of xylenes, etc., may be regarded practically as a mixture of toluene and benzene; also, the distillate that follows after pure toluene has ceased to appear, may be regarded practically as a mixture of toluene and xylenes.

Consequently, by submitting 100 c.c. of the run of the still to distillation as described in Part II. of the method for the determination in naphthas, and by subsequent reference to the tables given, the composition of the distillate at any moment can be revealed, and thus the course of the distillation can be intelligently followed. This simple test can be performed by the stillman himself with very little practice, and it can be accomplished in a few minutes. It is hardly necessary to lay stress on the advantage of knowing exactly what a still is doing at any moment.

NOTE ON THE WASHING OF NAPHTHA WITH SULPHURIC ACID.

The naphtha is shaken with 10 % of its volume of concentrated sulphuric acid for ten minutes in a separating funnel. (The mixture of acid and naphtha frequently becomes so hot that partial sulphonation of the latter occurs. To obviate this as far as possible, the separator containing the mixture should be immediately immersed in cold water, and shaken under the surface of the water until the contents no longer tend to become hot.)

The separator is allowed to stand for half-an-hour for settlement of the brown "acid-tar." This is then run off and 50 c.c. of water is poured in, but not agitated with the naphtha. When complete separation has occurred, the water is drawn off, and similar washings of water are poured in, without shaking, until they are free from opalescence. The naphtha is then, and then only, shaken gently with further successive washings of water until these no longer show opalescence. Ten c.c. of a clear solution of caustic soda (sp.gr. 1·075) is then run in and shaken with the naphtha, and drawn off, after complete separation. (If the solution of caustic soda is not entirely free from suspended solid matter, difficulty will probably be experienced in effecting a separation from the naphtha.)

Finally, the naphtha is shaken with two washings of water, each of 50 c.c., which are drawn off to the last drop.

Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Ferou 8, Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

British Patent Laws, and their bearing on future German trade. J. Keith. J. Gas Lighting, 1916, 133, 309.

THE Patents Act of 1907, with the Act of 1914 and rules made thereunder—after the war had begun—are stated to be responsible for the following present grievances:—1. The Comptroller of the British Patent Office has not apparently the power to refuse acceptance of any application for a British patent, even although a patent for the identical invention may have been granted and published years before in a foreign country. 2. Any German desiring to appropriate a British invention for which a British patent has been granted to a British inventor may do so in the following circumstances: Supposing the British inventor applies within twelve months for a patent in Germany for his invention, his application may be successfully opposed there on one ground or another, and a decision issued in circumstances such that the British applicant cannot secure a hearing. In the case of an opposition to a British application of a German subject, proceedings are postponed to the end of the war. 3. Under the 1907 Patents Act, anything known or unknown for which a patent is applied in this country, however impracticable (for which a British patent specification has not been filed in the British Patent Office Library during fifty years before the date of application), is entitled to British patent protection—51 years' anticipation does not count.

It is urged that in the revision of our patent system (foreshadowed recently by Mr. Runciman, the President of the Board of Trade), there should, among other things, be included:—1. A real search to ensure novelty and validity, before any application for a patent be entertained. 2. No patent to be granted unless novel or practicable. 3. The entire abolition of all renewal fees. 4. The extension of the period for each patent from fourteen to seventeen years. 5. Some form of a guarantee for a *bonâ fide* inventor. 6. Simplified Court procedure in patent cases, so as to limit the heavy expense of patent litigation. Moreover, in the formulation of any new Patents Act, inventors, engineers, and business men should be called into consultation more than patent-counsel, lawyers, and patent agents, as has hitherto been the case.

PATENTS.

Drying by hot air circulation; Process of and apparatus for——. G. D. Harris, Bayonne, N.J., U.S.A. Eng. Pat. 23,291, Nov. 30, 1914.

HEATED air is passed successively over the upper and lower surface of the material to be dried, which is supported on foraminous trays in a superposed series of chambers. The air is reheated by coils in chambers at the side of the drying chamber between each passage over or under the material.—W. H. C.

Vacuum-dryer. H. E. Allen and F. T. Mitchell, Washington, D.C. U.S. Pat. 1,165,306, Dec. 21, 1915. Date of appl., May 25, 1915.

A CYLINDRICAL, jacketed, vacuum drying chamber has ground flanges at each end, which make a tight joint with seats formed in the flanges of the end walls of the chamber. The ends are kept in position by bolts which pass through the annular heating space.—W. H. C.

Dryer. A. F. Grambauer, Chicago, Ill. U.S. Pat. 1,165,774, Dec. 28, 1915. Date of appl., Mar. 27, 1914.

AN inclined drum is provided with axial heating coils and with a rotating shaft carrying brushes which sweep over the inner surface of the drum and the outer surface of the heating coils, and at the same time feed the material forward. Air is forced through the drum in the opposite direction.—W. F. F.

Drying ovens; Automatic regulation of the temperature of—— by means of a thermostat. H. Laissle, Cannstatt. Ger. Pat. 287,706, Oct. 17, 1913.

THE movement of the thermostat is communicated by suitable gearing to a connecting rod having projections which work in slotted pieces controlling the valves of the fuel and air supply pipe. The inclination of the slotted pieces to the connecting rod is adjustable. Dampers in the heating flues are also operated by the movement of the thermostat.—A. S.

Furnaces; Reverberatory and the like——. A. Payne, Moxley, and W. Smith, sen., W. Smith, jun., J. F., F. J., and S. B. Smith, Darlaston. Eng. Pat. 4948, Mar. 31, 1915.

WATER-COOLING chambers are formed in the side walls and bridge of the combustion chamber of an oil-fired furnace. The water chambers have taper branches leading to the combustion chamber. The liquid fuel is supplied from a main through pipes, which are fixed in the water chambers and provided with atomising jets, which pass through the tapered branches. Air is supplied to a closed chamber beneath the hearth, which is formed partially or entirely of perforated bricks, and passes up through the perforations into the combustion chamber. The hearth may be fixed or made to slide in and out of the furnace.—W. H. C.

Separator. Sifter or screen. G. H. Fraser, New York. U.S. Pats. (A) 1,165,865, (B) 1,165,866, (C) 1,165,867, (D) 1,165,868, (E) 1,165,869, and (F) 1,165,870, Dec. 28, 1915. Dates of appl., (A) Dec. 29, 1910; renewed Mar. 30, 1915; (B), (C), (D), (E), and (F), June 29, 1915.

(A) THE material in the separator is divided by distributors into a number of separate portions, and currents of air are caused to flow horizontally outwards through each portion by independent suction blowers surrounding each distributor. (B) The material enters the separator at the top, and falls into an inverted cone having a depending central tube opening into a chamber into which air is forced through a tangential inlet by a blower. The material is forced back and outwards over the top of the cone, and falls through an annular space bounded by the outer wall of the casing and a cylinder depending from the periphery of the cone. The heavier particles pass downwards to an outlet and the lighter particles pass upwards within the cylinder and over the edge of a cone just below the first-mentioned cone.

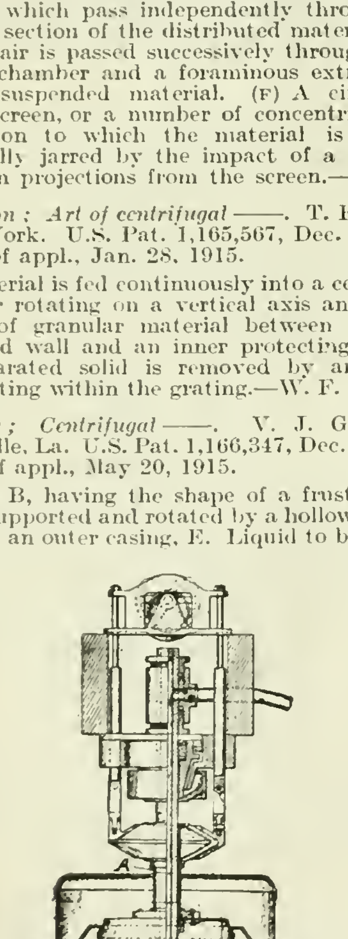
This cone is provided with a similar depending tube, which opens into a settling chamber connected to the suction side of the blower. (C) The material is fed into a rotating cup in the upper part of the casing, and is distributed over the rim on to the uppermost of a series of superposed and alternately oppositely inclined annular plates spaced apart from one another. Air is caused to flow through the series of plates from within, while collecting cones for coarse and fine material are provided below the chambers inside and outside the series of plates. (D) The material is fed by a rotary distributor against a series of inclined baffles above a collector for coarse material, on the same principle as in (C), while air is forced through from within to a surrounding annular chamber opening into a settling chamber below. An outer annular chamber, open at the bottom, is connected tangentially at its upper end to the suction side of the blower. (E) In apparatus as in (D), the air is divided into annular currents which pass independently through each separate section of the distributed material. The exhaust air is passed successively through a dust settling chamber and a foraminous extractor, to remove suspended material. (F) A circular or conical screen, or a number of concentric conical screens, on to which the material is fed, are periodically jarred by the impact of a revolving striker on projections from the screen.—W. F. F.

Separation; Art of centrifugal ——. T. E. Brown, New York. U.S. Pat. 1,165,567, Dec. 28, 1915, Date of appl., Jan. 28, 1915.

THE material is fed continuously into a centrifugal separator rotating on a vertical axis and having a filter of granular material between its outer perforated wall and an inner protecting grating. The separated solid is removed by an ejector reciprocating within the grating.—W. F. F.

Separator; Centrifugal ——. V. J. Gianelloni, Burtville, La. U.S. Pat. 1,166,347, Dec. 28, 1915. Date of appl., May 20, 1915.

A DRUM, B, having the shape of a frustum of a cone, is supported and rotated by a hollow spindle, A, within an outer casing, E. Liquid to be treated is supplied to the hollow spindle and passes through perforations into the drum. The smaller end of the drum is closed and is provided with perforations spaced away from the periphery, and the lower, larger end is provided with a cover, C, which can be closed or opened whilst the drum is rotating. The outer casing is provided with a diaphragm, E^1, and with outlets, G, F.—W. H. C.



Refrigeration; Process of ——. H. H. Southworth, Cleveland, Ohio, and C. G. Armstrong, New York, Assignors to The Iceless Machine Co., Cleveland, Ohio. U.S. Pat. 1,165,633, Dec. 28, 1915. Date of appl., June 14, 1912.

GAS is driven off from a solution thereof in a still, and condensed in an absorbent liquid. The condensed gas is re-evaporated by heat abstracted from the substance to be cooled, and passed back to the original solution. The heat acquired by this weak solution in the first stage is used to control the heat supply to it, and to release the solution to an intermediate vessel, whence it passes to the absorbing vessel, whilst strong solution from the latter passes to the still. The heat of the weak solution after leaving the still is used to control the admission of the strong solution from the absorber to the still. The transference is effected by the pressure set up due to the interchange of heat between the weak and strong solutions.—W. F. F.

Catalytic metal [nickel] powder. C. Ellis, Montclair, N.J. U.S. Pat. 1,165,956, Dec. 28, 1915. Date of appl., July 3, 1915.

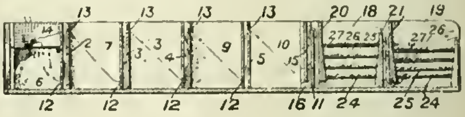
A CATALYTIC metal powder is prepared from a friable mixture of non-colloidal nickel hydrate (hydroxide) and salts soluble in water, but free from insoluble foreign substances.—W. F. F.

Catalytic body [cerium] and method of making the same. C. Ellis, Montclair, N.J. U.S. Pat. 1,167,280, Jan. 4, 1916. Date of appl., Aug. 9, 1912.

GRANULAR charcoal is purified by treating it with solvents to dissolve compounds of alkali and alkaline-earth metals. After drying, the purified charcoal is impregnated with finely divided cerium by spraying it with the atomised molten metal. —W. H. C.

Filtering apparatus. J. P. Albert, Warren, and N. R. Buller, Harrisburg, Pa. U.S. Pat. 1,166,802, Jan. 4, 1916. Date of appl., Apr. 21, 1915.

A RECTANGULAR tank is divided by a series of detachable hollow partitions, 2, 3, 4, 5, 20, 21, into a series of separate compartments, 6, 7, 8, 9, 10, 18, 19. The liquid to be filtered is fed into the compartment, 6, which is provided with a strainer, and flows from the bottom through the opening, 12, in the first partition, upwards between the partition walls and through the opening, 13, into the second compartment, 7, and so on to compartment, 10. From the latter it flows under the partition, 15, upwards and over the partition, 11, then downwards and below the partition, 20, into the compartment, 18. This compartment is provided with trays, 25, 26, 27, which support suitable filtering material, and the liquid flows upwards through the filter, over the top of the partition, 21, and in a similar manner through the compartment, 19.—W. H. C.



Filter; Pressure ——. Gebr. Sachsenberg A.-G., Rosslau. Ger. Pat. 287,243, Sept. 11, 1914.

A PRESSURE filter, for use in connection with fixed or rotating boilers in which alkali or other solutions are evaporated, consists of a box fitting in an opening in the wall of the boiler and fixed to this wall by means of bolts. The side of the box within the boiler is perforated, and at the opposite side the box is closed by a removable perforated plate held in place by bolts passing through the box. On the outer side of the perforated plate is a removable cover provided with an outlet opening. The inner faces of the perforated sides of the box are lined with filtering material, and the box is filled with gravel or the like.—A. S.

Filter-cakes; Process for automatically pressing —— and indicating the thickness of the cakes. A. L. Genter, Berlin-Wilmersdorf. Ger. Pat. 287,318, May 3, 1914.

A movable press-plate, D (fig. 1), is placed in the closed filtering chamber at the desired distance from the filter-plate, B. The liquid entering through A, exerts pressure on both sides of D, and maintains it in position until the press-cake, C, becomes sufficiently thick to interfere with the supply of liquid on one side of the plate, D, whereupon the latter is forced against the press-cake and compresses it; the thickness of the cake is indicated by the pointer, F. In fig. 2 is shown an arrangement in which the filter-plates, E, are movable and themselves act as press-plates.—A. S.

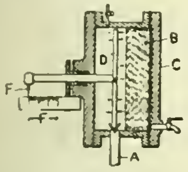


FIG. 1

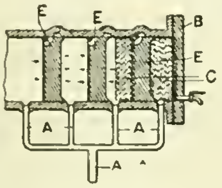


FIG. 2

Filter for dehydrating vinasse and the like. Schmidt und Blecher, Hamburg. Ger. Pat. 287,513, Apr. 28, 1914.

The filter-chamber is mounted to rotate around a vertical hollow shaft and is divided into compartments, each of which is provided at the bottom with a cylindrical casing into which a suction pipe and a pressure pipe open at different levels. An automatically operated piston valve opens and closes the openings, so that each compartment is placed alternately under suction and under pressure.—A. S.

Evaporator-shells; Automatic feed apparatus for ——. J. Sorensen, Brooklyn, N.Y. U.S. Pat. 1,166,273, Dec. 28, 1915. Date of appl., Mar. 31, 1915.

A vacuum evaporating vessel is provided with a float chamber connected with the evaporator below the level of the liquid and also connected with the space above the liquid by a vacuum conduit. A float within the float chamber operates a lever in the vacuum conduit to connect or disconnect the latter with a pressure device, which opens or closes the liquid feed valve.
—W. H. C.

Evaporator. J. Naef, Dermott, Ark. U.S. Pat. 1,167,204, Jan. 4, 1916. Date of appl., Oct. 1, 1915.

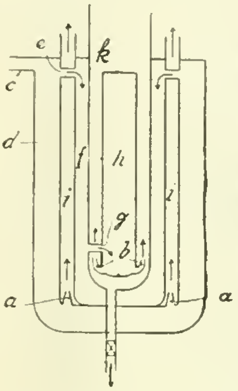
An open circular pan, having a dished bottom, is seated upon a boiler and has an upstanding spiral partition forming a spiral trough, through which the liquid to be evaporated flows from the periphery to the centre, where it is discharged through a pipe, which passes through the boiler. The spiral trough has radial plates to impede the flow of the liquid.—W. H. C.

Suspended solid or liquid particles from gases; Electrical separation of ——. H. Püning, Munich. Ger. Pat. 286,912, Nov. 5, 1913.

Vertical wires, threads, bands, or the like, down which water or other electrically conducting liquid is caused to flow, are used as discharge electrodes. Tarry or like particles are thus prevented from adhering to, and reducing the efficiency of the electrodes.—A. S.

Liquefaction and separation of gases; Accelerating the working of apparatus for the ——. R. Mewes, Berlin. Ger. Pat. 286,764, July 19, 1913.

The compressed gas enters at *c* into the annular chamber, *d*, passes through the valves, *a*, into the chamber, *i*, where it expands, and flows to the outlet as shown. At the same time either a portion of the compressed gas, entering at *c*, is passed through *e* into the chamber, *f*, and thence through *g* into *h*, or an independent supply of compressed gas is forced through a pipe not shown and then through *e* into *f*. At the commencement the valves, *b*, are kept closed and hence the gas in *f* and *h* is practically stagnant. The expanded gas flowing upwards through *i* cools the compressed gas flowing through *d*, and also, more strongly, the stagnant gas in *f*. After some time, the valves, *b*, are opened, and the compressed gas in *h* passes through and expands, and flows to the outlet, *k*, cooling still further the compressed gas in *f*, so that liquefaction of the gas in *h* commences very soon after opening the valves, *b*.—A. S.



Gases; Electrical purification of ——. G. A. Krause, Munich. Ger. Pat. 287,648, Oct. 9, 1913.

The discharge and the collecting electrodes of each set, of opposite polarity, are connected with the source of current alternately. In this way it is possible to place the electrodes very close to one another and utilise nearly the whole of the cross-sectional area of the chamber traversed by the gas under treatment. Moreover, the possibility of sparking between the electrodes is practically excluded, and hence it becomes possible to treat explosive gases.—A. S.

Gases; Electrostatic purification of ——. G. Brodtmann, Berlin. Ger. Pat. 287,783, Mar. 26, 1914.

The gas is dried before being passed into the purifying apparatus.—A. S.

Separating dust from air or other gases; Apparatus for ——. Zeitzer Eisengiesserei und Maschinenbau-A.-G., Zeitz. Ger. Pat. 287,189, Apr. 9, 1914.

The dust is separated by causing the air or other gas to pass through a rotating wheel provided with several layers of radial troughs, U-shaped in cross-section, disposed with their concave sides facing the stream of gas, and opening, at the periphery of the wheel, into an annular dust-chamber. The troughs are spaced apart, and those in one layer are in register with the intermediate spaces in adjacent layers; the intermediate spaces are blocked, except for a small opening, at some distance from the periphery.—A. S.

Agglomerates from powdered materials; Production of ——. C. A. Brackelsberg, Düsseldorf-Stockum. Ger. Pat. 287,606, Nov. 6, 1913.

The powdered material is mixed with a suitable solution to form a mixture which will set or harden on evaporation of the solvent. The mixture may be preheated and fed into a rotating drum, which serves both as an agglomerating and a drying chamber, or the cold mixture may be agglomerated in a rotating drum, and the agglomerates dried in a second, heated drum rotated independently of the agglomerating drum. The agglomerating drum is provided with pressing devices and means for conveying away the liquid which separates. Different solutions may be used as binding material according to the nature of the powdered material; manganese and iron ores, for example, may be agglomerated by means of solutions of a manganese salt and an iron salt respectively.—A. S.

Cleaning surfaces [of engines, etc.]; Process of ——. G. Durham and C. W. McGuirk, Scranton, Pa., U.S.A. Eng. Pat. 10,139, July 12, 1915. Under Int. Conv., July 10, 1914.

Tanks or the like for heating liquid. H. R. Brain, London. Eng. Pat. 14,122, Oct. 5, 1915.

Mixing apparatus. J. E. Marwedel, Cologne-Ehrenfeld, Assignor to Chem. Fabr. vorm. Weiler-ter Meer, Uerdingen, Germany. U.S. Pat. 1,166,139, Dec. 28, 1915. Date of appl., July 20, 1910.

See Ger. Pat. 228,544 of 1909; this J., 1911, 73.

Gases; Method and means for effecting the combination of ——. R. Winne, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,166,294, Dec. 28, 1915. Date of appl., Oct. 20, 1913.

See Eng. Pat. 6739 of 1911; this J., 1915, 552.

Drying apparatus. J. J. F. Balés, Talence, France. U.S. Pat. 1,166,311, Dec. 28, 1915. Date of appl., Mar. 5, 1914.

See Fr. Pat. 455,223 of 1913; this J., 1913, 859.

Emulsifying apparatus. S. H. Blichfeldt, Southall, Assignor to Flakes A S, Copenhagen. U.S. Pat. 1,166,319, Dec. 28, 1915. Date of appl., Aug. 24, 1914.

See Eng. Pat. 23,653 of 1913; this J., 1914, 1167.

Evacuation process. U.S. Pat. 1,166,792. *See* IIb.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal and coke supplies; Committees on ——.

Owing to the increasing demands of industries connected with the War, District Coal and Coke Supplies Committees have been appointed, with the object of ensuring that munition firms and other important consumers obtain the supplies they need with as little delay as possible. Committees have been formed or are in course of formation in the following districts:—1. Scotland; 2. Northumberland; 3. Durham; 4. Cumberland; 5. Lancashire, Cheshire, and North Wales; 6. West Yorkshire; 7. South Yorkshire; 8. Nottingham, Derby, and Leicester; 9. Staffordshire, Warwickshire, and Shropshire; 10. South Wales; and 11. Somersetshire and Forest of Dean, and Bristol Coalfield. It will be the business of these Committees to see that the resources of their districts are utilised to the best advantage and that the requirements of important industries are fully met. Mr. Runciman has appointed the following gentlemen to be a Committee to consider all questions relating to the distribution of coal and coke that may be referred to them from time to time by the Board of Trade or submitted by the District Coal and Coke Supplies Committees:—Mr. W. F. Marwood (Board of Trade), Chairman; Sir Richard A. S. Redmayne (H.M. Chief Inspector of Mines), Vice-Chairman; Mr. H. F. Carlill (Board of Trade); Commander T. Fisher (Admiralty); Mr. J. C. Hamilton Greig; Mr. F. J. Jones; Mr. Leonard W. Llewelyn (Ministry of Munitions); Mr. Arthur H. Pease; Mr. K. W. Price (Ministry of Munitions); Mr. F. Tatlow (Railway Executive Committee); and Mr. W. Walker (Deputy Chief Inspector of Mines). Mr. W. A. Lee (Board of Trade) and Captain C. E. Williams (Ministry of Munitions) will act as Secretaries to the Committee.

Wood; Determination of the calorific power of ——. K. Moroto. Bureau of Forestry, Dep. Agric. and Commerce, Tokyo, 1915. 4 pages.

The calorific power of 130 species of wood was determined by heating 2 grms. of each sample (sawdust) with an excess of litharge and multiplying the weight of lead reduced by 117: the results given vary between 1175·5 and 4469·2 calories per grm.—W. E. F. P.

Flame; Propagation of —— *in mixtures of hydrogen and air. The "uniform movement."* W. A. Haward and T. Otagawa. Chem. Soc. Trans., 1916, **109**, 83—89.

Mixtures of hydrogen and air, when ignited in horizontal tubes, behave differently from mixtures of methane and air (Wheeler, this J., 1914, 1195). The flame travels more rapidly in the hydrogen mixtures, and in some cases the explosion wave develops after the flame has travelled a short distance from the open end of the tube; but the phenomena preceding the development of the explosion wave, or occurring when the explosion wave is not set up, resemble those obtaining with mixtures of methane and air; the flame travels at first at a uniform speed, and this "uniform movement" is succeeded by a "vibratory movement." Experiments were made with mixtures ranging from the lower to the upper limit of inflammability, using tubes of 9, 11·5, and 25 mm. diameter. Over a great part of the range of inflammability, the speeds in the 11·5 mm. tube were 25—30 cm. per sec. higher than in the 9 mm. tube, and with a 25 mm. tube the speeds, over two-thirds of the range, were 75—100 cm. per sec. higher than in the 9 mm. tube. With mixtures rich in hydrogen, however, the speeds were almost identical in the three tubes; that is, the cooling influence of the walls became nearly negligible, owing probably to the high thermal conductivity of hydrogen. The maximum speed of propagation of the flame, which, in the 25 mm. tube, was about 500 cm. per sec., was obtained with mixtures containing 38—45% H, and not with one particular mixture as stated by Mallard and Le Chatelier (Ann. des Mines, 1883, [viii], 4, 314).—F. Sodn.

Petroleum and asphalt; Origin of ——. C. Richardson. Amer. Petroleum Congress, San Francisco, Oct. 25, 1915. J. Ind. Eng. Chem., 1916, 8, 4.

The author has shown previously (this J., 1915, 412) that the formation of Trinidad asphalt is to be attributed to the surface action of colloidal clay upon a heavy petroleum. This conception is now extended and it is considered that the origin of all forms of petroleum must be attributed to surface action between a natural gas and the "sands" with which it comes in contact. The character of the petroleum will depend on the nature of the gas and of the "sand." If the gas contain sulphur, a sulphur-containing petroleum will result, but this may be of a different type from a petroleum formed when the "sand" contains sulphur. This may explain the difference between Trinidad and Mexican petroleums, which contain sulphur in quite different forms. If the "sand" is of a colloidal nature, asphaltic petroleum will be formed, but if it more nearly resembles a true sand, showing less surface action, oil of a paraffin nature may be formed.—A. S.

Utilisation of kitchen refuse and industrial refuse for the production of dry fodder and fat, by the application of the waste heat in gas-works. Frank. *See* XIXb.

Patents.

Briquettes: Apparatus for cooling coked ——. Diamant-Brikettwerke G. m. b. H., Berlin. Ger. Pat. 287,372, May 13. 1914. Addition to Ger. Pat. 280,554.

The briquettes are conveyed from the carbonising kiln to a hopper and fall thence into a chamber in which they form a uniform layer on a sloping perforated table. A longitudinal reciprocating motion imparted to the table causes the briquettes to travel through and out of the chamber, whilst they are cooled and at the same time deprived of gases and dust by a current of cold air which is passed downwards through the table. The separated dust settles on the sloping floor of the chamber and passes out at its lowest point into a trough of water, and the gases are carried to an exit flue with the heated air.—F.Sodn.

Coke-ovens: Continuous process ——. J. A. Bishop, Mascoutah. Ill. U.S. Pat. 1,166,175, Dec. 28, 1915. Date of appl.. June 14. 1915.

The carbonising chamber of the coke-oven is provided with a rotary element having radial arms and shovels. which transfer the fuel from the centre towards the periphery of the chamber. The raw fuel is supplied through a central opening in the floor of the chamber and the coked material is discharged through a peripheral opening. The shovels are fixed on the rotating arms at an angle to the tangent of the circle in which each rotates. and in different radial positions, so that the transfer of the fuel from the charging opening in the centre to the peripheral discharge is regular and continuous.—J. B. C. K.

Coke ovens of exceptional height; Heating system for ——. Dr. C. Otto und Co. G. m. b. H., Bochum. Ger. Pat. 287,234, Sept. 15, 1914.

The heating walls of oven chambers of 3·5 m. or over have each two separate superposed systems of heating flues receiving gas and air independently of each other, so as to be heated more or less strongly at will. A regenerative oven is described, with vertical flues, heated from below with a portion of its own distillation gases, and a regenerative coke oven. heated from below, which is adapted for heating both with high- and low-grade gas.—F. Sodn.

Gas-producer. W. B. Chapman, Assignor to Chapman Engineering Co., New York. U.S. Pat. 1,165,569, Dec. 28, 1915. Date of appl., Feb. 26, 1912.

The producer is provided with a travelling shelf or scoop to remove the upper portion of the mass of ashes. The ashes are removed periodically from the scoop by a fixed or moving scraper mounted above it.—W. F. F.

Gas apparatus. O. B. Evans, Lansdowne, Pa., Assignor to The United Gas Improvement Co., Philadelphia. U.S. Pat. 1,165,657, Dec. 28, 1915. Date of appl., Aug. 6, 1912.

A gas-generator producing gas with an increasing combustible content is connected with a vessel for the combustion of the gas, and the secondary air-supply pipe communicating with this vessel is provided with a valve operated by mechanism which slowly opens the valve as the combustible content of the gas increases. A meter may be employed in connection with this valve, and a pressure device used for opening the valve, or a bell with counterweights may be employed for the same purpose.—J. B. C. K.

Gas; Means of controlling the quantity and quality of ——. J. M. Rusby, Assignor to The United Gas Improvement Co., Philadelphia. U.S. Pat. 1,165,715, Dec. 28, 1915. Date of appl., Oct. 12, 1909.

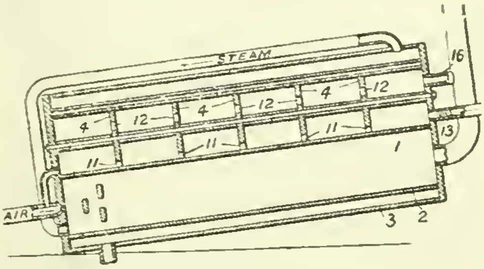
The primary and secondary air supplies to a gas-producer are produced by means of a fan under automatic control, so that the volume of air supplied to the primary and secondary air ducts can be maintained constant, means being provided for throttling the power which drives the fan, when the volume of air passing is in excess of that required by the producer.—J. B. C. K.

Gas; Method of making ——. H. A. Carpenter, Sewickley, Pa., Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,166,183, Dec. 28, 1915. Date of appl., June 1, 1914.

Coal is heated to a carbonising temperature within a retort having porous walls which allow the gas to escape, and different pressure conditions are maintained within the heating chamber and the retort so that the escape of the gas is facilitated. The heating chamber in which the retort is placed is heated by gaseous fuel.—J. B. C. K.

Gaseous fuel; Apparatus for producing ——. F. M. Rites, Ithaca, N.Y.; C. H. Gallagher, Exor., Assignor to P. C. Rites. U.S. Pat. 1,167,021, Jan. 4, 1916. Date of appl., May 27, 1915.

An apparatus for producing gaseous fuel from crude oil, consists of an inclined tube, 1. divided into compartments by parallel partitions, 4. Each of these partitions has an opening, 11. at the bottom to permit the oil to flow downwards through the compartments, also an opening, 12, in the top to permit the products of distillation to flow upwards through the compartments, from one end of the tube to the other. The crude oil is supplied through the tube, 13, and the gas produced is withdrawn through 16. The residue which drains from the tube is burned under it in the chamber, 2, in order to provide the heat required for vaporising the oil, and the tube is surrounded by a water-jacket, 3, for the production of steam, which is injected into the combustion chamber.—J. B. C. K.



Coal gas; Method of and apparatus for treating ——. H. A. Carpenter, Sewickley, Pa., Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pats. (a) 1,167,149 and (b) 1,167,150, Jan. 4, 1916. Dates of appl., May 6 and Aug. 6, 1914.

(a) The gas, as it comes from the retorts, is passed in a continuous stream through a stand-pipe which is maintained at a uniform gas-fixing temperature, and then into a gas container maintained at a substantially lower temperature, within which tar and certain other impurities are removed. (b) The apparatus includes one or more vertical stand-pipes in communication with the gas-generating apparatus, and discharging at their upper ends into a cooling and condensing chamber; the stand-pipes project upwards through the bottom of the cooling chamber. Means are provided for cooling the gas by a liquid spray immediately upon its discharge into the cooling chamber, and the purified gas passes out through a take-off main from the upper part of the cooling chamber. The cooling chamber has an outlet for liquid below the level of the upper ends of the stand-pipes. —J. B. C. K.

Water-gas ; Shaft-furnace for the production of ——. Dellwik-Fleischer Wassergas-Ges., Frankfort. Ger. Pat. 287,616, Nov. 10, 1914.

The furnace has a grate of inverted conical shape, to the bottom of which is fixed a pipe composed of bars with relatively wide spaces in between. This pipe connects the grate with the upper end of a discharge pipe projecting downwards from the bottom of the furnace into a water-seal. The clinker in passing from the grate to the discharge pipe is exposed to the air blast and steam entering below the grate, and any particles of coke present in the clinker are thus burnt.—A. S.

Petroleum ; Apparatus for refining ——. R. G. Jones, Los Angeles, Cal. U.S. Pat. 1,166,375, Dec. 28, 1915. Date of appl., Dec. 11, 1913.

Petroleum is heated in a series of communicating superposed vessels, alternate vessels fitting against opposite sides of the surrounding stack, so as to form a sinuous passage between them. These vessels, which are heated progressively from top to bottom, are connected with condensing jackets, and there are communicating cooling tubes connected with the lowest vessel. The vessels are fed through a main supply pipe which has two branches each closed by a valve. One of these is connected with the uppermost heating vessel, while the other passes through the condensing jackets. Means are provided for drawing off the vapours from the heating vessels.—C. A. M.

Oil ; Apparatus for treating [cracking] ——. C. J. Greenstreet, Webster Groves, Mo. U.S. Pat. 1,166,982, Jan. 4, 1916. Date of appl., Apr. 13, 1912.

The oil is injected together with steam into a helical coil, which is directly heated to dull redness in a furnace. On leaving the coil it passes through a condensing tank into a separating tank, whence it is drawn off from the aqueous layer into a collecting tank.—C. A. M.

Lubricating oils and the like ; Manufacture of ——. J. Rosen, Assignor to Soc. Anon. des Combustibles Industiiels, Paris. U.S. Pat. 1,165,909, Dec. 28, 1915. Date of appl., July 9, 1914.

To obtain lubricating oils, cylinder oils, and the like from petroleum residue, the latter is heated to about 320° C. in a series of communicating compartments, and solar oil or cracked oil, at a lower temperature, is introduced into one of the compartments, wherein it is vaporised and then serves as a carrier for the distillate from the petroleum residue.—A. S.

Combustible liquids from gases ; Production of ——. F. Hultgrén, Stockholm. Ger. Pat. 287,992, Dec. 25, 1912.

A gaseous hydrocarbon, carbon monoxide, or carbon dioxide, and hydrogen are caused to interact at a temperature of 2000°—4000° C. produced by an electric arc or an electric spark discharge, and the reaction products are cooled, whereby a volatile combustible liquid is recovered. For example, 1 part by weight of hydrogen and 13—15 parts of acetylene are brought together in a closed electric arc furnace. On cooling the reaction products a liquid of sp.gr. 0·723 and b.pt. about 85° C., is obtained. About 60% of the acetylene is converted, and 1 litre of liquid is obtained for a consumption of 2 kilowatts. With carbon monoxide about 50%, and with carbon dioxide about 30%, is converted into condensable products.—A. S.

Gas retorts ; Apparatus for controlling charging and discharging operations in connection with ——. H. A. Carpenter and A. W. Warner, Sewickley, and Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 5266, Apr. 7, 1915.

Gas coolers or air blast heaters [for gas producers]. K. Berninghaus, Duisberg, Germany. Eng. Pat. 513, Jan. 12, 1915. Under Int. Conv., Jan. 13, 1914.

Coke ; Apparatus for the manufacture of ——. J. Armstrong, London. U.S. Pat. 1,166,422, Jan. 4, 1916. Date of appl., Jan. 22, 1912.

See Eng. Pat. 4427 of 1911 ; this J., 1912, 323.

Petroleum ; Refining ——. H. G. Hennebutte, Paris. U.S. Pat. 1,165,877, Dec. 28, 1915. Date of appl., Nov. 1, 1910.

See Fr. Pat. 421,550 of 1910 ; this J., 1911, 409.

Hydrocarbons ; Distillation of ——. H. Hennebutte, Assignor to Soc. des Combustibles Industriels, Paris. U.S. Pat. 1,165,878, Dec. 28, 1915. Date of appl., Feb. 3, 1913.

See Eng. Pat. 28,972 of 1912 ; this J., 1914, 246.

Petrol-proof grease. Eng. Pat. 116. *See* XII.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Acetone as war material. Board of Trade J., Feb. 10, 1916.

The Minister of Munitions calls attention to the fact that dealings in acetone are now subject to the restrictions imposed under Defence of the Realm Regulation 30A, which provides that no person shall, without a permit, trade in any war material to which this Regulation may be applied by order of the Admiralty or Army Council or the Minister of Munitions.

Charcoal burning in Japan and condensation of wood vinegar. S. Mimura. Bureau of Forestry, Dep. Agric. and Commerce, Tokyo, 1915. 16 pages.

Japanese charcoal, of which about 1000 millio kilos. is consumed annually, is classified as " black " or " white " according as it is produced by th inside or outside method of kiln extinction. I the former process, the air and flue passage of the earthen kiln used are closed as soon a carbonisation is complete, and the product remove after perfect extinction of the fire ; in the latter the mouth of the stone kiln employed is graduall opened in proportion to the progress of carbonisation, on completion of which the charcoal i removed red hot and then covered with a mixtur of moist ash and charcoal dust. Black charcoa is generally soft and readily kindled but does no burn strongly ; white charcoal is strong burnin but difficult to kindle. The temperature o carbonisation in a Japanese kiln does not generall exceed 600° C., but may attain 900° C. in th outside extinction method. The yield of blac or white charcoal is usually about 20% o 15—18%, respectively, of the weight of woo carbonised, the sp.gr., temperature of ignitio and calorific value of the product being directl proportional to the temperature of carbonisatio The recovery of wood vinegar, now extensivel carried out in Japan, is facilitated by the co struction of the kiln, the chimney of which always fixed; and, provided the normal working of the kiln is not affected by the method of condensation employed, the yield and quality of the charcoal are not impaired thereby. The yield of calcium acetate is usually about 25% of that obtained by the dry distillation of wood in retorts, the amount of methyl alcohol condensed being negligible.—W. E. F. P.

Carbon in the electric arc; The consumption of ——. III.—The anode loss. W. G. Duffield and M. D. Waller. Proc. Roy. Soc., 1916, A **92**, 247—252. (See this J., 1915, 1237.)

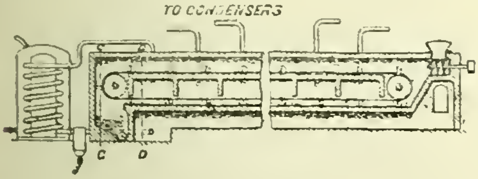
The anode consumption of carbon has been determined by employing a rapidly rotating electrode, thus forming a stable arc in which the rotating anode remained cool, and the formation of a crater was avoided. The ratio of anode loss, with fixed and rotating poles, was found to be, in the most reliable experiments, between the limits 17·6 : 0·25 and 10·8 : 0·36. The conclusion is drawn that the anode loss of carbon is unimportant in the mechanism of the arc, and that the main function of the anode is to receive the carriers of the current produced by the essential process occurring at the surface of the cathode. The differences in potential between the poles for arcs with rotating and fixed poles have also been determined, the former being smaller though the arc is greater, and this is accounted for by the reduction of electronic emission from the anode. —B. N.

Light-reflecting values of white and coloured paints. Gardner. *See* XIII.

Patents.

Oils, spirits, and gases from organic or other materials; Apparatus for obtaining ——. A. N. Macnicol, Melbourne, Australia. U.S. Pat. 1,165,889, Dec. 28, 1915. Date of appl., July 21, 1915.

A gas-tight retort is divided transversely into a number of sections, heated by separate flues and from which the gases may be removed independently to a condenser by means of a fan, the uncondensable gases being conducted to the source of heat for use as fuel. Means are provided for driving over the floor of the retort rabbles with rollers at their ends separated from the heating sections of the retort.—F. W. A.



Electrode; Arc-light ——. I. Ladoff, Cleveland, Ohio, Assignor to W. D. Edmonds, Boonville, N.Y. U.S. Pat. 1,164,728, Dec. 21, 1915. Date of appl., Nov. 27, 1911.

The electrode is composed of at least 60% of carbon, and barium titanate, giving a substantially white light in the arc.—B. N.

Incandescence light; Production of —— from rare earths. G. F. Jaubert, Paris. Eng. Pat. 23.443, Dec. 2, 1914.

A hollow receptacle, of carborundum, alundum, or other refractory earth, is constructed with a circular groove, near the open end, for retaining the mixture of rare earths, which is rendered incandescent by the use of an oxy-acetylene or like burner. The mixture is composed of:—Thorium oxide, 92 parts; cerium oxide, 2; magnesia, 2; lime, 1; and an alkaline polysilicate, acting as a flux, such as ground glass, 3 parts. The exposed surface is hardened by the flux, and may be regenerated by applying a quantity of the dry or moist glass.—B. N.

Metallic filament [tungsten] lamps; Maintaining the efficiency of ——. A. J. Liebmann, Assignor to N. Hofheimer, New York. U.S. Pat. 1,166,464, Jan. 4, 1916. Date of appl., Oct. 25, 1913.

Tungsten filaments are heated and the vacuum restored, during manufacture and use, by building up, by contact or catalytic reaction, defective portions of the filament produced by the volatilisation through excessive heat of infinitesimal particles, formed at a critical moment by abnormal voltage. The contact or catalytic substance, such as barium fluoride, is volatilised spontaneously within the lamp by the excessive heat, forming temporarily tungsten fluoride and barium, the tungsten fluoride being then decomposed and the tungsten deposited on the thinnest and hottest or defective portions of the filament.—B. N.

Evacuation process [for electric lamp bulbs]. H. C. Snook, Cynwyd, Pa. U.S. Pat. 1,166,792, Jan. 4, 1916. Date of appl., Oct. 8, 1912.

The bulb is partially exhausted and energy is passed through the remaining atmosphere in the bulbs between an anode and a cathode, the latter being heated by the energy. The bulb is then further exhausted until the cathode glow fills the bulb and acts on the inner walls thereof. The exhaustion is stopped for a period during which the cathode glow fills the bulb, and is then started again, and continued until the cathode glow dies away.—W. H. C.

Heat; Process and furnace for generating ——. W. Thomas and A. E. Mainwaring, Nanaimo, British Columbia. Eng. Pat. 782, Jan. 18, 1915.

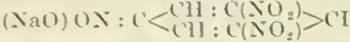
See U.S. Pat. 1,128,199 of 1915; this J., 1915, 269.

III.—TAR AND TAR PRODUCTS.

Peat tar; Utilisation of ——. G. T. Morgan and G. E. Scharff. Economic Proc. Roy. Dublin Soc., 1915, **2**, 161—167.

The destructive distillation of peat in retorts, producer gas plants, etc., yields a tar which on subsequent distillation gives neutral oils differing from the aromatic oils of coal tar and from the paraffins in being highly unsaturated, as shown by the rapid manner in which they absorb atmospheric oxygen. Alkaline extraction of these oils separates oils of high boiling-point and powerful germicidal power; these oils are sparingly soluble in water, and may be used in aqueous suspension, emulsified by admixture with gum acacia mucilage, castor oil soap, etc., or as solid disinfectants mixed with hard soap, dextrin, etc. Small amounts of basic substances of the pyridine group are present in the crude peat tar oil. The higher fractions of the neutral oils are waxes similar to the montan wax of lignite (see Ryan and Dillon, this J., 1909, 878). The residue from the distillation of peat tar is a typical soft pitch, which could be used as asphalt, caulking material, or for electrical insulators. A sample of the crude tar contained 29·3% moisture, 52·6% volatile oils and waxes, 5·8% pitch, and 11·7% solid matter. (See also Perkin, this J., 1914, 395; and Eng. Pat. 19,253 of 1914; this J., 1915, 448.)—F. W. A.

Nitro group in aromatic compounds; Reactivity of the ——. M. Giua. Gaz. Chim. Ital., 1915, **45**, II., 348—362.

The coloured compounds formed by the interaction of aromatic nitro-compounds with alkalis or alkali alkyloxides are of two types: from some the nitro-compound can be regenerated by the action of dilute acids, but not from others. Compounds of the former type have been formulated by Meisenheimer (this J., 1902, 1158) as quinonoid addition-products. The sodium hydroxide addition compound of *symm.*-trinitrobenzene,  $(NaO)ON:C{<}\begin{matrix}CH:C(NO_2)\\CH:C(NO_2)\end{matrix}{>}CH.OH$, which has not hitherto been isolated, may be obtained by adding a 28% solution of sodium hydroxide to a solution of the nitro-compound in acetone. It is a reddish-brown substance, readily soluble in water, and explodes when heated. It yields trinitrobenzene when treated with dilute acid. Coloured compounds of the second type were obtained by interaction of 1.3-dinitrobenzene, 2.4-dinitrotoluene, and 2.4.6-trinitrotoluene, respectively, with sodium ethoxide, and of 2.4-dinitrotoluene with sodium hydroxide. The composition of the compounds corresponded with that of addition products of 1 mol. of the nitro-compound and 1 mol. of the alkali hydroxide or ethoxide, except in the case of the sodium ethoxide compound of 2.4-dinitrotoluene, the composition of which corresponded to the formula.

$$(CH_3)C_6H_3(NO_2)_2.2C_2H_5ONa,C_2H_5OH.$$

From none of these coloured compounds could the original nitro-compound be regenerated by treatment with dilute acid. They were all readily soluble in water and exploded when heated. The coloration given by nitro-compounds when fused with diphenylamine, which disappears when the fused mass solidifies, cannot be due to the formation of addition compounds, for examination of mixtures of diphenylamine with 1.3-dinitrobenzene, 2.4-dinitrotoluene, and 2.4.6-trinitrotoluene, respectively, showed that such addition compounds, if formed, are completely dissociated in the fused state. Each of the three nitro-compounds mentioned forms an intensely yellow coloured addition product when fused with one molecular proportion of acenaphthene.—A. S.

Phenylpropiolic acid ; Nitration of ——. S. Reich. Comptes rend., 1916, **162**, 129—130.

THE direct nitration of phenylpropiolic acid with nitric acid (sp.gr. 1·5) free from nitrous fumes at —20° C. gives *p*-nitrophenylpropiolic acid (m.pt. 181° C.); nitration at 0° C. leads to the production of a small amount of the *ortho*-isomer; in neither case could the production of *m*-nitrophenylpropiolic acid be detected. This orientation of the nitro-group was not to be expected from the results obtained with C ⋮ N and COOH as substituents, which cause the nitro-group to enter the *meta*-position: it agrees, however, with the behaviour of cinnamic and hydrocinnamic acid. The group C ⋮ C.COOH is about a hundred times more electronegative than the group COOH, as judged from the dissociation constants of phenylpropiolic and benzoic acids, and the results contradict the view that electronegative groups induce substituents to enter the *meta*-position.
—F. W. A.

PATENTS.

Toluene ; Process for the production of ——. W. B. Sifton, and Harding Bros., London. Eng. Pat. 8886, June 16, 1915.

METHYL chloride is formed by passing gaseous hydrochloric acid through heated methyl alcohol and fused zinc chloride. The methyl chloride is dried and passed through benzene in the presence of a mixture of anhydrous aluminium chloride and iron filings heated to between 45° and 55° C. The hydrochloric acid liberated in the last process is used over again to produce more methyl chloride. It has been found that when the reaction is allowed to proceed at the temperature prescribed practically no homologues of benzene higher than toluene are formed as is the case when higher temperatures are used.—W. H. C.

Pitch or like material ; Disintegrating and loading hard ——. C. Still, Recklinghausen, Germany. Eng. Pat. 13,546, Sept. 23, 1915. Under Int. Conv., Oct. 2, 1914.

A CHAIN is laid in a waved line along the bottom of the pan before the pitch is run in, and is torn out at one end by mechanical means after the pitch has set, thus disintegrating the mass, which is removed for loading by scrapers.—F. W. A.

Toluene ; Apparatus for the production of ——. W. B. Sifton, London. Eng. Pat. 9437, June 28, 1915.

IN carrying out the process for converting benzene into toluene (see preceding abstract) the following apparatus is used. Hydrochloric acid (only required in sufficient quantity to make up losses) is generated in a still and is passed, along with the hydrochloric acid liberated in the subsequent stages of the process, through suitable drying towers and thence through vessels charged with fused zinc chloride and methyl alcohol. The vessels are heated by steam coils and are provided with reflux condensers to condense any methyl alcohol which distils off. The methyl chloride formed is passed through a series of towers provided with bubbling trays and charged with benzene and anhydrous aluminium chloride mixed with iron turnings. The towers are heated by steam coils. The hydrochloric acid gas from the last tower of the series is collected in a receiver and returned to the process at the beginning. When all the benzene in the first tower of the series has been converted into toluene, the tower is cut out of the series and the second tower becomes number one. The toluene is drawn off and passed through a filter-press and washed to remove any dissolved hydrochloric acid. The tower is then recharged with benzene and connected last in the series.—W. H. C.

Dimethylphenylbenzylammoniumdisulphonic acid [for discharge printing] ; Manufacture of a [zinc] salt of ——. A. Ashworth, Bury. From Chem. Fabr. Rohner und Co., Pratteln, Switzerland. Eng. Pat. 24,695, Dec. 28, 1914.

DIMETHYLPHENYLBENZYLAMMONIUM zinc chloride (Swiss Pat. 64,016) is sulphonated in the usual manner, and the excess of sulphuric acid removed by means of an alkaline-earth carbonate. The zinc salt of the disulphonic acid has considerable advantages over the monosulphonic acid or the sodium and calcium salts of the disulphonic acid in discharge printing; a white discharge may be obtained direct without addition of zinc oxide, which is essential in case the calcium salt is employed, and if zinc oxide be used a much smaller quantity of the zinc salt than of an alkali or alkaline-earth salt suffices to produce a given discharge effect. *Example:* 100 kilos. of dimethylphenylbenzylammonium zinc chloride is introduced into 50 kilos. of sulphuric acid monohydrate, the mixture heated to 70°—80° C., and the hydrochloric acid expelled by means of air; 200 kilos. of 70% fuming sulphuric acid is added at 20° C., and the mixture again warmed for some time. The sulphonation mixture is poured into water, and the excess of sulphuric acid removed by barium or calcium carbonate. The neutral solution is separated, and the zinc salt of the dimethylphenylbenzylammonium disulphonic acid is obtained as a hygroscopic, yellow powder by evaporation.—F. W. A.

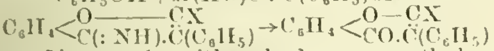
Process of making picric acid. U.S. Pat. 1,168,266.
See XXII.

IV.—COLOURING MATTERS AND DYES.

Flavones; A synthesis of ——. B. N. Ghosh. Chem. Soc. Trans., 1916, 109, 105—122.

In the condensation of ethyl α-phenylacetoacetate with phenols which leads to the production of substituted flavones (this J., 1915, 861), the former substance may with advantage be replaced by the corresponding nitrile, when an imide is produced which is converted by boiling with dilute sulphuric acid into the flavone. The reactions proceed, according to the scheme:

$$C_6H_5OH + X(HO)C:C(C_6H_5)CN \rightarrow$$



$$C_6H_4{<}\begin{matrix}O\text{———}CX\\C(:NH).\overset{\cdot\cdot}{C}(C_6H_5)\end{matrix} \rightarrow C_6H_4{<}\begin{matrix}O-CX\\CO.\overset{\cdot\cdot}{C}(C_6H_5)\end{matrix}$$

where X may be either hydrogen, methyl, or phenyl. Sulphuric acid, hydrogen chloride, phosphoryl chloride, and zinc chloride were used as condensing agents, and the condensation was carried out with a variety of substituted mono-, di-, and tri-hydric phenols on the one hand and with acetyl-, formyl-, and benzoylphenylacetonitrile and benzoylacetonitrile on the other hand. Some of the imide condensation products described are coloured, and others colourless, but they all form coloured salts which are regarded as oxonium compounds.—G. F. M.

Nitrates of aminoazo compounds. L. Casale. Gaz. Chim. Ital., 1915, 45, II., 397—405.

An experimental study of the decomposition by heat of nitrates of aminoazo compounds containing respectively one and two mols. of nitric acid to one mol. of base (this J., 1915, 828), indicates that the nitrate is first dissociated and the liberated nitric acid then acts on the aminoazo compound in accordance with the equation:

$$Ar.N_2.Ar.NH_2 + 2HNO_3 =$$
$$(NO_2)Ar.NH_2 + Ar.N_2.NO_3 + H_2O.$$

In the case of the nitrates with 1 mol. of acid to 1 mol. of base, the above reaction takes place with difficulty and incompletely, and the reaction products are contaminated by substances produced by secondary reactions.—A. S.

Patents.

[Dis]azo dyestuffs. M. Herzberg, Opladen, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,160,406, Nov. 16, 1915. Date of appl., Jan. 20, 1915.

The tetrazo-compound of a *p*-diamine of the diphenyl series is coupled with 2-amino-5-naphthol-7-sulphonic acid or a derivative and with an amino-substituted derivative of this acid containing an amino group in the substituent. Suitable first components are 2-phenyl- or ethylamino-5-naphthol-7-sulphonic acid, 2-amino-5-naphthol-1.7-disulphonic acid, etc.; suitable second components are *m*- or *p*-amino-phenyl- or -benzoyl-2-amino-5-naphthol-7-sulphonic acid, *m*- or *p*-aminophenylnaphthothiazole-5-hydroxy-7-sulphonic acid, *p*-aminophenylnaphthiminazole-5-hydroxy-7-sulphonic acid, etc. The alkali salts of the products dye cotton red to violet or blue shades, which are fast to washing when treated with formaldehyde.—F. W. A.

Sulphur dyes; Brown ——. C. Müller, Ludwigshafen, and W. Stober, Mannheim, Assignors to Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,165,531, Dec. 28, 1915. Date of appl., Apr. 15, 1914.

See Eng. Pat. 17,317 of 1913; this J., 1914, 306.

Disazo dyes; Yellow ——. H. Geldermann. Gross-Lichterfelde-Ost, and F. Haas, Treptow, Assignors to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,166,346, Dec. 28, 1915. Date of appl., July 22, 1913.

See Fr. Pat. 454,661 of 1913; this J., 1913, 863.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Paper imports; Restriction of ——.

A Royal Proclamation, signed on February 15th, orders that: "As from and after March 1st, 1916, subject as hereinafter provided, the importation into the United Kingdom of the following goods is hereby prohibited, viz.:—All materials for the manufacture of paper, including wood pulp, esparto grass, and linen and cotton rags; paper and cardboard (including strawboard, pasteboard, millboard, and wood pulp board) and manufactures of paper and cardboard. Nothing in this Proclamation shall apply to any goods of the descriptions specified which are imported under license given by or on behalf of the Board of Trade, and subject to the provisions and conditions of such license."

His Majesty has issued a Commission to grant licenses for the importation of such quantity or such proportion of these goods as the Board of Trade may from time to time direct, and to arrange for the importation of this quantity or proportion and for the distribution of the imports among paper makers and paper users on such terms as may appear to the Commission to be equitable. The following have been appointed to serve upon the Commission:—The Right Hon. Sir Thomas Whittaker, M.P. (Chairman), Sir Rowland Bailey, Mr. George Brown, Mr. W. Howard Hazell, Mr. James Jeremiah, Sir Frederick Macmillan, Sir Walter Nugent, M.P., Mr. Ernest Parke, Mr. Oswald Partington, M.P., Mr. Albert Reed, The Right Hon. Sir Albert Spicer, M.P. The Hon. John Singleton Clemons will act as Secretary to the Commission, and all communications should be addressed to him at Central House, Kingsway, London, W.C.

In a letter to the Chairman of the Commission, dated February 16th, the President of the Board of Trade states that the Government has fixed the percentage reduction in importation for the present at 33⅓%. (See also p. 280).

Cellulose; The adsorption of caustic soda by ——. A. Leighton. J. Phys. Chem., 1916, 20, 32—50.

Dealing with the question of the formation of one or more definite compounds of cellulose with sodium hydroxide, the author discusses critically the work of Gladstone (Trans. Chem. Soc., 1853, 5, 17), Vieweg (this J., 1907, 1157, and 1908, 1081) and Hübner and Teltscher (this J., 1909, 641). Gladstone's conclusions had already been shown by the last-named authors to be invalid, because the treatment of the soda-cellulose with alcohol was not carried to a final equilibrium. Hübner and Teltscher's experiments are unsatisfactory because the quantity of soda remaining in the cellulose after washing with alcohol is a function of the temperature; their data show nothing in regard to the way in which cotton adsorbs sodium hydroxide from aqueous solution. The method employed by Vieweg (titration of the soda solution before and after contact with the cellulose) is quite invalid, because the cotton adsorbs water as well as alkali from the solution. In the present experiments absorbent cotton was purified by heating for 18 hours at 100° C. with 2% sodium hydroxide solution, souring with dilute hydrochloric acid, washing with alcohol and ether, and drying at 115° C. Trials having shown that 1 hour's contact, as employed by previous investigators, was insufficient to determine equilibrium, portions of 1—1·2 grm. each of cotton were shaken for 3 hours with 100 c.c. of caustic soda lyes of various strengths. The cotton was then centrifuged in a brass wire basket, 4·5 in. diam., rotated at 4000 revs. per min. The alkali retained was determined gravimetrically after incineration with sulphuric acid and ammonium carbonate. It is assumed provisionally that after centrifuging for one hour the cotton is freed from all adherent caustic liquor, the error involved by this assumption being left for subsequent determination. In the same experiments the caustic soda solutions were titrated before and after contact; from the two sets of data it was then possible to calculate the adsorption of water as well as of sodium hydroxide. There is no experimental evidence of the formation of any chemical compound of cotton with sodium hydroxide at any stage of concentration, the graphic representation of the results having the form of a perfectly smooth adsorption curve. Some of the results obtained are set forth in the table below.

Solution, grms. NaOH per litre.	1 grm. of cotton adsorbed:		Solution, grms. NaOH per litre.	1 grm. of cotton adsorbed:	
	Water, grms.	NaOH, grms.		Water, grms.	NaOH, grms.
475	0·82	0·92	100	3·65	0·37
350	1·16	0·83	75	4·00	0·30
250	1·66	0·70	50	4·00	0·20
150	2·68	0·50	25	4·00	0·10

—J. F. B.

Filter-paper; Purification of —— with hydrofluoric acid. A. Gawalowski. Z. anal. Chem., 1915, **54**, 503.

The treatment of filter-paper with hydrofluoric acid only removes completely the silica, but not lime or iron oxide, unless the washing be very prolonged, in which case the iron fluoride may be removed. Long-stored paper that has become yellow in colour contains iron in the ferric state, probably as ferri-oxy-cellulose, and the resulting ferric fluoride will be completely removed by long-continued washing unless the wash-water contains traces of ammonium, potassium, or sodium salts, in which case insoluble double-salts are formed with the ferric fluoride. The hydrofluoric acid must be used in the form of dilute solution, and the excess of acid completely removed by washing, otherwise "mercerisation" of the fibres will occur, and the filtering properties of the paper will suffer. On the other hand, the treatment with hydrofluoric acid increases the toughness of the paper, a fact made use of in the production of hardened papers.—J. B. C. K.

Nutritive substance separated from the pressed pupa waste of the silkworm. Inouye and Iwaoka. *See* XIXa.

Patents.

Fabrics; Process of removing stains from ——. G. E. Darrow, Eugene, Oreg. U.S. Pat. 1,164,705, Dec. 21, 1915. Date of appl., Apr. 11, 1914.

The stained fabric is treated first with a solution of oxalic and sulphurous acids and then with a solution of calcium hypochlorite.—J. F. B.

Impregnated [textile] fabrics. R. A. Marr, Assignor to General Waterproofing Co., Norfolk, Va. U.S. Pat. 1,166,847, Jan. 4, 1916. Date of appl., Nov. 12, 1914.

Textile materials are impregnated at a temperature above 100° C., *e.g.*, at 116°—127° C., with a mixture containing paraffin wax and a relatively small amount of naphthalene, the mixture being free from hard materials. The temperature of the bath may be allowed to fall somewhat during impregnation, or a second bath at a temperature below 100° C. may be used.—F. C. T.

Viscose: Manufacture of threads from ——. T. H. Verhave, The Hague, Holland. Eng. Pat. 2485, Feb. 16, 1915. Under Int. Conv., Feb. 28, 1914.

The threads are coagulated in an aqueous solution of sulphuric acid (the strength of which may vary between 7 and 11%) in presence of two or more readily soluble sulphates in such a quantity that the liquid contains at least 5 grm.-mols. of SO_4''-ions to every 3 grm.-mols. of H'-ions. A suitable bath is composed of 16 parts of anhydrous sodium sulphate, 30 of crystallised magnesium sulphate, 9 of sulphuric acid, and 45 of water.—J. F. B.

Cellulose: Manufacture from —— of a fireproof substitute for "excelsior" for bedding and packing purposes. A. C. Borzner, Philadelphia, Pa. U.S. Pat. 1,165,062, Dec. 21, 1915. Date of appl., Jan. 21, 1915.

Waste paper, corn-stalk, or the like is treated with an alkaline solution to remove foreign matters and to reduce it to a pulp-like condition; it is then treated with a fire-proofing solution and formed mechanically into sheets or otherwise so that it is adapted, after drying, to be broken up into shreds or fluted and cut for the purposes specified.—J. F. B.

Cotton stalks, etc.; Process for manufacturing paper stock and paper from ——. W. H. Croll, Atlanta, Ga. U.S. Pat. 1,165,323, Dec. 21, 1915. Date of appl., May 15, 1913; renewed May 20, 1915.

The material is steeped in water to cause it to swell and then digested with a saturated solution of lime containing a little caustic soda, further quantities of lime being added as combination with the resinous and fatty matters proceeds.

—J. F. B.

Waterproofing material; Method of heating —— and supplying the same to paper. G. R. Wyman, Assignor to C. S. Bird, East Walpole, Mass. U.S. Pat. 1,165,367, Dec. 21, 1915. Date of appl., June 17, 1915.

The waterproofing substance is heated out of contact with air to about its flash point, and is then applied to the material to be waterproofed.

—J. H. J.

Vegetable substances [paper-making materials]; Method of treating —— for the recovery of their values. M. W. Marsden, Philadelphia, Pa. U.S. Pat. 1,165,689, Dec. 28, 1915. Date of appl., Feb. 4, 1915.

Vegetable matter containing starch and invertible carbohydrates is completely saturated by steeping in comparatively short lengths in water; it is then shredded and digested in water under a steam pressure of 10—40 lb. until the extractive matter is converted into a saccharine solution, from which useful by-products may be recovered. The fibrous residue is then scoured and agitated under a pressure of steam higher than that previously employed, and treated in any suitable manner for the manufacture of paper.—J. F. B.

Pulp and paper; Process of making ——. R. A. Marr, Assignor to General Fibre Co., Norfolk, Va. U.S. Pat. 1,166,848, Jan. 4, 1916. Date of appl., Jan. 6, 1915.

Organic materials containing cellulose are digested with a solution containing 2% to 4% of zinc sulphate, or with a solution containing zinc sulphate and zinc chloride, with or without small amounts of tannic acid and glycerin.—F. C. T.

Fibrous material; Digester and process of cooking ——. J. D. Tompkins, Valatie, N.Y. U.S. Pat. 1,167,030, Jan. 4, 1916. Date of appl., Sept. 16, 1913.

A closed vapour-circulating system is attached

to the digester in such a manner that vapour, leaving the digester at the top, is circulated by positive means through the system, in which it is heated and deprived of water during its passage, being returned to the digester at the bottom.
—J. F. B.

Bleaching apparatus [*for fibre pulp*]. F. G. Ten Broeck, Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pat. 1,167,728, Jan. 11, 1916. Date of appl., Feb. 16, 1915.

A rotary, inclined, cylindrical bleacher, divided into sections and fitted with agitating and mixing devices, has a discharge end of smaller diameter connected to a continuous washer. The washed and partly dried material passes from the washer into a second bleacher, from which it is discharged near to the feed end of the first bleacher.—F. W. A.

Wood pulp liquor : Process of recovering solid by-products [*alkali*] *from* ——. A. B. Ayerst and C. N. Waite, Wilmington, Del. U.S. Pat. 1,166,509, Jan. 4, 1916. Date of appl., July 7, 1911.

In the continuous process of recovering alkali from wood pulp black-liquor, the liquor is thickened by partial evaporation, then mixed with granular charcoal from a previous operation in proportions suitable for diffusion under agitation ; the mixture is calcined directly with agitation, and the calcined product is leached for the recovery of alkali. The residual charcoal is dried for subsequent use in a similar manner.—J. F. B.

Cellulose ; Derivatives of —— *containing the residue of an organic acid and nitrogen, and process of making same.* L. Clément and C. Rivière, Paris, Assignors to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,168,164, Jan. 11, 1916. Date of appl., Aug. 21, 1912 ; renewed June 19, 1915.

See Fr. Pat. 449,253 of 1912 ; this J., 1913, 482.

Textile and like printing machines. Eng. Pat. 4444. *See* VI.

Waterproofed wood and process of producing same. U.S. Pat. 1,165,355. *See* IX.

Utilisation of waste from pine apple. U.S. Pat. 1,166,674. *See* XIXa.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Patents.

Jigger for dyeing fabrics and similar purposes. H. L. Quick, New York. U.S. Pat. 1,165,803, Dec. 28, 1915. Date of appl., Jan. 7, 1914.

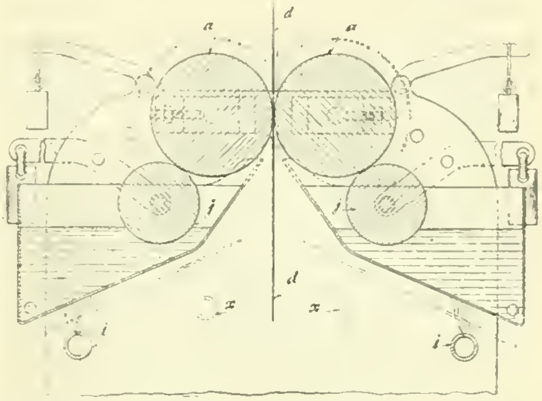
A friction clutch is provided whereby one of the revolving supports used for jigging the fabric through the tank may be thrown into operation and the other out of operation simultaneously ; independently operated jaw clutches may be used for throwing out of operation either of the supports independently of the friction clutch.—F. W. A.

Bleaching, dyeing, etc., fabrics ; Machine for ——. W. I. Lewis, Walpole, Mass., Assignor to F. A. Sayles, Pawtucket, R.I. U.S. Pat. 1,166,063, Dec. 28, 1915. Date of appl., Apr. 16, 1914.

A jigger or similar machine for treating open fabrics is provided with a combined driving and pressure-roll mounted reversibly on a swinging support so that it can be moved from one side of the tank to the other. The fabric can thus be squeezed at the side at which it leaves the tank in either direction of travel.—F. W. A.

Printing machines ; Textile and like ——. H. D. Herring and H. Harrison, Manchester. Eng. Pat. 4444, Mar. 22, 1915.

In printing with wax, etc., on cotton fabrics, paper, and the like, the rollers are heated externally below the point where the fabric meets them. For example, the wax from the furnishing rollers, *j*, is transferred to the printing rollers, *a*, and kept liquid until transferred to the fabric, *d*, by the heat from the multi-jet gas burners, *i*. Instead of utilising the heat from the burners, *i*, the space below the printing rollers may be heated by independent burners, *x*.—F. W. A.



Mercerising cotton piece goods and the like ; Apparatus for ——. W. T. Craven, Ilkley, L. J. Craven, Leeds, C. H. Young, Brighouse, F. H. Cliffe, Hipperholme, and W. S. Cliffe, London. U.S. Pat. 1,165,570, Dec. 28, 1915. Date of appl., Apr. 7, 1913.

See Fr. Pat. 455,744 of 1913 ; this J., 1913, 940.

Dyeing apparatus. W. Inman, Milwaukee, Wis., Assignor to The Psarski Dyeing Machine Co., Cleveland, Ohio. U.S. Pat. 1,166,989, Jan. 4, 1916. Date of appl., Feb. 24, 1913.

See Addition of Apr. 5, 1913, to Fr. Pat. 436,936 of 1911 ; this J., 1913, 1064.

Manufacture of a [*zinc*] *salt of dimethylphenylbenzylammoniumdisulphonic acid* [*for discharge printing*]. Eng. Pat. 24,695. *See* III.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Sulphuric acid prices.

The Minister of Munitions has fixed the following maximum prices per ton for sulphuric acid delivered into railway trucks, carts, or barges at makers' works :—

Class	Degrees Twaddell	£	s.	d.
A.—Arsenical acid........	140	3	0	0
B.—Dearsenical acid......	144	3	15	0
C.—Arsenical acid	168 (93—95% H_2SO_4)	5	15	0
Dearsenical acid......	168 (93—95% H_2SO_4)	6	0	0

Incidental charges are also to be regulated as follows :—

1. When the acid-maker supplies the tank-trucks he shall be entitled to make a further charge of not more than five shillings per ton for filling and hire of tank-trucks.

2. When the acid-maker supplies the acid in his own drums, he shall be entitled to make a further charge of not more than ten shillings per ton for filling and hire of drums.

3. When the acid is supplied in the acid-maker's own carboys he shall be entitled to make a further charge of one pound per ton for filling and hire of carboys. (When carboys are supplied by the purchaser, it is recommended that a charge of ten shillings per ton should be made by the acid-maker to cover the cost of filling.)

The maximum prices came into force on February 14th.

Halogen salts of the alkali metals; Changes in volume upon solution in water of the ——. G. P. Baxter and C. C. Wallace. J. Amer. Chem. Soc., 1916, 38, 70—105.

EXPERIMENTS were made with solutions of different concentrations and at different temperatures between 0° and 100° C. From the detailed results, reproduced in tables and curves, it is seen that lithium and caesium halides produce expansion during solution; in the case of lithium chloride, however, this is true only at high concentrations and between 25° and 50° C. Sodium and potassium chlorides produce the greatest contraction during solution, viz., 0·1—0·2 c.c. per grm. except at the highest temperatures and concentrations. With the other salts the contractions at 25° C. vary irregularly between 0·02 and 0·09 c.c. per grm. An explanation of the effects observed is proposed, based on hydration and on Richards' hypothesis of compressible atoms. From the data given in the tables it is possible to calculate the densities of aqueous solutions of all the alkali halides at different temperatures.—A. S.

Ammonia from [calcium] cyanamide; Production of ——. W. S. Landis. Amer. Inst. Chem. Eng., Jan. 12, 1916. Met. and Chem. Eng., 1916, **14**, 87—90.

A PLANT producing several tons of pure ammonia gas per day from calcium cyanamide has been in continuous operation for six months by the American Cyanamid Co., the process being essentially that described in U.S. Pat. 1,149,653 (this J., 1915, 961). A steel autoclave, 6 ft. diam. and 21 ft. high, capable of working at a pressure of 300 lb. per sq. in., and provided with a powerful stirrer, is charged with about 12,000 lb. of water or mother liquor from a previous operation, and calcium cyanamide (7000 lb.) is added, with continuous agitation, during 1 hour. A ventilating system is provided, by means of which acetylene, generated from undecomposed carbide present in the calcium cyanamide, is removed without risk of explosion. Calcium hydroxide and sodium carbonate (2% and 3·5% respectively of the calcium cyanamide) are then added, the autoclave is closed, and steam is introduced for about 15 mins., until the pressure reaches 3 or 4 atmospheres. The reaction thus started is exothermic, and valves are provided through which the steam and ammonia produced are discharged. The pressure rises to 12—15 atmospheres in about 20 mins. with the relief valve open, and then falls slowly; the rate of discharge is regulated so as to maintain, as far as possible, a constant pressure in the ammonia pipe. After about 1½ hours from the start, the evolution of ammonia has usually ceased, and steam is again introduced till the pressure reaches 6—8 atmospheres, and then ammonia is again discharged for a period of about ½ hour. The steaming and discharge of ammonia are repeated once more, but in this last period only about 2% of the total ammonia is obtained, and it may be omitted if circumstances demand. Curves are given showing the rate of discharge of the ammonia and the change of pressure during a complete run. The residual mud in the autoclave is discharged into suction filters, the residue washed with water, and the liquor returned to the process. The dried sludge contains about 65% CaO as carbonate and hydroxide, and nitrogen equivalent to 0·2% NH_3: it is used for agricultural purposes. The ammonia may be converted directly into sulphate, or the steam is separated by condensation in a rectifying column, and the resulting ammonia gas used as desired. The yield of ammonia is more than 98% of the theoretical quantity, and the product is of a high degree of purity. A plant with 8 working autoclaves and 1 spare one could be erected for about 120,000 dollars (£24,000), excluding cost of land, foundations, and sludge disposal, and the operating cost, excluding the cost of the cyanamide, is estimated as follows:—

Capacity 30,000 lb. ammonia per day, gas saturated with water at cooling water temperature.

	Per day.		Per. lb. ammonia.
	£	s.	d.
Freight of calcium cyanamide, 60 tons	37	10	0·300
Lime, 1·2 tons	1	10	0·012
Soda, 2·1 tons	7	0	0·056
Power, 2400 h.p.-hours	5	0	0·040
Steam, 72 million lb.	4	10	0·036
Water, 60 million galls.		4	0·002
Labour, 300 men-hours	18	14	0·150
Repairs and renewals	4	14	0·037
Interest, 6%	4	4	0·033
Depreciation, 8%	5	12	0·045
Miscellaneous	5	2	0·041
Total cost of conversion, excluding losses of ammonia	94	0	0·752

The manufacture of ammonia from calcium cyanamide is carried on successfully in Norway, Germany, France, Switzerland, Italy, and Japan. In Norway large quantities are used in the Birkeland-Eyde plants for the production of ammonium nitrate, and in Germany very large quantities are being utilised for the manufacture of nitric acid by oxidation.—A. S.

Sulphides, thiosulphates, and dithionates; Analysis of a mixture of alkali ——. J. A. Muller. Bull. Soc. Chim., 1916, **19**, 8—9.

THE sulphide and thiosulphate are determined by titration with iodine in dilute acetic acid solution, and a second portion is acidified with acetic acid in a small round flask, the hydrogen sulphide expelled by exhausting with a water pump for about ten minutes, and then the thiosulphate determined by titrating with iodine as before. These titrations are not appreciably affected by the presence of thionates since the action of iodine on them is very slow even in acid solution. These compounds are determined by oxidising them to sulphates by rendering alkaline a solution freed from hydrogen sulphide as above, evaporating, and fusing with potassium nitrate in a silver capsule. After deducting from the barium sulphate finally obtained the amount due to the sulphate or thiosulphate originally present, the difference represents the thionic compounds. Results are given of the analysis of a mixture by these methods which show good agreement with the calculated values.—G. F. M.

Arsenic acid: Action of hydrogen sulphide on ——. W. Foster. J. Amer. Chem. Soc., 1916, **38**, 52—57.

ARSENIC acid is not reduced by hydrogen sulphide directly to arsenious acid, but the reduction occurs, if at all, through the intermediate formation of monosulphoxyarsenic acid, H_3AsO_3S. This substance is somewhat unstable, especially in presence of high concentrations of hydrochloric acid and low concentrations of hydrogen sulphide, concentrated hydrochloric acid (32%) for example rapidly causing its decomposition, even at 0° C., into arsenious acid and sulphur. With a rapid stream of hydrogen sulphide no reduction takes place even after standing for many hours, whatever be the concentration of the hydrochloric acid present, the precipitate obtained in many experiments under otherwise varying conditions representing always a quantitative yield of the pentasulphide. Many of these results are at direct variance with those described by Usher and Travers (this J., 1905, 1065).—G. F. M.

Potassium orthothioantimonite: Electrolysis of an aqueous solution of ——, and the constitution of this compound. J. A. Muller. Bull. Soc. Chim., 1916, **19**, 3—8.

The electrolysis of an aqueous solution of potassium orthothioantimonite in a divided cell in an atmosphere of hydrogen, using a 17% solution of sodium hydroxide as the anodic solution, a platinum anode, and an antimony cathode, resulted in the deposition of a certain quantity of antimony on the cathode and an increase in the antimony and sulphur content of the anodic liquid which, allowing for diffusion through the porous diaphragm, corresponded almost exactly to the migration of an electro-negative group, SbS_3. Oxygen was liberated at the anode and the sulphur was accordingly found mostly as sulphate or thiosulphate. There was no evidence found for the existence of negative SK ions, and the author concludes that the thioantimonite is a combination of the thioantimonious radicle, SbS_3, with three atoms of potassium.—G. F. M.

Oxidation and reduction without the addition of acid. II. The reaction between stannous chloride and potassium bichromate. A contribution to colloid chemistry. M. Neidle and J. C. Witt. J. Amer. Chem. Soc., 1916, **38**, 47—52. (See also this J., 1915, 1089.)

The stoichiometric relations in the reaction between potassium bichromate and stannous chloride are the same with or without acid. In the latter case the products of the reaction are potassium and chromium chlorides and stannic and chromic hydroxides in colloidal solution, the equation representing the change being

$$2K_2Cr_2O_7+6SnCl_2+(6x+y)H_2O \rightleftarrows 4KCl+6SnO_2.xH_2O+Cr_2O_3.yH_2O+2CrCl_3+2HCl.$$

Dialysis of the product yields a mixed hydrosol of the hydrated oxides in the molecular ratio expressed above. The formation of the hydrosol maintains the concentration of hydroxyl ions within definite limits, insuring a minimum concentration of hydrogen ions which enables the reaction therefore to proceed to completion. From this and previous work the conclusion is drawn that, when in oxidation-reduction reactions the stoichiometric relations are the same with and without acid, colloidal hydrated oxides are always formed in the latter case, if the addition of acid is necessary for the formation of normal salts.
—G. F. M.

Aluminium in silicates; Determination of ——. E. Selch. Z. anal. Chem., 1915, **54**, 395—403.

Decomposition of silicates with hydrofluoric acid and sulphuric acid yields satisfactory results if the last traces of fluorine are removed by treating the residue with dilute sulphuric acid, evaporating the mixture, and expelling the sulphuric acid by heat. The residue is then dissolved in hydrochloric acid and the alumina precipitated in the usual way. If the silicate is decomposed by fusion with alkali carbonates, the alumina should be treated with hydrofluoric acid and sulphuric acid, evaporated, and ignited until again constant in weight; any loss which takes place is due to silica and a corresponding weight is added to that of the main quantity of silica. The latter should also be treated with hydrofluoric acid and sulphuric acid and any residue remaining after ignition should be counted as alumina.—W. P. S.

Persilicate; Alleged formation of —— by the action of air on sodium silicate solutions. H. Ditz. J. prakt. Chem., 1915, **92**, 112—118.

Komarowsky (this J., 1914, 199) concluded that persilicic acid or a perhydrogel of silicic acid was produced by the action of hydrogen peroxide on sodium silicate, and the possible existence of persilicic acid was supported by the experiments of Jordis (this J., 1911, 253). The author, however, found that no trace of hydrogen peroxide was formed on exposing sodium silicate solution to the air for 3 months. The so-called odour of chlorine observed by Jordis was probably the odour of nitrous gases absorbed from the air. Moreover, any manganese, which is a common impurity in sodium silicate, would be oxidised by atmospheric oxygen and would then decompose hydrochloric acid, with the liberation of chlorine. The proofs of the existence of persilicate cited by Jordis are therefore inconclusive.—C. A. M.

Rare earths giving the more soluble double sulphates: Separation of the —— from Brazilian monazite sand. C. James and A. J. Grant. J. Amer. Chem. Soc., 1916, **38**, 41—47.

The rare earth sulphates were treated with less than the theoretical amount of potassium sulphate, and the oxides from the mother liquors converted into double magnesium nitrates which were fractionally crystallised, and thus roughly separated into a least soluble portion, A, of white or greenish crystals containing lanthanum, cerium, and praseodymium, an intermediate fraction, B, coloured deep amethyst, consisting mainly of neodymium magnesium nitrate, and mother liquors, C, containing neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, yttrium, erbium, thulium, ytterbium, and lutecium. From A cerium was separated as basic nitrate, and the other two metals by repeated crystallisation of the double ammonium nitrates. The rare earths in the liquors, C, were converted into oxides and back into double magnesium nitrates, from which samarium and europium were separated by crystallising from nitric acid (1 : 1) in presence of bismuth magnesium nitrate. Gadolinium, terbium, and dysprosium were separated by the crystallisation of the bromates, and the residues from the above nitric acid solution, precipitated as oxalates, and consisting mostly of yttrium, were further separated by fractional crystallisation of their bromates, and by the basic nitrate method.—G. F. M.

Hydrogen phosphide; Determination of ——. Gravimetric and volumetric methods. H. Reckleben. Z. anal. Chem., 1915. **54**, 308—321.

Gravimetric methods usually employed yield more or less inaccurate results, and only when the gas is absorbed in an excess of chlorine or bromine water or potassium permanganate is it at once converted into phosphoric acid which may be precipitated by molybdic acid solution. If potassium permanganate solution is used to absorb the hydrogen phosphide, the excess of permanganate may be titrated with oxalic acid solution, but, mainly owing to the large excess of permanganate required, the results are only approximately correct; better results are obtained by decomposing the excess of permanganate by oxalic acid, and then precipitating the phosphoric acid in the usual way. Approximately correct results may be calculated from the weight of the precipitate obtained when the gas is led into ammoniacal silver nitrate solution or into Fehling's solution; the precipitate will consist of silver or cuprous oxide, respectively.—W. P. S.

Ionisation; Theory of multiple ——. *A modification of the electrolytic dissociation theory.* J. F. F. Heyroth. J. Amer. Chem. Soc., 1916, 38, 57—65.

A new theory of multiple ionisation, based fundamentally upon the assumption that all non-metallic and metallic hydroxides are essentially amphoteric, is developed in order to account for facts which appear as anomalies in the ordinary dissociation theory, and to throw light upon certain questions on which that theory is silent, such as the reason of the different degrees of ionisation, of the departures from the law of mass action, etc. The theory states that substances undergoing electrolytic dissociation in solution tend to dissociate into ions in at least two ways—as acids and as bases—the ratio between the different ionisation constants varying from 1 : 1 to very nearly 1 : ∞. For example nitric acid dissociates as follows: $HNO_3 \rightleftharpoons H^{\cdot} + NO_3'$, and $HNO_3 \rightleftharpoons OH' + NO_2^{\cdot}$, the latter method of ionisation being of course extremely feeble. The more important consequences of the theory may be summarised as follows: An acid anhydride must be regarded as a salt formed by the self-neutralisation of an acid. If the number of molecules of a hydroxide dissociating as an acid exceeds the number dissociating as a base then the substance is an acid, but determination of its relative strength by conductivity measurements will be erroneous since no account is taken of the velocities of the ions formed by the hitherto unassumed mode of ionisation. The oxidising action of nitric and sulphuric acids is ascribed to their basic ionisation into NO_2' and SO_4'' ions. The precipitation of Ag_2O and not $Ag(OH)$ is due to the multiple ionisation of the latter giving Ag' and $AgO^{\cdot}$ ions which immediately unite to form the insoluble oxide.—G. F. M.

Organosols of metals and metallic hydroxides of the platinum group. Amberger. *See* XX.

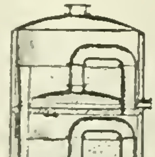
Potassium bicarbonate as a standard for acidimetry. Incze. *See* XXIII.

Ignition of ferric oxide in the gravimetric determination of iron. Selch. *See* XXIII.

Patents.

Acid-absorbing apparatus. P. A. Paulson, Appleton, Wis. U.S. Pat. 1,165,281, Dec. 21, 1915. Date of appl., May 11, 1915.

An apparatus for preparing bisulphite and similar solutions consists of a series of superimposed chambers constituting a tower, an arched and perforated gas-distributing plate being fixed near the bottom and extended nearly to the walls of each chamber; the periphery of the plate may be serrated. A gas-conduit connects the peripheral portion of each chamber with the gas-distributing plate in the chamber next above, and an acid overflow pipe, with its upper end at a level intermediate between the gas-distributing plate and the bend of the gas-conduit, carries the collected liquid into the chamber next below.



—J. B. C. K.

Magnesia; Process of obtaining ——. J. A. Bradburn, Syracuse, N.Y. U.S. Pat. 1,156,662, Oct. 12, 1915. Date of appl., Nov. 28, 1914.

Dolomite or dolomitic limestone is calcined at 800° C. and the calcined material is treated for one to three days with water in a tank provided with a stirrer. The resulting milk of lime and magnesia is mixed with a solution of sodium and ammonium chlorides containing 60 to 90 grms. NaCl and 120 to 180 grms. NH_4Cl per litre, *e.g.*, with liquor of this degree of concentration made by the ammonia soda process. The quantity used is sufficient to convert the calcium and magnesium hydroxides into the corresponding chlorides, and to leave an excess of ammonium chloride. The liquor is then distilled to recover ammonia, and calcined dolomite is added to the residual liquor in sufficient quantity to precipitate the magnesium hydroxide. During this precipitation the liquor is heated and agitated, and the liquid with the precipitated magnesium hydroxide and the magnesia from the calcined dolomite is then passed through a series of settling-tanks. The specifically heavier magnesia settles first and can be recovered separately from the lighter magnesium hydroxide.—J. B. C. K.

Carbon dioxide and solid sodium sulphite; Process of making ——. H. Howard, Boston, Mass. U.S. Pat. 1,164,649, Dec. 21, 1915. Date of appl., Mar. 6, 1913.

An aqueous solution of a suitable bisulphite is treated with a quantity of a solid carbonate not in excess of that required to produce the normal sulphite, the water being present in insufficient quantity to dissolve completely the latter salt as formed. The process can be applied to the manufacture of pure carbon dioxide and solid sodium sulphite in a single operation, by treating an aqueous solution of sodium bisulphite with solid sodium carbonate.—J. B. C. K.

Aluminium chloride; Manufacture of ——. B. T. Brooks, Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,165,065, Dec. 21, 1915. Date of appl., Sept. 8, 1915.

A mass of aluminium is maintained in a molten condition in a graphite vessel and a stream of chlorine gas is forced beneath the surface of the molten metal under sufficient pressure to keep the mass agitated.—J. F. B.

Potassium and aluminium; Process of producing soluble salts of ——. M. F. Coolbaugh, Rapid City, and E. H. Quinney, Pierre, S.D. U.S. Pat. 1,165,154, Dec. 21, 1915. Date of appl., Apr. 23, 1914.

Silicious rocks, earths, or minerals containing insoluble compounds of potassium and aluminium are reduced to powder, and mixed with gypsum in the proportion of 2·8 parts of gypsum, by weight, to each one part of silica in the raw material. The mixture is heated to incipient fusion, cooled quickly, and leached with dilute sulphuric acid, and the resulting potassium and aluminium sulphates are separated from the leach-liquors by crystallisation.—J. B. C. K.

Titanic oxide; Method of obtaining —— *and the resulting product.* A. J. Rossi and L. E. Barton, Niagara Falls, N.Y., Assignors to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,166,547, Jan. 4, 1916. Date of appl., Apr. 18, 1914.

Material containing titanic and iron oxides is fused with an alkali oxide, and the melt, after being lixiviated to remove excess of alkali, is digested with hydrochloric acid in amount sufficient to combine only with the alkali metal and the iron present. On treating the product with the requisite amount of water at the proper temperature, together with some sodium chloride, the titanic oxide settles out; the residual liquor is withdrawn and evaporated, and the residue calcined.—E. H. T.

Zinc oxide ; Process of making pure ——. W. Asef, Philadelphia, Pa. U.S. Pat. 1,165,743, Dec. 28, 1915. Date of appl., Oct. 26, 1914.

Zinc oxide is precipitated by adding sodium carbonate to a zincate solution, and separated by filtration; the filtrate is treated with lime to regenerate caustic soda.—W. E. F. P.

Barium chloride ; Process of manufacturing ——. E. V. Granö, Leonia, N.J. U.S. Pat. 1,167,061, Jan. 4, 1916. Date of appl., May 4, 1915.

Chlorine is passed into a concentrated solution of barium sulphide at a temperature high enough to prevent barium chloride crystallising out. The precipitated sulphur is constantly removed, and treated to remove adhering barium chloride. —E. H. T.

Chlorine ; Process of purifying electrolytic ——. U. Ishikawa, Tokyo, Japan. U.S. Pat. 1,166,524, Jan. 4, 1916. Date of appl., Apr. 6, 1915.

The greater part of the free hydrogen contained in the chlorine is converted into, and removed as, hydrogen chloride by passing the impure gas over a material which effects the union of hydrogen and chlorine, and at the same time exposing it to light containing actinic rays. The hydrogen chloride is oxidised by passing it over the same catalyst but at a lower temperature.—E. H. T.

Sulphate furnace ; Mechanical ——. K. Thelen and F. Wolf, Stolberg, Germany. U.S. Pat. 1,165,815, Dec. 28, 1915. Date of appl., June 1, 1914.

See Ger. Pat. 279,997 of 1913 ; this J., 1915, 355.

Hydrosulphites ; Manufacture of anhydrous ——. E. von Portheim, Smichow, Austria-Hungary, U.S. Pat. 1,166,160, Dec. 28, 1915. Date of appl., June 12, 1913.

See Eng. Pat. 11,010 of 1913 ; this J., 1914, 643.

Process of effecting oxidation of copper. U.S. Pat. 1,164,838. *See* X.

Process of manufacturing nitrogen compounds [*from distillers' wash*]. U.S. Pat. 1,165,358. *See* XVIII.

VIII.—GLASS ; CERAMICS.

Patents.

Glass articles ; Furnace for the manufacture of ——. H. G. Slingluff, Allegheny, Pa., Assignor to Pittsburgh Plate Glass Co. U.S. Pat. 1,164,766, Dec. 21, 1915. Date of appl., Dec. 3, 1907.

In a glass melting and drawing furnace a drawing ring is supported with its upper edge projecting above the surface of the molten glass. A ring of slightly larger diameter, and provided with a removable cover, is suspended so that it can be raised and lowered. During the drawing operation the movable ring is lowered over the upper edge of the drawing ring to act as a shield, whilst during the reheating operation it is raised so as to form, with its cover, a practically closed chamber, in which hot gases circulate over the surface of the glass within the drawing ring.—A. S.

Glass-furnace. S. B. Bowman, Blackwell, Okla. U.S. Pat. 1,166,576, Jan. 4, 1916. Date of appl., Aug. 1, 1914.

The furnace is provided with an extension, in the bottom of which is a vertical delivery opening with a flared upper end. Vertically above the opening, a plug with a rounded lower end is arranged to move up and down; one end of a lever, carrying a weight, is pivoted to the upper end of the plug, and the other end of the lever to a vertically reciprocating bar, the lower end of which is connected with a compressed air cylinder to adjust the lever. The lower part of the plug, for a length greater than the depth of the delivery opening, has a diameter less than that of the opening and is hollow and provided with means for circulating cooling fluid within it, whereby a gathering of chilled glass is formed on the plug. Combined with the opening is a flat reciprocating knife, arranged under the tank extension and a water-cooled plate, the flat under surface of which can be brought in contact with the flat upper surface of the knife. An opening in the plate registers with the delivery opening, the portion of the plate on one side of the opening having an area equal to that of the knife, so that when the latter is moved across the face of the plate the glass passing through the opening in the plate is severed and the delivery opening is closed in order to retain the glass in the tank extension, the knife always being in contact with the water-cooled plate. —W. C. H.

Glass ; Method and batch or mixture for making illuminating ——. J. O. Meara, Assignor to Gill and Co., Philadelphia, Pa. U.S. Pat. 1,166,922, Jan. 4, 1916. Date of appl., Sept. 19, 1914.

Illuminating glass is made by fusing together a foundation mixture, capable of yielding a colourless glass, composed of sand, 100 lb.; alumina, 30 lb.; lead oxide, 22 lb.; "silex," 12 lb.; soda, 37 lb.; borax, 6 lb.; arsenious oxide, 3 lb.; antimony oxide, 1¼ lb.; common salt, 1½ lb.; saltcake, 1½ lb.; crystallised Glauber salts, 2 lb.; and gypsum, 1½ lb. The heating operation is stopped before the glass returns to a clear glass stage and when the specks in the glass are substantially eliminated.—W. C. H.

Potter's and like materials ; Grinding or milling of ——. F. T. H. Goodwin, Longton, Staffs. Eng. Pat. 12,202, Aug. 24, 1915.

The machine is of the type in which the finished product is carried out by a rising stream of water and in which the inner grinding elements cooperate with a vertical cylindrical grinding surface on the outer element. The inner grinding element is mounted so that a clear space is provided beneath it. An annular baffle is provided in the upper part of the grinding chamber to arrest the motion of the stream of water which carries the material from the grinding elements and so promote precipitation of partially ground material.—W. C. H.

Grinding members or wheels. E. C. R. Marks, London. From Norton Co., Worcester, Mass., U.S.A. Eng. Pat. 269, Jan. 7, 1915.

Grinding wheels formed of abrasive particles, *e.g.*, alundum, carborundum, etc., held together by a vitreous, silicate or other binder to form a porous structure, are immersed in a molten mass of resin, *i.e.*, colophony, preferably after being heated to a temperature approximately the same as that of the molten resin, in order to fill the voids in the structure.—W. C. H.

Fireproof vessels, implements or the like ; Manufacture of ——. W. P. Thompson, London. From O. Knoefler und Co., Plötzensee, Germany. Eng. Pat. 2438, Feb. 16, 1915.

See U.S. Pat. 1,157,662 of 1915 ; this J., 1915, 1209.

IX.—BUILDING MATERIALS.

Patents.

Timber; Seasoning ——. J. J. Owen, Liverpool. Eng. Pat. 23,411, Dec. 2, 1914.

Timber is subjected to the action of steam passing from end to end of a chamber which wholly encloses the timber, and is then dried by passing steam through pipes in the chamber. A stove is arranged to produce, at a comparatively slow rate, gaseous or vaporous products from wood or other vegetable matter, or coal, coke, or like hydrocarbon materials, which products are conducted into the chamber enclosing the timber. The apparatus also includes a steam producer connected either directly or through the stove with the interior of the chamber, and also with pipes in the chamber.—W. C. H.

Wood; Waterproofed —— and process of producing same. D. H. Bibb. Assignor to Continental Process Corporation, New York. U.S. Pat. 1,165,355, Dec. 21, 1915. Date of appl., Jan. 6, 1915.

Wood is impregnated with waste sulphite liquor to a density of 25°—33° B. (sp.gr. 1·197—1·277) and then heated to 550°—650° F. (288°—343° C.) for about 20 minutes to render the sulphite liquor insoluble.—J. F. B.

Timber; Preservative treatment of ——. W. D. Clark, Portland, Oreg. U.S. Pat. 1,165,753, Dec. 28, 1915. Date of appl., July 3, 1914.

Timber is immersed in a preserving liquid to season it artificially and then withdrawn from the liquid. Surfaces which are to resist further penetration of the preserving liquid are then coated with a compound and the timber is replaced in the preserving liquid and subjected to pressure to force the liquid into the uncoated parts. The coating compound consists of magnesium oxide, a mineral auxiliary filler including magnesium silicate, and a solution of magnesium chloride, the proportions of oxide, filler, and chloride solution being varied according to the amount of resistance to the preserving liquid desired.—W. C. H.

Wood and other porous materials; Method of treating ——. A. P. Derby and J. H. Dargie, Assignors to P. Derby and Co., Gardner, Mass. U.S. Pat. 1,166,819, Jan. 4, 1916. Date of appl., June 11, 1915.

Wood is subjected in a closed chamber to a mixture of hot air and steam, the pressure of which is alternately and repeatedly raised and suddenly lowered. The supply of steam is then discontinued and hot air is introduced into the chamber and the pressure alternately and repeatedly raised and suddenly lowered; a forced circulation of the air and progressively diminishing residue of steam is maintained during the periods of air pressure and blowing off in order to dry the wood.—W. C. H.

Refractory [furnace] lining. T. A. R. W. Torsen, Lynn, Mass., Assignor to General Electric Co. U.S. Pat. 1,167,135, Jan. 4, 1916. Date of appl., Jan. 20, 1914.

The furnace lining is composed of about 40 to 50 parts by weight of a refractory compound of silica and carbon, about 15 to 25 parts of fireclay, and about 33 to 48 parts of silica.—W. C. H.

Sulphur dioxide; Process for recovering —— [in cement manufacture]. L. P. Basset, Montmorency, France. U.S. Pat. 1,168,046, Jan. 11, 1916. Date of appl., July 7, 1913.

See Fr. Pat. 437,511 of 1912; this J., 1913, 1012.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron; Magnetic and other properties of electrolytic —— melted in vacuo. T. D. Yensen. Univ. Ill. Eng. Exp. Stat., Bull. No. 72, Mar., 1914. 71 pages.

Starting with Swedish charcoal iron as the first anodes and using the deposited iron as the anodes for a second refining, an iron was obtained containing Fe 99·97 to 99·98%, C 0·006%, and Si 0·01%. Melting in a Hoskin electric resistance furnace, in an atmosphere of carbon monoxide, was found to cause contamination of the iron with oxygen and carbon, and a vacuum furnace of the Arsem type, capable of melting 500 to 600 grms. of iron in 30 minutes, with a vacuum of less than 0·5 cm. of mercury, was therefore used. Low-carbon iron melted in this furnace lost 50—90% of the original carbon content, and when carbon was added to the electrolytic iron an amount was lost which is considered to indicate the presence of about 0·1% of oxygen in the melted iron. Melting was carried out in crucibles composed of fused magnesia. The cooled iron was reheated in a coke forge and forged into bars, which were tested as forged, and after different heat treatments. Magnetisation, electrical resistance, tensile, and critical temperature measurements were made, and the various specimens examined micrographically. The apparatus employed is described in detail in a series of appendices. The permeameter was of the compensated double bar and yoke type, and the electrical resistances were measured on a Thompson double bridge, using 13 cm. of the rods between the contacts. The results showed that the magnetic quality of electrolytic iron melted *in vacuo* is decidedly superior to any grade of iron thus far produced, the maximum permeability obtained being 19,000 at a flux density of 9500 gausses. The average hysteresis loss was less than 50% of that found in the best grades of commercial transformer iron. The specific electrical resistance was 9·96 microhms. The photomicrographs showed that the structure of pure iron is not changed materially by quenching either in iced brine or liquid air. The critical temperature determinations gave the point Ar 3 for the average electrolytic vacuum iron as 894° C. Tests made on Swedish charcoal iron after being melted *in vacuo* showed it to have a magnetic quality approximating to that of electrolytic iron melted *in vacuo*, owing chiefly to the reduction of the carbon content.—T. St.

Boron; The effect of —— upon the magnetic and other properties of electrolytic iron melted in vacuo. T. D. Yensen. Univ. Ill. Eng. Exp. Stat., Bull. No. 77, Mar., 1915. 19 pages.

Tests were made to ascertain if boron added to electrolytic iron melted *in vacuo* would remove any oxygen remaining in the iron, and thus improve its magnetic properties, and at the same time increase its electrical resistance, and thus make it more suitable for use where eddy-currents must be kept down (see preceding abstract). The boron was added as boron suboxide B_7O (this J., 1910, 23), and as "boron suboxide flux," which contains about 8% B_7O, the remainder being magnesium borate and boric anhydride. The results are summarised as follows:—(1) Small percentages of boron added to pure iron and melted *in vacuo* have a double effect upon the iron, since part of it reduces the iron oxide present and the remainder combines with the iron. In this respect boron differs from carbon, as the latter does not combine with the iron unless added in larger quantities than are needed to reduce all the iron oxide present. (2) Small additions of boron to iron have a slightly beneficial effect upon the magnetic properties, probably on account of the reduction of iron oxide, which more than offsets the effect of the combined boron. The beneficial effect in the present case reaches a maximum with addition of 0·05% B_7O or 0·1% B_7O-flux, and ceases as soon as the amount of combined boron becomes measurable, which occurs with the addition of 0·1% B_7O or 0·75% B_7O-flux. (3) Boron added in sufficient amount to leave a measurable quantity combined with the iron has a decided detrimental effect upon the magnetic properties of the iron. (4) Boron increases the specific electrical resistance of iron by 0·62 microhm per 0·1% B combined with the iron. (5) The effect of boron upon the mechanical properties of iron is in general similar to that of carbon. It raises the elastic limit and increases the ultimate strength, at the same time decreasing the toughness. *Determination of boron in iron.* 2 to 3 grms. of iron is dissolved in an 800 c.c. flask in 10 c.c. each of nitric acid of sp. gr. 1·4, hydrochloric acid of sp. gr. 1·2, and water; about double the amount of dry calcium carbonate necessary for complete neutralisation is added at one time, the solution being rotated; 250—300 c.c. of water free from carbon dioxide is added and the solution boiled under a reflux condenser for at least 30 minutes; the iron precipitate is collected in a Buchner funnel and washed 8 or 10 times with well-boiled distilled water, a bulk of about 50 c.c. of washed wet asbestos fibre being added before filtering to facilitate washing; the filtrate is cooled under the tap and titrated with $N/10$ sodium hydroxide solution, using phenolphthalein as indicator; when a pink colour is produced, 1 grm. of mannitol is added, the solution well stirred, and the titration continued with further addition of mannitol until a permanent pink colour is obtained. Familiarity with the end point is attained by practice. A control determination should be made with pure iron.—T. St.

Iron-carbon equilibrium diagram. O. Ruff. Ferrum, 1915, **12**, 121—123. J. Chem. Soc., 1916, **110**, ii., 36. (Compare this J., 1912, 233, 1130.)

The cementite which is decomposed, with formation of graphite, during the cooling of liquid iron-carbon alloys, is that which is in excess of the equilibrium concentration, but below the saturation concentration. Any excess above this latter concentration separates as free cementite. The true eutectic temperature is 1125° C. or possibly nearly 1130° C.; the pseudo-eutectic temperature is higher, about 1138° C.

Iron-carbon alloys; "Near-eutectic" temperature of the ——. O. Ruff and W. Bormann. Ferrum, 1915, **12**, 124—126. Z. angew. Chem., 1915, **28**, Ref., 537. (See preceding abstract).

The "near-eutectic" (pseudo-eutectic) temperature (Howe. Trans. Amer. Inst. Min. Eng., 1912. 1181) of pure iron-carbon alloys (*i.e.*, the temperature of saturation with respect both to mixed crystals and graphite) was found to be 1138·8° ± 1° C. The temperature could be determined with such precision that it is suggested as a standard, and one, moreover, which is applicable in a carburising atmosphere. (See also Ruff, this J., 1912, 233.)—F. Sodn.

Slag enclosures in acid steel; Behaviour of ——. F. Giolitti and S. Zublena. Int. Zeits. Metallog., 1914, **7**, 35—82. J. Chem. Soc., 1916, **110**, ii., 37. (Compare Giolitti and Tavanti, this J., 1915, 179.)

Specimens were cut from the sound central portion of an ingot of acid open-hearth steel containing C 0·38%, Mn 0·60%, Si 0·22%, S 0·008%, P 0·02%, and Ni 2·02%. In all cases the enclosures of grey sulphide slag were found in the central part of the ferrite masses, completely separated from the pearlite. When heated for four hours at a constant temperature of 1060° C. in carbon dioxide, slight decarburisation took place, and the slag enclosures were then frequently in contact with pearlite. The effect was more marked at 1100° C. In carbon monoxide at 1100° C. the carburised portion showed the ferrite and slag completely independent. This occurred whenever carburisation took place, whilst ferrite formed during an oxidising process enclosed the slag. The results are attributed to the influence of the slag on the oxidation of the carbide and consequent liberation of ferrite. Repeating the experiments with a steel containing C 0·40%, Mn 0·58%, Si 0·20%, S 0·006%, P 0·03%, and Ni 1·98%, also of acid open-hearth origin, the same changes were found to take place still more readily. The only slag enclosures which exert an influence on the distribution of ferrite are those of light grey colour, usually regarded as manganese sulphide.

Copper; Recent progress in the metallurgy of ——. H. O. Hofman. J. Franklin Inst., 1916, **181**, 83—97.

Blast-furnace smelting. Coke smelting of roasted copper ores is gradually being abandoned, as it involves preliminary roasting and is therefore slower and more costly than pyritic smelting. Pure pyrite smelting (this J., 1916, 118) is uncommon, the partial pyrite process (this J., 1913, 736) being now generally adopted in America. The chemical distinction between pure and partial pyrite smelting lies in the oxidation of the coke which is accomplished near the throat by the ascending sulphur dioxide in the former, and mainly by the air blast in the latter process. Three methods of collecting flue dust and fume have proved successful: the Roesing wire system (Great Falls, Mont.), bag filtration (Mammoth Smelter, Shasta Co., Cal.), and the Cottrell electric process (Anaconda, Mont.; see also this J., 1915. 1096). The briquetting of flue-dust is falling into disuse: the dust is mixed with molten matte or converter-slag, or agglomerated by blast-roasting. *Reverberatory smelting.* Lump ore is best suited for blast-furnace work, while reverberatories work better on fines, hence their general adoption for smelting concentrates. Though it involves roasting, reverberatory smelting is cheaper than blast-furnace smelting; the multiple-hearth MacDougall is the favourite roasting furnace. The reverberatory furnace is of the long-hearth type connected with waste-heat boilers, generally fired with oil or coal dust, and worked on the principle of feeding small charges at short intervals near the fire-bridge; this prevents excessive cooling and results in greater output and longer life of the furnace. A great advantage of oil-firing is avoidance of loss of heat in the fire-box (estimated at about 25%) as the oil is blown on to the hearth. The largest reverberatory (117 ft. long, 25 ft. wide), fired with coal-dust, is being built at Anaconda, where blast-furnace smelting has been stopped owing to its higher working cost. *Converting copper matte.* Basic converting (*i.e.*, in a converter lined with magnesite brick, adding the silica required for slagging the iron in the form of silicious ore) has almost wholly superseded the acid process. Of the two types of converters, the vertical works quicker than the horizontal. *Fire-refining.* The improvements are mainly mechanical and refer to charging the furnace, and ladling and casting the refined metal.—W. R. S.

Electrolytic copper; Structure of ——. M. von Schwarz. Int. Zeits. Metallog., 1915, **7**, 124—173. J. Chem. Soc., 1916, **110**, ii., 34—35. (Compare Faust, this J., 1912, 1133.)

Very large crystals, 5 cm. or more in length, may be obtained from an ordinary sulphate bath for the electrolytic deposition of copper, the temperature being 1°—7° C., and all agitation being avoided. The crystals are repeatedly twinned octahedra, and their orientation is confirmed by etching. The growth of crystal grains in massive electrolytic copper on annealing is also described. The larger grains absorb the smaller, except where the metal has been locally strained. The very small grains produced by straining grow much more rapidly than the others at first, but this difference only persists for a short time of annealing. Electrolytically deposited crystals grow parallel to the surface of the cathode, one octahedral face being in contact with the cathode, and elongation taking place along a trigonal axis. Twinning occurs when these crystals are annealed, but again disappears after prolonged annealing. The effect of pressure on isolated crystals in causing the formation of new crystal centres is also shown by the experiments, and the observations are utilised for a discussion of the hypothesis of an amorphous modification produced by flow, and also present at the crystal boundaries in cast metals.

Cerium-copper alloys ; Constitution of ——. Cerium alloys. I. F. Hanaman. Int. Zeits. Metallog., 1915, 7, 174—212. J. Chem. Soc., 1916, **110**, ii., 35.

The metallic cerium used contained Ce 96·71 %, Fe 0·50 %, the remainder being cerite metals. It melted at 715° C., and as a small quantity of an iron eutectic was undoubtedly present the true melting point of cerium must be close to 720° C. The metals were melted in unglazed porcelain crucibles, under a layer of sodium chloride or mixed potassium and sodium chlorides. The cerium is best added to molten copper, except for alloys containing more than 80 % Ce, for which the reverse process is used. The thermo-couple was protected by a very thin tube of unglazed porcelain, and the cooling curves were determined by the inverse-rate method. The freezing-point curve has two well-marked maxima, corresponding with a compound Cu_6Ce, which melts at 935° C., and Cu_2Ce, melting at 820° C. There are also two compounds which are formed by reactions between solid and liquid, thus giving rise to breaks in the freezing-point curve ; Cu_4Ce at 780° C., and CuCe at 514° C. There are three eutectic points, at 875° C., 757° C., and 415° C., occurring at 17 %, 44 %, and 84 % Ce respectively. Solid solutions are not formed. The alloys richest in cerium contain traces of a ternary eutectic of copper, cerium, and iron. . The hardness curve of the alloys, determined by Brinell's method, has two pronounced maxima, corresponding with the compounds Cu_6Ce and Cu_2Ce, the former being nearly four times as hard as copper. The microstructure of the alloys is described in detail and illustrated. The colour of the alloys resembles that of copper as far as the first eutectic ; from that point to the third eutectic it resembles that of bronze, and then becomes steel-grey. Only those alloys which contain between 55 % and 85 % Ce are pyrophoric. Those containing less than 30 % Ce are stable and retain their colour in air ; richer alloys soon disintegrate.

Organosols of metals and metallic hydroxides of the platinum group. Amberger. *See* XX.

Patents.

Iron ores and other metallic oxides ; Process of reducing —— to the metallic state. E. B. Pratt, Lakewood, Ohio. U.S. Pat. 1,167,016, Jan. 4, 1916. Date of appl., Dec. 24, 1913.

The ore is reduced by means of hydrogen, the composition of the charge and temperature of reaction being regulated so that the resulting metal contains the proportions of carbon and silicon desired.—W. E. F. P.

Cast iron or steel ; Process of plating —— [with aluminium]. F. Moench, Rushville, Ill. U.S. Pat. 1,165,338, Dec. 21, 1915. Date of appl., Apr. 12, 1915.

Iron or steel surfaces to be coated with aluminium are cleansed first from oxides by means of hot hydrochloric acid, and then from organic matter by potassium permanganate and potassium chlorate. The article is then heated to dull redness, and rubbed with a piece of aluminium previously washed with hydrogen peroxide and heated almost to the melting point. The aluminium coating is scratched in on the surface and smoothed over while still melted. The coated article is then allowed to cool slowly.—T. St.

Armour plates ; Manufacture of ——. J. Brown and Co. Ltd., Sheffield, and T. J. Tresidder, London. Eng. Pat. 3423, Mar. 3, 1915.

To prevent the surface of armour plate from becoming supersaturated with carbon during cementation, a plate of iron or mild steel, or a layer of sand, etc., is interposed between the face of the armour plate and the carburising agent. —W. E. F. P.

Iron and steel articles ; Process for case-hardening —— by means of gases or vapours. P. Orywall, Berlin-Steglitz, and G. Bauer, Düsseldorf. Ger. Pat. 287,319, Apr. 2, 1914.

The preheated gases or vapours are drawn through the carburising chamber under diminished pressure, by the aspirating action of a current of air which then passes with the issuing gases to the heating chamber. Possible increase of pressure through heating is thus reduced, the velocity and carburising effect of the gases increased, evaporation of liquid hydrocarbons facilitated, and danger of decomposition through pressure or overheating is lessened. Risk of explosion may be avoided by admitting the gases to the carburising chamber through valves which are actuated by suction of the air current.—F. Sodn.

Leather charcoal for hardening steel and iron ; Preparation of ——. M Lindner, Gernsbach. Ger. Pat. 287,665, Aug. 2, 1914.

Leather waste is slowly heated to about 140° C. in an autoclave, in which pressure is at first avoided by leading off the evolved gases through porous material rendered free from air, and the temperature is then raised to 190°—210° C., whilst the pressure is allowed to reach about 15 atmos. The charcoal thus obtained is very rich in nitrogen compounds and cyanides, and produces in iron and steel a cementation layer of great hardness, to a depth of 1·5 mm., whilst leaving a very tough core. The yield of charcoal is 72—76 %.—F. Sodn.

Iron alloy. H. E. Field and F. C. T. Daniels, Wheeling, W. Va. U.S. Pat. 1,166,342, Dec. 28, 1915. Date of appl., Oct. 17, 1914.

A casting alloy said to possess hardness, strength, toughness, and shock-resisting qualities has the following composition : Si 0·25—1·50, S 0·025—0·20, P 0·01—1·00, Mn 1·50—3·50, C 1·50—3·50 %, and iron to make up the balance.—W. R. S.

Metallic compounds [e.g., tin oxide] ; Deposition of —— from a state of suspension in liquids Ester and Co., Ltd., and A. P. Strohneager. London. Eng. Pat. 15,908, Nov. 11, 1915.

Water carrying slime in suspension is electrolysed between aluminium electrodes with an alternating current of not less than 60 volts. Minute charged particles of aluminium hydroxide are produced and attach themselves to the charged particles of slime, causing the latter to subside.—W. R. S.

Furnaces; Treating materials [zinc ores] in electric ——. E. S. Berglund. Trollhättan, Sweden. U.S. Pat. 1,160,241, Nov. 16, 1915. Date of appl., Apr. 21, 1915.

SUBSTANCES which are either fusible or form an easily fusible slag with the coverings or crusts which form on the furnace walls, especially in the vicinity of the tapping hole, are added to the furnace at intervals. A special charge containing the substances, or the fluxing substances alone, may be introduced through openings in proximity to the tapping hole, or larger quantities of the substances may be mixed with the charge and introduced through the ordinary charging opening. In the example given, fluorspar or fluorspar and lime are used as special fluxes, in the manner indicated, in the electric smelting of zinc ore.—B.N.

[Zinc] smelting process; Duplex ——. W. McA. Johnson and E. W. Hale, Assignors to The Continuous Zinc Furnace Co., Hartford, Conn. U.S. Pat. 1,165,371, Dec. 21, 1915. Date of appl., Mar. 16, 1914.

HIGH-GRADE zinc ores, in which the sulphur content has been reduced to a low amount, are mixed with carbon and heated in externally-heated fire-clay muffles to a maximum of about 1150° C. A partial reduction under non-slagging conditions is thus effected and a portion of the metallic values obtained. The residue from the retorts is then mixed with additional carbon and the ultimate metallic values obtained by developing heat electrically, under slagging conditions, within the charge while enclosed in an air-excluding container.—T. St.

Zinc; Process for the production of ——. O. Baltin, Lipine, Germany. U.S. Pat. 1,166,170, Dec. 28, 1915. Date of appl., Jan. 3, 1914.

THE ore is mixed with a reducing agent and made into rounded briquettes, which when packed together touch each other only at a single part and expose a large surface to the action of heat. —W. R. S.

[Zinc] ore charges for retorts and method of treating the same. C. A. H. de Saulles, New York. U.S. Pat. 1,166,447, Jan. 4, 1916. Date of appl., Mar. 8, 1915.

THE front part of a retort or muffle is fitted with a briquette of reducing agent and ore low in iron and lead, which retains these metals.—W. R. S.

Ores; Process of extracting values [precious metals] from ——. H. Foersterling and A. L. Halvorsen, Perth Amboy, N.J., Assignors to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,164,636, Dec. 21, 1915. Date of appl., June 3, 1914.

THE ore is treated with a solution of a cyanide capable of forming a soluble cyanide salt with the metal to be extracted, and a rotating, vertical, continuously-renewed, adherent film of an amalgam capable of displacing the metal in the solution, and of regenerating the original cyanide, is then passed through the solution.—T. St.

Gold-extraction machine. Superfine-gold extractor. C. Suiter, Billings, Mont. U.S. Pats. (A) 1,164,676 and (B) 1,164,677, Dec. 21, 1915. Dates of appl., July 21 and July 24, 1914.

(A) THE machine comprises a conical trough holding amalgam, a floating cover with a central conical opening, a stationary distributing cone extending upwards from the trough into the conical opening of the cover, a rotary feed cone operating over the stationary cone, and a feed pipe communicating with the central opening of the floating cover. The feed pipe contains a rotating screw by which the pulp is forced into the amalgam. (B) The apparatus consists of a circular run-off trough and a central vertical rotary pipe with feed openings leading into a series of superposed conical amalgam plates secured to and rotatable with the feed pipe; the plates slope outwards and downwards towards the periphery, and are of diminishing diameter from the uppermost one to the lowermost one. The overflow edges of all the plates lie in the vertical plane of and discharge into the trough. —W. R. S.

Furnace; Ore-roasting ——. J. C. Simmons, Colorado Springs, Colo. U.S. Pat. 1,164,761, Dec. 21, 1915. Date of appl., Oct. 15, 1914.

IN a reverberatory furnace for continuous roasting, an oscillating adjustable air-blast feed at the top of the roasting-chamber distributes the ground ore evenly over a bed formed on an oscillating grate operated by eccentrics. The grate grinds away the lowest layer of the bed of ore.—W. R. S.

Smelting-furnace. C. K. Davis, Detroit, Mich. U.S. Pat. 1,165,393, Dec. 28, 1915. Date of appl., Aug. 14, 1915.

A VERTICAL blast-furnace, having separate conduits at the top for admitting fuel and discharging gases, is supplied with roasted ore from an inclined, rotary kiln, the latter being fired with gas or oil from the lower end and connected with the upper part of the furnace by an inclined conduit. The waste gases from the furnace and kiln are utilised for preheating the respective air-blasts, the pressures in the two parts of the apparatus being adjusted to prevent the passage of gases from the furnace to the kiln.—W. E. F. P.

Smelting [copper] ores. J. H. Klepinger, M. W. Krejci, and C. R. Kuzell, Great Falls, Mont. U.S. Pat. 1,164,653, Dec. 21, 1915. Date of appl., Mar. 3, 1915.

THE charge of ore, etc., in a finely-divided state, is subjected, while in suspension, to the action of an oxidising atmosphere in the presence of a combustible component, the temperature being maintained sufficiently high to effect fusion of the charge, and a quantity of unoxidised raw material is distributed through the mass, while still at the temperature of reaction, to correct over-oxidation of the original charge. In the application of the method to the production of copper-matte, a mixture of fluxing material and finely-divided copper sulphide ore, containing iron, is sprayed into the treatment-chamber in the presence of a supporter of combustion, the charge is ignited, the air-supply is regulated to maintain oxidation of the sulphur and the iron, and the temperature is maintained at the point of fusion of the copper sulphide and the slag, which fall and collect on the floor of the chamber, where a suitable amount of unoxidised raw material is distributed throughout the mass, to correct over-oxidation.—J. B. C. K.

Copper; Process of effecting oxidation of ——. S. G. Martin, Chicago, Ill., Assignor to W. O. Bartholomew, St. Louis, and E. Schaaf, St. Marys, Mo. U.S. Pat. 1,164,838, Dec. 21, 1915. Date of appl., Apr. 17, 1911.

A SOLUTION containing a copper salt, potassium hydroxide, and potassium nitrate, is heated, charged with atmospheric air, and subjected to the action, by direct impact, of steam under pressure.—T. St.

Furnace for melting metals. E. Bosshardt, Emmenbrücke, Switzerland. U.S. Pat. 1,164,983, Dec. 21, 1915. Date of appl., Dec. 28, 1914.

An open-hearth furnace has a gas generator adjacent to each side of the melting chamber, and each side wall of the latter has a horizontal slot by which the melting chamber, at the hearth-level, is placed in direct communication with the white-heat zone of each generator. The gas from the generators is preheated and passes into the melting chamber through channels opening above the level of the horizontal slots, and below passages leading from the melting chamber to air regenerators.—W. R. S.

Vanadium, uranium, and radium; Process of extracting —— from ores. R. B. Moore, Denver, Colo. U.S. Pats. (A) 1,165,692 and (B) 1,165,693. Dec. 28, 1915. Dates of appl., Oct. 7, 1913, and Jan. 22, 1914.

(A) The ore is leached first with a solution containing sodium carbonate and hydroxide and then with a solution of hydrochloric acid, vanadium being subsequently recovered from the former and uranium and radium from the latter solution. (B) Radium is precipitated as radium-barium sulphate by adding barium chloride and sulphuric acid, in succession, to the acid solution.—W.E.F.P.

Lead ores; Apparatus for the dissolution of —— [in nitric acid]. S. W. Anderson, Spokane, Wash. U.S. Pat. 1,165,742, Dec. 28, 1915. Date of appl., Nov. 29, 1913.

The apparatus consists of a number of closed earthenware vessels partly immersed in a water-bath. Each vessel has a central, vertical stirrer; a tap at the bottom for discharging the solution; a side tube near the top, through which the gaseous products of the reaction are conducted to a common conduit and drawn thence to a regenerating tower; and an air inlet, normally closed, through which air may be drawn to displace the gaseous reaction products.—W. E. F. P.

Cobalt from ores or by-products; Process for separating ——. P. M. McKenna, Assignor to Chemical Products Co., Washington, D.C. U.S. Pat. 1,166,007, Dec. 28, 1915. Date of appl., Sep. 25, 1914.

Speiss containing cobalt and nickel is fused with an amount of boron trioxide equal to the weight of cobalt present, to form a "boric cobalt slag," which is separated from the nickel arsenide speiss by settling and then heated to about 1000° C., under oxidising conditions, to expel arsenic and antimony.—W. E. F. P.

Ores, etc.; Calcining, desulphurising, and agglomerating ——. F. Meyer, Englewood, N.J., Assignor to Dwight and Lloyd Metallurgical Co., New York. U.S. Pat. 1,166,142, Dec. 28, 1915. Date of appl., Nov. 9, 1907; renewed Sept. 11, 1913.

A horizontal, circular grate, mounted to rotate about a vertical axis above an upright, hollow shaft, is divided into radial sections communicating with a series of conduits similarly arranged in the shaft. Means are provided for feeding the ore evenly on to the grate, for controlling the flow of air through the conduits automatically and successively during the rotation of the charge, and for detaching the latter from the grate at a predetermined point.
—W. E. F. P.

Smelting ores; Process for ——. O. Baltin, Lipine, Germany. U.S. Pat. 1,166,171, Dec. 28, 1915. Date of appl., May 28, 1914.

The ore is mixed and pressed into briquettes with gypsum and cell-pitch.—W. R. S.

Bismuth metal; Method of treating impure ——. W. C. Smith, Assignor to United States Metals Refining Co., Chrome, N.J. U.S. Pat. 1,166,721, Jan. 4, 1916. Date of appl., May 12, 1914.

Impure molten bismuth is treated with the following reagents in succession and skimmed after each operation: sulphur, to remove the greater part of the arsenic, antimony, and copper; sodium hydroxide, to remove tellurium and the remaining arsenic, antimony, and sulphur; zinc, to remove gold, silver, and the remaining copper; and sodium hydroxide, to eliminate zinc. The refined metal is finally purified from lead by crystallisation.
—W. E. F. P.

Flue-dust; Process of recovering [sintering] ——. S. W. Osgood, Assignor to A. J. Jewell, Chicago, Ill. U.S. Pat. 1,166,927, Jan. 4, 1916. Date of appl., June 22, 1914.

The flue-dust is made into a paste with a suitable binding material, and formed into pellets, which are dried and then sintered by placing them in molten slag delivered from a furnace.—W. H. C.

Gold alloy. K. G. P. Richter, Assignor to Richter und Co., Pforzheim, Germany. U.S. Pat. 1,165,448, Dec. 28, 1915. Date of appl., Apr. 30, 1913.

See Fr. Pat. 448,407 of 1912; this J., 1913, 431.

Coating iron with aluminium; Process of ——. S. Uyeno, Tokyo. U.S. Pat. 1,165,920, Dec. 28, 1915. Date of appl., June 4, 1912.

See Eng. Pat. 11,836 of 1912; this J., 1913, 238.

Furnace; Mechanical roasting ——. K. J. Beskow and A. Ramén, Helsingborg, Sweden. U.S. Pat. 1,166,654, Jan. 4, 1916. Date of appl., Oct. 17, 1912.

See Eng. Pat. 12,214 of 1911; this J., 1911, 1157.

Furnace for roasting; Horizontal mechanical ——. P. Sarrasin, Dijon, France. U.S. Pat. 1,167,118, Jan. 4, 1916. Date of appl., Nov. 29, 1913.

See Eng. Pat. 26,915 of 1913; this J., 1914, 1214.

Smelting of ores, and apparatus therefor. F. W. Highfield, Caversham. U.S. Pat. 1,167,176, Jan. 4, 1916. Date of appl., Feb. 23, 1915.

See Eng. Pat. 4937 of 1914; this J., 1915, 720.

Alloys of high melting point having ductile properties; Production of ——. H. Kaiser, Assignor to Wolfram-Lampen A.-G., Augsburg, Germany. U.S. Pat. 1,167,827, Jan. 11, 1916. Date of appl., Feb. 14, 1914.

See Fr. Pat. 466,737 of 1913; this J., 1914, 835.

Metals, such as lead or zinc; Process of obtaining —— in an electric furnace. A. Helfenstein, Vienna. U.S. Pat. 1,167,998, Jan. 11, 1916. Date of appl., Feb. 2, 1914.

See Fr. Pat. 468,145 of 1914; this J., 1914, 969.

[Lubricant for] wire-drawing. B. L. Benbow, Cleveland, Ohio, Assignor to General Electric Co. U.S. Pat. 1,168,050, Jan. 11, 1916. Date of appl., Dec. 7, 1912.

See Eng. Pat. 2001 of 1913; this J., 1914, 87.

Catalytic metal powder. U.S. Pat. 1,165,956. *See* I.

Production of agglomerates from powdered materials. Ger. Pat. 287,606. *See* I.

XI.—ELECTRO-CHEMISTRY.

Calomel standard cell. G. F. Lipscomb and G. A. Hulett. J. Amer. Chem. Soc., 1916, 38, 20—27.

STANDARD mercury cadmium cells,

$Hg \mid HgCl_2 \mid CdCl_2 \mid Cd$ amalgam,

using calomel as depolariser instead of mercurous sulphate, were constructed, and were found to give a constant voltage at 25° C. of 0·67079—0·67080 volt over a long period of time, and to show no tendency towards a gradual decrease in E.M.F. as is frequently the case with Weston cells. Both saturated and unsaturated solutions of cadmium chloride were used with a view of eliminating the temperature coefficient, which with the saturated solution was 0·000067 at 18° C., but this object was not attained. The mercurous chloride was prepared electrolytically from mercury and hydrochloric acid; it was grey in colour owing to the presence of finely divided mercury, and its efficiency appears to be due to this, probably because mercuric salts are thereby excluded. The thermodynamics of the saturated combination were investigated and good agreement was obtained for the heat of the reaction calculated from the electromotive force data and from thermochemical measurements.—G. F. M.

Standard cells; Study of double salts in ——. G. F. Lipscomb and G. A. Hulett. J. Phys. Chem., 1916, 20, 75—82.

THE phase relationships of the double sulphates and chlorides of zinc and potassium have been investigated, and the results plotted to determine the limits of concentration over which they are stable at a given temperature. These double salts have been employed in standard cells, using the combinations:—

$$\text{Zn Amalg} \mid (K_2SO_4.ZnSO_4.6H_2O)Hg_2SO_4 \mid Hg$$

$$\text{and Zn Amalg} \left| \begin{Bmatrix} K_2SO_4.ZnSO_4.6H_2O \\ K_2SO_4 \end{Bmatrix} Hg_2SO_4 \right| Hg.$$

The double salts appeared to hydrolyse the depolariser, and gave inconstant results. The difficulty was overcome with the combination:—

$$\text{Zn Amalg} \left| \begin{Bmatrix} K_2SO_4.ZnSO_4.6H_2O \\ ZnSO_4.7H_2O \end{Bmatrix} Hg_2SO_4 \right| Hg$$

and the E.M.F. was found to be 1·41976 at 25° C., with a negative temperature coefficient of 0·00133. Similarly the combination

$$\text{Cd Amalg} \mid (2KCl.CdCl_2.6H_2O)Hg_2Cl_2 \mid Hg$$

gave very constant results, the E.M.F. being 0·70504 at 25° C. with a temperature coefficient of +0·00015 at 18° C.—B. N.

Consumption of carbon in the electric arc. III. The anode loss. Duffield and Waller. *See* IIB.

Electrolysis of an aqueous solution of potassium thioantimonite, and the constitution of this compound. Muller. *See* VII.

PATENTS.

Furnace; Electric ——. W. J. Wrighton, Assignor to The Leeds and Northrup Co., Philadelphia, Pa. U.S. Pat. 1,165,055, Dec. 21, 1915. Date of appl., Feb. 19, 1915.

A TUBULAR electric heating element is produced by winding a resistance conductor upon and at a distance from a removable form, having a surface corresponding with the inner surface of the tubular element. Plastic material is applied around the conductor and against the form, and a second plastic-material of a different nature is merged with it, after which the materials are allowed to set, the form being then removed. The resistance conductor, for producing a temperature of 1800° F. (980° C.), is thus embedded in non-vitreous refractory material, of relatively high conductivity for heat, forming the furnace wall, the material and conductor having substantially equal coefficients of expansion at and below the temperature given above.—B. N.

Galvanic cell. M. L. Kaplan, Brooklyn, N.Y., Assignor to Beacon Miniature Electric Co., Inc., New York. U.S. Pat. 1,166,414, Dec. 28, 1915. Date of appl., May 1, 1915.

THE depolarising agent is composed of a mixture of conducting carbon and "acid manganous polymanganite" in a hydrated condition.—B. N.

Electrical separation of suspended solid or liquid particles from gases. Ger. Pat. 286,912. *See* I.

Electrical purification of gases. Ger. Pat. 287,648. *See* I.

Electrostatic purification of gases. Ger. Pat. 287,783. *See* I.

Process of purifying electrolytic chlorine. U.S. Pat. 1,166,524. *See* VII.

XII.—FATS; OILS; WAXES.

Japanese fatty and essential oils; Notes on some ——. S. Higuchi. Bull. Forest Expt. Stat., Meguro, Tokyo, 1915. 8 pages.

THE oils obtained by pressing various Japanese plant products have been examined and their constants, and the constants of the mixed fatty acids obtained from them, have been determined, with the following results:—

	Sp. gr.	M.pt. °C.	Acid value.	Sap. value.	Iodine value.	Hehner value.	Reichert-Meissl value.	Neutralisation value.	Mean mol. wt.
Yabunikkei seed oil	0·8743*	11°—15°	0·78	276·9	8·46	90·97	1·30	—	—
do. fatty acids	0·8671	31°	—	—	8·05	—	—	285·2	196·6
Shiraki seed oil	0·9365	—	0·51	197·1	164·0	92·0	0·17	—	—
Beechnut oil	0·9205	—	0·78	201·5	112·2	—	—	—	—
do. fatty acids	0·9040	17°—17·5°	—	—	118·8	—	—	210·4	—
Inugaya seed oil	0·9222	—	0·51	195·6	129·2	97·06	0·85	—	—
do. fatty acids	0·9085	23°	—	—	130·8	—	—	201·0	—
Onigurumi oil	0·9275	—	0·51	187·5	153·7	96·74	4·9	—	—
do. fatty acids	0·9037	28°	—	—	150·6	—	—	193·8	—
Tsunohashibami nut oil	0·9195	—	0·46	190·9	104·6	95·68	3·2	—	—
do. fatty acids	0·8964	16°	—	—	103·5	—	—	211·4	—
Styrax oil	0·9341	—	0·75	185·1	108·1	93·19	6·94	—	—
do. fatty acids	0·9164	41°	—	—	118·4	—	—	195·2	—
Tsubaki oil	0·9159	—	4·6	196·13	80·9	95·57	0·41	—	—
Sazanqua oil	0·9145	—	7·68	193·3	81·41	95·03	0·35	—	—
do. fatty acids	0·8947	22°	—	—	80·68	—	—	186·3	—
Kaya oil	0·9236	—	0·48	190·1	135·8	95·89	0·66	—	—
do. fatty acids	0·9075	18°	—	—	137·84	—	—	195·2	—

* At 100° C.

Yabunikkei seed oil is obtained from the small seeds of a large tree *Cinnamomum pedunculatum Nees.*, which contain 61·86% of oil and 1·69% of water and yield 37·7% of oil on a manufacturing scale. The oil forms a crystalline mass which is liquid in the summer months. It is non-drying and well suited for the manufacture of hard soap. Shiraki seed oil is obtained from the seeds of a tree, *Excoecaria japonica, Muell Arg.*, the kernels of which contain 53·9% of oil and 4·76% of water, the seeds yielding 23·2% of oil on a manufacturing scale. The oil is a good drying oil and on exposure to sunlight in a thin layer forms a hard varnish after a few days. It is a good substitute for linseed oil. Beechnut oil is obtained from the seed kernels of *Fagus sylvatica, L., var. Sieboldi, Maxim.* The kernels contain 39·6% of oil and 7·3% of water, the entire nuts yielding 10·6% of oil on a manufacturing scale. The cold-drawn oil is pale yellow in colour, with a slight agreeable smell, and becomes turbid on cooling It is semi-drying and is used as an edible oil and as a lubricant. Inugaya seed oil is obtained from the kernels of the seeds of *Cephalotaxus drupacea S. et Z.* The nuts contain 62·02% of oil and 4·52% of water, the entire seed yielding 28% of oil on a manufacturing scale. The oil is a semi-drying oil suitable for soap and for blown oil and after rectification with alkali is also suitable for edible purposes. Onigurumi oil is obtained from the nut of *Juglans Sieboldiana, Maxim*, the kernel containing 62·02% of oil and 28·19% of water. The cold-drawn oil is colourless, with a pleasant smell and an agreeable taste. It is a drying oil and is used for white paints for artists. Tsunohashibami nut oil is obtained from the seeds of *Corylus rostrata Ait. var. Sieboldiana Maxim.* The kernels contain 46·06% of oil and 11·65% of water, the entire seeds yielding only 6·7% of oil on a manufacturing scale. The oil is colourless, with a slight agreeable smell, and is used as a hair-dressing and as a superior edible oil. Styrax oil is obtained from the seeds of *Styrax japonica, S. et Z.*, the kernels of which contain 41·12% of oil and 4·58% of water. The entire seed yields up to 8·15% of oil on a manufacturing scale. The oil is tasteless and odourless and has a violet colour which is difficult to remove. It is a non-drying oil and is used as an inferior lubricant. Tsubaki oil is obtained from the seeds of *Thea japonica, Nois.* The kernels contain 56·78% of oil and 17% of water, the entire seed yielding 28·3% of oil on a manufacturing scale. The oil is non-drying and is used in hair-dressing, as an edible oil, and as a machine oil, and also in the preparation of Turkey-red oil. Sazanqua oil is obtained from the seeds of *Thea sazanqua, Nois.*, the kernels containing 61·76% of oil and 4·8% of water, the entire seed yielding 27·8% of oil on a manufacturing scale. The oil has a peculiar smell and is used in hair-dressing and as a superior machine oil. Kaya oil is obtained from the seed of *Torreya nucifera, S. et Z.*, the kernels containing 48% of oil and 6·09% of water, the entire seed yielding 24% of oil on a manufacturing scale. The oil is edible and is also used in paints and varnishes. The bark, roots, and leaves of the Yabunikkei tree (*Cinnamomum pedunculatum Nees.*) all contain volatile oil, the dried leaves on distillation with steam yielding 1·4%. The oil has a fresh pungent smell and distils between 190° C. and 245° C., the greater part distilling at 230°—245° C. The oil has the following constants:—Acid value, 1·1; ester value, 0. Caustic potash solution extracts a phenol from the oil, b.pt. 264°—267° C., sp.gr. at 15° C., 1·0665, giving a benzoyl derivative, m.pt. 65° C.—T. C.

Marine animal oils; The Tortelli-Jaffe colour reaction for ——. M. Tsujimoto. J. Chem. Ind. Japan, 1915, **18**, 1368—1380.

Most marine animal oils give this reaction (see this J., 1914, 1061), especially when the oils are fresh: old and inferior samples, however, give no coloration, or the coloration obtained is indistinct. In some cases, the coloration is given by old oils after these have been refined. The mixed fatty acids of marine animal oils as well as their distillates give the coloration, but the unsaponifiable matters and higher unsaturated fatty acids do not enter into the reaction. Hydrogenised fish oils give indistinct colorations with the test: vegetable oils and terrestrial animal oils and fats do not give a reaction. (Compare Davidsohn, this J., 1916, 186.)—W. P. S.

Fats; Catalytic hydrogenation of —— by means of nickel oxides. W. Meigen. J. prakt. Chem., 1915, **92**, 390—411.

In reply to Erdmann's criticisms (this J., 1915, 969) the author cites further experiments in support of his conclusion (this J., 1914, 323) that metallic nickel is present in the catalyst after hydrogenation. The fats used in the former experiments were pure, and the same results have been obtained with other fats. In all cases hydrogenation was carried out at 250° to 260° C., and with 2% of catalyst, as stated to be the most suitable by Erdmann himself. There was no excessive hardening, and the nickel carbonyl reaction was also obtained with still fluid products. As a proof that the conditions were not such that reduction by carbon monoxide occurred in the reaction, it is pointed out that positive results were obtained by Normann and Pungs (this J., 1915, 237) at 30° C. The presence of organic impurities interferes with the reaction and also affects the sp.gr. of the catalyst. A lack of electrical conductivity is not conclusive of the absence of nickel. The view of Bedford and Erdmann that an oxide or suboxide or a hydride of nickel is the active hydrogenating agent may be correct, but is only a hypothesis which lacks proof.—C. A. M.

Erucic, brassidic, and isoerucic acids; Isomerism of ——. L. Mascarelli and G. Sanna. Gaz. Chim. Ital., 1915, **45**, II., 335—348.

It has been shown previously that erucic, brassidic, and isoerucic acids have the same molecular weight. Determinations of the cooling curves of binary mixtures of the three acids and behenic acid showed that in the case of mixtures of erucic acid with brassidic acid, isoerucic acid, and behenic acid respectively, no solid solutions are formed, the curves each consisting of two branches intersecting at an eutectic point. In the case of mixtures of isoerucic and brassidic acids and of brassidic and behenic acids, there is partial miscibility in the solid state, whilst isoerucic and behenic acids form a continuous series of solid solutions. The results indicate that erucic acid has a structure quite distinct from that of the other acids, whilst isoerucic and brassidic acids have a configuration resembling more nearly that of behenic acid.—A. S.

Emulsifying action of soap. A contribution to the theory of detergent action. S. A. Shorter and S. Ellingworth. Proc. Roy. Soc., 1916, A, **92**, 231—247. (See also this J., 1915, 289.)

It has been shown that the alkali, produced by hydrolysis in a soap solution, is capable of assisting in the formation of the surface layer of soap, by interacting with the free fatty acid in an oil, but the "surface activity" of this alkali is much smaller than that of the undecomposed soap. The "surface activity" of free alkali in a soap solution is less than that of the same concentration of alkali in water, but the addition of alkali to a soap solution increases the "surface activity" of the soap, and this effect is too great for explanation by the assumption that hydrolysis is suppressed. It is suggested that the effect is partly due to an increase in the colloidal nature of the "semi-colloidal" soap solution.—B. N.

Stability of the growth-promoting substance in butter fat. Osborne and Mendel. *See* XIXa.

Utilisation of kitchen refuse and industrial refuse for the production of dry fodder and fat, by the application of the waste heat in gas-works. Frank. *See* XIXb.

PATENTS.

Grease; Petrol-proof ——. A. G. Hopkins, Kidderminster. Eng. Pat. 116, Jan. 4, 1915.

A silicate (sodium silicate) is mixed with a non-drying oil (castor oil), with or without light precipitated chalk or similar substance to give consistency. The grease may be warmed, so as to be readily absorbed by fibrous or other packing for pumps, etc. A coating composition may be made by boiling 6 parts of castor oil, 6 parts of linseed oil, and 3 parts of rosin, with 48 parts of sodium silicate and 6 parts of precipitated chalk.—C. A. M.

Carbon tetrachloride and other halogen-hydrocarbons, or hydrocarbons; Process of rendering —— *soluble in dilute solutions of soap.* L. Frank, Berlin, and G. Fendler, Steglitz, Germany. U.S. Pat. 1,165,498, Dec. 28, 1915. Date of appl., June 21, 1910.

See Fr. Pat. 419,235 of 1910; this J., 1911, 222.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Paints; The light-reflecting values of white and coloured ——. H. A. Gardner. J. Franklin Inst., 1916, **181**, 99—108.

Unlike the relative value of the different types of artificial illuminants, the light-reflecting power of the interior surfaces where such illuminants are used has been but little studied, especially in the case of oil-paints. Traces of carbon in a paint, or dust on a painted surface, enormously decrease the illuminating value. A method of testing paints is described, by which the reflected light proved to vary from 12 for dark green, blue, and red, to 67% for lithopone in a very light-coloured flat varnish. The reflection of heat rays is also subject to considerable variations according to the colour of the painted surface.—W. R. S.

PATENTS.

Paint or coating; Process for the fabrication of a heat- and acid-proof ——. E. R. Stowell, Oden, Mich. U.S. Pat. 1,164,670, Dec. 21, 1915. Date of appl., Oct. 1, 1914.

A mixture of silicon carbide (carborundum powder) and sodium silicate is heated to 80°—100° F. (27°—38° C.) to promote the formation and escape of the hydrogen resulting from interaction of the caustic alkali in the silicate with the free silicon or silicon compounds in the carborundum powder. Water is then added to give the required consistency, and the preparation is packed in sealed vessels.—C. A. M.

Rosin; Stable —— *and process of making the same.* B. T. Brooks, Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,167,264, Jan. 4, 1916. Date of appl., Dec. 2, 1914.

A resin of the colophony class is hydrogenated in presence of a catalyst to obtain a product with the saponification value of colophony, but with an iodine value not exceeding 20. It is stable in the air and does not absorb oxygen or form fissures when spread in thin films.—C. A. M.

Pigment. L. Blangey, Mannheim, Assignor to Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,166,808, Jan. 4, 1916. Date of appl., Feb. 26, 1914.

See Eng. Pat. 20,106 of 1913; this J., 1914, 652.

Liquid compositions for lacquering purposes. O. Schmidt, T. Eichler, and O. Allemann, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,166,790, Jan. 4, 1916. Date of appl., June 5, 1913.

See Eng. Pats. 21,668 and 23,544 of 1912; this J., 1913, 1021.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Latex; Coagulation of Hevea —— *and a new method of coagulation.* B. J. Eaton and J. Grantham. Agr. Bull. Fed. Malay States, 1915, **4**, 26—30.

If latex be allowed to stand in tall cylinders, a slimy, alkaline, surface scum is formed, whilst the lower layers become acid and coagulation occurs. The surface changes are putrefactive in character, and are brought about by organisms which are favoured by aerobic conditions. The changes in the deeper parts of the latex are considered to be due to the activity of anaerobic organisms. Both classes of bacteria infect the latex after collection, and the authors find that by providing a medium more favourable to the growth of the non-putrefactive organisms, by the addition of various sugars, such as dextrose, sucrose, lactose, arabinose, mannose, and lævulose to the latex, coagulation can be induced with unfailing regularity.—E. W. L.

Plantation rubber; Vulcanisation experiments on ——. B. J. Eaton and J. Grantham. Agr. Bull. Fed. Malay States, 1915, **3**, 218—225, 397—401, 442—445. (See this J., 1915, 989, 999.)

A series of nine experiments was carried out, the primary object of which was to determine the factor or factors responsible for the variability of plantation rubber. (1) Samples were crêped 5, 10, 15, 20, and 25 times respectively, but the results of mechanical tests gave no indication of any differences due to this varied treatment. (2) Samples were (*a*) treated in the normal manner, and (*b*) severely macerated on the crêpeing rolls. The only effect was slightly to retard the rate of cure, the stress-strain curve of sample (*b*) being steeper than that of sample (*a*). (3) A similar effect was revealed by comparing the stress-strain curves of the 5 samples in *Exp.* 1, mixed and vulcanised after a lapse of 7 or 8 months. The mechanical results as a whole were lower in this case than in *Exp.* 1, probably owing to the age of the rubber. (4) A slight difference in rate of cure was found between samples coagulated by 3 oz. and 15 oz. respectively of 5% acetic acid per gallon of latex, the optimum mechanical results being obtained at 2½ and 2¾ hrs. cure respectively. (5) Two samples were prepared, (*a*) by the addition of 3 oz. of 5% acetic acid per gallon of latex, (*b*) by the addition of the same amount of acid and 2 oz. of 5% sodium bisulphite solution per gallon. No difference between the two samples as regards mechanical properties or optimum time of cure was observed. (6) It was found that each stage in the process of preparing thin crêpe has a retarding effect upon the vulcanisation of the rubber. The samples examined were:—(1) Coagulated slab simply allowed to drain, kept for 20 days, made into thin crêpe and dried; (2) coagulum rolled once, then treated as (1); (3) rough crêpe, afterwards treated as (1) and (2); (4) thick crêpe; (5) thin crêpe. The optimum

time of cure (from stress-strain curves) was, respectively, 1½, 2, 2½, 2¾, and 3 hours. All these samples contained sodium bisulphite. (7) To ascertain how far uniformity is possible under ordinary estate conditions, samples of 10 days' rubber, prepared as follows, from bulked latex, were examined. Coagulation was effected by adding 3 oz. of 5% acetic acid to each gallon of latex; the rubber was crêped an hour or two after coagulation; in 8 cases a little formalin was added to prevent spotting. Little difference between "formalin" and "non-formalin" samples was indicated by the mechanical tests. All 8 "formalin" samples had an optimum time of cure of 3¼ hrs. and the mechanical properties varied as follows:—load, 1·12 to 1·20 kilos. per sq. mm.; elongation 963 to 998%; product, 1097 to 1184. It is considered that these differences are negligible in practice, but the slow rate of cure, due to the method of preparation, is a disadvantage. (8) The effect of the various stages in the preparation of block rubber was studied, on the following samples: A, slab from the coagulating pans; B, thick crepe; C, thin crêpe; D, E, F, G, H, J, K, L, wormed rubber, as it came from the machine, and after 1, 2, 3, 4, 5, 6, and 7 hours respectively in the hot drier; M, the final block. Sample A cured in about half the time of the other samples, and samples E to M had lower tensile strengths than samples A to D, besides showing a slightly lower rate of cure. Subsequent heating after 1 hour was apparently without effect on these properties. (9) Block rubber prepared as usual on the day following coagulation showed a very much lower rate of cure, and had poorer mechanical properties, than block prepared from coagulum left for 10 days in slab form before blocking and crêpeing, or than similar slab, crêped and dried without blocking.
—E. W. L.

Rubber; Nitrogen content of —— and its relation to the rate of vulcanisation. J. Grantham. Agr. Bull. Fed. Malay States, 1915, 4, 1—4.

Nitrogen determinations by Kjeldahl's method were carried out on a number of samples prepared in various ways and in the following table the figures are given, together with the optimum time of vulcanisation:—

Type of rubber.	Nitrogen, per cent.	Optimum cure, hours.
Smoked sheet	0·445	3
do. after crêpeing	0·441	3
Smoked slab after crêpeing	0·451	1¾
Unsmoked sheet	0·423	2¾
do. after crêpeing	0·434	2¾
Unsmoked slab after crêpeing	0·321	1¼
Thick smoked slab	0·425	1½
Thin do.	0·398	1¾
Thick smoked sheet	0.400	2½
Thin do.	0·416	3
Thick unsmoked slab	0·210	1¼
Thin do.	0·352	1¼
Thick unsmoked sheet	0·386	2½
Thin do.	0·394	3

Although smoked slab vulcanises much more rapidly than smoked sheet, there is no appreciable difference in nitrogen content. In the unsmoked rubbers, however, as the nitrogen content falls the speed of vulcanisation increases. The loss of nitrogen is probably due to decomposition of the protein, but since smoking, whilst preventing loss of nitrogen, does not prevent a slab developing rapid curing properties, it cannot be loss of nitrogen which accelerates vulcanisation. The loss of nitrogen at various stages in the preparation is shown by the following figures:—

Nitrogen in wet slab 2 hrs. after pressing, 0·6% (on dry rubber).
Nitrogen in slab, after drying for 13 days, 0·324% (on dry rubber).
Nitrogen in dry crêpe from dried slab, 0·220%.
Nitrogen in wet crêpe, made immediately from the wet slab, 0·396% (on dry weight).
Nitrogen in the dried crêpe, 0·360%.

The loss is therefore partly in the serum which drains away and partly in the gaseous form.
—E. W. L.

Vulcanisation experiments. The effect of mixing different raw rubbers. B. J. Eaton. Agr. Bull. Fed. Malay States, 1915, 4, 4—6.

Samples of rapidly curing and slow curing rubber were prepared, the former by allowing slabs to stand for 6—9 days after coagulation, the latter by crêpeing a few hours after coagulation. Three mixtures of these two rubbers were also prepared containing respectively 2, 1, and 1 part of the former, to 1, 1, and 2 parts of the latter, and the five rubbers were vulcanised at 140° C. with 10 parts of sulphur to 90 of rubber. The mechanical tests and optimum curves showed that the rate of cure was graduated, according to the proportion of fast or slow curing rubber in the mixture, the actual optimum cures, from the curves, being 1, 1½, 1¾, 2¼, and 3 hours. The vulcanised samples were equal in physical and mechanical properties. A ball of Fine Hard Para consists of rubber from latex collected over several months, and the results confirm the view that the uniformity is due to averaging, and indicate a method of obtaining similar results on the plantation.—E. W. L.

Rubber; A new rapidly vulcanising ——. B. J. Eaton. Agr. Bull. Fed. Malay States, 1915, 4, 30—33.

Latex, diluted to contain 1½ lb. of dry rubber per gallon, was coagulated in pans with 3 oz. of 5% acetic acid per gallon. The following day the slabs were pressed and soaked, one in 1% caustic soda, one in 1% sodium carbonate, and one in saturated lime-water, for 18—24 hours. The slabs were then placed on racks for 10 days, thinly crêped, dried, and vulcanised with one-ninth of their weight of sulphur at 140° C. The optimum times of cure were ½ hour and ¾ hour for the first two samples, whereas the control (untreated) sample cured in 1¼—1½ hour. The sample soaked in lime-water cured rather more slowly than the control. The two rapidly curing samples, more especially that soaked in caustic alkali, were very easily overcured.—E. W. L.

Patents.

Rubber goods; Process for eliminating porosity in ——. W. E. Piper, Melrose, Mass., Assignor to Boston Rubber Shoe Co. U.S. Pat. 1,164,860, Dec. 21, 1915. Date of appl., Aug. 27, 1912.

A bottom for rubber shoes is made into its final shape from calender-sheeted vulcanisable rubber, then heated at atmospheric pressure at about 130° F. (54° C.) for about 36 hours to expel gases, etc., causing porosity, and finally vulcanised.
—C. A. M.

Rubber, rubber-like or similar materials; Process of vulcanising ——. P. I. Murrill, New York, Assignor to Revere Rubber Co. U.S. Pat. 1,166,777, Jan. 4, 1916. Date of appl., Feb. 9, 1915.

The cold-vulcanising liquor employed consists of a solution of sulphur monochloride in gasoline which has been freed from olefines by appropriate chemical treatment.—E. W. L.

Rubber; Revulcanising ——. R. B. Price, New York, Assignor to Rubber Regenerating Co. U.S. Pat. 1,166,784, Jan. 4, 1916. Date of appl., Jan. 25, 1913.

The process of revulcanising rubber consists in exhausting, and compressing the material under excessive compacting pressure, in order to minimise destructive distillation, at the same time heating it to a temperature below its fusing point under the increased pressure, and then subjecting it to vulcanising heat, afterwards quickly cooling it to check surface vulcanisation.—E. W. L.

Rubber; Art of devulcanising ——. H. J. Mayers, Cleveland, Ohio, Assignor to Empire Rubber Co. U.S. Pat. 1,167,359, Jan. 4, 1916. Date of appl., Feb. 17, 1912.

Devulcanisation is effected by treatment with pine oil, obtained by distillation of pine wood. The oil has a sp.gr. between 0·88 and 0·96, and is previously freed from resins and turpentine by distillation with water at about 212° F. (100° C.), in conjunction with a salt or not.—E. W. L.

Froth fillings [rubber, etc.]; Manufacturing ——. F. Pfleumer, Dresden, Germany. U.S. Pat. 1,167,518, Jan. 11, 1916. Date of appl., Aug. 12, 1912.

See Addition of May 18, 1912, to Fr. Pat. 430,473 of 1911; this J., 1912, 1139.

Isoprene and homologues thereof; Manufacture of ——. H. S. A. Holt, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,168,070, Jan. 11, 1916. Date of appl., June 13, 1912.

See Eng. Pat. 21,519 of 1911; this J., 1912, 702.

Leather substitute and process for the production thereof. Eng. Pat. 15,269. *See* XV.

Manufacture of an elastic material, and tyres and other objects formed therefrom. Eng. Pat. 17,242. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Leather; Detection of free mineral acids and lactic acid in ——. R. Lauffmann. Ledertech. Rundschau, 1915, 8, 292—301. J. Chem. Soc., 1916, **110**, ii., 57.

Dried and undried portions of the leather are dialysed; if the former dialysate is acid, mineral acids or oxalic or lactic acid may be present. If only the latter dialysate is acid, the acidity is due to volatile organic acids. In the former case an extract of 20—30 grms. of the leather in 200 c.c. of hot water is tested for sulphate, chloride, and oxalic acids ions. If the latter is present, the question as to whether the leather contained free mineral acid cannot be decided. If absent, lactic acid is tested for in an extract of the finely divided leather prepared by prolonged digestion at 60°—65° by the author's method (this J., 1915, 725). If both oxalic and lactic acids are proved absent, the sulphate and chlorine ions must have been present as free acid. In this case the dialysing process can be utilised for their quantitative estimation, the aqueous dialysate being titrated with N/10-alkali hydroxide, using Congo-red as ndicator.

Gelatin-water mixtures; Vapour pressure of ——. K. Gerike. Kolloid. Zeits., 1915, 17, 78—104. J. Chem. Soc., 1916, **110**, ii., 18—19.

Comparative measurements showed that gelatin sols have a slightly lower vapour pressure than pure water. The difference is very small, and increases very slightly with increasing concentration of the gelatin in the sol. The vapour pressure of solutions of potassium bromide is increased, and that of odium chloride solutions diminished by addition of gelatin, whilst lithium chloride and ammonium nitrate solutions show an effect which varies according to the temperature. Gelatin gels have a slightly lower vapour pressure than that of pure water, and the concentration of the gel is of little importance below 70% of gelatin. For gels containing more than this the vapour pressure is much lower, and there appears to be a further jump in the vapour-pressure curve when the concentration of the gelatin reaches about 94%. Von Schroeder (Z. physik. Chem., 1903, 45, 75) found that gelatin which has taken up a maximum amount of water by direct contact with the liquid gives off a relatively large proportion of this when it is exposed to the saturated vapour at the same temperature. Cellulose (blotting-paper) when treated in the same manner takes up a further quantity of water in contact with the saturated vapour. If, however, the cellulose is dissolved in ammoniacal cupric oxide and reprecipitated, it behaves like gelatin. Conversely, when the surface of gelatin (after swelling in water) is roughened, it loses water much less readily on contact with saturated water-vapour. These observations show that the nature of the surface of the swollen protein has considerable influence on its behaviour in an atmosphere of water-vapour. It is suggested that the swollen gel is under the influence of external pressure, which causes water to exude at the surface when the gel is suspended in the vapour. If the surface is smooth, then small drops of water are formed, which evaporate, but if the surface is rough, then the exuded water is distributed in the system of capillary depressions, and in these circumstances evaporation does not take place in the saturated vapour.

Gelatin; "Hydratation" and "dissolution" of ——. M. H. Fischer. Kolloid. Zeits., 1915, 17, 1—7. J. Chem. Soc., 1916, **110**, i., 90.

Experiments in which 2 c.c. of a 10% gelatin gel was mixed with 8 c.c. of water or an equal volume of a solution of an electrolyte of varying concentration and kept at 25° C. for about twenty-four hours, showed that hydrochloric acid and sodium hydroxide have a very pronounced influence on the liquefaction of the gel, in that the gel liquefies more and more readily as the concentration of the acid or alkali is increased. For dilute solutions of acid or of alkali hydroxides, the effect of the addition of salts is to counteract the liquefying tendency of the acid or base. For a given concentration of dilute hydrochloric acid, sodium chloride has a maximum effect at a definite concentration, and if this is exceeded the salt effect becomes smaller. Other salts behave similarly to sodium chloride. The observations are considered to support the view that "hydratation" of protein gels consists in the combination of the proteins with water, and that "dissolution" (liquefaction) corresponds with an increase in the degree of dispersity of the colloid.

Patents.

Leather; Process of treating ——. *Impregnated leather and method of making same.* R. A. Marr, Assignor to General Waterproofing Co., Norfolk, Va. U.S. Pats. (A) 1,166,845 and (B) 1,166,846, Jan. 4, 1916. Dates of appl., Jan. 14 and 13, 1914.

(A) Skin or leather is immersed in a bath of preservative and waterproofing materials, such as a mixture of diatomaceous earth, paraffin wax, and rosin, which mixture is liquid at a temperature slightly above 100° C. (B) Skin or leather is impregnated with a filling material such as a mixture of diatomaceous earth, paraffin wax, and naphthalene, at a temperature somewhat above 100° C. The leather is rendered more resistant to wear and moisture.—F. C. T.

Waterproof leather ; Flexible —— and method of making it. Flexible and waterproof porous material [leather] and method of making the same. J. W. Barber, Newton, Mass. U.S. Pats. (A) 1,167,326 and (B) 1,167,327, Jan. 4, 1916. Dates of appl., Oct. 10, 1910, and June 9, 1913. (A) Renewed July 14, 1913.

(A) Leather is rendered pliable and waterproof by immersing it first in a mixture of three parts of vaseline and one of paraffin wax, and later in a mixture containing equal parts of paraffin wax and vaseline. The proportion of paraffin is thus greater in the surface of the leather than in the interior. (B) Leather or other porous material is successively impregnated with different mixtures of waterproofing substances, the last composition being absorbed by the material, and confining the previously applied composition.—F. C. T.

Leather substitute and process for the production thereof. A. L. Nielsen, Copenhagen. Eng. Pat. 15,269, Oct. 29, 1915.

Canvas or cloth strips left over when the covers of old pneumatic tyres are devulcanised by potassium cyanide, are laid one over the other and pressed together under the action of heat. The mass so prepared may be covered by rubber on one or both surfaces. The material is characterised by strength, durability, and resistance to water rather than by suppleness and elasticity.—F. C. T.

Elastic material; Manufacture of an —— and of tyres and other objects therefrom. M. Barricelli, Nordstrand, Norway. Eng. Pat. 17,242, July 21, 1914. Under Int. Conv., July 22, 1913.

An elastic material is prepared by melting together bone glue, 4 ; gelatin, 1 ; glycerin, 3 ; and water, 3 kilos., and incorporating with the mass so obtained antimony pentasulphide, 0·5 kilo., and acetic acid, 0·5 litre. The mixture is maintained in a molten state in a boiling water bath, and immediately before moulding it into the desired form a mixture of acetic acid, 0·5 litre, and formalin, 1 litre, is added. Other hardening ingredients may be used in place of formalin.—E. W. L.

Preparation of leather charcoal for hardening steel and iron. Ger. Pat. 287,665. *See* X.

XVI.—SOILS ; FERTILISERS.

Soil ; The reaction of —— and measurements of hydrogen-ion concentration. L. J. Gillespie. J. Washington Acad. Sci., 1916, **6**, 7—16.

The reaction of a soil should be studied from the standpoints of quantity of acid substance, and of intensity of the acidity. The amount of lime, or of other neutralising materials, required to correct acidity, depends upon the first, but probably the characteristic effects of acidity upon fertility are more clearly correlated with the latter, which can only be measured by determining the hydrogen-ion concentration. Twenty-two soils of seven distinct types were investigated from this point of view, both by the electrometric and colorimetric methods. In both of these the soil was air-dried, passed through a coarse sieve, and then mixed with twice its weight of water. The electrode vessel, which was shaken continuously throughout the determination, contained a platinum electrode coated with palladium, means for filling the space above the soil suspension with pure hydrogen, and at its base a stop-cock to connect the liquid with a saturated solution of potassium chloride. The difference of potential between the platinum and a saturated potassium chloride calomel electrode was found by means of a very sensitive voltmeter. In the colorimetric method, the liquid was first centrifuged, and after the indicator solution had been added, the colour produced was measured by comparison with that of a solution of known H-ion concentration. The indicators used were methyl red, the sodium salt of phenolsulphone-phthalein, phenolphthalein, and the recently prepared tetrabromophenolsulphone-phthalein, dipropyl red, and bromothymolsulphone-phthalein (see this J., 1915, 1226). Each soil sample was tested with two of these indicators. The results were in close agreement with one another, and with the electrometric determination. The H-ion concentration expressed as the H-ion exponent of Sörensen, varied from 4·4 to 8·6, the exponent 7 indicating neutrality. The application of the colorimetric method to soils under field conditions is now under investigation.—E. H. T.

Moisture in soils ; Method for the estimation of hygroscopic ——. W. D. Haigh. Sci. Proc. Roy. Dublin Soc., 1915, **14**, 529—531.

The ordinary method of determining the hygroscopic moisture (*i.e.*, the water left after air-drying) in a soil by heating it at about 100° C. for 12—24 hours, gives high results owing to the loss of volatile matter other than water. The method now proposed, which gives lower but strictly consistent results, consists in shaking the soil with powdered calcium carbide and measuring the acetylene evolved in a nitrometer. The mixing vessel is a thick glass tube shaped like a Kjeldahl flask but with a bent neck ; a small test-tube fits into the neck but cannot pass the bend. The carbide (about 3 times the weight of soil) is first placed in the bulb : the small tube with the soil is inserted in the upper, bent portion which is kept horizontal ; and then the flexible joint is connected to the nitrometer. The tube is tilted to empty the soil on to the carbide, and the mixture is shaken ; the acetylene comes off rapidly and can be measured within a few minutes. A blank experiment should be performed with ignited sand and a known weight of water. As found by other workers, the volume of acetylene liberated from 0·018 grm. of water measured 10·5 c.c. instead of the theoretical 11·2 c.c. The combined water contained in the hydrated silicates of a soil is practically unaffected by the carbide.—E. H. T.

Potassium ; Adsorption of —— by the soil. A. G. McCall, F. M. Hildebrandt, and E. S. Johnston. J. Phys. Chem., 1916, **20**, 51—63.

To ascertain the effect of contact for a short time between a soil and a salt solution, and the influence of surface area upon the amount and rate of adsorption, an approximately $N/500$ solution of potassium chloride was caused to percolate through a Durham sandy loam soil (Cabarrus Co., N.C.), the potassium in the percolate being estimated colorimetrically. This soil was used in two different states : [A] dried and passed through a 2 mm. sieve, and [B] very finely ground in a porcelain-lined ball mill for 4 days. The apparatus consisted of a Pasteur-Chamberland filter tube surrounded by a brass jacket to hold the soil, the whole being enclosed in a porcelain-lined filter chamber, into which the solution was poured, and which was fitted with an airtight cap in connection with an automobile tyre pump. The amount of potassium leached out of the soil samples by pure water was first ascertained : much more was dissolved from [B] than from [A]. Twenty grms. of [A] was treated with 250 c.c. of the potassium chloride solution containing 62 parts per million of potassium, the flow was maintained at a uniform rate, and the percolate was collected in fractions of 50 c.c. The amount of adsorbed potassium was then immediately found by leaching with pure water, at the same rate of flow. The amounts of potassium in the first five percolates were, 40, 36, 40, 41, and 59 parts per million respectively, and the corresponding amounts retained per million parts of dry soil were, 58, 124, 181, 226, and 233. The leaching action of water gave 7, 11, 9, 9, 8 p.p.m. of potassium in the fractions. With soil sample [B], it was found, very unexpectedly, that the amount of potassium in the solution was increased and not decreased by its contact with the soil, and this increase was only partly accounted for by the solvent action of the solution on the potassium in the soil. Allowing for this correction, a potassium chloride solution containing 78 p.p.m. gave fractional percolates containing 107, 91, 82, and 92 p.p.m. of potassium. By the subsequent leaching action of water, 39, 24, 21, 18, 15 and 18 p.p.m. of potassium were removed in the different fractions. The above case of negative adsorption is probably due to the solvent (water) being adsorbed more rapidly than the solute. Positive adsorption gradually diminishing and changing to negative adsorption was observed by Williams (this J., 1914, 505) for certain electrolytes in water with blood charcoal, but the above is the first recorded instance of initial negative adsorption.—E. H. T.

Soil bacteria; Comparative effects of phosphates and sulphates on ——. E. B. Fred and E. B. Hart. Agric. Exper. Stat. Univ. Wisconsin, Research Bull. 35, 1915. J. Chem. Soc., 1916, **110**, i., 104—105.

Ammonification occurs with peptone in solutions, and with casein in soils, both with pure and mixed cultures. Addition of mono-potassium phosphate to peptone solution greatly increased the production of ammonia, especially at the end of the second day, whilst precipitated calcium phosphate stimulated ammonia production in five-day liquid cultures. With tricalcium phosphate, or bone-ash, there was no increase of ammonia in peptone solutions. Calcium and potassium sulphates slightly increased ammonification, the latter being the more effective. Addition of mono-potassium phosphate results in an enormous increase in the numbers of bacteria, followed by a rise in ammonia production, which, however, is not in proportion to the number of bacteria. In the soil experiments, dipotassium phosphate stimulated ammonification and cell production, whilst tricalcium phosphate gave a slight increase. All phosphates, especially dipotassium phosphate, increased the numbers of bacteria. Addition of sulphates and phosphates to soil increased the production of carbon dioxide; with ammonium sulphate the increase was very great. The results indicate that the increased crop production following an application of soluble phosphates is partly due to increased bacterial activity. With increased ammonification the plants obtain more available nitrogen, and with ncreased production of carbon dioxide more available mineral nutrients.

Potash and phosphoric acid contained in certain rocks; Displacement of —— by means of substances employed as manures. G. André. Comptes rend., 1916, **162**, 133—136.

T has been shown previously (Comptes rend., 913, **157**, 856) that prolonged trituration of microclinic felspar with water containing salts, mployed as manures or contained in soils, will berate a certain quantity of potash from the felspar. Similar experiments have now been made with finely-divided glauconite (a hydrated silicate of iron and potassium); with sodium chloride, sodium nitrate, calcium carbonate, and calcium sulphate in solution, more potash is dissolved than from felspar. The greatest amount is dissolved in the case of ammonium sulphate, equal to about 10% of the total potash in the mineral. Experiments have also been made on the solubility of phosphoric acid in apatite, with negative results in the cases of ammonium carbonate, sodium nitrate, and potassium nitrate; with potassium carbonate a small quantity of phosphoric acid was dissolved, equivalent to 0·35% of the total phosphoric acid in the mineral.—B. N.

Potassium in fertilisers: Determination of —— F. Pilz. Z. landw. Vers.-Wesen Oesterr., 1915 18, 77—108. J. Chem. Soc., 1916, **110**, ii., 51.

The author has investigated the perchlorate method, and recommends the following procedure for the estimation of potassium in fertilisers: (A) *In potash fertilisers (potassium chloride, kainit, etc.).*—10 grms. of the sample is heated with 200 c.c. of water and 10 c.c. of concentrated hydrochloric acid; barium chloride solution is added in quantity sufficient to precipitate all the sulphate present, the mixture is cooled, diluted to 500 c.c., and filtered. Twenty-five c.c. of the filtrate is transferred to a glass basin, 10 c.c. of perchloric acid of sp.gr. 1·125 is added, and the mixture is heated until hydrochloric acid vapours are no longer given off; after cooling, the contents of the basin are treated with 25 c.c. of alcohol containing 0·2% of perchloric acid, the precipitate is rubbed down to a fine powder, then collected in a Gooch crucible, washed with the acid alcohol, and dried at 120°—130° C. for 30 minutes. The process must be carried out in an atmosphere free from ammonia vapour. (B) *In mixed fertilisers (superphosphates, wood-ash, etc.).*—10 grms. of the sample is dissolved, and the sulphate precipitated as described under (A); the solution is then rendered ammoniacal, heated, treated with ammonium carbonate, cooled, diluted to 500 c.c., and filtered. Fifty c.c. of the filtrate is evaporated in a platinum basin, the residue is dried and heated to expel ammonium salts, then dissolved in water, the solution filtered, and the potassium precipitated with perchloric acid as described (compare Davis, this J., 1912, 1045; 1915, 1246).—W. P. S.

Leaves; The leaching action of water on the nitrogen and mineral constituents of ——. G. André. Bull. Soc. Chim., 1915, **17**, 429—441.

To ascertain the loss of nitrogen, potassium, and phosphoric acid, suffered by fallen leaves on exposure, 100 yellow chestnut leaves were taken from a tree in autumn, a similar number from the ground in the spring, and both lots analysed. It was found that during the six months' exposure 7·5% of the original nitrogen, 67·4% of the phosphoric acid, and 87·7% of the potash had disappeared. The leaching action of distilled water containing a trace of formalin, on chestnut leaves was investigated by immersing them, changing the water at definite intervals, analysing the solutions, and so on until exosmosis was complete. A large number of substances diffused into the water, including salts of potassium, calcium, and magnesium, and phosphates, amino-acids derived from protein, and phosphate derived from lecithins and nucleins; the potassium was present almost entirely as salts of organic acids. The greatest loss of nitrogen, phosphorus, and potash occurred during the early days of immersion, and the younger the leaf the greater the loss; young leaves contained much nitrogen in the amino-form and phosphorus was contained in them chiefly as soluble phosphate. Nitrogen was removed very slowly, 5·49% after 58 days and only 6·27% after 255 days; 73·36% of the original phosphoric acid diffused out in 58 days, 98% of the potash in the same period, this constituent always diffusing most rapidly. Comparing an exposed leaf manure with a good farmyard manure, the former contains about twice as much nitrogen, but in a less available form, about the same amount of phosphate, but no potassium at all. Of the total calcium present in the leaves, about 20% was lost in one month, 40—50% of the magnesium, and 57—68% of the sulphur, which is present almost entirely as mineral sulphate. The experiments were performed during three successive years and the results were consistent.—E. H. T.

Patents.

Manure: Artificial —— for accelerating or improving the growth of plants. J. J. W. H van der Toorn, The Hague, Holland. Eng. Pat. 24,778, Dec. 30, 1914.

The manure is composed of magnetic titaniferous iron sand or oxide, such as titanium iron oxide, and superphosphates, potassium compounds, or guanos. The magnetic substance increases the magnetic inductivity of the soil, and this has a stimulating effect on the growth of plants.—B. N.

Fertiliser. T. L. Willson and M. M. Haff, Ottawa, Assignors to Southern Investment Co. of Canada, Ltd., Montreal, Canada. U.S. Pat. 1,166,104, Dec. 28, 1915. Date of appl., Oct. 1, 1912.

A dry fertiliser consisting of monocalcium-ammonium phosphate and a little acid-free ammonium phosphate, mixed with a fertilising material of basic nature.—E. H. T.

XVII.—SUGARS; STARCHES; GUMS.

Sucrose and invert sugar; Comparative actions of —— on alkaline copper solutions. L. Maquenne. Comptes rend., 1916, **162**, 145—149. (See also this J., 1915, 1263.)

The author studied the influence of temperature and duration of heating on the reduction effected by sucrose and invert sugar separately, in the reaction-liquid previously described (*loc. cit.*). The relatively great influence of temperature on the reducing power of sucrose as compared with invert sugar, is illustrated by the following figures, which are proportional to the amounts of copper reduced by immersion of the reaction-mixtures for 10 mins. in water at the given temperatures:—

	65° C.	70° C.	75° C.	80° C.	85° C.	90° C.	95° C.	100° C.
Invert sugar, 20 mgrms.	58	63	64	65	66	66·5	67	68
Sucrose, 10 grms.	3	4	6	9	12	17	25	41

The reducing power of sucrose at constant temperature was found to be almost proportional to the duration of heating (between 10 and 60 mins.), whilst that of invert sugar was affected only to a slight extent. The author points out that when reaction mixtures containing much sucrose are boiled or heated in boiling water, the results obtained may depend to a slight extent on the barometric pressure inasmuch as this affects the boiling point.—J. H. L.

Patents.

Rolls for sugar-cane mills. J. McNeil, Glasgow. From C. McNeil, Havana, Cuba. Eng. Pat. 701, Jan. 16, 1915.

Method of treating vegetable substances for the recovery of their values. U.S. Pat. 1,165,689. *See* V.

XVIII.—FERMENTATION INDUSTRIES.

Yeast cell; "Volutin" or "metachromatic corpuscles" of the ——. W. Henneberg. Woch. Brau., 1915, 32, 301—304, 312—315, 320—323, 326—329, 331—337, 345—347, 351—354.

The author regards the "metachromatic corpuscles" of yeast, described by Guilliermond in 1902 (compare this J., 1901, 731), as identical with the "chromatin grains" of Zettnow, and asserts that they consist of volutin in a viscous or pasty condition and are directly concerned in fermentation. These "volutin drops" are frequently visible in cell vacuoles, as more or less globular bodies, distinguished from fat globules by their capacity for movement and their lower refractivity. Attempts to stain the volutin in living cells with methylene blue, give uncertain results which often change rapidly. The volutin usually becomes red and the vacuoles themselves red, violet, or blue. The volutin is best stained after the yeast has been killed, preferably with undiluted formalin; after the rest of the cell has been decolorised with sulphuric acid the volutin retains a deep blue or violet blue colour. In resting yeast the volutin usually occurs in relatively large globules, often visible unstained, and when the yeast is stored it slowly disappears. When the yeast is transferred to sugar solutions the volutin drops begin to subdivide almost instantaneously in normal cells, and take up a position near the walls of the vacuole in a very finely divided state. This condition is characteristic of fermentation, but accumulation of glycogen sometimes causes the volutin to be displaced to the cell wall of the yeast. The amount of volutin increases during fermentation but part of it is invariably transferred to daughter-cells; after fermentation has ceased the quantity again diminishes. Addition of certain salts, notably dipotassium phosphate, or of peptone, stimulates the production of volutin. The fermenting power of culture yeasts is closely related to their content of volutin; bottom-fermentation beer yeast contains more than ordinary pressed yeast. The author suggests that volutin may be the fermentative enzyme itself or its mother-substance. The volutin in other organisms may be similarly related to their specific activities, and there is some evidence of this in the case of lactic and acetic bacteria.—J. H. L.

Yeast; Nitrogenous constituents of ——. J. Meisenheimer. Woch. Brau., 1915, 32, 325—326.

A pure culture distillery yeast and a pure culture bottom-fermentation beer yeast were autolysed until 95—98·5% of their nitrogenous constituents had passed into solution. The following mono-amino-acids were found in the solutions:—glycine, alanine, valine, leucine, proline, phenylalanine, aspartic and glutamic acids, tryptophane, and probably serine, cystine, and an amino-butyric acid. Extraction of the cell residues with alcohol yielded a further small quantity of nitrogenous matters, and also phytosterol. The residues were afterwards dissolved in boiling hydrochloric acid, and their composition, apart from the presence of 1·6% of glucosamine in the case of the top-fermentation yeast, was found to be very similar to that of yeast protein. In other experiments tryptophane, which was isolated in the crystalline state, was found to constitute about 0·3% of both top- and bottom-fermentation yeasts.—J. H. L.

Yeast protein. C. Neuberg. Woch. Brau., 1915, 32, 317—320.

Maceration juice prepared by digesting dried yeast with twice its weight of water for 12 hours at 12°—16° C., was filtered, diluted with twice its volume of water, and heated in a water-bath until coagulation of protein was complete. The precipitate was washed and extracted with alcohol and ether. It formed a fine white powder containing 13·02—13·28% N, 0·92—0·94% S, and 0·59—0·62% P (corresponding to 6·2% of yeast nucleic acid). A second maceration of the same yeast for 14 hours yielded a further quantity of coagulable protein containing 13·39—13·46% N, 0·95—1·01% S, and 0·26—0·30% P. These two preparations accounted for 34% of the nitrogen of the yeast, and very similar results were obtained with a second yeast. Yeast protein contains alanine and tryptophane in addition to the amino-acids found by previous investigators. (Cp. preceding abstract, and Pringsheim, this J., 1913, 802.)—J. H. L.

Yeasts ; Formation of acids by ——. E. Moufang. Allgem. Z. Bierbrau. u. Malzfabr., 1915, **43**, 159. Z. ges. Brauw., 1915, **38**, 300—301.

Different brewery yeasts were found to produce, from the same wort, beers differing considerably in acidity, and those which generated the largest quantities of acid gave rise to more brilliant beers than the others. Mixed yeasts often produced higher acidities than their behaviour separately gave reason to expect. The author suggests that the brilliance of beers might in many cases be improved by a suitable choice of yeast with a view to increased production of acid.—J. H. L.

Beer ; Degree of complete attenuation of —— *: its regulation and its relation to the degree of attenuation attained in the vat and after storage of beer.* K. Windisch. Woch. Brau., 1915, **32**, 285—288.

The degree of complete attenuation of a wort is found by fermenting the wort to the utmost possible limit by a relatively large amount of yeast, subtracting the saccharometer indication of the fermented from that of the unfermented wort, and expressing the difference as a percentage of the latter. It affords a convenient check on the mashing process since it constitutes a measure of the amount of fermentable matter in the wort and of the relative amounts of sugars and unfermentable extract. The extent to which it exceeds the degree of apparent attenuation actually attained in brewing, indicates the amount of fermentable matter in the finished beer and therefore the liability of the beer to attack by yeasts and foreign organisms. The author discusses the influence of mashing temperatures on the proportion of maltose to dextrins in wort, and points out that an alteration of this proportion (by modification of the mashing process) may have a slight effect on the yield of extract, since 100 parts by weight of starch will produce 105·6 parts of maltose but only about 102·8 parts of dextrins. Conversion of dextrins into maltose has often been found to occur in worts drawn off from the mash tun and allowed to cool to the optimum temperature for saccharification, *e.g.*, when worts at 73°—75° C. have been run into a cold copper. In Germany, the average degree of complete attenuation of pale worts is 72—75% and that of dark worts 67—70%. Apart from export and Dortmund beers, which are almost or quite completely attenuated, pale beers usually contain 0·2—0·3% and dark beers 0·3—0·5% of fermentable sugar, and their respective degrees of attenuation are accordingly 3—4% or 5—7% below those of complete attenuation. After the primary fermentation they usually contain 1—1·2% of sugar in excess of these amounts, to allow for the secondary fermentation ; for a 13% wort the degree of attenuation reached in the vat is therefore about 10% lower than that of the finished beer.—J. H. L.

Wine ; Determination of total tartaric acid, calcium tartrate, potassium hydrogen tartrate, and free tartaric acid in ——. R. Kunz. Arch. Chem. Mikroscopie, 1915, No. 3. J. Chem. Soc., 1916, **110**, ii., 57—58.

Fifty c.c. of the wine is treated with exactly 3 c.c. of $N/2$-hydrochloric acid and 2 c.c. of 20% potassium chloride solution, and evaporated to 10 c.c. Another portion of 50 c.c. of the wine is evaporated at the same time, without any addition, until the residual solution weighs 10 grms. To each of the residual solutions is now added 100 c.c. of 96% (by vol.) alcohol ; after twelve hours the precipitates are collected, washed with alcohol, then dissolved in hot water, and the solutions titrated with $N/10$-alkali solution. The quantity of the total tartaric acid and of the potassium hydrogen tartrate in the wine is thus obtained. The filtrate from the potassium hydrogen tartrate estimation (the precipitate contains also the calcium tartrate) is treated with 2 c.c. of 20% potassium chloride solution ; after 12 hours, 2 c.c. of $N/10$ hydrochloric acid is added, the precipitate is collected, washed with alcohol, dissolved in hot water, and the solution titrated. This result gives the amount of free tartaric acid present, and the difference between the quantity of total tartaric acid and the sum of the quantities of free tartaric acid and that present as potassium hydrogen tartrate gives the amount present as calcium tartrate.

Bacteria ; Rate of growth of ——. A. Slator. Trans. Chem. Soc., 1916, **109**, 2—10.

The organism used was a lactic acid-producing organism of the *B. Delbrücki* type occurring in malt-wort. This organism produces a silky appearance in wort cultures similar to that produced by finely divided asbestos shaken with water, and a series of tubes containing asbestos and water was used as a standard for measuring the concentration of the bacilli in the wort cultures. An active culture of the organism at 45° C. was compared with the standard tubes and then dilutions to 100,000 times made in fresh wort tubes. After incubation, the time taken by these diluted cultures to match the standards was observed, and from these observations it was calculated that the generation time of the organism was 21·5 minutes. Observations were conducted over the range of temperature (22°—55° C.) in which growth occurs, and it was found that the rate of increase was a maximum at 50° C. The rate of growth was retarded by the lactic acid produced in the cultures, and the use of a culture which had been grown for several generations in acid wort, did not prevent this retardation from taking place. The rate of unrestricted growth was determined indirectly by finding the rate of production of the lactic acid in two cultures seeded with the organisms in a known ratio. The increased length of time required by the lesser seeding to produce as much acid as the other gives the time required for the organisms in the lesser seeding to become as numerous as those in the greater. The rate of growth calculated from this, agreed with the rate as determined above. The rate of growth was found to be independent of the concentration of the wort over a large range.—J. H. J.

Whisky distilleries taken over by Government.

The Ministry of Munitions announces that it has arranged to take over, until the end of the war, all those distilleries employed in making whisky by the patent-still process.

Alcoholometry ; Practical ——. H. P. Barendrecht. Chem. Weekblad, 1915, 34, 736—741. Woch. Brau., 1915, 32, 349—350.

In the determination of alcohol in beer and similar fermented liquids by distillation methods now in use, small quantities of volatile matters besides alcohol pass into the distillate and affect its surface tension to such an extent that hydrometers, standardised with pure aqueous alcohol, may indicate a percentage of alcohol in the distillate in some cases 0·4 lower than the true percentage as found with a pyknometer. Such errers may amount to 8% or more of the quantity of alcohol determined. The author describes a copper distillation apparatus designed to concentrate the whole of the alcohol from 2·5 litres of beer in about 1/20 of this volume of distillate, in which it may be determined accurately with a hydrometer. The vapours from the still ascend into a narrow annular space, packed with copper gauze, between two tall copper cylinders, the outer one of which is surrounded by a casing filled with 15 litres of cold water at the commencement of distillation. The alcoholic vapours, condensed in the annular space, remain there (the reflux to the still being practically free from alcohol) until the surrounding water becomes warmed to about 78° C. The alcohol then passes over into a condenser, and the last traces are carried over at a later stage by the first portions of aqueous distillate when the surrounding water has reached 100° C. The still is heated by a steam pipe or by six Bunsen burners, and the whole process occupies about 80 mins.—J. H. L.

Preparation for improving barley. Schönfeld and Krumhaar. *See* XIXA.

PATENTS.

Beer filters and the like; Apparatus and appliances for washing and sterilising pulp for ——. F. Barber, Sheffield. Eng. Pat. 4104, Mar. 16, 1915.

THE apparatus consists of a circular tank having an upper portion of larger diameter than the lower and a removable perforated metal ring supported on the edge of the lower portion so as to form an annular space with the enlarged wall of the upper portion. In the centre of the tank is a displacer having a detachable upper portion and surrounding a removable central overflow pipe; other removable overflow pipes are provided in the annular space outside the perforated ring in the upper portion of the tank. The cakes of filtering pulp are broken up and placed in the tank, in which the mass is given a gyratory motion by means of jets of water and steam introduced tangentially to the walls of the tank, the dirty water being discharged through the perforated ring at the top. —J. F. B.

Grapes or berries; Process of exhausting unfermented ——. E. Monti, Turin, Italy. U.S. Pat. 1,167,006, Jan. 4, 1916. Date of appl., Mar. 5, 1914.

THE juice from berries, particularly grapes, is strained and fermented at a temperature not exceeding 15° C.; the pomace from the crushed and pressed berries is steeped in warm water at 50°—60° C., the temperature being maintained until the pomace has been exhausted; the mass is pressed and the liquid strained, then used for steeping a further supply of pomace at the same temperature. The collected liquid is cooled to about 0° C. and ultimately concentrated to produce an extract containing 60—80% of sugar and solid matter. —J. F. B.

Nitrogen compounds [*from distillers' wash*]; *Process for manufacturing* ——. E. Kochendoerfer, Frankfort, Germany. U.S. Pat. 1,165,358, Dec. 21, 1915. Date of appl., Oct. 31, 1912.

NITROGENOUS gases, generated by the carbonisation of distillers' wash, or from other sources, are converted into a nitrogen compound by conducting them through unobstructed highly heated channels in which the gases are exposed to heat radiating from the walls of the channels, which are lined with a vitrified material capable of retaining its smooth, non-porous character in presence of the gases at the high temperature of the process. —J. F. B.

Filter for dehydrating vinasse and the like. Ger. Pat. 287,573. *See* I.

Method of souring raw potatoes. Ger. Pat. 287,187. *See* XIXA.

XIXA.—FOODS.

Butter fat; Stability of the growth-promoting substance in ——. T. B. Osborne and L. B. Mendel. J. Biol. Chem., 1916, **24**, 37—39.

ANIMALS cease to grow when fed on certain mixtures of isolated food substances unless some of the natural fats are added to the ration. Of these fats, butter fat and beef fat possess the growth-promoting factor, but lard is inefficient. The growth-promoting substance remains in the more liquid or oil fraction of butter and beef fats when these are fractionated, whilst the portion of the fats with a higher m.pt. is more or less free from the substance. In the case of butter fat itself, the growth-promoting substance maintains its efficiency for more than a year, but the oil fraction loses its power within this period. —W. P. S.

Rice; Pentosans contained in ——. T. Katayama. J. Chem. Ind. Japan, 1915, **18**, 1364—1368.

DETERMINATIONS of methylpentosans and pentosans in many varieties of rice and rice starch showed that the quantity of methylpentosans in the rices and rice starches was nearly 1%. Formosan rice starches contained about 1% of pentosans whilst Japanese rice starches contained less. Ordinary rice contained more pentosans than did glutinous rice, and uncleaned rice contained more than cleaned rice. The difficulty with which rice starch is saccharified by diastase does not depend on the pentosan-content of the starch.—W. P. S.

Barley; Preparation for "improving" ——. F. Schönfeld and H. Krumhaar. Woch. Brau., 1915, **32**, 333.

A LIQUID preparation placed on the market, to be applied in the form of spray to old or musty grain, was found to contain probably hydrogen peroxide or an organic ozonide, together with volatile substances resembling turpentine and oil of bitter almonds in odour. The authors consider the preparation practically worthless.—J. H. L.

Nutritive substance separated from the pressed pupa-waste of the silkworm. R. Inouye and S. Iwaoka. J. Chem. Ind. Japan, 1915, **18**, 1319—1364.

ONE hundred grms. of the pupa-waste is boiled for 16 hours with 300 c.c. of 20—25% sulphuric acid, the mixture is then filtered, the filtrate neutralised with barium hydroxide, again filtered, and concentrated under reduced pressure until crystals separate; these are removed by filtration and the liquid is evaporated to dryness under reduced pressure. The product thus obtained consists of an amorphous, yellow powder, readily soluble in water and having a pleasant taste. Analysis of the syrupy form of the preparation yielded the following results:—Water, 27·41; ash, 2·96; total P_2O_5, 0·37; sugars (as dextrose), 2·24 ; total nitrogen, 11·05 ; nitrogen precipitated by phosphotungstic acid, 4·35 ; glycocoll, present ; alanine, 1·38 ; leucine, 1·73 ; phenylalanine, 0·35 ; glutamic acid, 3·30 ; serine, 0·88 ; *l*-proline, 0·37 ; oxyproline, 0·08 ; histidine, 0·106 ; arginine, 0·602 ; lysine, 0·051 ; choline, 0·097 ; betaine, 0·076%. Pigeons and mice increased in body-weight when fed on a diet composed of a mixture of rice and the above product, and it was found that the latter could be used in place of meat extract in the preparation of culture media for bacteria.—W. P. S.

Fluorine in the vegetable kingdom. A. Gautier and P. Clausmann. Comptes rend., 1916, **162**, 105—112.

In vegetable life, the leaves are generally richer in fluorine (3—14 mgrms. per 100 grms. of dry material) and also in phosphorus, whilst the buds (cauliflower and asparagus) are poorer (2·6—7·9 mgrms.), though asparagus is very rich in phosphorus. Stems, wood, and bark are less rich in both the elements, whilst the edible roots examined contain very variable quantities. The edible portions of pulpy fruits are moderately rich in fluorine (2·5—4·1 mgrms.) and the phosphorus is of average amount, but in the same fruit, the skin is richer in these elements than the pulp. In the edible seeds, the quantities of fluorine are average in amount (0·6—2·5 mgrms.), and granitic soil is favourable to the enrichment in fluorine of flour and cereals. The seed-coat of wheat grain is very poor in fluorine but rich in phosphorus, but the flours furnished by these grains are only moderately rich in phosphorus. There appears to be no group in the vegetable kingdom where fluorine is particularly abundant, and there is apparently no simple law linking up the variable quantities of phosphorus and fluorine in the different organs, but, as in animal life (see this J., 1914, 280), the two elements appear most frequently to increase and decrease together. For the same species of tissues, the ratio P : F appears more variable in plant than in animal life, and is also much lower in vegetable tissues where the life is active than in the active life tissues of animals.—B. N.

Utilisation of kitchen refuse and industrial refuse for the production of dry fodder and fat, by the application of the waste heat in gas-works. Frank. *See* XIXb.

Patents.

Freezing food and the like ; Method of and apparatus for ——. T. Kreuger, Stockholm. Eng. Pat. 7701, May 22, 1915. Under Int. Conv., May 26, 1914.

A vertical shoot, closed with a loose bottom movable vertically, is filled with alternate layers of ice and food. As the shoot is filled, the bottom is lowered on to a larger perforated platform below the lower end of the shoot. A freezing liquid, such as brine, drops from a sprinkler at the top of the shoot over the ice and food, giving up its heat to the ice and removing heat from the food. The brine passes through the perforated platform into a reservoir from which it is sprinkled over ice in a chest with a perforated floor. The cooled brine is then pumped up to the sprinkler over the shoot, a constant circulation being thus kept up. The frozen food is removed from the bottom of the shoot. The method is specially suited for the freezing of fish on a large scale. A simpler form of the apparatus is provided for discontinuous use.—J. H. J.

Soy milk ; Process of making ——. L. J. Monahan and C. J. Pope, Oshkosh, Wis. U.S. Pat. 1,165,199, Dec. 21, 1915. Date of appl., Apr. 10, 1913.

Soya beans are ground to a coarse powder, a small quantity of coconut oil added if desired, and the mass emulsified with about an equal amount of water at a temperature above 80° F. (27° C.) in presence of alkali, *e.g.*, sodium bicarbonate and lime. The liquid portion is separated and heated for several hours below its boiling point ; or the emulsion is heated first and filtered afterwards. —J. H. J.

Grain ; Process for sterilising and preserving ——. E. R. Barrow, Memphis, Tenn. U.S. Pat. 1,165,220, Dec. 21, 1915. Date of appl., Nov. 16, 1914.

Grain from which the hulls have not been removed, is intimately mixed with 5 % of its weight of finely divided sodium chloride.—J. H. J.

Cereal food ; Manufacture of a ——. W. T. Bailey, Assignor to J. H. Barrett, Girard, Ohio. U.S. Pat. 1,165,646, Dec. 28, 1915. Date of appl., May 25, 1915.

Grain is heated "until it becomes efflorescent," and the efflorescent portions are freed from all foreign matter and then ground to a powdered or granulated form.—J. H. J.

Pineapple ; Utilisation of waste from ——. R. A. Gould and C. S. Ash, San Francisco, Cal. U.S. Pat. 1,166,674, Jan. 4, 1916. Date of appl., Feb. 8, 1915.

Pineapple waste is comminuted and pressed, the press juice strained, and the pulp diffused in water at 160° F. (71° C.) and 20 lb. pressure per sq. in. to remove the remaining juice, the pulp afterwards being dried and used as a source of cellulose. The pressed and diffused juices are mixed, heated to 180° F. (82° C.) to coagulate the albumin, and the albumin recovered. The remaining juice is treated with a neutralising reagent which forms an insoluble compound with citric acid and leaves the acidity about *N*/100. The juice is filtered from the citrate, concentrated under diminished pressure to precipitate the remaining citrate, and again filtered. The syrup obtained is heated to 160° F. (71° C.), decolorised, and used as a sugar syrup for canning purposes.—J. H. J.

Meat fibre ; Process of making sterilised granulated ——. C. Marchand, New York, Assignor to L. N. Depeyre, Colorado Springs, Colo. U.S. Pat. 1,167,193, Jan. 4, 1916. Date of appl., Mar. 14, 1907. Renewed Nov. 22, 1915.

Meat pulp is macerated in hydrochloric acid at 25° C. until it is gelatinised, then neutralised, and hydrogen peroxide added to prevent putrefaction. The mass is heated to 40° C. to melt the fat, which is then removed together with the moisture, and the residue is reduced to granular form.—J. H. J.

Potatoes ; Method of souring raw ——. Verein der Spiritusfabrikanten in Deutschland, Berlin. Ger. Pat. 287,487, Feb. 13, 1914.

The potatoes are subdivided by a method which does not cause separation of the juice, then treated with sodium chloride to induce separation of the juice, and inoculated with a pure culture of lactic acid bacteria. The bacteria develop rapidly, and formation of acid takes place throughout the mass ; the product can then be stored without alteration for a long time.—A. S.

Bread ; Process for, and substance for use in the manufacture of ——. W. J. Mellersh-Jackson, London. From Ward Baking Co., New York. Eng. Pat. 1690, Feb. 2, 1915.

See U.S. Pats. 1,158,933 and 1,158,934 of 1915 ; this J., 1915, 1268. Calcium di-acid phosphate and /or ammonium acid tartrate may be used in place of calcium sulphate and /or ammonium chloride.

XIXb.—WATER PURIFICATION ; SANITATION.

Waters : Determination of hardness in —— having regard to the presence of alkali carbonates. O. Mayer. Z. anal. Chem., 1915, **54**, 289—308.

In the determination of the total hardness by Wartha's (acidimetric) method, it is preferable to titrate the precipitate formed on boiling the water with "alkali mixture" (20 grms. $NaOH$ and 30 grms. Na_2CO_3 per litre) instead of titrating the excess of alkali in the filtrate ; the precipitate should be washed with 70% alcohol. To determine temporary hardness, 200 c.c. of the water is boiled for 30 minutes, cooled, diluted to the original volume, and filtered. The precipitate, together with 10 c.c. of the liquid, is titrated with $N/10$ hydrochloric acid, using methyl orange as indicator ; allowance is made for the alkalinity of the 10 c.c. of liquid, if the filtrate exhibits alkalinity. Generally, the alkalinity of the filtrate is due to magnesium carbonate, but alkali carbonates may also be present. The latter may be detected by evaporating the water, and treating the residue with alcohol of sp.gr. 0·892—0·896 (about 60% by weight) and containing phenolphthalein. To determine alkali carbonates, 1 litre of the water is evaporated nearly to dryness and the residue extracted with the dilute alcohol until the solution is no longer alkaline to phenolphthalein. The alcoholic solution is then evaporated to remove alcohol and the remaining aqueous solution is titrated with $N/10$ hydrochloric acid, with methyl orange as the indicator. An alternative method consists in extracting the residue from 1 litre of the water with successive small quantities of water until 30 grms. of aqueous solution is obtained, diluting this with 96% alcohol to 110 c.c., filtering the mixture after 15 minutes, evaporating 100 c.c. of the filtrate, and titrating the residue as described.—W. P. S.

Sea-water ; Carbon dioxide in ——. Can it be directly determined by titration ? S. Morgulis and E. W. Fuller. J. Biol. Chem., 1916, **24**, 31—35.

Owing to the difficulty of obtaining a sharp end-point when titrating sea-water with $N/100$ alkali solution, using phenolphthalein as the indicator, and to the fact that many factors, such as the quantity of indicator, length of time since the indicator has been added, excessive agitation of the water, etc., all cause appreciable differences in the titration, the authors conclude that the method is inaccurate. In a series of experiments in which known quantities of carbon dioxide were added to sea-water, tap-water, and distilled water, respectively, the amounts of carbon dioxide found by titration varied widely, and not more than an average of 33% of the quantity added was recovered.—W. P. S.

Kitchen refuse and industrial refuse ; Utilisation of —— for the production of dry fodder and fat, by the application of the waste heat in gas-works. A. Frank. J. prakt. Chem., 1915, **92**, 419—424.

In Nov., 1914, the attention of the authorities of Prussian towns was directed by the Prussian Home Secretary to the necessity of utilising kitchen refuse. Experiments showed that when this was rapidly dried in a suitable plant it was disinfected and concentrated and yielded a feeding-stuff with a food value of 67·3 to 68·3%, as against 67·9% for fodder barley. It has now been made obligatory for householders to separate material suitable for fodder from paper and other unsuitable refuse. A further improvement suggested is to separate the fat (estimated at about 20 grms. per head daily) from the refuse, and to utilise the waste heat from gas-works for working the plant. In 1913 the gas works in Berlin produced about 333 million cb. m. of gas, from about 917,000 tons of coal, from which was obtained about 640,000 tons of coke. About 14% of this coke was used for heating the retorts, or 50% more than was necessary. Taking the amount of kitchen refuse at about 250 grms. per head daily, the waste heat of the gas works, even at the lowest summer production, would be more than sufficient for working the plant and drying the material. This source of heat could also be used for drying potatoes for food, and for treating trade refuse such as brewers' grains, etc.—C. A. M.

Utilisation of peat tar. Morgan and Scharff. *See* III.

Rate of growth of bacteria. Slator. *See* XVIII.

Patents.

Sewage and analogous liquids ; Purification of ——. W. Jones, and Jones and Attwood, Ltd., Stourbridge. Eng. Pat. 21,976, Nov. 4, 1914.

Active bacterial sludge is prepared by forcing air in small bubbles through raw sewage, keeping the latter in circulation ; after a time the sludge is allowed to deposit, the liquid run off, a fresh quantity of sewage run in, and the process repeated. Sufficient active sludge is prepared to fill the treatment tank one-fifth to one-third full. The tank is then filled up with raw sewage. The tank is formed of one or more long endless channels of rectangular form, the bottom of the tank sloping to one end. The dividing wall between the two portions of the channel has vertical slits in it so as to permit of the free passage of sludge and water and the maintenance of level throughout the channel. Air is supplied in small bubbles transversely across the channel at several points, and just in front of each of these points a baffle plate is hung. In this way the rising mixture of air and sewage causes a current of sewage under the baffle, and the current is kept up throughout the channel, inducing a continuous circulation of the sewage. Aeration is conducted for 1—5 hrs. and then stopped for 1—2 hrs., the clear liquid is drawn off down to as low a level as is desired, and the tank is filled up with fresh sewage. The sludge formed from each charge is drawn off from time to time. Closed tanks may also be used : the air liberated at the surface of the first channel is led to the bottom of the adjoining one, and so on, the last channel being open or the air led away by a shaft. The pressure of air over the liquid may also be used for emptying the channels. When the sewage is below 46° F. (8° C.), it is warmed to this temperature in order that nitrification of the sludge may not be hindered.—J. H. J.

Sewage-filtering system. R. W. Amos, Brooklyn, N.Y., Assignor to National Purification Co. U.S. Pat. 1,165,711, Dec. 28, 1915. Date of appl., Jan. 25, 1911.

In a sewage-filtering system, the sewage compartments are arranged in groups of two pairs, with a supply channel between each pair. Each compartment is provided with a filter-box, and between opposing pairs a central clear water channel is disposed for the purpose of draining the compartments on either side.—W. E. F. P.

Garbage, sludge, and like substances ; Process for the disposition of ——. R. W. Amos, Brooklyn, N.Y., Assignor to National Purification Co. U.S. Pat. 1,165,368, Dec. 21, 1915. Date of appl., Dec. 17, 1910.

The garbage is heated with lime in a tank and the vapours given off are collected and separated, the lighter being passed over lime, while the heavier are condensed. After all the vapours are given off, the residue is mixed with a nitrate and lime, and is then burned.—J. H. J.

Sewage and the like; Treatment of ——. T. K. Irwin, Assignor to Anglo-Continental Fertilizers Synd., Ltd., London. U.S. Pat. 1,166,373, Dec. 28, 1915. Date of appl., June 1, 1915.

See Eng. Pat. 13,235 of 1914; this J., 1915, 886.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids in Papaver somniferum, L. var. nigrum; Formation of —— *and the opium obtained from the plant.* L. van Itallie and J. A. van Toorenburg. Pharm. Weekblad, 1915, **52**, 1601—1606. J. Chem. Soc., 1916, **110**, i., 18.

The opium from *Papaver somniferum*, var. *nigrum* contains thebaine, narceine, morphine, codeine, and papaverine, but not narcotine.

Atropine, hyoscyamine, and scopolamine; Sensitive colour reaction for ——. R. Wasicky. Z. anal. Chem., 1915, **54**, 393—395.

The reagent used is prepared by dissolving 2 grms. of *p*-dimethylaminobenzaldehyde in 6 grms. of concentrated sulphuric acid and adding 0·4 grm. of water. The three alkaloids give an intense red coloration when warmed with a drop of the reagent, but do not react in the cold. As the mixture cools, the coloration changes to a more intense cherry-red and then to violet-red, which is stable for several days. Morphine and codeine at once give a red coloration with the reagent in the cold, but the violet coloration does not develop. Quinine yields a reddish brown coloration, narcotine and papaverine an orange colour, whilst physostigmine and veratrine give a green coloration when warmed with the reagent. The reaction is not given by homatropine and tropacocaine, and hence is probably due to the tropic acid portion of the molecule and not to the tropine residue.—W. P. S.

Eserine and geneserine; Partial synthesis of ——. *Alkaloids of calabar bean. IV.* M. Polonovski and C. Nitzberg. Bull. Soc. Chim., 1916, **19**, 27—37. (See also this J., 1915, 920, 1070.)

Eserine was synthesised by the action of methyl isocyanate on eseroline in ethereal solution, in presence of a minute quantity of sodium in the cold. By the spontaneous evaporation of the solvent crystals were obtained which, after recrystallisation, melted at 106° C. and were completely identical with the natural product, the constitution of which as a methylurethane, $C_{13}H_{17}N_2O.CO.NHCH_3$, is thereby confirmed. The above condensation takes place in the absence of sodium with the formation of an isocyanomethylate of eseroline, an unstable white powder, m.pt. 110°—115° C., which on heating is transformed into isoeserine, a compound isomeric with eserine, in which the imino-nitrogen of eseroline has reacted with the isocyanate to form a substituted urea of the probable constitution $[C_{13}H_{13}(OH).N]N.CO.NHCH_3$. This compound is neutral in reaction, dissolves in alkalis by virtue of its free phenolic hydroxyl, and gives no methiodide. From geneseroline geneserine was synthesised in a similar way to eserine, but no product analogous to isoeserine could be obtained.
—G. F. M.

Baptisin in Baptisia tinctoria (roots); Microchemical detection of ——. O. Tunmann. Apoth.-Zeit., 1915, **30**, 272—274. J. Chem. Soc., 1916, **110**, ii., 59—60.

Pyridine is a better solvent than dilute alcohol for the extraction of baptisin from the powdered roots of *Baptisia tinctoria* (wild indigo); after repeated crystallisations from dilute alcohol, the glucoside is obtained as a white, crystalline powder, m.pt. 244° C. It is soluble in aniline, pyridine, amyl alcohol, and potassium hydroxide solution, insoluble in ethyl acetate, and turpentine, and slowly soluble in chloral hydrate solution and acetic acid. Baptisin may be detected in sections of the root by treating the section with vanadium sulphate; the edge of the section exhibits a violet coloration which changes to light blue; cerium sulphate and tungsten sulphate yield reddish-violet colorations. Baptisin sublimes for the greater part without decomposition. If 5 mgrms. of the powdered root is heated, the first sublimate obtained consists of colourless or light yellow needles of the glucoside; the subsequent sublimate consists of white prisms of baptigenin. The glucoside and its derivative give a red coloration with vanadium sulphate, the colour changing gradually to violet and brownish-blue. When the sublimate is treated with a drop of sulphuric acid and a crystal of tungstic acid is added, the edges of the crystal show a deep violet coloration. If the sublimate is mixed with iodic acid solution, dried, the residue washed with water and then treated with sulphuric acid, the crystals become red, then violet or black, and dissolve, whilst the edge of the sulphuric acid exhibits a bluish-grey colour. Baptisin is localised in the parenchyma.

Frangula substitute; the barks of Rhamnus carniolica and Alnus glutinosa. O. Tunmann. Schweiz. Apoth.-Zeit., 1915, **53**, 313—318; 325—332. J. Chem. Soc., 1916, **110**, ii., 60.

A proposed substitute for frangula consists of a mixture of 15% of the bark of *Rhamnus carniolica* and 75% of the bark of *Alnus glutinosa*. The former bark contains both free and combined hydroxymethylanthraquinones and might serve as a substitute for frangula, but the bark of *Alnus glutinosa* is worthless. The three *Rhamnus* drugs may be distinguished by the rays in the cambium layer; in the case of frangula they form one or two, very seldom three, layers; in *R. purshianus* they appear in one to three, seldom four, layers; in *R. carniolica* they are in four, six, or even eight, layers. *R. carniolica* contains 1·84% of free, and 3·78 of combined, hydroxymethylanthraquinones; frangula-emodin is also present, but not chrysophanic acid. The total anthraquinones in *R. carniolica* may be estimated as follows: Five grms. of the dry powder is boiled with 100 grms. of dilute sulphuric acid for thirty minutes under a reflux apparatus, the mixture then filtered, and the filtrate extracted twice with chloroform (50 and 20 grms.). The chloroform solution is shaken for fifteen minutes with two quantities of 50 grms. of 5% sodium hydroxide solution, the alkaline extract is acidified with hydrochloric acid, the precipitated hydroxymethylanthraquinones collected, dried at 100° C. and weighed.

Japanese essential oils; Notes on some ——. S. Uchida. Bull. Forest Expt. Stat., Meguro, Tokyo, 1915. 6 pages.

The wood of the Hinoki tree (*Chamaecyparis obtusa, S. et Z.*) which is extensively grown in Japan as a valuable timber tree, yields about 2·4% of oil on dry distillation. The oil is brown, with a woody, empyreumatic smell, and after rectification with steam and treatment with dilute sodium carbonate solution, has the following constants: sp.gr. at 15·5° C., 0·8821; $\alpha_D^{15}=$ —50° 37′ in 10% chloroform solution. The oil contains α-pinene and cadinene and when fractionally distilled yields 60% of a colourless oil distilling below 170° C. which can be used as a good substitute for oil of turpentine. *Essential oil of Sansho* is obtained by distilling the dried berries of a shrub (*Xanthoxylum piperitum, Rutaceae*) which grows wild in Japan, the yield of oil being 5·7 %. The oil is pale yellow and mobile, with a very agreeable smell, resembling that of citronella oil, and has the following constants: sp.gr. at 15·5° C., 0·8501 ; $\alpha^{15}_{D} = -46\ 30$; $n_D = 1·46$; acid value, 3·3 ; ester value, 19·28 ; ester value after acetylation, 23·23 ; and the following composition : free acid (chiefly palmitic acid) 2·0 % ; aldehydes 15 % ; esters (as acetic ester of $C_{10}H_{18}O$) 5·7 % ; alcohols ($C_{10}H_{18}O$) 1·1 % ; terpenes (chiefly dipentene) 77·0 %. *Oil of Sugi leaves.* The green leaves of the Sugi tree (*Cryptomeria japonica*, Don.), a coniferous tree indigenous to Japan and extensively grown as a valuable timber tree, yield 0·7 % of a mobile, brownish-yellow oil on distillation with steam, having the following constants : sp.gr. at 15·5° C., 0·9217 ; $[\alpha]_{D} = +19·29°$ in 10 % chloroform solution ; $n_D = 1·4895$; acid value, 1·0 ; ester value, 6·56 ; ester value after acetylation, 14·35. The oil has approximately the following composition : free acid (as acetic acid) 0·1 % ; free alcohols (as $C_{10}H_{18}O$ b.pt. 266°—268° C.) 3·14 % ; esters (as caprylic ester of $C_{10}H_{18}O$) 3·28 % ; terpenes (chiefly α-pinene) about 34 % ; sesquiterpenes (cadinene and an unidentified sesquiterpene, b.pt. 266°—268° C., $[\alpha]_D = +15·19°$ in a 6 % chloroform solution, sp.gr. at 15° C. 0·9335), about 30 % ; a sesquiterpene alcohol $C_{15}H_{26}O$ (b.pt. 284°—286° C., sp.gr. at 15·5° C., 0·9623, $[\alpha]^{15}_{D} = 16·76°$ in 5 % chloroform solution), 12 % ; and a new crystalline diterpene, α-cryptomerene (m.pt. 61° C., b.pt. 345° C., $[\alpha]^{20°}_{D} = —34·22°$ in a 4·7 % chloroform solution), about 18 %.—T. C.

Camphor and camphor oil. B. J. Eaton. Agr. Bull. Fed. Malay States, 1915, **3**, 402—404.

Two samples of camphor oil obtained by decantation and expression from the crude camphor of the Japanese camphor tree, *Cinnamomum camphora*, were examined at the Imperial Institute. The camphor separated by cooling to —10° C. to —12° C. was 19·3 and 12·8 % ; by prolonged cooling a further 1·4 % was separated from the second sample. The physical constants of the two samples thus purified were : sp.gr. at 15°/15° C., 0·913, 0·920 ; rotation in 100 mm. tube, 41° 1′ at 18° C., 38° 23′ at 22° C. ; acid value of second sample, 1·1 ; saponification value of original oil (2nd sample), 3·6 (=0·7 % esters) ; after acetylation, 25·7 (=6·1 % alcohols). The oil is pale yellow, containing much crystalline deposit. Fractional distillation of the 2nd sample gave 150°—195° C., 40 % ; 195°—225° C., 46 % ; 225°—275° C., 14 % by vol. Fraction (1) gave 4·3 % cineol (on original oil) ; fraction (2) gave more camphor on cooling to —12° C. (making 30·5 % in all on original oil). Safrole was absent, probably because the original distillate was obtained from young twigs and leaves, whereas commercial Japanese camphor oil is derived from old wood of mature trees. The first sample of oil was valued, in 1912, at 7½d.—8d. per lb. in London, and at 30s. per cwt. in Europe by a German firm ; the second, in March, 1915, at £45 per ton in London. The crude crystalline camphor separated during distillation, after pressing in a hand press, lost 11—12 % on further pressing and gave the following rotations :—crude camphor, +40° 50′ ; after further pressing, +42° 20′ ; recrystallised from petroleum spirit, +41° 25′. Camphor separated from the oil gave +42° 20′. The crude camphor was valued at £6 to £6 5s. per cwt., with Japanese Monopoly B camphor at £7 2s. 6d.—E. W. L.

Chlorinated ketones ; Identification of ——. E. E. Blaise. Bull. Soc. Chim., 1915, **17**, 425—428.

Chlorinated ketones are best identified as semicarbazones, of which the melting points are relatively low. This constant is determined preferably by placing the semicarbazone on the surface of mercury heated in a bath and observing the temperature of fusion. The semicarbazones can nearly always be prepared by treating one mol. of the ketone with 1½ mols. of semicarbazide hydrochloride in aqueous solution. If the hydrochloride does not react, an alcoholic solution of the free base can be used. The purification by crystallisation is best effected by washing the dried, crude material with water and then with benzene or chloroform ; it is then transferred, without drying, to a large excess of either of these solvents, heated on a water-bath at a temperature not exceeding 50° C., a little sodium sulphate added, and the liquid filtered ; on cooling, the semi-carbazone crystallises out slowly. The semi-carbazones of the α-monochloroketones are easily transformed into those of the corresponding alcohol-ketones by treating for several hours with an aqueous solution of potassium carbonate ; and the acetic esters of the semicarbazones are obtainable by heating the chloro-compounds with anhydrous sodium acetate in alcoholic solution for a few minutes on the water-bath. Thus the chlorinated ketones can be identified from the melting points of three easily obtainable derivatives. Chlorinated ketones of the types : $R.CCl_2.CO.R'$ and $CHCl_2.CO.R'$, do not yield semicarbazones but di-semicarbazones : $R.C(CON_3H_3).C(CON_3H_3).R'$ and $CH(CON_3H_3).C(CON_3H_3).CR'$; these are distinguished by their insolubility in organic solvents, except acetic and formic acids. Details of the isolation of a number of semicarbazones and di-semicarbazones are given.—E. H. T.

Aromatic alcohols containing mercury ; Method of preparation of ——. V. Grignard and A. Abelmann. Bull. Soc. Chim., 1916, **19**, 18—25.

Aromatic alcohols containing mercury, similar to the compounds obtained by Dimroth (this J., 1898, 1173, and Ber., 1902, 2032), were prepared from the chloromercuric derivatives of acetophenone and benzophenone by the action of organo-magnesium compounds, and subsequent hydrolysis in iced water. Thus ω-chloromercuriacetophenone and magnesium ethyl bromide reacted in ethereal solution to give a compound which on hydrolysis and crystallisation from chloroform yielded phenylethylchloromercurimethyl carbinol, $(C_6H_5)(C_2H_5)C(OH).CH_2HgCl$, as a slightly yellow, crystalline powder, m.pt. 129°—131° C. It reacts energetically with magnesium, and gives with ammonium sulphide a precipitate of mercuric sulphide, and with sulphuric acid a green coloration which disappears on addition of water. A dimercuri-carbinol was also isolated from the mother liquors of the above compound. From *o*-chloromercuribenzophenone and magnesium ethyl bromide, ethylphenyl-*o*-chloromercuriphenylcarbinol was similarly obtained as a white powder of m.pt. 106° C. (with decomp.). It gives a similar reaction with sulphuric acid, but resists the action of ammonium sulphide.—G. F. M.

Allyl alcohol ; Preparation of ——. A. Hoff. K. Danske Videnskab. Selskab. Forhand., 1915, Nos. 3—4, 199—224. J. Chem. Soc., 1916, **110**, i., 6—7.

The following method, depending on the direct reduction of glycerol with formic acid, was found to be the most satisfactory. 825 grms. of 97 % glycerol and 84·2 grms. of 95 % formic acid are heated together in a retort ; the receiver is changed at 200° C. and the distillate collected between 200° and 250° C. After cooling, further quantities of 165 grms. of glycerol and 84·2 grms. of formic acid are added and the distillation carried out as before. This process is repeated ten times. From the distillate between 200° and 250° C., which weighs about 1170 grms., allyl alcohol is obtained in the usual way by appropriate treatment with potassium carbonate, the yield being about 51%, calculated either with respect to the glycerol or the formic acid (compare Chattaway, this J., 1915, 511).

Ethyl bromide; Preparation of ——. A. Holt. Chem. Soc. Trans., 1916, **109**, 1—2.

Absolute alcohol (1500 c.c.) was slowly added to a mixture of sulphuric acid (1500 c.c.) and water (900 c.c.), avoiding undue rise of temperature, and, when cold, 1100—1200 grms. of potassium bromide, or the equivalent quantity of sodium bromide, was introduced (less water being employed in making the acid mixture when using the hydrated bromide, $NaBr,2H_2O$) The mixture was distilled at as low a temperature as possible, heating on a sand-bath for 8—9 hours, and the distillate was collected in water, washed repeatedly with water, and dried over calcium chloride. The product was practically free from ether (as shown by specific gravity), and the yield rarely fell below 90%, calculated on the weight of bromide taken.—F. Sodn.

Ether; Determination of alcohol in ——. P. Szeberényi. Z. anal. Chem., 1915, **54**, 409—411.

A method for the determination of small quantities (1—4%) of alcohol in ether depends on the fact that, whilst alcohol is readily oxidised when boiled with dilute sulphuric acid and potassium bichromate solution, ether is scarcely affected. Five c.c. of the sample of ether is diluted with water to 100 c.c. and 30 c.c. of this solution is transferred to a flask already containing 10 c.c. of $N/2$ bichromate solution, 20 c.c. of dilute sulphuric acid (1 : 1), and 40 c.c. of water; the contents of the flask are boiled for 15 minutes under a reflux condenser, then cooled, diluted to about 250 c.c., and the excess of bichromate is titrated iodometrically. Under these conditions the ether reduces 0·6—0·9 c.c. of the bichromate solution, but the exact quantity must be determined by actual experiment with pure ether. Each c.c. of $N/2$ bichromate solution is equivalent to 0·64 mgrm. of alcohol. Larger quantities of alcohol in ether may be determined similarly by oxidising 5 c.c. of the aqueous solution of the ether (see above) with a mixture of 20 c.c. of $N/2$ bichromate solution, 20 c.c. of dilute sulphuric acid, and 55 c.c. of water; in this case, a correction for the bichromate reduced by the ether need not be made, as the reduction is not appreciable. To determine the ether as well as the alcohol a 2% aqueous solution of the sample is prepared. Ten c.c. of this solution is oxidised as described for the determination of the alcohol. Another quantity of 10 c.c. of the solution is then placed in the flask, 40 c.c of $N/2$ bichromate solution and a cooled mixture of 40 c.c. of concentrated sulphuric acid and 10 c.c. of water is added, the flask is closed with a stopper and, after 12 hours, the mixture is diluted to 500 c.c., and the excess of bichromate titrated. Under these conditions both the alcohol and the ether are oxidised: the quantity of bichromate reduced by the alcohol is multiplied by 1·1 and deducted from the quantity reduced by the alcohol and ether together; the result, in c.c. of $N/2$ solution, is multiplied by 4·6 to obtain the quantity of ether.—W. P. S.

Organosols of metals and metallic hydroxides of the platinum group. III. C. Amberger. Kolloid. Zeits., 1915, **17**, 47—51. J. Chem. Soc., 1916, **110**, ii., 41. (Compare this J., 1912, 1006, 1007; 1914, 41.)

Colloidal osmium dioxide may be obtained by the method which has been used previously for the preparation of organosols of platinum and palladium. Lanoline is impregnated with a solution of potassium osmate and the mixture reduced by the addition of hydrazine hydrate. The product is dissolved in light petroleum, and can be precipitated by the addition of alcohol. It consists of colloidal osmium dioxide in admixture with lanoline as protective colloid. If the precipitated organosol is heated in a current of hydrogen at 50° to 60° C., the oxide is reduced to metal, and the metallic organosol dissolves readily in ether, benzene, light petroleum, and other organic solvents. An organosol containing 21% of metallic osmium has been obtained in this way.

Notes on some Japanese fatty and essential oils. Higuchi. *See* XII.

Patents.

Amino-aliphatic acids containing an arseno-aryl group. W. P. Thompson. Liverpool. From Soc. Anon. les Etablissements Poulenc Frères. Paris. Eng. Pats. (a) 17 and (b) 18, Jan. 1, 1915.

(a) Stable derivatives of arseno-aryl derivatives of α-amino-aliphatic acids are obtained by treating them with formaldehyde, preferably in solution, before isolating the solid substance. Details of the preparation of the *p*-arsenophenylglycine compound are given. (b) Stable derivatives are obtained by replacing the hydrogen of the secondary amino group by an aromatic or aliphatic acyl group. It is preferable to introduce the acyl group into one of the parent bodies rather than into the arsenoaryl compound itself. Details are given of two methods of preparing acetylarsenophenylglycine.—B. V. S.

Iminoketones; N-Alkylated ——. K. Hess, Leverkusen, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,158,496, Nov. 2, 1915. Date of appl., Oct. 6, 1914.

Heterocyclic imino-alcohols containing an exocyclic carbinol group are heated with an aldehyde; oxidation and alkylation occur simultaneously, resulting in the production of N-alkylated imino-ketones. The new products are oils with an alkaline reaction, generally soluble in water, alcohol, and ether, and yield crystalline picrates and oximes. *Example:* 560 parts of α-pyrrolidylpropane-1-ol is dissolved in 1000 parts of water, concentrated hydrochloric acid added, and the liquid heated with 500 parts of 40% formaldehyde for 4 hrs. at 115°—120° C. The product is separated by addition of alkali and solution in ether, and consists of α-N-methyl pyrrolidylpropane-1-on (b.pt. 70°—75° C. at 12 mm.).—F. W. A.

Physiologically active base. H. Hoerlein, Vohwinkel, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,166,206, Dec. 28, 1915. Date of appl., July 22, 1913.

A mixture of water-soluble salts, such as the hydrochlorides, of about 1 part of *p*-hydroxyphenylethylamine and about 4 parts of β-iminazolylethylamine.—B. V. S.

Silver glycocholate; Manufacture of compounds of —— *readily soluble in water.* O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. Eng. Pat. 1185, Jan. 25, 1915.

See Ger. Pats. 284,998 and 284,999 of 1914, and U.S. Pat. 1,161,867 of 1915; this J., 1915, 1166; 1916, 141.

Medicinal extract of aperient drugs. R. Tambach, Assignor to Knoll und Co., Ludwigshafen, Germany. U.S. Pat. 1,167,230, Jan. 4, 1916. Date of appl., July 29, 1909.

See Ger. Pat. 214,805 of 1908; this J., 1909, 1223.

Mercury preparation for therapeutic purposes. H. Buchtala, Grätz, Assignor to Dr. Bayer Es Tarsa, Budapest, Austria-Hungary. U.S. Pat. 1,167,622, Jan. 11, 1916. Date of appl., May 23, 1914.

See Ger. Pats. 267,411 and 267,412 of 1912; this J., 1914, 220.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Colour photography. W. Buchanan-Taylor, T. F. Dawe, F. Willmot, and J. F. Shepherd, London. Eng. Pat. 20,433, Oct. 1, 1914.

Negatives are taken through separate colour filters in the usual way and a positive made from one of them. The gelatin film of this positive is sensitised with potassium bichromate solution, exposed behind one of the remaining negatives, dyed with the corresponding colour, and the excess dye washed out. This operation is repeated for each of the remaining negatives and the silver image of the first positive is finally toned to its proper colour. In the three-colour example given the order of printing is "blue," "red," and "yellow," the last operation being the toning of the "blue" silver image with an acid solution of ferric-ammonium citrate and potassium ferricyanide.—B. V. S.

Photographic papers and the like; Preparation of ——. M. Roth, Letmathe, Germany. Eng. Pat. 21,884, Nov. 2, 1914.

See Ger. Pat. 285,562 of 1912; this J., 1915, 1168.

Photographic colour print and process of producing same. Photographic process. W. F. Fox, Assignor to Kinemacolor Co. of America, New York. U.S. Pats. 1,166,121, 1,166,122, and 1,166,123, Dec. 28, 1915. Dates of appl., Mar. 11 and May 29, 1914, and Feb. 3, 1915.

See Eng. Pats. 552 and 8728 of 1914 and 3666 of 1915; this J., 1914, 1227; 1916, 73.

XXII.—EXPLOSIVES; MATCHES.

Trinitrotoluene; Purification of ——. M. Copisarow. Chem. News, 1916, **113**, 37—38.

A fairly pure crude product may be readily freed from the mineral acid left from the nitration by melting and repeated shaking with hot water for not too long a time. On cooling the washings the dissolved trinitrotoluene crystallises in fine needles. It is not advisable to neutralise the acid with alkalis, owing to the possibility of the formation of alkali salts of the acid and phenolic by-products. Volatile products (moisture) are expelled by heating the trinitrotoluene for several hours at 95° to 100° C. Crude products containing a relatively high proportion of mineral matter and organic by-products may be purified by recrystallisation from alcohol or toluene, the mother liquors in the latter case being transferred to the nitrating plant. If this is not practicable, the crude product may be treated with: (1) sulphuric acid of sp.gr. 1·65 and upwards; (2) nitric acid; or (3) sulphuric acid containing about 5% of nitric acid or sodium nitrate. Trinitrotoluene is fairly soluble in concentrated sulphuric acid at 90° to 100° C. and separates unchanged on cooling or diluting the solution (preferably not below a sp.gr. of 1·2; see McHutchison and Wright, this J., 1915, 781) while the sulphonated impurities remain dissolved. The addition of nitric acid inhibits a reversible reaction, *e.g.*, substitution of sulpho for nitro-groups in the trinitrotoluene and partial oxidation of organic impurities. The acidity of crude trinitrotoluene varies with the purity of the product. Its persistence after repeated washing appears to be due to organic acid or phenolic by-products rather than to retained mineral acid. The acidity of recrystallised trinitrotoluene may be attributed to the formation of nitro-acids or dinitro-cresols under the influence of the hot water, whereas the acidity of the washed product is probably due to by-products formed in the nitration. (See also this J., 1915, 1168, 1273.)—C. A. M.

Reactivity of the nitro group in aromatic compounds. Giua. *See* III.

Patents.

Blasting-cartridge. W. Weber, Hayingen, Germany. U.S. Pat. 1,157,270, Oct. 19, 1915. Date of appl., July 8, 1915.

The cartridge consists of a double-walled outer casing with a layer of corrugated paper between the walls and with channels to receive priming wires. Within the casing is a perforated inner storage vessel of liquid air, which is surrounded by absorptive non-inert organic matter (powdered cork, cotton, etc.) and which projects from the outer casing, the projecting portion being closed by a perforated stopper. Below the vessel of liquid air and separated from it by cotton is a bag containing metallic (aluminium) powder and a primer connected with the priming wires. Tests are described showing that this explosive is much more powerful than dynamite and that it is safe to handle.—C. A. M.

Explosive powder; Process of making ——. J. N. Wingett, Wilmington, Del. U.S. Pat. 1,166,731, Jan. 4, 1916. Date of appl., Mar. 25, 1907.

A solution of the crystallisable ingredients is mixed with the other constituents of the powder in a closed vessel which is heated to the temperature required to give the necessary physical condition to the ultimate mixture, and the solvent is then partially evaporated while the mixture is in motion; or the crystallisable ingredients may be mixed in a melted condition and crystallisation prevented by heating the vessel.—C. A. M.

Powder; Process for superficially gelatinising compressed pieces of ——. O. Schmidt, Hasloch. Ger. Pat. 286,784, Oct. 30, 1913.

The outer layer of the pressed pieces is first gelatinised in a bath of acetone, ether, or the like, and the material is then transferred to a second bath of, for example, benzine, solvent naphtha, or benzol, which, whilst accelerating hardening of the external layer and increasing its toughness, degelatinises the surface to a small extent, so that it loses its stickiness and acquires the roughness necessary for uniform ignition. The second treatment renders the material more sensitive to ignition and ensures more uniform velocity results in ballistic tests.—F. Sodn.

Picric acid; Process of making ——. G. B. Bradshaw, Roselle Park, N.J. U.S. Pat. 1,168,266, Jan. 11, 1916. Date of appl., Nov. 8, 1915.

Phenol is sulphonated to give a mixture of the monosulphonic acids, and the mixture diluted and steamed to obtain an aqueous solution of practically pure *p*-monosulphonic acid. The resulting solution is mixed with three and a half parts of nitric acid (sp.gr. 1·5), the mixture heated to about 93° C. until the reaction is complete, and the picric acid allowed to crystallise.—F. W. A.

Explosive ; Process of producing a liquid ——. O. Reuter, Schlebusch-Manfort, Assignor to Dynamit-A.-G., Hamburg, Germany. U.S. Pat. 1,166,516, Jan. 4, 1916. Date of appl., July 27, 1912.

SEE Ger. Pat. 261,503 of 1910 ; this J., 1913, 1088.

XXIII.—ANALYSIS.

Viscosity measurement ; Some sources of error in ——. E. C. Bingham, H. I. Schlesinger, and A. B. Coleman. J. Amer. Chem. Soc., 1916, **38**, 27—41.

THE average pressure used in the calculation of a viscosity measurement is not exactly half the sum of the initial and final pressures as usually assumed, and an equation has been developed which expresses more nearly the correct value. Since the loss of kinetic energy when the liquid flows from capillaries having ends as nearly as possible at right angles to the axis, can be easily calculated, whereas with a trumpet-shaped opening the correction is uncertain, it is suggested that in the construction of viscometers the capillaries should have ends at right angles to the axis, and also that the bulbs should be as short as possible. It is immaterial whether the capillary is in a vertical or horizontal position. Stress is laid on the value, for relative as well as absolute measurements, of using an instrument in which the time of flow of the liquid may be varied by varying the pressure.—G. F. M.

Micro-analysis ; Qualitative ——. F. Emich. Z. anal. Chem., 1915, **54**, 489—502.

THE author discusses the application of microscopical methods of analysis with especial reference to the use of capillary tubes of very small diameter for distillation and sublimation, the detection of minute amounts of nitrogen (by conversion into ammonia and recognition of latter by means of litmus paper or mercurous nitrate test paper) and of mercury being described in some detail, as illustrative of the application of this method of analysis. Frequent references are made to the earlier work and publications of Rachlmann, Ostwald, and Emich on this subject.—J. B. C. K.

Potassium bicarbonate as a standard for acidimetry. G. Incze. Z. anal. Chem., 1915, **54**, 585—602.

POTASSIUM bicarbonate is most readily obtained by passing a current of carbon dioxide into an alcoholic solution of potassium hydroxide, and may be purified by precipitation with alcohol from its aqueous solution. Several commercial samples were sufficiently pure for analytical purposes without further treatment. The salt forms colourless monoclinic prisms with sp.gr. 2·17. It is soluble in 1200 parts of alcohol. In aqueous solution it is almost neutral to phenolphthalein, but when the solution is largely diluted it is hydrolysed with the formation of potassium hydroxide. It is absolutely stable when exposed to the air in a perfectly dry condition, but when moist or in solution loses carbon dioxide. It is free from water of crystallisation and therefore does not effloresce.—C. A. M.

Potassium ; Determination of small quantities of ——. A. J. Hamburger. Biochem. Zeits., 1915, **71**, 415—463. J. Chem. Soc., 1916, **110**, ii., 50—51.

THE principle of the method consists in the precipitation of the potassium as potassium sodium cobaltinitrite, $Co(NO_2)_3.3(K/NaNO_2),nH_2O$, separating the precipitate by centrifuging, and measuring its volume. The cobalt reagent is prepared by dissolving 50 grms. of cobalt nitrite in 100 c.c. of water, and adding 50 c.c. of glacial acetic acid. A second solution is made by dissolving 50 grms. of sodium nitrite in 100 c.c. of water. Six parts by volume of the solution of the cobalt salt is mixed with ten parts by volume of the solution of sodium nitrite shortly before use. Five c.c. of the solution containing the potassium salt is mixed with 1·5 c.c. of the cobalt solution, and the mixture is kept for sixteen hours at 37° C. It is then introduced into a special form of funnel which ends in a calibrated capillary tube of 0·01 c.c. capacity, etched in 100 parts, each of which corresponds with 0·001 grm. of potassium. The precipitate is separated by centrifuging into this tube, and the volume is then determined. It is necessary to keep to the specified conditions of experiment to obtain satisfactory results, which are not influenced by the presence of relatively large amounts of sodium, nor by the presence of calcium, magnesium, or sulphates. Phosphoric acid must, however, be removed, and for this purpose a mixture of calcium chloride and hydroxide or magnesia mixture is best employed.

Cadmium and zinc ; Volumetric determination of ——. H. Enell. Z. anal. Chem., 1915, **54**, 537—546.

TESTS were made to ascertain if the reaction, $CdS+I_2=CdI_2+S$, could be utilised for the determination of cadmium. The precipitated cadmium sulphide was washed free from hydrogen sulphide and the filter and precipitate vigorously shaken with 50 c.c. of water and a measured volume of standard iodine solution. Finally the excess of iodine was titrated with standard thiosulphate solution. It was found that the reaction between the cadmium sulphide and the iodine took from 14 to 24 hours for completion. Good results can be obtained, but the method cannot be regarded as entirely satisfactory. Accurate results can be obtained by a method based on the reaction, $CdS+2AgNO_3=Ag_2S+Cd(NO_3)_2$, which takes place quickly and quantitatively. The precipitated cadmium sulphide is washed with warm 2% ammonium sulphate solution till free from hydrogen sulphide, and paper and precipitate are then vigorously shaken with 50 c.c. of water. An excess of $N/10$ siver nitrate solution is added, the mixture well shaken, 5 c.c. of 25% nitric acid added, the mixture again well shaken, and after standing for a few minutes, filtered through pulp. Iron alum is added to the filtrate, which measures about 250—300 c.c., and the excess of silver nitrate is determined by titration with $N/10$ ammonium thiocyanate solution. The same method is applicable to the estimation of zinc, which is precipitated as sulphide in acetic acid solution, the chief difficulty being to avoid contamination of the zinc by iron. The procedure adopted by the author is described in detail.
—T. St.

Cerium ; Volumetric determination of —— *by means of potassium permanganate.* V. Lenher and C. C. Meloche. J. Amer. Chem. Soc., 1916, **38**, 66—70.

TRIVALENT cerium may be determined by titration with potassium permanganate according to the equation : $6Ce(NO_3)_3+K_2Mn_2O_8+4H_2O=$
$4Ce(NO_3)_4+2Ce(OH)_4+2KNO_3+2MnO_2$.
Since the ceric nitrate formed is hydrolysed with liberation of free nitric acid, which tends to reverse the reaction, it must be neutralised. For this purpose zinc oxide or magnesia was found most suitable. Fairly good results were also obtained using borax or sodium bicarbonate, whilst sodium

carbonate, acetate, etc., were not so satisfactory. The titration is best started in the cold and finished hot, the neutralising agent being added towards the end. A sharp end point and results of considerable accuracy are thus obtained. Trivalent cerium can also be determined in presence of quadrivalent cerium by the method.
—G. F. M.

Magneto-chemistry. Application to analysis. A. Quartaroli. Gaz. Chim. Ital., 1915, **45**, II., 406—425.

After a brief review of the present position of magneto-chemistry, the author describes a method for the determination of paramagnetic metals. This is based on the fact that water being diamagnetic ($H \times 10^6 = -0{\cdot}72$), solutions of salts of paramagnetic metals also become diamagnetic when diluted sufficiently, and, at a definite concentration, are completely inactive. It is difficult in practice to ascertain when a solution is completely inactive, and the author instead takes as a standard the concentration at which the solution under examination has the same magnetic susceptibility as air ($H \times 10^6 = +0{\cdot}024$) or hydrogen in the case of ferrous salts. The solution under examination is placed in a tube between the poles of a powerful electro-magnet (in the author's experiments a magnetic field of about 25,000 gauss units was used), and by means of a capillary tube connected with a U-tube into which water is introduced, air is caused to bubble slowly and uniformly through the solution. On activating the magnet the stream of bubbles is stopped or retarded if the solution is magnetic, accelerated if the solution is diamagnetic, and unaffected if the magnetic susceptibility is equal to that of air. Experiments were made with various salts of magnetic metals and, excluding sulphates because in certain cases the sulphate anion exerts a somewhat disturbing influence, the following values were obtained for the standard concentration at which the magnetic permeability is equal to that of air: Fe''', 2·88—2·94 grms. per litre: Fe'' (hydrogen instead of air), 3·19: Mn, 2·59—2·62; Co, 3·78—3·81; Ni, 9·45—9·52; Cr, 6·60; Cu, 30·70—30·83 grms. per litre. In applying the method the solution containing a salt of a magnetic metal is diluted, or strengthened (by addition of a solution of known concentration), until it is inactive magnetically with respect to air, and then the quantity of magnetic metal present is calculated from the volume of water or of stronger solution added. Salts of diamagnetic metals and acids have practically no influence on the results. An inactive solution of a salt of one magnetic metal remains inactive when mixed in any proportion with an inactive solution of a salt of another metal, that is, in the mixed solution each metal exerts separately its specific action. Hence if two magnetic metals are present together, *e.g.*, iron and chromium, they may be determined by magnetic measurement combined with a gravimetric or other estimation of the iron and chromium together. Brief descriptions are given of the determination of chromium, iron, or manganese in presence of aluminium, of iron and chromium, manganese and chromium, and nickel and cobalt when present together, and of iron and manganese in presence of aluminium and phosphoric acid.
—A. S.

Purification of filter-paper with hydrofluoric acid. Gawalowski. *See* V.

Analysis of a mixture of alkali sulphides, thiosulphates, and dithionates. Muller. *See* VII.

Determination of aluminium in silicates. Selch. *See* VII.

Determination of hydrogen phosphide. Reckleben. *See* VII.

Effect of boron upon the magnetic and other properties of electrolytic iron melted in vacuo. [*Determination of boron in iron.*] Yensen. *See* X.

Tortelli-Jaffe reaction for marine animal oils. Tsujimoto. *See* XII.

Detection of free mineral acids and lactic acid in leather. Lauffmann. *See* XV.

Determination of hygroscopic moisture in soils. Haigh. *See* XVI.

Determination of potassium in fertilisers. Pilz. *See* XVI.

Comparative actions of sucrose and invert sugar on alkaline copper solutions. Maquenne. *See* XVII.

Degree of complete attenuation of beer: its regulation and its relation to the degree of attenuation in the vat and after storage of the beer. Windisch. *See* XVIII.

Determination of total tartaric acid, calcium tartrate, potassium hydrogen tartrate, and free tartaric acid in wine. Kunz. *See* XVIII.

Practical alcoholometry. Barendrecht. *See* XVIII.

Determination of hardness in waters, having regard to the presence of alkali carbonates. Mayer. *See* XIXb.

Carbon dioxide in sea-water. Can it be determined by titration? Morgulis and Fuller. *See* XIXb.

Sensitive colour reaction of atropine, hyoscyamine, and scopolamine. Wasicky. *See* XX.

Microchemical detection of baptisin in Baptisia tinctoria roots. Tunmann. *See* XX.

Frangula substitute, the barks of Rhamnus carniolica and Alnus glutinosa. Tunmann. *See* XX.

Identification of chlorinated ketones. Blaise. *See* XX.

Determination of alcohol in ether. Szeberényi. *See* XX.

XXIV.—MISCELLANEOUS ABSTRACTS.

Emulsification; Theory of ——. VIII. W. D. Bancroft. J. Phys. Chem., 1916, **20**, 1—31. (See also this J., 1915, 560.)

Since the adsorption of gases by solids and liquids plays a part in ore flotation, the author discusses the various phenomena which bear on such adsorption. All solids show selective adsorption of gases and vapours. The film of condensed gas (air) shows itself in the abnormal mobility of very fine powders, in a resistance to the passage of an electric spark between solid terminals (Schuster, Phil. Mag., 1890, **29**, 197), and in the fact that two pieces of a broken object will not re-unite when pressed together. All liquids show selective adsorption of gases and vapours. The film of condensed gas shows itself in the behaviour of fountains and impinging jets (Rayleigh, Newall, Burton and Wiegand), splashes and rolling drops (Worthington, Kaiser), soap-bubbles (Boys); it causes errors in the determination of molecular weights by the air bubbling method (Campbell, Trans. Faraday Soc., 1915, **10**, 197). The change which takes place in the surface tension of mercury on standing for about an hour, recorded by Stöckle (Wied. Ann., 1898, **66**, 49), has been attributed by Freundlich to the adsorption of gas on the surface of the liquid, but the author shows that this explanation is insufficient.—J. F. B.

Trade Report.

British trade after the war. [Cd. 8181.]

THE sub-committee of the Advisory Committee to the Board of Trade on commercial intelligence with respect to measures for securing the position, after the war, of certain branches of British industry, have made the following recommendations:—

1. *Scientific Industrial Research and Training.*—(*a*) Larger funds should be placed at the disposal of the new Committee of the Privy Council, and also of the Board of Education, for the promotion of scientific and industrial research and training. (*b*) The Universities should be encouraged to maintain and extend research work devoted to the needs of the main industry or industries located in their respective districts; and the manufacturers engaged in those industries should be encouraged to co-operate with the Universities in such work either through their existing Trade Associations or through Associations specially formed for the purpose. Such Associations should bring to the knowledge of the Universities the difficulties and needs of the industries, and give financial and other assistance in addition to that afforded by the State. In the case of non-localised industries, Trade Associations should be advised to seek, in respect of centres for research, the guidance of the Advisory Council of the Committee of Privy Council for Scientific and Industrial Research. (*c*) An authoritative record of consultant scientists, chemists, and engineers, and of persons engaged in industrial research, should be established and maintained by some suitable Government Department, for the use of manufacturers only.

2. *Copyright.*—The United Kingdom copyright law should be brought into line with that of the United States.

3. *Patents.*—(*a*) The efforts which have been made to secure uniformity of Patent Law throughout the Empire should be continued. (*b*) The provisions of the law as to the compulsory working of patents in the United Kingdom should be more rigorously enforced, and inspectors should be appointed to secure that such working is complete and not (as has frequently been the case) only partial. (*c*) The fullest possible information as to enemy patents should be given to British firms during the war, and every practicable assistance for their use.

4. *Trade Marks.*—(*a*) All German and Austrian goods imported into the United Kingdom should be required to be marked with an indelible mark "Made in Germany" or "Made in Austria-Hungary," and goods imported from other foreign countries should be similarly marked either with the country of origin or with the words "Foreign Made" or "Not British." Such marking should be in all cases on the actual goods and not merely on the package. (*b*) Alien firms and alien-owned companies should be prohibited from registering in the United Kingdom trade marks containing English words. (*c*) The Government of India should be urged to reconsider the question of the establishment of trade mark registration in India. (*d*) As regards the entry into this country of goods bearing infringing trade marks, as a part of the information to the firm affected by the infringement, there should be supplied, as a matter of course, the names of the consignor and consignee, which have hitherto been withheld on the ground that the Customs have no power to give the required information, which is in many cases actually in their possession. In cases where shippers, or brokers, are alone concerned in the importation, the Customs should be enabled to require full information as to the original consignor, and the actual consignee, as a condition of entry of the goods, and this should be effected by legislation, or regulation, as may be found necessary.

5. *Transport Facilities.*—(*a*) An impartial tribunal should be set up to secure that no preference is accorded to traders in other countries by British shipping companies or shipowners, or by home railways. (*b*) A definite policy for the improvement and extension of the canal system of the United Kingdom should be formulated. (*c*) Shipping companies should be prohibited from charging higher rates of freight from British ports than from any North European ports.

6. *Financial Assistance.*—(*a*) The Joint Stock Banks should be invited by His Majesty's Government, so soon as opportunity offers, to consider the possibility of affording a greater measure of assistance to British industrial enterprise. (*b*) All Government Departments, Local Authorities and Statutory Bodies entrusted with the control of monies raised by taxes or rates, should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire. (*c*) British financial houses concerned in the issue of foreign loans in the United Kingdom should be urged to endeavour to secure that preferential treatment be accorded to British contractors and manufacturers in respect of the public works to be carried out by means of such loans.

7. *Trade Exhibitions.*—The following broad principles should be adopted in respect of future Trade Exhibitions:—(*a*) Trade Exhibitions should be held under the control of the Board of Trade. (*b*) Exhibitions should be exhibitions of manufacturers' wares for traders, and should not be organised with a view to attracting the general public. (*c*) Exhibitions should not be too general in scope, but should be for a limited number of branches of industry at a time, according to the importance and dimensions of each particular industry in this country. (*d*) At least one year's notice of the intention to hold any particular exhibition should be given to manufacturers.

8. *Protection of British Trade Marks Abroad.*—His Majesty's Consular Officers should be directed, so far as practicable, to watch for, and report immediately with the fullest details obtainable, cases of the apparent infringement of British trade marks, or attempts to pass off foreign-made goods as British.

9. *Establishment of a Ministry of Commerce.*—His Majesty's Government should be urged to consider anew the advisability of establishing a separate Ministry charged solely with the safeguarding and extension of British industry and trade, and freed from the regulative duties in respect of Railways, Shipping and Harbours, and the duties in respect of Labour, which at present devolve upon the Board of Trade.

10. *Extension of the System of Trade Commissioners.*—The appointment of Trade Commissioners, responsible, and reporting directly, to the Board of Trade, should be extended to the principal foreign countries.

11. *The Consular Service.*—The organisation of the Consular Service should be dealt with so soon as possible after the completion of the Report of the Royal Commission on the Civil Service, with a view to the increase of its commercial utility.

12. *Undervaluation of Foreign Imports.*—Efforts should be made, by the co-operation of the Consular Officers and the Trade Commissioners suggested in Recommendation 10, with representative British Chambers of Commerce and Trade Associations, to check the undervaluation of goods which

is believed to be widely practised by some non-British importers into countries having tariffs on an *ad valorem* basis.

13. *Commercial Travellers in British Dominions.* Representations should be made to the Governments of the Self-Governing Dominions and of the Colonies with a view to the preferential treatment of British commercial travellers in respect of licence fees.

14. *Trade Catalogues.*—Representations should be made to the Governments of such British Possessions as levy import duties on imported catalogues and trade circulars, with a view to the substantial reduction of such duties in respect of the catalogues and circulars of British manufacturers.

15. *Tariff Protection.*—Where the national supply of certain manufactured articles, which are of vital importance to the national safety, or are essential to other industries, has fallen into the hands of manufacturers and traders outside this country, British manufacturers ready to undertake the manufacture of such articles in this country should be afforded sufficient tariff protection to enable them to maintain such production after the war.

The amount of the tariff duties which it was suggested should be imposed naturally varied with the different branches of industry. The following statement summarises the proposals made:—

Paper manufactures, 15% *ad valorem.* Printed matter, 33⅓% *ad valorem.* Silversmith's wares, 15% *ad valorem.* Cutlery, 10—20% *ad valorem.* Fancy leather goods, 33⅓% *ad valorem.* Glass ware: table glass and lighting glass, total prohibition of German and Austrian glass for a period of three or five years, then 33⅓% *ad valorem*; optical and chemical glass, 25—30% *ad valorem* for five years; common glass wares, 10—15% *ad valorem*; glass bottles, 5% *ad valorem.* China and earthenware, 20% *ad valorem* (with a higher rate on fancy wares). Toys, other than mechanical, 25—30% *ad valorem*; toys, mechanical, "an absolutely prohibitive rate." Brushes and brushware, 15% *ad valorem.* Magnetos, 33⅓% *ad valorem.*

It is also recommended that a larger proportion of the Revenue should be raised by reasonable import duties. Such import duties would go a long way towards satisfying the requests for special protective treatment for the industries under consideration. In view of the threatened dumping of stocks which may be accumulated in enemy countries, the Government should take such steps as would prevent the position of industries, likely to be affected, being endangered after the war or during the period required for a wider consideration of the whole question.

The report is signed by Algernon F. Firth, A. J. Hobson, Stanley Machin, E. Parkes, and Albert Spicer, the last-named with the reservation that the consideration of a tariff for the special industries should wait until after the war, unless it can be undertaken earlier, when the whole issue can be again considered in the light of an agreed policy with our Dominions overseas and our present Allies.

Import of paper. Commission's regulations.

THE Royal Commission on Paper appointed by the Board of Trade have issued regulations as to licenses for the importation of paper and paper-making materials. It is provided that on and after March 1, 1916, no paper or paper-making materials shall be imported by any persons other than those who are licensed by the Commission or by an agent acting on behalf of a person so licensed. Licenses may be granted to paper-makers to import during the twelve months commencing March 1, 1916, two-thirds of the weight of imported materials which they consumed in the standard year. Licenses may also be granted in exceptional cases to dealers in paper-making materials at the discretion of the Commission. Licenses may be granted to importers of paper to import during the twelve months commencing March 1, 1916, two-thirds of the weight of paper which they imported in the standard year. The standard year shall be 1914.

Licenses will be granted subject to the condition that the licensees comply with the regulations of the Commission as to the distribution of the materials of paper imported, and of the paper made from the imported materials. The licenses issued will be subject to withdrawal by the Commission at any time. Applications must be made to the Commission for a license to import paper.

Then follow a series of conditions which are to be observed by licensed importers. Importers shall, if required, supply such paper and the paper made from such materials to those persons whom they supplied with paper in the standard year to the extent of two-thirds of the weight of paper supplied by them in that year.

The Commissioners have power to deal with any person who unreasonably refuses to supply his customer with two-thirds of the weight of paper supplied in that standard year. The Commission have also power to deal with the question of an unreasonable price being demanded.

Mr. Rawlinson asked the President of the Board of Trade whether he will give instructions to the Paper Commission to give serious consideration to the special requirements of those weekly trade, technical, and professional publications which are so necessary for the maintenance of our export trade and industrial efficiency and to hear the evidence of the representatives of such publications before arriving at a decision.

Mr. Runciman has replied in Parliamentary papers: I do not think that it is possible for the Commission, in arranging for the distribution of paper amongst the various users, to take account of the purpose to which the paper is to be put.

Prohibited exports. Order in Council, Feb. 12, 1916.

The exportation of carbon electrodes for electric furnaces and of petroleum coke is prohibited to all destinations.

The heading "Capsicum and oleo-resin of capsicum" in the list of goods the exportation of which is prohibited to all destinations, is replaced by the heading "Oleo-resin of capsicum."

The heading "Bones for manure, dissolved bones, bone flour, bone meal and bone ash," in the list of goods the exportation of which is prohibited to all destinations abroad other than British Possessions and Protectorates, is replaced by the heading "Bones, in any form, whole or crushed (including dissolved bones, bone flour and bone meal), and bone ash."

The heading "Capsicum and peppers" is included in the list of goods the exportation of which is prohibited to all destinations abroad other than British Possessions and Protectorates.

The heading "Lead, pig, sheet or pipe (including solder containing lead)" in the list of goods the exportation of which is prohibited to all destinations abroad other than British Possessions and Protectorates, is replaced by the heading "Lead, pig, sheet, pipe or scrap (including solder containing lead)."

The exportation of the following goods is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal:—Arrack; casein; cork and cork dust, not including floor coverings manufactured partly of cork dust.

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Edinburgh Section.

Meeting held at Edinburgh on Wednesday, 17th November, 1915.

PROF. JAMES WALKER IN THE CHAIR.

WOOD PULP.

BY ALLAN SMITH.

The different kinds of wood pulp which are largely produced may be divided into two main classes, mechanical and chemical. Mechanical pulp, as the name suggests, is produced by mechanical means, and chemical pulp by a combination of mechanical and chemical processes. The process is only about 50 years old.

I will assume that the raw material is in the form of peeled and cleaned logs (preferably spruce) 4 in. to 7 in. in diameter. The first process is the grinding. The grinders are circular stones, of 4 to 5 ft. diameter and 18 in. to 24 in. wide. In fact, much wider stones are sometimes used, say, up to 43 in., arranged with presses (generally hydraulic) fixed so as to press the logs against the stone. The grinders make about 150 to 180 revolutions per minute, giving a speed of about 2400 ft. per minute on the grinding surface.

There are two kinds of grinding, called "cross grinding," and "long grinding," according to the motion of the surface of the stone towards the wood fibres. Cross ground pulp from the end of the log has a short, fine fibre, and is suitable for most papers, while long ground pulp is more suitable for printing and stronger papers, and especially for cardboard. The logs are pressed on the stones by hydraulic pressure or by an arrangement of weights, and the fibres ground or rubbed off are mixed with large quantities of water and run over a coarse sieve which removes the knots and coarse chips. The material which has passed through the coarse sieve (or screen) is then passed on to a series of sieves, the last being the finest, which allows only fibre of the required fineness to pass through, the coarser material left on the intermediate sieves being passed through a machine for reducing or refining, after which it is passed back over the sieves with fresh pulp from the grinders. A large quantity of water is required in the process, 100 to 200 thousand gallons, or 450 to 900 tons, to produce one ton of air-dried pulp, 98 to 123 cubic feet of wood being also required, and about 7½ horse power for 24 hours.

The mixture of fibre and water leaving the grinders contains only about ½% of solid material. The separation of the pulp from the water is usually carried out by means of a cylinder machine. This consists of a vat in which a cylinder revolves which is covered with a wire netting of about 6 meshes to the inch, and this again supports a finer wire cloth of about 70 meshes to the inch. The top of the cylinder is above the contents of the vat, and as it revolves the water passes through to the inside and leaves a thin layer of pulp on the outside, which is picked up by a felt running over rolls on the top of the cylinder. The felt and pulp are passed between press rolls which squeeze out more water and leave the pulp with 65 to 70% of water. The film of pulp is then wound on a roll until a thick solid layer is formed, which is cut through and falls from the roll in a thick sheet. A pile of these sheets is made, with pieces of felt or wire cloth between each pair of sheets, and the piles are placed in a hydraulic press, where a pressure of 500 to 700 tons can be obtained, whereby a further quantity of water is removed. The sheets are then made into bales of a definite weight, packed (in Hessians), and bound with iron wire ready for shipment. As the material has often to be delivered to paper mills at great distances from the pulp mills, it is essential that the pulp should be as free from water as possible to save freight; but if the pulp is produced where it is to be converted into paper, it can be scraped off the roll of the machine into trucks without being made into sheets, and then transferred direct to the beating engine of the paper mill.

In America hot grinding is the general practice, the temperature, about 52° to 54° C., being produced by the friction of the grinding stones, only sufficient water to prevent combustion being used. Hot grinding (cross) produces a stronger pulp than cold grinding, in which a much greater quantity of water is run on the stones. The mass is then strained through sieves consisting of copper plates with slits of 0·011, 0·013, and 0·015 inch in width (according to quality of pulp required). What does not pass through the slits goes into the river as waste.

If the wood is steamed for some time before grinding, a brown pulp is obtained, which is largely used, either alone or along with other fibres, for the production of brown papers. Ground wood alone has not much strength but is a good and cheap filler, and is largely used in combination with other fibres.

Mechanical pulp is put on the market in two forms, 50% and 100%. The allowance in England for atmospheric moisture is 10%, that is, a sample of 90% fibre and 10% moisture is known as air-dry pulp, and is sold and invoiced on this basis. Consequently a 50% mechanical sample should be invoiced as 100 lb. for every 45 lb. of absolutely dry fibre. As it is almost an impossibility to deliver pulp containing an exact amount of moisture, moisture tests are made of the consignments, and the weight to be invoiced calculated from the results.

The following procedure is used in testing the pulp:—

We will suppose that a consignment of 50% pulp consists of 1000 bales; say 5%, that is, 50 bales, weighing 5 tons, are taken and accurately weighed. Samples are cut from them in various ways, say, from sheets 1 in. from the top of the bale, from the centre and from 2 in. from the bottom. Sometimes triangular pieces are cut from each of these sheets, sometimes strips, the object beng to get proper proportions from the sides and centre of the sheet. If the pulp has been packed some considerable time, the outer portions may have dried more than the inside; or if exposed to the weather, as when loaded as deck cargo on the steamers, the bales may be wetter outside than in the centre.

The samples which have been taken are accurately weighed and then dried at 100° C. in a water oven or air bath until the weight remains constant. Let us assume that the wet samples weighed 100 grms., and 49·5 grms. when dry. This would give 49·5% of fibre. Now if 50 bales weigh 5 tons, 1000 bales weigh 100 tons, and 100 tons at $49{\cdot}5\,\% = \frac{100 \times 49{\cdot}5}{45} = 110$ tons, the weight to be invoiced.

It will be obvious that the main thing, and the most difficult to secure, is the obtaining of samples which fairly represent the bulk of a delivery.

From a long experience, both as a paper mill chemist and as a pulp mill chemist, I must admit it is very difficult to get results which are really fair and satisfactory to both parties, and I think in the pulp trade there are probably more disputes about moisture contents than in regard to quality.

The most delicate test for mechanical wood pulp is the production of a deep red colour with phloroglucinol in alcohol and concentrated hydrochloric acid. By its use a fairly accurate estimation of mechanical fibre in a paper made from various materials can be made.

There are three varieties of chemical pulp known as soda, sulphate, and sulphite pulps.

Nearly every variety of wood can be reduced to pulp by one or other of these processes; but spruce, silver fir, Scotch fir, hemlock, among the conifers, and poplars, among the broad-leafed trees, are principally used. The pulps produced from the various woods differ greatly in strength and felting properties and in their amenability to bleaching.

Soda pulp is prepared by digesting with caustic soda. This is the oldest method.

Sulphate pulp is prepared by digesting with a mixture of caustic soda and sodium sulphide (the material used for making the flux being sodium sulphate from which the process takes its name). When the liquor is prepared it has a composition of about 11—12 grms. of Na_2CO_3, 90—100 grms. of $NaOH$, and 25—28 grms. of Na_2S per litre. The yield from spruce is greater in the sulphate process than in the soda method, and the product is stronger.

Sulphite process.

This process gives the largest yield of paper-making material from wood, and I propose to deal principally with it, as it is the one in which I have had practical experience.

In Austria the hills are well wooded, two species of fir predominating, viz., Fichten and Tannen, the former being the more abundant.

In the autumn gangs of men go out into the woods in selected areas. The private owner is not allowed to cut as he chooses. He has to get permission from the State Department, and in many cases they insist, or are supposed to insist, on the replanting. That is, a man who cuts or clears an area has to deposit with the Government a certain amount of money which is refunded when he has replanted that area successfully. As a rule he pays the money but does not plant. It is very hard to persuade a peasant to invest money in a business where it may take 30 or 40 years to get any return. Going out to buy lumber, often the first thing one requires to do is to advance a sum of money to enable the man to clear off a mortgage which he has given on it. Then he comes again, and one has to give him another advance to pay the wages of the men who are to cut it, and sometimes by the time the wood is ready for delivery and the accounts are squared up it turns out that the amounts paid to account are often fully equal to, and sometimes even more than the value of the goods to be delivered. This is a very difficult thing to avoid, competition being so keen, and these men have the buyers practically in their hands. Some ten years ago timber was very easy to obtain, but now it is a matter of considerable difficulty. The trees are generally barked in the woods—the bark being used for tanning purposes—the branches are cut off and only the stem wood marketed. The trunks are allowed to lie where felled and stripped until the snow falls and gets frozen, when they can be easily slid down the valleys, either to the roads or, in some districts, to the banks of the streams. The transport to the railways or mills for short distances is on sleighs, which, being lower than lorries, are loaded with less labour, and the teams can haul far heavier loads if the weather conditions are good, and the snow nicely frozen, but if the season is a bad one the logs are often left over until the following year. If the transport is by river, the logs are cut into small lengths of 1 or 2 metres, and marked, so that the ownership will be known, and pushed into the stream or river when the first high water comes in the spring, either through rain or a rapid thaw, and are thus cheaply conveyed to their final destination, or at least part of the journey. In some cases the logs are left in their full length and made up into rafts, sometimes of great size, and if the journey is a long one, huts or shelters are built on these rafts for the men who have to steer or guide them. The rafts are sometimes floated with the flow of the river or a number of rafts may be towed by a tug boat. Some of the mills are saw mills, as in the forests some of the wood is generally more valuable for sawing than for pulp-making; and large quantities of the hard wood are sold for fuel, which is more commonly used for domestic purposes than coal, as this is often very dear owing to the distance from the coal-fields. The stoves also are better adapted for wood fuel.

When the logs arrive at a pulp mill, they are measured (the method of measurement varying in different countries), and while some may be taken directly to the mill, the bulk is stored, being piled in large stacks in the open air. The reasons for storing are twofold, one being, as already explained, the fact that the transport is mostly done whilst the frozen snow is lying; the second reason is that logs which have dried give much less trouble in the manufacture, green wood often forming globules of resin (or pitch, as it is generally termed) in the mill. When the logs are taken into the mill they are cross sawn in lengths of from 18 in. up to, say, 40 in., according to the manner in which they are to be treated afterwards. The next process is barking, and by this is meant the removal, not only of the outer bark, if this has not already been done, but also of the inner bark, which must also be carefully removed if good clean pulp is to be produced. The barking may be performed either by hand or by machinery. Many different machines for this purpose are on the market, some of them being very efficient. In hand barking the workmen employ an implement like a carpenter's draw knife. Barking by machinery involves a loss of from 15 to 50%, but with careful hand barking the loss is much less. Where material is cheap and labour dear, it pays to use machinery and sacrifice part of the cheap material; but if wood is dear and labour not too highly paid, then it is probably an advantage to resort to hand barking.

Wood which has had the bark removed loses from 10 to 30% in the processes of cleaning and preparing for the boiling process. The diameter of the logs affects the percentage of loss very much, the loss being the greater the smaller the diameter. The knots represent a large proportion of the loss.

The wood from the barking machine is transferred to the choppers which chop discs obliquely from the ends of the logs, the object of cutting at an angle being to save power. The chopping is done very quickly, and the machines consume a fair amount of power.

The chips from the chopping machine fall into a pit and are lifted by an elevator to a disintegrator or crushing machine which breaks them up into small pieces. From the crusher the chips fall down a shoot into a sorter—a cage 15 to 18 feet in length, slightly smaller at the entrance, and this cage revolves horizontally, the chips travelling along towards the larger end. The narrow end is covered with a fine sieve just large enough to allow the sawdust, sand, and dirt to fall through; the next portion is covered with a coarser sieve and allows coarser sawdust to pass through—this can be worked up for cheaper papers—the first portion is generally blown or conveyed along with the bark to the boiler house for fuel. On the third and longest portion of the sorter is a very coarse sieve with openings of, say, 6 in. by 1 in., through which the good chips pass and fall on to a belt, which conveys them to a suitable position where they can easily be raised by an elevator to a loft above the pans or digesters. The bigger portions, knots, etc., fall out at the end of the cylinder and are either treated by a crushing machine and returned to the cylinder at the entrance end, or more often conveyed by an elevator, or blown by strong fans through pipes, to the steam boiler plant for burning.

Slide doors in the floor of the chip loft allow the digesters to be easily filled as required.

While the chips are got ready in one portion of the mill, the cooking liquor is being prepared in another part of the works and retained in the store tanks.

In the preparation of the cooking liquor, which is essentially a solution of a bisulphite in excess of sulphurous acid, the base used is either lime or magnesia (or a mixture of these two, say from dolomite), and in some cases soda. The objection to lime is that if any sulphate is produced its practical insolubility leads to precipitation on the fibre: but with care this can be easily avoided.

There are two methods of preparing the liquor—first, the tower system, and second, the milk of lime process. In each system the first step is the preparation of sulphur dioxide. This is obtained either by the direct combustion of sulphur in air, or by the roasting of pyrites. The choice of material will depend much upon local conditions. If pyrites can be had near at hand, it is by far the cheaper, but if high freight has to be paid sulphur is preferable.

For our purpose we will assume that sulphur is being used. This may be recovered sulphur, refined Sicilian product, or the natural sulphur from the American mines. Louisiana sulphur is guaranteed to have a purity of 99 %, and analyses which I have made often show up to 99·7 %. In spite of its purity it is not a good free-burning sulphur. There is some small proportion of impurity which, when burning in the oven, cakes on the top of the sulphur and almost stops the combustion. Various forms of ovens are used, some of which have scrapers to keep the surface of the melted sulphur free from a fine coating which often forms, or rotary ovens may be used. My experience is that it is good works practice if an average of 16 % SO_2 can be regularly obtained by burning sulphur.

The theoretical yield of sulphur dioxide from burning pyrites in air is 16·2 % by volume, but owing to a portion of the oxygen combining with the iron, 12 % of SO_2 in the gases from the pyrites ovens would be as much as could be expected. The amount of sulphur trioxide formed in using pyrites is also much greater than from sulphur. The smaller quantity formed from sulphur may be neglected, but when large quantities are formed they must be removed by scrubbing, otherwise calcium sulphate is formed on the surface of the limestone, and is a source of much indirect as well as direct loss; the quantity of heat formed is also much greater, and scrubbers have to be provided to remove the bulk of the sulphur trioxide, and more cooling capacity provided.

The mixed gases, sulphur dioxide and trioxide, oxygen, and nitrogen, coming from the ovens or kilns are passed first through cast iron pipes, which are not much attacked by the hot gases, but are soon destroyed by cooler gas. After the gases have been cooled to a temperature below that at which lead melts they are passed through lead pipes to cool. Different kinds of coolers are used, amongst others, brick chambers containing lead pipes through which cold water flows, or the gases are passed through lead pipes cooled by water on the outside. The gases are generally cooled to about 25° C., before being brought into contact with the limestone.

Tower system.

In some cases there are three or four towers of great height. A little above the base of each is a false bottom made by crossing wood posts of about 4 in. thick and spaced about 2 in. apart. On the top of these false bottoms limestone is filled in, and on the top of the tower is a spray so that liquids can be distributed over the stone. The gas from the sulphur or pyrites burners is drawn or forced in under the false bottom. In some cases there is a fan between the sulphur ovens and the towers by which air is drawn through the burners and the resulting gases forced through the towers. In other cases a fan or ejector is put on the top of the last tower and the gas is drawn right through from the burners. Gas passing through the first tower is brought down through earthenware pipes to the bottom of the second tower, from the top of the second to the bottom of the third, and in some cases from the third to the fourth. Water is introduced at the top of the tower, from which the residual gases (principally nitrogen and carbon dioxide) are being discharged. As it flows down over the stone it dissolves sulphur dioxide, forming sulphurous acid which attacks the limestone, producing a solution of calcium bisulphite. From the bottom of this tower the solution is pumped up to the top of the next tower in the series, and so on; the liquid passing through in the opposite direction to that in which the gases are travelling. At the fourth tower the sulphurous gases are practically all absorbed. If the system is in good working order, the fourth tower should be doing practically no work, but acting only as a reserve. Each tower can be separately disconnected from the system for refilling or for repairs while the remainder are at work. The liquor leaving the towers contains about 3½ % SO_2, of which 1·3 % is combined, that is, equal to a base of 1·14 % calcium oxide. About 2·2 % is free SO_2. This liquid passes from the last tower into a store tank, and there it is enriched by gases recovered from the cooking process. The gases coming back from the digesters are passed through the liquor in the store tank, which is thereby enriched, so that a liquor of, say, 6 % of SO_2, of which 0·84 % is combined, can be obtained. This is equivalent to 0·73 % calcium oxide and 5·16 % free SO_2. It would be very desirable, if it could be done, always to have liquor of a constant composition, but that is impossible in practice. Variation in the strength of the liquor depends, for one thing, on whether the chips are wet or dry. In winter, the chips sometimes appear to be half wood and half ice, and when such chips go into the digester the amount of gas recovered from that digester will be less, since less liquor must be used. Such chips are exceedingly cold, and this necessitates far more steam to obtain the necessary temperature, which tends to make weaker liquor. The temperature of the air and of the water are factors to be reckoned with. In summer a difficulty in many mills is to get water cold enough for working satisfactorily. In winter there may be very cold days, with a resulting increase of condensation in the steam pipes and from the digester. Again, a consignment of poor coal may make it impossible to keep up the pressure of steam in the boilers to the usual standard, and the digesters being supplied with steam of lower temperature, the strength of the liquor is reduced, and a smaller quantity of gas is liberated in a form suitable for enriching the liquor for the next cook, which is consequently weaker, and it in its turn yields a poor recovery, for if the liquor is low in free acid, the amount of recovery is bound to be less; consequently it is very desirable to have strong liquors, as, if they once get low in free acid, they go from bad to worse, the effect being cumulative. If the normal strength of the total acid can be kept at about 6 grms. SO_2 to the 100 c.c., there is always sufficient gas being recovered to keep the liquor fairly good under adverse conditions, otherwise I do not think there is much advantage in having too rich liquor.

Assuming that the wood is ready and that the digester is filled with the chips, the liquor is then pumped in until the digester is nearly filled. There are different methods of cooking. In slow-boiling processes like the Mitscherlich process, the wood is first steamed, then treated with a weak liquor in the digester, and cooked at a comparatively low temperature for a long period. This gives a very fine pulp but an expensive one to produce. It is, however, one of the quick boiling processes which I shall describe. The boilers are of different kinds. There are rotary boilers, some revolving horizontally and some like spheres, but in most of the big mills the boilers are of cylindrical shape, standing upright. These are of various sizes, and the shape is often altered to suit the fancy of the pulp maker. The main thing is to have the digester of such a shape that when steam is injected at the bottom it has a fairly good circulation in every part. If there are parts of the digester where there is no circulation, or if the steam passes up the sides or up the centre, inequality in the cooking is the result. The shell of the digester is made of steel plates, about an inch thick. They have to be exceedingly strong, because they are subjected to great pressure. The action of the liquor on the plate is very rapid if the acid comes into contact with it. I have seen a plate cut to a considerable depth in one cooking where there was a small leak, and so it is necessary to protect the plates by a lining. Perhaps the most satisfactory lining is one in which there are two layers of brick, one almost close to the shell with a coating of cement and other ingredients behind, and the other on the top of that built inside like a brick wall or a chimney stack. Different kinds of brick are used, and digesters are lined with white firebrick and a good quality of hard brick. Some of these linings are very satisfactory. I know some which have been working many years and still seem as good as new. On the top of the lower neck of the digester a perforated plate is fixed. Underneath this plate are the inlets for the steam. On the top of the digester there are generally two pipes, one to take the liquor when the pan is full and the liquor is boiling over owing to the condensation, and the other when there is less liquor and only gas and steam are coming off. In some cases all the gas of the digester is passed back into the liquor for the next cook, in other cases it goes through a separator, in which some of the gases are separated and recovered and the liquor runs away. The separator, so far as my experience goes, is very extravagant. There is a great loss of sulphur when much of the liquor is run into streams. On the side of the digester there is generally a small cock or tap where the panman can take a sample of the liquor; pressure gauges and thermometers are also fixed. It is impossible to tell the temperature of a digester from the pressure, since there is an unknown quantity in the tension of the SO_2. When the chips and liquor have been filled into the digester, the lid is securely fixed and the steam turned in. It takes probably four hours to boil the contents of a pan. During this operation it is necessary to relieve the increase of pressure in the digester, otherwise the entrance of more steam is prevented. The gas which is being liberated is taken back, after cooling, into the liquor in the storage tanks. Afterwards, when the digester is full, not only gas, but liquor, comes back, which means bringing back both base and acid. After the liquor reaches the boiling point, the steam is kept on until the temperature reaches 130° to 140° C. During cooking, the panmaster cannot see the contents of the pans, and it is impossible to get a sample of the wood to see how it is digested, but he can get a sample of the liquor, and, by means of standard iodine solution, estimate the amount of sulphurous acid. He observes the smell of the liquor and its colour, and by these indications he can tell fairly accurately what the condition of the pan is, and how much longer it must be cooked; if the cooking is not sufficiently carried out, the pulp is too raw, and if over-cooked it is too soft and too weak, in addition to giving a low yield of fibre. In some mills the pans are cooked for about 10 hours, in others for 16 or 17, and in some even for 26 or 27 hours—depending to a great extent on the temperature at which the process is carried out, and the strength of the cooking liquor. After the cook is finished, the panmaster in some cases opens the gas taps to the full, shuts off the steam, and lets off as much of the sulphurous acid as possible. He then opens the tap at the bottom and runs out the liquor into the river. The pan may be filled up with cold water and the pulp washed once or twice and run out into drainers, which are large tanks with perforated bottoms through which the water can get away. In other mills a valve is opened and the wood is blown out under full pressure into a large tank, which also acts as a drainer. In this manner a digester of 10 tons capacity can be blown out in ten minutes, whereas by the first method it would take two or three hours to get the pan emptied. In the one case time is saved, and the plant turns out more pulp; in the other sulphur is saved, as when a pan is blown under pressure the residual liquor always contains a larger percentage of SO_2.

Some mills make pulp with 10% of sulphur, others use nearer 15%, partly owing to the difference in the manner in which the digesters are emptied. The pulp is washed in the drainers and then run through sand traps, which are long canals or wooden troughs, in which the knots and heavy material settle to the bottom, and the rest flows on to the screens. These screens are of various kinds, principally revolving copper sheets with very fine slits through which the fibres pass. The solution, as it comes through, has just the appearance of water, but contains the fibre in a very fine state. If the pulp is to be marketed in the unbleached condition, it is made into a web on a paper machine, then made into rolls or cut into sheets and packed ready for shipment, but if it is to be bleached the drying process is omitted. The moist pulp coming from the wet end is put into large bleaching engines where the bleaching takes place. It generally takes 2% more bleach for a pulp maker to bleach his pulp, if he is going to put it on the market, than a paper maker requires, because he has to bring it up to a much better colour to allow for a certain amount of going back, which will occur unless it is very well made and well bleached.

I have had experience in bleaching with sodium hypochlorite as the bleaching agent, made by electrolysis from common salt and used in that condition. A good many people maintain that electrically prepared solutions are more efficient in bleaching than solutions of similar strength prepared from bleaching powder. I made a very exhaustive test on a big scale, in which many tons of material were bleached at the same time—one by a solution of bleaching powder, and one by sodium hypochlorite, and I found the same, or practically identical results, in both cases. Sodium hypochlorite is much the more advantageous bleaching agent, because, when stored, the pulp will retain its colour better than pulp bleached with bleaching powder, probably owing to the fact that small quantities of calcium remain in the fibre which it is impossible to wash out in the mill.

In the condition as marketed, every ton of pulp has taken about 160 cubic feet of peeled wood, 2 cwt. of sulphur, 2½ cwt. of limestone, 2 cwt. of bleaching powder, and for cooking probably 12 cwt. of coal, that is in a mill using water power. Otherwise, where steam has to be used, both for cooking and for power, it takes more than a ton of coal to produce a ton of pulp. Less than 25 % of the weight of the original tree is found in the pulp which is produced, and to convey some idea of the great amount of this product which is used in the paper trade, it is safe to say that over two-thirds of the material used in paper-making at the present time is one or other of these wood products. Thousands of tons of this cellulose are also used by the artificial silk maker every year.

New York Section.

Meeting held at Rumford Hall on Friday, January 21st, 1916.

DR. W. M. GROSVENOR IN THE CHAIR.

PRESENTATION OF THE PERKIN MEDAL TO DR. L. H. BAEKELAND.

The Chairman, in the course of some introductory remarks, recalled the circumstances under which the Perkin Medal fund was established in 1907.

Prof. C. F. Chandler, in presenting the Medal, said that Dr. Baekeland was born in 1863 at Ghent, where he received his early education. In 1880 he entered the University, and later was appointed Assistant Professor, and in 1889 Associate Professor of Chemistry. In the meantime, in 1887, he had been appointed Professor of Chemistry and Physics at the Government Normal School of Bruges.

Before leaving Ghent, he had become deeply interested in photography. Since the early 'eighties Ghent had become a centre of the new industry of dry-plate manufacture, started there by Dr. Van Monckhoven. Dr. Baekeland was an enthusiastic amateur photographer, and had followed every step of the new processes, with the result that he acquired some reputation in this new branch of chemical industry.

On his arrival in New York in 1889, he was appointed chemist to Messrs. E. and H. T. Anthony and Co., manufacturers of photographic films and bromide paper. This firm later joined the Scoville Co. in establishing the Ansco Co.

After two years, he left the Anthony firm and established himself as a consulting research chemist, and devoted himself to developing several chemical processes which he had devised.

In 1893, in partnership with Mr. Leonard Jacobi, he founded, in Yonkers, the Nepera Chemical Co., where he started the manufacture of various kinds of photographic papers. One of these papers, which was called "Velox," has since earned a great reputation as a printing paper.

Dr. Baekeland had worked to perfect this paper as far back as 1883, while he was still a student in Ghent, but its importance as a possible subject for a commercial enterprise did not become apparent to him till much later.

Silver chloride emulsions had been proposed and described in 1891 by Eder and Pizzighelli, but their process was carried out along the same general lines as the manufacture of silver bromide emulsions, namely, precipitation and ripening, followed by washing to remove the soluble salts resulting from the reaction.

Baekeland had found that, as far as silver chloride emulsion is concerned, the last two operations, although they increased the sensitiveness of the emulsion, had a disastrous influence on the tone and general gradation of the image, especially in the shadows. He had discovered that, in order to keep these desirable qualities, it was necessary to produce silver chloride in a special colloidal condition, which is easily disturbed by any after treatment of the emulsion, as for instance "ripening" or washing. By omitting the washing entirely, Baekeland found that he could make a colloidal silver chloride which was relatively insensitive to the yellow rays of the spectrum, and therefore could be manipulated by candle or gaslight, if not brought too near. This made the paper incomparably inferior to bromide paper or ordinary silver chloride paper, so far as speed is concerned. But Baekeland realised the important fact that by exposing quite close to the artificial light, and developing the image at a safe distance (a few feet), the apparent defect could be turned to a great practical advantage.

The paper was sold under the name of "Velox," and met with very scant favour at first; but after the value of the process was clearly recognised, it gained rapidly in popularity, and in 1899 the Eastman Kodak Company bought the entire business enterprise. This placed Dr. Baekeland in a position to devote all his time and energy to study and research.

Dr. Baekeland then turned his attention to electro-chemistry, and after spending a winter in the electro-chemical laboratory at the Technological Institute at Charlottenburg, he equipped a modest private laboratory at Yonkers, and provided it with a few electro-chemical appliances for further study.

About that time, C. P. Townsend had invented his now famous electrolytic cell, for producing caustic soda and chlorine from salt. Baekeland was requested by Mr. E. H. Hooker to take the direction of the work preliminary to the industrial development of this invention. This he did in company with the inventor and several other experts. The work finally resulted in the formation of the Hooker Electrochemical Co., and the erection at Niagara Falls of one of the largest and best-equipped electro-chemical plants in the world, with which he is still connected in an advisory capacity. In this connection he took out his first two patents, "Apparatus for regenerating electrolytes," and "An electrolytic diaphragm and method of making same."

Bakelite.

Dr. Baekeland's crowning work is the solving of the mysteries involved in the action of formaldehyde upon phenols, and giving to the world the new material "*Bakelite.*"

Bakelite is a so-called condensation product of phenol and formaldehyde. Instead of phenol, its homologues, cresols, or other phenolic bodies can be used, and instead of formaldehyde, other substances which have the same functions, as for instance, methylal, paraform, and hexamethylenetetramine.

Baekeland's first work in this direction consisted in an unsuccessful attempt to discover a solvent for the infusible and insoluble product obtained by Kleeberg using concentrated hydrochloric acid as condensing agent. He next attempted to produce the same product where it was ultimately required, *e.g.*, in the wood fibre, hoping thereby to incrust the fibres of the wood with an unusually hard and inert substance, and give to the wood new properties. He encountered endless difficulties. Certain classes of wood, specially the higher grades, instead of becoming harder, became softer. He also noticed that chemical reactions in these capillary conditions proceed in a very different way than in a flask, for the reason that the chemical dynamics in capillary spaces are considerably disturbed, so that the reaction, which may terminate rapidly and completely in a wide vessel, will be considerably hampered when the mobility of the molecules is disturbed by capillary conditions. On this account, the phenol, before it had time to enact upon the formaldehyde, had every opportunity for destroying the fibre. He concluded that in order to have any success, he should either be able to accelerate the reaction by some means, or partially start the reaction outside the wood fibre, and finish it afterwards within the tissue of the wood, after injection.

This led him to a long systematic investigation, in which he established practically all important facts on which is based the foundation of the present industrial processes of Bakelite. He found that, under certain conditions, he could dissect the reaction in different succeeding steps, where one of the first steps was the production of an intermediate substance which, although it had the general appearance of a resin on account of its brittleness, its solubility, and its fusibility, differed radically from the natural resins by the fact that as soon as it was heated at a certain temperature above its melting point, it changed into an entirely different body, much harder and stronger than the original resinous material, and having the appearance of natural amber though much stronger, and had another advantage over amber or similar resins, it was infusible and insoluble in all known solvents.

He also established the fact that in the different reactions which engendered this substance, there is one phase where polymerisation occurs and that this phase is accompanied by self-heating, which brings about a considerable rise of the temperature of the mass, so that whenever an attempt is made to hasten this part of the process which produces hardening, the self-heating becomes so exaggerated that gaseous products are evolved, which cause porosity of the mass, making it worthless. In order to offset this, he introduced, besides other means, the use of a very strong counter-pressure during the period of polymerisation.

He discovered also that the presence of ammonia, or another base, in suitable proportions, would lead to the production of the infusible product, while in the presence of an acid, the formation of permanently fusible resins will be favoured if phenol is in excess; also that the use of a suitable base in proper quantities, gives an easy means of controlling the reaction at whatever phase is desirable. From then on, it became possible to prepare an initial condensation product which was still fusible and plastic, and mould or form it, or dissolve it, and then afterwards, under the action of heat, polymerise and harden it to the final condition of maximum hardness and strength, where it is no longer fusible or soluble.

The initial Bakelite is designated usually as Bakelite A; before it is polymerised, it dissolves and melts to a liquid; but this liquid, when sufficiently heated, is converted into a solid which will not melt or dissolve; it has been polymerised into Bakelite C.

The action of ammonia in presence of formaldehyde in this process is similar to that of the use of hexamethylenetetramine.

It was found also that the mechanical properties of these infusible condensation products were enormously improved by the introduction of fibrous substances, as for instance, wood fibre or asbestos. All pulverulent fillers which are successfully used in conjunction with other plastics, instead of improving Bakelite, make it worse. This is due probably to the fact that Bakelite, although it has an unusually high tensile strength, has a relatively low degree of elasticity which makes it sensitive to impact and shock. The introduction of fibrous materials into Bakelite makes it enormously more resistant to shock than the pure article.

Many other facts were established by his work. For instance, it was demonstrated that among the homologues of phenol, it was not immaterial what kind of homologue is used. Thus *o*-cresol tends towards the formation of fusible products of low strength; *p*-cresol also gives condensation products of very inferior qualities, while *m*-cresol, or mixtures of *m*- and *p*-cresol, give the best product. This enables the use of some of the more available cresols, instead of expensive phenol.

He not only pointed out reliable methods for producing, at will, either a fusible or an infusible resin, but he gave the explanation why in one case one substance and in another case a different one was obtained, when starting from the same raw materials. He established the theoretical relations and parentage of those different substances, all derived from the same raw materials and yet so different in their properties and technical uses.

Before he had pubished the results of his work, there existed not a single industry, nor a single application of any importance based on these condensation products. Since he has published his patents and read his papers there have been started here and in Europe numerous factories where these processes are used for the most varied purposes, ranging from the manufacture of a billiard ball to that of a wireless telegraphic apparatus; from the manufacture of a self-starter for automobiles to that of transparent fountain-pens, this range of varieties embracing such articles as switch-boards for battleships, mouldings for kodaks, phonograph records, casings for instruments of precision, armatures and commutators for dynamos and motors, telephone receivers, railroad signals, grinding wheels, umbrella handles, buttons, cigar-holders and pipe stems, articles of ornament, etc.

The General Bakelite Co. has a very complete plant at Perth Amboy, where the raw materials are made; there are a large number of licensees in the United States; Bakelite plants in Germany, France, and England; and several factories in Europe where Bakelite goods are manufactured under license, for example, two Bakelite button factories in Germany and one in Russia.

It was at first thought, by some, that some of the early investigators, beginning with Adolf Bayer, must have anticipated Dr. Baekeland in his discoveries and inventions, but this is not the case. The subject was thoroughly tried out in the U.S. District Court, Eastern District of New York, before Judge Chatfield, who rendered his decision in Dr. Baekeland's favour, clearly pointing out step by step the radical difference between the work of Baekeland and each one of the prior writers and patentees.

Dr. L. H. Baekeland, in thanking the Perkin Medal Committee for the honour which had been conferred on him, said:—My real intense education only began after I had left the University of Ghent, and became confronted with the big problems and responsibilities of practical life; this education I received mainly in the United States, where for twenty-seven years I was thrown in contact with so many varied subjects. I hope to remain a post-graduate student at that greater school of practical life, which has no fixed curriculum and where no academic degrees are conferred, but where wrong petty theories are best cured by hard knocks. When a young teacher of chemistry, I believed that everything was as simple as it appears in the text books. This lasted until I tried to make silver bromide for the commercial preparation of photographic emulsions. Stas had already shown that there were three or four different varieties of silver bromide, all of exactly the same chemical composition, yet differing in their physical properties. By the time I got fully engaged in the manufacture of silver-salt products for photographic purposes, I had come to the conclusion that there existed perhaps a hundred varieties, but that of those hundred varieties, there was only one which would assure me success as a manufacturer.

This gave me one of my first warnings not to accept any chemical explanation in too simple terms, and engendered in me the ever-growing belief that the apparently simplest chemical reactions are incomparably more complicated than text-book generalisations led us to believe.

My experience is probably similar to that of many an industrial chemist who has had to learn by experience, that after he may think he knows everything on a certain subject, he is constantly confronted with endless matters of detail which at first seemed so trifling as to be unworthy of attention. And yet it is these details which frequently determine whether the practical solution of a problem is possible or not.

The History of Velox.

In undertaking the manufacture of some new kinds of photographic paper I was lucky enough to make the acquaintance of Mr. Leonard Jacobi, of San Francisco, who was willing to risk some capital in my venture. He knew nothing of chemistry, nor of any technical matters, but he was very careful and conscientious in business matters, and honoured me with his implicit confidence. From him I learned some of the practical rules of business life. We had more than our share of the usual technical troubles which accompany the starting of any new enterprise. It was found, for instance, that while we could make excellent paper in temperate weather, it became practically a hopeless task to do so in the hot summer days. The remedy seemed easy enough, so we tried to rectify the conditions of temperature by artificial cooling, but this had not the required effect, and after a while we found the troubles were not due so much to the factor of temperature as to the moisture in the air. This led us to instal a refrigerating system over which the air could be drawn first so as to precipitate its moisture as ice, after which the dried air could be sent over heated pipes so as to heat it to the proper temperature before it entered the paper-coating machine. At that time, this seemed a rather paradoxical method of operating, but to-day it has been adopted by several large manufacturers of photographic papers and films. In the Gayley process a similar method is used for insuring uniform dryness of the air for blast furnaces.

In Europe, where the humidity of the air does not vary to such a great extent between seasons, manufacturers have scarcely any conception of what difficult problems are encountered in the United States, where in winter the air is so dry as to cause electric sparks and abundant static electricity by friction, while in the summer months, the air is often so saturated with moisture that any objects or machinery condense humidity on their surfaces at temperatures as high as 75° F. The humidity in the air during our hot summer season is very hard on photographic prints, which frequently deteriorate in a few weeks in summer time.

In the early nineties and following years, this country was using more and more photographic printing methods, which consisted of the so-called combined-bath processes, by which the image was toned and fixed at the same time. At that time, practically all manufacturers of new sensitised paper advocated this rather easy process. Few, if any, hesitated to promise permanency of these prints, and this on the strength that such prints had been preserved successfully in Europe. A rather simple test gave me a method of distinguishing which kind of photographic prints were most likely to fade. This test consisted in cutting a photograph in two and exposing one half in a jar to the fumes of ammonium hydrosulphide. This treatment, in a few hours, showed the same amount of fading as would have been produced under ordinary conditions after months or years. Upon the result of these experiments, I had based the manufacture of several sensitised papers which I could unhesitatingly recommend as giving permanent prints. One of those papers we called Velox. In this process prints are exposed for a short time to artificial light and developed by the same light. It required four years of strenuous introduction before the business began to show some slight profit, notwithstanding the fact that all unnecessary expenses were carefully avoided. Two years more and the business enterprise began to prosper rapidly, and then I was offered a good price for my interest in the business by the Eastman Kodak Company, and I retired entirely from this field.

Velox was never patented, but its name is a trade-mark. At that time, I was already aware how difficult and expensive it is to carry on patent litigation, and I realised too well that we could neither afford the money nor the time connected with patent fights. So I preferred to keep the process secret long enough to permit us to build up a solid business by the time our competitors would have been able to devise the same methods.

Although I have had to change somewhat my views on the subject of patents, I still believe that the man who takes out a patent for chemical processes, and does not have at his disposal abundant means to defend his patent-rights before the courts, is at a considerable disadvantage against unscrupulous infringers. Chemical process patents which can be followed out in secrecy can be too easily infringed with impunity, because it is too difficult and expensive to establish these infringements before our courts of law.

"Product patents" for chemical substances protect somewhat better; but even there, litigation is considerably more difficult and intricate than for purely mechanical patents, which are easier to understand by intelligent judges even if they have no scientific training; this important point of difference has too often been lost sight of in any proposed changes of our patent laws.

Electrolytic soda.

About twelve years ago, I was entrusted by Mr. E. H. Hooker with the examination of the Townsend cell. The inventor of this cell, C. P. Townsend, had already studied the details of his invention with a thoroughness which is rather uncommon; he furthermore, in its construction, had the benefit of the engineering experience of Elmer A. Sperry. Together they had practically tested in the laboratory everything which seemed of importance about the design and operation of the cell. At that time, there existed much scepticism as to whether a diaphragm cell for the manufacture of caustic soda and chlorine would ever rival the mercury cell, brought to such perfection by H. Y. Castner.

To investigate this cell under actual factory conditions where it would be operated by average labour, two full-sized model cells were built and operated under varying conditions, day and night uninterruptedly for months. This gave us an opportunity of improving details of construction. With the additional experience thus gained, we could now make more correct estimates and specifications for a full-sized plant. But even this plant was not built in full at once, but only to the extent of the smallest section which could be operated. We had thus further opportunities for detecting weak points and introducing further improvements or simplifications. After this period, however, there was no further risk in the construction of the full-sized plant. Moreover, the experience which had been gained by the preliminary expenditure of about $300,000 prevented blunders which might have cost several millions; through carefully planned development like this the Hooker Electrochemical Company has to-day become one of the leading electrochemical concerns of the world.

I cannot claim any further credit for the success of the technical development of this enterprise, and more specially for the Townsend cell, beyond the fact that it was my good fortune to work in collaboration with a group of unusually able men. Apart from those already mentioned, there were Albert H. Hooker, H. Willard Hooker, Clarence W. Marsh, Jasper M. Rowland, T. B. Lyster, C. N. Lansing, George W. Stone, and others, all of whom did their full share in introducing improvements.

I mention this example of successful team work in opposition to other instances where similar problems were entered into recklessly, and where, either through impatience or through false economy, a large-sized plant was put up at an enormous cost before all doubtful details of the process had been eliminated, with the result that the irregularities in manufacturing became so overwhelming and money losses became so heavy, that the enterprise failed before it was possible to overcome them.

The principle: "Commit your blunders on a small scale and make your profits on a large scale," should guide everybody who enters into a new chemical enterprise.

Synthetic resins and Bakelite.

When I undertook the intricate study of synthetic resins, which led to Bakelite, I did not rest until I had mastered the details of the subject, as far as my laboratory methods allowed me to do so. Then, immediately afterwards, I installed a small working unit where I could prepare the material in ton lots under various conditions. At the beginning, I committed the mistake of trying to make the processes and the material as inexpensive as possible, using mostly the cheaper cresols, being guided by the idea that cheapness is a paramount consideration in the manufacture of plastics. It took me some time to find out that the best chances for Bakelite lie where special technical effects are more important than mere cheapness, and that there is no use in wasting time and money trying to introduce the new process, where about the same results could be obtained by the older plastics. In other words, the process had to be introduced on its own merits, where, for instance, unusual strength or great resistance to heat or chemicals was essential, and not as a competitor to hard rubber, celluloid, or natural resins.

The most important part of the problem we had before us was to give technical instruction to those who were willing to learn, and this technical instruction ranged from the first principles of how to use the product to all the engineering details of the equipment of their plant. I concluded that the best way for avoiding failure was to conduct the manufacture of the raw materials to beyond the stage where chemical knowledge or too much experience is required. At first, I intended to sell the raw material unmixed with fillers, and let the individual user make his own moulding compositions. This idea, too, had to be abandoned after I found that the preparation of these compositions in itself involved an amount of skill, knowledge, and care, which could hardly be expected from average workmen. Only after all these details had been well established and taken into consideration could I proceed to organise a complete factory, and similar establishments were started in Europe. Each of these factories was supplemented by a research laboratory and experimental department, in which could be investigated the different applications of Bakelite as well as the refinements in its processes of manufacture, and a further general scientific study of the subject.

But even then we soon found that the greatest drawback of Bakelite was its multiplicity of applications, which threatened the squandering of our efforts in too many directions at the same time. On this account, we had to be guided somewhat by opportunism, and learn when and where it was best to direct our efforts.

In my later enterprises I was able not only to carry out all my preliminary work by my private resources, but I felt that, if necessary, I could run the whole commercial enterprise without the financial assistance of others. This undoubtedly put me at a great advantage. I had learned by former experience how very valuable it is to have the co-operation of competent men for advice or influence. Therefore, in selecting business associates for my new industry, I took less in consideration any money they were willing to introduce than their personal qualifications and business experience. This point of view, on which I put great stress, is too often overlooked by chemists who start in a new enterprise, where they are primarily confronted with the problem of finding the necessary funds. Frequently they make reckless connections with almost anybody who can furnish them the first money, regardless whether they are the proper persons to help, or advise, or inspire them in their work, or whether they are men utterly uncongenial, or who do not see in an enterprise anything but getting quickly as much cash as possible out of it, regardless of any other consideration.

If in the enterprises with which I have been connected I managed to get along pretty well, I can attribute it, to a large extent, to the fact that in each instance I had the good fortune of being surrounded with congenial partners or collaborators, who, instead of causing friction and irritation, aroused my highest enthusiasm.

To put my opinion in a short formula, I would say: "Better do not attempt much if you have, as business associates, only men whom you cannot trust, or who do not trust you, or who irritate or depress you, or who are dangerous by their greed, their recklessness, their superficiality, their weak character, or their general unreliability."

A great mistake has frequently been made of starting into a new business with just enough money to get along, provided everything went well. This is one of the surest roads to failure. I know of few chemical enterprises, if any, where the initial expenses were not decidedly higher than what was estimated at first. It happens too often that there is not enough reserve capital at hand for weathering safely the first storms through which the newly launched ship has to navigate. It is easy enough to find all the capital when things go smoothly, but it is hard work to persuade anybody to advance funds for a business enterprise which encounters troubles, except at an entirely disproportionate sacrifice. More failures in chemical enterprises have resulted from this than from almost all other causes.

Present opportunities for chemical industry in United States. Possible sources of failure.

I want the men of this country who are desirous of joining in your chemical enterprises to realise that it is not enough to have good chemists at their disposal. There are numerous conditions under which even the best chemists cannot possibly make a success. Will our present magnificent opportunities lead us to efficient development of an unprecedentedly advantageous position, or shall we stumble and fall through sheer blundering in the way we conduct our new chemical enterprises; will these unparalleled chances of success only result in some kind of a "flash-in-the-pan?" If we turn our present opportunities into a gigantic fiasco, then let me tell beforehand to the public at large, that we should not put the whole blame on our chemists. This country has enough able chemists, all eager to do their full share of good work. Our principal universities and engineering schools are now at least as good, for all practical purposes, as the very best European institutions of the kind. If some special branches of chemical industry, as, for instance, synthetic dye manufacturing, have uot attained here the same development as in Germany, this was mostly a matter of different opportunities. On the other hand, we can point to some of our other chemical industries, where conditions were more favourable, and where this country has become a leader in quantity, in quality, and in pioneership.

Shall we now strengthen our position of economic independence from foreign countries, by adding new chemical industries for which heretofore there was scant inducement for the man of enterprise, alongside of much better opportunities in other directions? Shall we become what we ought to be with the abundant opportunities now at our disposal—the greatest centre of chemical enterprise of the world?

The answer to this question will depend at least as much on the kind of men who are at the business end of those new chemical enterprises as on the chemical part of the problem. In this respect, I look with considerable apprehension on the future of some of the ventures which are being started now by men who are merely trying to make money quickly, and who, in a chemical enterprise, see only a pretext for realising their greedy ambitions; men who look upon their chemists merely as temporary tools, ready to sacrifice their enterprise and everything connected with it, as soon as they can quickly cash in their profits, instead of trying to build up a permanent establishment run along steady business lines with a good underlying financial foundation, with the purpose of insuring, for years to come, regular and lasting profits, even if they may seem more modest.

It will certainly do no harm to many of our new chemical enterprises if, among their directors, they have at least some chemists as well as purely business men, or bankers and lawyers. If the average chemist makes a poor business man, it is simply due to the fact that he seldom, if ever, has an opportunity of obtaining business experience by being allowed to participate in discussing important business propositions in the councils of the concern that employs him. It is really a sad thing to see, in this and some other countries, so many chemical companies where the board of directors does not comprise any chemists, except in a subordinate capacity. Why should a chemist, if he is intelligent enough to master the most intricate problems of chemistry, not be able also to learn how to exercise enough common sense and good judgment to help to discuss and devise successful business policies. Those of the large chemical enterprises of the world, which are counted as a model in their line, have always had prominent chemists among their directors, and the policy of these enterprises has not been left entirely in the hands of a set of purely business men who remained wilfully ignorant of the essential technical facts upon which their enterprise was based. I have known too many instances where serious technical difficulties were not estimated at their proper value by ignorant directors, and where serious losses, disappointments, and even failure arose from that source. Of course, it would be out of the question to expect that every director in a chemical enterprise should be a full-fledged chemist, but he ought, at least to some extent, to be able to follow the difficulties, the vicissitudes, and progress of the technical problems with which the enterprise is confronted. It has been my experience that intelligent business men, even if they have no technical or scientific training, can easily be made to follow with intense interest the technical questions of a chemical enterprise, provided there be among them, as fellow-directors, some chemists who can keep them informed, without going into unnecessary details, and who in doing so, can speak with some authority, instead of the directors obtaining their information from subaltern employees, who are often so dependent on their position that they are too timid to speak without hesitation, or to impress their views with some insistence.

Germany has set us an example in industrial preparedness, and her large banks, long ago, have mastered the art of nursing new chemical industries. Those banks have their staff of scientific experts, whom they freely consult about any new chemical enterprise which requests their financial support. To these scientific representatives of the bank, the chemist or inventor can explain clearly what he has to propose, without being barred in his appeals by the hopeless ignorance in technical or scientific matters of the bank directors, or without playing on their imagination or making them exaggerated promises.

Our large American banks have not yet begun to learn how to support new enterprises based on fresh scientific discoveries, which, on this account, can best thrive and grow to powerful maturity if allowed to be started tentatively on a small scale, provided they can reckon on adequate financial support when they need it.

The higher educational effect of chemical enterprises.

A successful industry built upon sound scientific knowledge does not mean merely dividends for its stock-holders or wages for its workmen. It consists in putting in practice principles of efficiency and introducing knowledge where ignorance formerly existed, with its usual accompaniments of waste, slovenliness, misery, want, vice, and sorrow. It means surrounding our life with increasing and better opportunities by using the laws of nature to the greater help of man.

Progress, in general, is very slow, and is still more slow in assimilating. Science only began to make rapid progress as soon as it found applications which led to the payment of cash dividends. Chemical and electrical companies, for instance, spend more money for research and scientific investigation than all the universities combined. The result has been that it is those two fields of science which have shown by far the greatest development, as compared with all others. By a sort of hyperinduction, science, after helping industry, got stimulated itself by the growing exigencies of industrial enterprises. But some will ask me: "Where does all this lead us to? Will the world at large be better for it? Are not our scientists, our chemists and engineers, just those who have helped to make the present war so atrocious?" To this I can answer, that those who are responsible for what is happening now are not the scientists themselves, even if their work has been pressed into service for means of destruction and sorrow. War is many ages older than science! Greed, iniquity, lust for power, the main inheritance of the aims and thoughts of the past, rendered respectable by a rather large share of our so-called classical literature, together with our awe for tradition, are the main influences which keep us in the cold, relentless grip of the wrong ethics of bygone ages. Even our men of science have not been able to shake off entirely many superstitious beliefs, many erroneous traditions, rendered respectable through pedagogic smugness with which the minds of the children of each succeeding generation have been mummified in prejudice of certain points of view. This accounts for the fact that the average man is still more easily swayed by elegant phrases than by scientific truths. True science, on the contrary, has no more respect for the most brilliant rhetoric of classical literature, if this latter promulgates ideals which are contrary to facts, than it has patience with the utterances of a politician whose passion or interest makes him overlook or distort facts.

Notwithstanding the fact that chemistry and electricity have enriched an enormous number of people, there are few, if any, instances where scientific men, engaged in applied science, have become as absurdly rich as some of the big money hoarders of this world? Why? Because their work is too interesting to induce them to get into a life of mere money-getting: for the chemist, the financial consideration is a necessity for his existence, but that is not the chief end, as it is for those whose conception of success does not go much beyond the desire of money or power.

If a mistake is made in arousing nations or social groups to hatred or fear, it is infinitely more costly than if a mistake is made in some special problem of physics or biology; but by an irony of fate, the denunciation by society in the latter case is apt to be much more severe than in the former. This is the result of the fact that the rigid consideration of truth and the feeling of responsibility for truthfulness which exact science has established, have not yet reached the masses. And this situation will last until the influence of the metaphysical romanticist has been replaced by that of the scientist.

Sydney Section.

Meeting held at Sydney, on Wednesday, 17th November, 1915.

PROF. C. E. FAWSITT IN THE CHAIR.

THE COMMERCIAL UTILISATION OF THE "GRASS TREE" (XANTHORRHŒA) AND "ZAMIA" (MACROZAMIA) IN WESTERN AUSTRALIA.

BY H. ROWLEY.

Throughout the Commonwealth of Australia, there are several species of *Xanthorrhœa* which have been defined by botanists, but to the manufacturer using the plant for destructive distillation and other commercial uses, these botanical differences are immaterial. The Western Australian type yields a resin which is known as "red gum acaroides," while that from one of the New South Wales forms is described as "yellow gum acaroides," this yellow form being derived from *Xanthorrhœa hastilis*. In Kangaroo Island, the resin is of a ruby colour, particularly in the fracture, and is there known as "Yacca gum." The species is *Xanthorrhœa tateana*.

In Western Australia *Xanthorrhœa* grows to a great size, frequently weighing as much as 1½ tons. The trees are not deeply rooted, and are thus easily pulled down.

When the author had proceeded sufficiently far with his experiments in the preparation of various products (alcohol, acetic acid, light and heavy tar oils, tar, etc.), from the "Grass tree" *Xanthorrhœa preisii*, commonly known as "Blackboy," he felt warranted in 1900 in applying for protection of the methods he had devised for the preparation of these several substances from this source. Later, other investigators took up the question of the utilisation of the "Blackboy," particularly in the preparation of alcohol from the central portion of the stem of the plant, which often contains as much as 15% of sugars; and it was thought, therefore, that alcohol might profitably be produced from it. Large areas of land containing "Blackboy" were at that time applied for, and certain concessions were granted; but the abundance of molasses available in Australia brought that idea to nothing. The trees are stacked in a suitable manner for drying, and after 15 or 20% of moisture has been removed, the outer portion of the stem is separated from the core by mechanical means, and allowed to dry further, as the distillation of damp or "raw" material is not so satisfactory as with the dried substance, nor is the tar so readily obtained. For destructive distillation, the outer portion of the plant containing the leaf bases and the resins is the most suitable. One of the principal products obtained in the process is tar, which closely approaches Stockholm tar in general characters, and is of commercial value for road making, is non-corrosive when applied to ironwork, and, as regards quality, is fairly constant. Ordinary gas retorts do not appear to be suitable for the distillation of "Blackboy." Some years ago, when a coal strike was in progress, the "grass tree" was used for the production of gas for public use. Free carbon was so abundant in the gas as to cause considerable choking in the pipes, and much trouble and expense were thus incurred. The experiment is not likely to be repeated in Western Australia.

From the air-dried heap of detached material which has been mechanically removed, a quantity of about 2 cwt. is placed in a crate frame, something like a tree-guard, a little over 2 ft. in diameter, and about 6 ft. long. This frame facilitates the withdrawal of the spent carbon, which usually represents about 50% of the original charge. The charged crate is placed in a cast-iron retort of slightly larger size, provided with a close fitting door, which is then closed, and the whole heated to distil off the volatile contents. Another retort is similarly prepared to take the place of the spent one, the operation of changing the crates taking less than five minutes. The distillation of the charge when in fair working order takes about two hours.

The object I had in view was to prepare tar as the main product, the gas going to waste. Tar oils are also produced abundantly, as well as charcoal or coke, while the aqueous fluids contain a considerable quantity of acetic acid.

Apparatus in ordinary use for gas production may be employed if necessary for the manufacturing of "Blackboy" tar, but it is needlessly expensive, and cannot be satisfactorily used for both gas and tar production on a large scale, at the same time. The most convenient appliance for the purpose is similar to those described for wood distillation, with necessary modifications to overcome local difficulties. I have designed a special form of apparatus in units of five retorts each, in batteries of five such sets, which are self-contained, although attached to each other. The firegrate is at one end, giving a reverberatory effect, and all waste gases are returned to the furnaces to be used for heating purposes. The retorts have a fall of about 1 in 12 towards the discharge end. The pipes carrying off the products are of thin steel, 15 in. in diameter, and discharge into a common receptacle at the rear of the furnace. These pipes are fitted with an ejector in conjunction with an exhaustor for continual clearance. The gases are drawn through condensers or vertical scrubbers, and the fluids, separated from the tar, are redistilled, for the preparation of alcohol, light oils, etc. The acid liquor is then treated with lime or soda for the preparation of acetate, and finally acetone. The washed gases are consumed in the furnaces. The waste fluids have some value as plant poison, and may be used in the destruction of prickly pear, and for similar purposes. The tar may be dehydrated if required, and supplied in such form and viscosity as may be demanded. It may also be treated by ordinary methods for the preparation of light oils, phenols, creosote, etc., which substances are produced in considerable quantity. It is not advantageous to heat the furnaces higher than about 1000° F. (540° C.), for it is desirable that as little gas as possible be produced. The aqueous distillate ordinarily contains about 10% acetic acid, 10% methyl alcohol, and 10% soluble tar.

The inner core of the "Blackboy" contains a considerable quantity of carbohydrate and other substances besides the fibre. The non-fibrous material is of good value for cattle food, more especially if mixed with treacle or corresponding material made from the starchy wastes of *Macrozamia*. The cores are cleansed from dust and loose gum, and passed under a high-speed revolving drum set with knives obliquely placed. The slicings being thin are readily dried by air heated by passing through tubes contained in the flues, and sent through a rotary drying apparatus. The contained substances are quickly separated from the heavier fibre, and are in a fine state of division suitable for treatment for various products, such as the preparation of sugars suitable for cattle foods. Alcohol and other products can also be produced. This vegetable material is practically soluble in warm water, and has a high food value. The core may also be cut into blocks which, after soaking in tar, make excellent footpaths, stable floors, etc., and are healthy, tough, and clean; they can also be used for brake blocks, corderoy roads, etc., and as a fuel. The resinous portions make excellent fire kindlers; and as a remedy against mosquitoes, the burning "Blackboy" is most efficacious. A fragrant aromatic oil can also be produced.

The Macrozamia.

Macrozamia Fraserii, commonly known in Western Australia as the "Palm," belongs to the natural order *Cycadaceæ*. Several species of *Macrozamia* occur in different parts of the Commonwealth. The form most commonly found in Southern New South Wales is *Macrozamia spiralis*, known as the "Burrawang." This occurs very plentifully in the Illawarra district of that State.

The Western Australian form, *Macrozamia Fraserii*, frequently attains a weight of considerably over a ton. When roughly trimmed these larger specimens have given as much as 40% of starch, calculated on the moist plant. The fibrous material represents about 20%. I consider the waste material from the New South Wales' "Burrawang" to be more than twice as much as that from the West Australian variety of *Macrozamia*, although the starch may be equally valuable in each.

The "Zamia" plants of New South Wales and Queensland have been dealt with somewhat fully in Wagner's "*Stärkefabrikation*," German edition, 1886, dealing with experimental work on foodstuffs, such as arrowroot, sago, etc. Baron von Mueller's work in this direction on the "Burrawang" is also given. Methods are described for reducing, pulping, centrifuging, and separating the starches from "Zamia" and other sources by well known wet processes, which methods have been in use by all starch makers. The starch when separated from the fibrous material and other vegetable substances of the *Macrozamia* may be used for laundry purposes as well as for food.

Macrozamia is commonly credited with causing certain diseases in cattle, browsing on the succulent new fronds which issue from the centre. In Western Australia many settlers dispute the statement that the so-called "rickets" are caused by cattle eating the central part of these plants. But from tests and experiments made, I fully believe that certain easily removed portions of the plant may be poisonous, and contain a substance which affects the kidneys and spinal column of some animals.

DISCUSSION.

The CHAIRMAN expressed their appreciation of the large and interesting series of exhibits sent from Western Australia to illustrate the paper. He thought there were economic possibilities in some of the products, but that figures should be given, showing the proportion of each that was obtainable.

Mr. T. STEEL said that charges of 2 cwt. in each retort were very small for work on a practical scale. He did not observe any mention of ammonia being yielded, as might be expected, and no mention was made of the results obtained by other investigators. In 1906 Mann reported to the Minister the result of his examination of *X. Preisii*, mentioning the resin as a basis for the manufacture of picric acid; while Mann and Wallas, who examined *X. hastilis*, reported the presence of acid potassium oxalate. The speaker had also found the same oxalate in various specimens he had examined; and, before a cattle-fodder was made from such material, he thought special precautions would have to be taken to eliminate the oxalate. The same applied to any food product made from the starch of the Zamia: it was necessary to make certain that no oxalate was present. The occurrence of oxalates was not uncommon in plants, and H. G. Smith had found calcium oxalate in certain species of *Eucalyptus*. *Macrozamia* was one of the ancestral types found fossilised in the tertiary rocks, but it still existed in Australia, because its isolation had freed it from competition with other plants which elsewhere had crowded it out.

Mr. H. G. SMITH said that as far back as 1855 the economic uses of "blackboy" were investigated, and the results published in the Journal of the Society of Arts. It was estimated that a ton of the material would yield 10,000 cubic ft. of gas of a greater illuminating power than coal-gas. Such immense quantities of this plant were going to waste in Western Australia, Queensland, and Kangaroo Island, that it was a pity so little use was made of it. Of course the products of each species would have to be separately investigated, for some of them contained as much as 70 to 80% of resin.

Mr. B. J. **Smart** thought the important questions at the present moment were whether the grass-tree resin had an economic value in the production of picric acid, and if the Germans had been purchasing large quantities of it for the manufacture of explosives. He doubted if that was so, but many people believed it to be the case.

Mr. E. **Elliott** said that as the *Macrozamia* weighed up to 30 cwt., and contained from 25 to 40 % of starch, the question sometimes asked was why it was not utilised. His opinion was that the starch had never yet been produced sufficiently pure: it always contained a small proportion of finely-divided fibrous matter, and until some way of removing this was adopted, it was unsuitable for the market.

DETERMINATION OF SULPHUR IN SPENT OXIDE.

BY E. V. ESPENHAHN.

The determination of free sulphur in iron oxide used for the purification of coal gas is generally carried out by extracting the sulphur with carbon bisulphide. This method presents difficulties in obtaining accurate results, even when no tar is present in the oxide. This impurity increases with the amount of sulphur, and is also dissolved by the carbon bisulphide, so that errors to the extent of 2—5 % may result. The oxidation of the sulphur in the extract and its determination as barium sulphate to eliminate this error, is tedious and, for the inexperienced, not easy to carry out.

The author had occasion to determine the sulphur in a natural oxide, which had also taken up a quantity of tar oils, carried forward by the gas. No method tried possessed the degree of accuracy required for a quick and reliable estimation. A suitable one has been worked out, based on the reaction first applied by M. Greger in 1881, who found that pyrites, when heated with iron, was reduced to ferrous sulphide, which gives off its sulphur as hydrogen sulphide on treating with a strong acid.

From 0·4—0·7 grm. of the oxide, finely powdered in an agate mortar, is weighed into a beaker and decanted twice with hot water. It is then run on to a small filter and washed with the aid of a filter pump until the solution gives no precipitate with barium chloride. After drying, the oxide is scraped into a small hard glass crucible, about 30 mm. long and 10 mm. in diameter, preferably made from ordinary combustion tubing. Here it is well mixed with 4 grms. of reduced powdered iron and covered with a layer of the same. The crucible is fitted into a hole in a board of asbestos, and the air displaced by carbon dioxide, led in through a pipette, which terminates in a short point slightly above the layer of iron. A small flame is first applied, and the temperature raised until the crucible reaches dull redness, which is maintained for 7—10 minutes. After cooling in the atmosphere of carbon dioxide the contents of the crucible are allowed to fall into a small Erlenmeyer flask, which is connected to three wash bottles, each containing 150 c.c. of $N/10$ iodine solution, acidified with hydrochloric acid, and a fourth with a few c.c. $N/10$ thiosulphate solution. The mass is covered with water, and after passing carbon dioxide for a few minutes, 50 c.c. of concentrated hydrochloric acid is run in through a funnel. The reaction should not proceed too rapidly, but a steady evolution of gas may be maintained by means of a small flame. As it slackens, the solution is heated to boiling, and a steady stream of carbon dioxide passed through the flask for 10 minutes. The excess of iodine is titrated back with thiosulphate, as well as the small amount held in the sulphur, which is extracted with a few c.c. of carbon bisulphide. In calculating results, allowance must be made for impurities in the reagents, which are determined by a blank test.

a. Determination of free sulphur. It was found that the accuracy was not influenced by organic compounds such as tar. Sublimed sulphur was distilled, powdered, and dried, and a weighed portion mixed with the powdered iron. The results, using about 0·2 grm. of sulphur, indicated 99·83 % and 99·88 % S. About the same weight of middle and tar oils was mixed with the sulphur, and the mass carefully fused. The results showed 100·11 % and 99·86 % S.

b. Determination of free sulphur and tar in spent oxide. The amount of free sulphur determined direct as hydrogen sulphide in two different samples was 41·40 % and 33·79 %.

For the determination of tar, the material was extracted with carbon bisulphide in a Soxhlet apparatus, special precautions being taken to prevent any particles of oxide being carried over into the weighing flask. The carbon bisulphide was then distilled on the water bath, and a current of air passed through the flask to dispel the last traces of the solvent. The percentages of extract (tar and sulphur) found were 46·18 and 34·17 %; deducting the percentages of free sulphur found as above, the amount of tar was indicated as 4·78 % and 0·38 % in the two samples.

The free sulphur was determined by extraction by *a.*, after the extract had been dried to constant weight at 106° C. The figures obtained were 41·43 % and 33·94 % S respectively.

When tar is to be determined, the first method of estimating free sulphur is preferable to the extraction process; besides, by drying, the extract is rendered hard and difficult to separate from the flask without breaking it.

Results obtained by the direct determination, provided the sample is sufficiently finely powdered and washed, agree to within 0·1—0·2 %, although they may differ to a greater extent when compared with those found by extraction. By the latter method, however, concordant results are by no means easy to obtain. As both the sulphur and sulphides of iron are converted into ferrous sulphide, the first method permits the estimation of the free sulphur in the oxide before revivification has been carried out. An error of any magnitude would only be introduced by the presence of insoluble sulphates, as calcium sulphate, in larger quantities, as these are only partly removed on washing and are reduced on heating with metallic iron.*

c. Determination of total sulphur. During the period of contact with the gas, and subsequent revivification by air, part of the absorbed sulphur of the oxide enters into combination to form sulphates and thiocyanates. The amounts of these salts present indicate the conditions existing during the treatment of the oxide, and to what extent loss of free sulphur has taken place. The amount of this fixed sulphur is arrived at from the difference between the total and free sulphur. The former is determined by heating the finely powdered and unwashed oxide with metallic iron, whereby thiocyanates and sulphates† are likewise converted into ferrous sulphide. This also includes the sulphur of the original material, for which, in the case of artificial oxides, a correction is often necessary.

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* Treadwell, Analytische Chemie, II. (1906), p. 275.

† Loc. cit.

If the control of purification is rendered necessary by undue losses of sulphur, the sulphur compounds may be estimated as follows. The difference between the sulphur of the thiocyanates and the fixed sulphur denotes the sulphur in the oxidised form, hence by determining the thiocyanates[‡] the sulphates are arrived at. In the above oxides the sulphur was found to be distributed as follows :—

% *Sulphur.*

	Total.	Free.	Fixed.	As CNS.	As SO_4.	% CNS.	% SO_4.
Sample I.	44·46	41·40	3·06	1·03	2·03	1·87	6·09
„ II.	39·66	33·79	5·87	0·86	5·01	1·56	15·01

[‡] Determined by Feld as hydrogen sulphide by reduction with aluminium and hydrochloric acid. J. Gasbeleucht., 1903, 46, 561; this J., 1903, 1068.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

Fractional distillation; Thermodynamics and ——. E. Chenard. Bull. Assoc. Chim. Sucr., 1915, 33, 47—55. (See also Fr. Pat. 443,499 and Additions; this J., 1912, 971; 1913, 184, 249; 1915, 480.)

In the numerous works which have been published on the fractional distillation of mixtures of water and alcohol, the mechanical factors which come into play and the effect of gravity seem to have been entirely neglected. Alcohol vapour has a density of 2·06 grms. per litre as compared with 0·806 grm. per litre for water vapour, and if aqueous alcohol be boiled in a conical flask with a long neck, and vapour withdrawn from the top and from a point near the surface of the liquid, the latter will be found richer in alcohol. In most forms of distilling columns the vapours leave each compartment at the top, an arrangement which is rational only in cases where the lower-boiling liquid has also a lower density. The system of bubbling the vapour through the condensed liquid is also condemned, and it is shown that in the case of a mixture of alcohol and water, the presence of liquid and vapour together tends to restrict the working range of temperature and to hinder the separation of the two substances, and therefore in order to attain satisfactory fractionation, whether by vaporisation or by condensation, the liquid and vapour should be separated as rapidly as possible. In the construction of apparatus for fractional distillation, the following rules should be observed. All obstacles to the free circulation of the vapour from the still to the condenser should be avoided. The parts through which the vapour circulates should be horizontal or slightly inclined. The condensed liquid should be removed rapidly from the different parts of the condensing system by vertical pipes, and again introduced into the system at places where it will be rapidly revaporised. Good results have been obtained with apparatus constructed in accordance with these principles in the laboratory and on a small commercial scale (capacity 6—10 hectolitres). —A. S.

Patents.

Evaporation. E. Barbet et Fils et Cie., Paris. Eng. Pat. 22,844, Nov. 20, 1914. Under Int. Conv., July 10, 1914.

The liquid is vaporised in steam-heated vertical pipes extending completely through a vertical drum and opening at the top into a chamber from which the liquid returns by a large pipe to the space below the lower end of the heating drum, the circulation being controlled by a valve. The top of the heating drum is domed or inclined towards the outlet and the vapour escapes upwards by a wide passage from the upper chamber. The steam supply is regulated to maintain a constant pressure in the heating drum.—W. F. F.

Evaporator. J. Snow, Cincinnati, Ohio. U.S. Pat. 1,168,573, Jan. 28, 1916. Date of appl., Feb. 26, 1915.

A circular horizontal plate is rotated about a vertical shaft above a cylindrical chamber through which a suitable heating medium is passed. The liquid to be evaporated is fed on to the centre of the plate and is guided towards the periphery by stationary scrapers. Crushing rollers are also provided to crush the material as it passes to the periphery of the plate.—W. H. C.

Evaporating apparatus; Vacuum ——. G. Stade, Schloss Hubertusberg, Germany, Assignor to Honolulu Iron Works Co., Honolulu, Hawaii. U.S. Pat. 1,168,758, Jan. 18, 1916. Date of appl., Mar. 29, 1913.

A conical, tubular heater is arranged near the bottom, but not in contact with the walls of the evaporator casing. A circulating ring of less diameter than the casing is fixed above the heater and a deflecting plate encircling the top of the heater is provided to separate the cooler liquid flowing back to the heater from the heated liquid rising from the latter, and to guide the hot liquid into the circulating ring.—W. H. C.

Crushing, grinding and pulverising machines. W. H. Coward, Kelston. Eng. Pat. 556, Jan. 13, 1915.

A directly driven conical edge-runner rotates within, and drives by friction, a conical drum which is supported on ball bearings within an outer casing. The crushed material is removed by a scraper so shaped as to scrape the faces both of the edge-runner and drum lining, and is delivered to a screen.—W. H. C.

Grinding machines; Centrifugal ——. J. W. Block, Joliet, Ill., U.S.A. Eng. Pat. 4067, Mar. 15, 1915.

A centrifugal grinding machine has the grinding elements supported on an upright shaft which is surrounded by a sleeve supported on the shaft by ball bearings. Oil for lubricating is forced from a reservoir below, through the hollow shaft to the upper part and returns through the space between the sleeve and the shaft.—W. H. C.

Mills for grinding grain and other substances; Vertical disc ——. E. C. Blackstone and R. E. Watts, Stamford. Eng. Pat. 5252, Apr. 7, 1915.

THE relative positions of the grinding surfaces are adjusted by radial levers of the second order, which are pressed by a grooved collar against the periphery of the "bedstones." The pressure of the levers is transmitted to the bedstones through spiral springs.—W. H. C.

Tube mill. J. S. Fasting, Copenhagen. Eng. Pat. 7160, May 12, 1915. Under Int. Conv., May 25, 1914.

THE inner surface of the tube mill is provided with projecting members, set in planes at right angles to the axis, to assist in supporting the material being ground.—W. H. C.

Pulveriser. O. Gerlach, La Salle, Ill. U.S. Pat. 1,169,075, Jan. 18, 1916. Date of appl., May 18, 1914.

A CYLINDRICAL container, arranged to rotate on a horizontal axis, has a number of shafts extending from end to end parallel to the axis and free to tumble as the cylinder rotates. A series of short hollow cylinders is strung upon each of the shafts. —W. H. C.

Absorption, elimination, condensation, or other treatment of chemical vapours, gases, or the like; Apparatus for ——. W. Wyld, Leeds, and S. W. Shepherd, Birmingham. Eng. Pat. 839, Jan. 19, 1915.

SUCCESSIVE inclined layers of strips of glass or other suitable material are arranged within a tower or chamber provided with a central pillar or support. The strips are arranged radially or tangentially to the central pillar and extend to the brick lining of the tower; they are supported on projections formed on the outer surface of the central pillar, and on the inner surface of the brick lining. Alternate layers may be inclined in opposite directions and the central tower may be made hollow to serve as a gas conduit. The outer leaden casing of the tower may be formed in sections and supported by the brickwork of the tower itself, for which purpose the edges of the sections are turned inwards to form flanges which penetrate between adjacent layers of bricks. —W. H. C.

Cooling water or air or treating air or gases with liquids; Apparatus for ——. Heenan and Froude, Ltd., and G. H. Walker, Manchester. Eng. Pat. 2441, Feb. 16, 1915.

A HORIZONTAL cylindrical casing is provided with a number of rotors consisting of convolutions of sheet metal wound concentrically and mounted on a horizontal shaft. The rotors rotate in separate compartments, each divided from the next one by a pair of partitions rising above the liquid in the casing, and enclosing an auxiliary compartment which does not contain a rotor. Liquid is delivered by a funnel against the rising side of the first rotor, is carried round, and on leaving the descending side passes through an adjacent weir in the partition. The liquid then passes diagonally through the auxiliary compartment and over a weir in the second partition, so placed that the liquid is delivered to the rising side of the second rotor.—W. F. F.

Gas; Apparatus for treating —— [with liquid]. L. A. Zöbe, Syracuse, N.Y. U.S. Pat. 1,168,451, Jan. 18, 1916. Date of appl., May 9, 1910; renewed June 15, 1915.

GAS is passed through a chamber having a false bottom from which a number of wide tubes rise nearly to the top of the chamber. Liquid is forced upwards through these tubes so as to overflow at the top over the outer surface, and thus come into contact with the gas. The temperature of the liquid in the tubes is controlled by smaller concentric tubes through which a suitable medium is circulated.—W. F. F.

Separators; Centrifugal ——. D. B. Weston, Sharon, Mass., U.S.A. Eng. Pat. 4912, Mar. 30, 1915.

THE basket of the machine has large upper and lower openings of which the bottom one is the larger. The material to be separated is introduced through the upper opening by a suitable conduit and is directed into the space between the upper edge of the basket and an inner ring. Both the liquid and the solid are discharged through the bottom opening, the liquid continuously while the basket is rotating and the solid when the rotation has been stopped. A discharge chamber is formed below the basket and is separated into an outer annular chamber to receive the liquid and an inner chamber to receive the solid.—W. H. C.

Chilling molten material and obtaining the solid in a subdivided state. J. W. Leitch, Huddersfield. Eng. Pat. 15,063, Oct. 25, 1915.

THE molten material is applied to the surface of a rotating drum cooled internally, by means of an intermediate toothed or grooved cylinder, which is rotated partly immersed in the molten material. —W. H. C.

Kilns; Method of utilising waste heat in ——. T. A. Edison, West Orange, N.J. U.S. Pat. 1,167,637, Jan. 11, 1916. Date of appl., July 7, 1910.

THE gases, of an approximately constant volume and temperature to avoid varying the draught, are used to generate excess of low-pressure steam in pipes. Part of the steam is used in a low-pressure condensing turbine, and the remainder allowed to escape.—W. F. F.

Dryer. C. F. Stehlin, New Rochelle, N.Y. U.S. Pat. 1,167,853, Jan. 11, 1916. Date of appl., Mar. 18, 1915.

THE heated material is fed through an inclined rotating drum and air is passed through in the opposite direction. Transverse partitions, spaced from the walls of the drum, are provided to distribute the air.—W. F. F.

Catalytic material; Apparatus for making ——. C. B. Morey and C. R. Craine, Assignors to Larkin Co., Buffalo, N.Y. U.S. Pat. 1,167,915, Jan. 11, 1916. Date of appl., May 15, 1914.

THE material flows downwards through an inclined conduit, which is pivoted at its lower end and oscillated by a rotating cam at the upper end, and is treated by a gas which is also supplied to the conduit.—W. F. F.

Separating solids [dust] from gas [air]; Method of and apparatus for ——. R. C. Newhouse, Assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. U.S. Pat. 1,168,543, Jan. 18, 1916. Date of appl., Apr. 29, 1915.

THE air is drawn through the open lower end and the sides of a loosely suspended fabric bag, and at intervals the flow is reversed and the bag suddenly stretched and then slackened in order to remove the separated solid matter.—W. F. F.

Distilling apparatus. J. Buchert, Newport, Ky. U.S. Pat. 1,169,122, Jan. 25, 1916. Date of appl., June 19, 1914.

A still, a refining column, and a fractional separator are combined together by suitable pipe connections. Both the refining column and the fractional separator are provided with water cooling systems so arranged that the column is maintained at a higher temperature than the separator.—W. H. C.

Leaching-tank. H. H. Stout, Assignor to Nichols Copper Co., New York. U.S. Pat. 1,169,205, Jan. 25, 1916. Date of appl., Mar. 8, 1915.

The bricks which form the walls of the tank are separated from each other and bound together by a suitable binding agent, which fills the spaces between the bricks, but does not extend to the inner face of the wall, thus leaving recesses; a priming material is applied to these recesses, and also upon the inner face of the tank wall. The inner surface of the tank wall and the recesses are then covered with an acid-resisting coating over the layer of priming material.—W. H. C.

Solid particles suspended in liquids; Apparatus for the separation of ——. B. Schilde Maschinenfabr. u. Apparatebau Ges.m.b.H., and S. Haun, Hersfeld. Ger. Pat. 287,587, Jan. 28, 1914.

The liquid is caused to flow through a series of receptacles, the lower parts of which taper downwards. Partitions in the upper part of each receptacle cause the liquid to take a tortuous path and facilitate the deposition of the solid particles. The deposited solid matter slides down the sloping sides of the lower part of the receptacle to an outlet, which is alternately opened and closed by raising and lowering a sliding door.—A. S.

Liquefaction of gases. G. F. Jaubert, Paris. Eng. Pat. 1086, Jan. 22, 1915 Under Int. Conv., Jan. 31, 1914.

See Fr. Pat. 475,255 of 1914; this J., 1916, 31.

Still. C. L. Turner, New York, Assignor to Improved Still Co. Re-issue No. 14,050. Jan. 18, 1916, of U.S. Pat. 1,091,781, Mar. 31, 1914. Date of appl., July 8, 1915.

See this J., 1914, 473.

Catalytic bodies: Process of manufacturing ——. O. D. Lucas, Assignor to Lucas's Low Pressure Oil Cracking Process, Ltd., London. U.S. Pat. 1,168,404, Jan. 18, 1916. Date of appl., Mar. 4, 1915

See Eng. Pat. 5847 of 1914; this J., 1915, 784.

Separating substances of different specific gravities; Apparatus for ——. A. Gründler, Berlin. U.S. Pat. 1,169.479. Jan. 25, 1916. Date of appl., July 29, 1913.

See Eng. Pat. 15,945 of 1913; this J., 1913, 1148.

Separation of liquid suspensions. F. W. Peek, jun., Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,170,184. Feb. 1, 1916. Date of appl., Feb. 18, 1913.

See Eng. Pat. 13,465 of 1913; this J., 1914, 780.

Oven suitable for use in the manufacture of tiles, bricks, pottery, and analogous ware, for annealing, and for other purposes. C. Dressler, London. U.S. Pat. 1,170,428, Feb. 1, 1916. Date of appl., Aug. 6, 1914.

See Eng. Pat. 18,821 of 1913; this J., 1915, 81.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Source of error in the elementary analysis of ——, *due to carbonates.* Knublauch. Z. angew. Chem., 1915, 28, 492—494.

In the determination of the calorific power of coals by calculation, the presence of considerable amounts of calcium and magnesium carbonates causes errors in the values found for carbon dioxide and ash. The combined carbon dioxide in a sample is found by decomposing 5 grms. of coal with hydrochloric acid in a flask fitted with a thermometer and connected to a 50 c.c. gas-burette, the lower extremity of which is provided with a bulb of 100—150 c.c. capacity. By comparing the amount of carbon dioxide found in this way with that evolved when the ash was ignited in a current of oxygen, it was ascertained that the quantity present in the ash as alkali carbonate was inappreciable.—E. H. T.

Sulphate of ammonia manufacture at by-product coke-ovens; Methods of ——. T. H. iley. Coke-Oven Managers' Assoc., Jan. 29, 916. J. Gas Lighting, 1916, **133**, 257—260.

The "semi-direct" process for recovering ammonia from coke-oven gases (this J., 1905, 839) is preferred to the usual indirect process (absorption by water in scrubbers) or the "direct" (hot recovery) process. In the semi-direct process naphthalene troubles do not arise, and, as compared with the indirect process, there is less risk of loss of ammonia, less effluent to be dealt with, and less steam required, whilst better sulphate is produced, with simpler and more efficient plant. Very little difference between the working costs of the two processes has been experienced, but with the semi-direct process an average yield of 31 lb. of sulphate per ton of coal is recorded, as against 25—27 lb., with a similar size of coal, by the indirect process. The "direct" process requires more power than the semi-direct process, leads to indirect loss of "fixed" ammonia, and gives a thicker tar, which is troublesome to remove, besides entailing wear and tear of a portion of the plant, owing to the presence of ammonium chloride, and yielding an effluent from the final coolers.—F. Sodn.

Petroleum industry of Mexico. P. C. A. Stewart. J. Inst. Petrol. Techn., 1915, **2**, 7—31.

The history of the industry is briefly outlined and particulars given of the more important topographical and geological features of the country. The methods and apparatus employed in drilling wells and in transporting, pumping, storing and refining the oil are considered in some detail, particulars being given of the pipe-lines and storage tanks owned by the various companies concerned. The density of the oils quoted varies from about 10° to 22° Bé. (sp.gr. 0·926—1·00), the flash-point from 45° to 96° F. (close test) and 165° to 175° F. (open test), the viscosity at 100° F. (Redwood) from 390 to 4000 secs., the sulphur content from 1·9 to 4·8%, and the calorific value from 17,570 to 19.960 B.Th.U. per lb. The oil usually contains both asphalt and wax and is refined by continuous distillation, high grade spirit, kerosene, fuel oil, and, more recently, lubricating oils being produced. The Mexican Eagle Oil Co. has one refinery at Minatitlan (capacity 15,000 barrels per day) including a wax plant, and one at Tampico of 12,500 barrels capacity; the Pierce Oil Corporation has a refinery at Tampico, capacity 10,000 barrels per day, including 32 stills and a wax plant; the Mexican Petroleum Corporation, at Ebano, has an asphalt plant the "toppings" from which are treated by the Pierce Oil Corporation; the Huasteca Petroleum Co. has a topping plant at Mata Redonda (Tampico Terminal) having a daily capacity of 10,000 barrels of crude oil, and the Standard Oil Co. of New Jersey a similar plant of 1000 barrels capacity at Tampico Bar. As regards wells, 420 were drilled up to the end of 1912, 130 during 1913, and 87 during 1914; in 1915 there were 93 producing wells, 32 abandoned, and 75 being drilled in the Panuco, the Topila, the Chila, Salinas and Caracol, and the Southern fields. The total production of petroleum in Mexico increased from 9750 U.S. barrels in 1901 to 31,867,410 barrels in 1914.—W. E. F. P.

Motor spirit and other products; The "cracking" of oils with a view to obtaining ——. W. A. Hall. J. Inst. Petrol. Techn., 1915, 1, 147—166.

The methods in use for the production of motor spirit by cracking are classified as "still" and "tube" processes. In the former, of which the Burton process is an example, a large volume of oil is subjected to a high temperature for a considerable time while passing slowly through a capacious still, the distillate being condensed under pressure or not; in the latter, the oil or vapour is passed, more or less rapidly, through a system of heated tubes to effect the desired conversion. As compared with still methods, tube processes are more productive, less dangerous, less expensive for fuel, and more uniform in operation and in composition of product, but generally more troublesome as regards deposition of carbon. In the author's process, the oil is vaporised and fed at a rate exceeding 70 galls. per hr., and under a pressure of 50—75 lb. per sq. in., through a system of 1 in. iron pipes more than 300 ft. in length; the temperature of the tubular system is about 550° C., and the speed of the vapour 5000—6000 ft. per min., thus minimising deposition of carbon. The vapour is then caused to impinge on a baffle disposed in the lower part of a vertical pipe, 12 in. or more in diam. and about 12 ft. high, filled with pieces of thin iron pipe about 1 in. long and ¾ in. in diam. Owing to the sudden reduction of velocity and pressure, about 99% of the free carbon in the vapour is deposited on the pieces of pipe; the temperature of the vapour is also increased by about 30° C., the vertical pipe thus acting as a secondary cracker. From this receptacle the vapour is conducted through dephlegmators, in which fractions of the required boiling points are separated; thence, without further condensation, to a single-acting mechanical compressor working at 70—100 lb. per sq. in., and finally through a cooler under the same pressure. By the use of the compressor the vapour is drawn at atmospheric pressure through the secondary cracker and dephlegmators, and the condensable vapour caused to combine with the gases which would otherwise be permanent, the light fractions of the product being thereby increased by 33%. The tubular system is periodically removed from the furnace and blown through with compressed air to remove the small amount of carbon deposited; the short pieces of iron pipe are likewise discharged from the vertical tube and heated in a special furnace for the same purpose. The maintenance of the tubular system at the exact temperature found necessary for the oil under treatment is of the greatest importance, comparatively slight variations causing large differences in the product. The consumption of fuel increases with the pressure employed, but the production of fixed gas decreases; by the use of high temperatures, highly unsaturated products are obtained, but below a certain temperature the conversion of oil into spirit declines rapidly. In the author's experience, the admixture of water or steam with the oil during cracking neither prevents deposition of carbon nor promotes hydrogenation of the unsaturated hydrocarbons. The latter, in large proportion, are objectionable in cracked spirit mainly because of the resinous carbon colloid with which they are usually associated and which, by oxidation, tends to form a varnish-like product detrimental to the working of motor engines. Owing to the combination effected in the compressor between the condensable vapour and the fixed gases, the spirit obtained by the present method is largely free from this objection. The author is of opinion that the most economical future source of petrol in Great Britain will be in connection with the manufacture of water-gas for illuminating purposes; by cracking gas-oil so as to obtain 25—50% of its volume of motor spirit as a by-product, the latter could be produced at an estimated cost of about 5d. per gallon.

—W. E. F. P.

Benzene, toluene, xylene, naphthalene, and anthracene from petroleum; Effect of temperature on the formation of —— *at atmospheric pressure.* G. Egloff and T. J. Twomey. J. Phys. Chem., 1916, 20, 121—150.

In the cracking of petroleum at atmospheric pressure to produce aromatic compounds, temperature, rate of feed, nature of the oil, and size of the cracking area influence the result, and of these factors temperature has the greatest effect. In the experiments described, 574 grms. of filtered oil was passed at the rate of 246 grms. per hour through an electrically heated furnace, the cracked oil being weighed and analysed and the volume of gas noted. The oil was obtained in refining Pennsylvanian crude petroleum and is known as gas oil. Different samples of the oil were cracked at temperatures ranging from 450° to 875° C., with 50° C. rise in temperature between 450° and 800° C. for each experiment. The specific gravity of the cracked product was taken on a Westphal balance after filtering from suspended carbon; it increased with rise of temperature. The oil was then fractionated and the fraction below 170° C. analysed for benzene, toluene, and xylene, and that above was distilled as in the case of coal tar, naphthalene and anthracene being separated, pressed, and dried. The percentage of cracked oil decreased slowly with increase of temperature from 450° to 550° C., then dropped sharply from 550° to 700° C., and above that temperature the rate of decrease was much lower, while the gas formation increased as the temperature rose, the maximum increase occurring between 550° and 700° C. Temperatures of 450° to 600° C. produced more toluene and xylene than benzene, more toluene than xylene, and also some aliphatic compounds. At 600° C. more toluene than benzene was formed and more benzene than xylene. Temperatures of 700° to 875° C. yielded more benzene than toluene or xylene, but more toluene than xylene, and aliphatic compounds were practically absent. Naphthalene formation began at 750° C. and anthracene at 800° C., and both increased with rise of temperature. In the cracked oil benzene attained a maximum of 21% at 800° C., toluene 8·3% at 700° C., and xylene 7·2% at 700° C., and beyond these respective temperatures the formation of each decreased fairly rapidly with rise of temperature. On the basis of oil used a maximum of 4·7% of benzene was obtained, 3·1% of toluene, 1·9% of xylene, 2·0% of naphthalene, and 0·3% of anthracene. (See also this J., 1915, 1199; 1916, 105.)—W. G. C.

Asphalts and asphalt cements; Effect of controllable variables upon the penetration test for ——. P. Hubbard and F. P. Pritchard. J. Agric. Res., 1916, **5**, 805—818.

Discordant results obtained in different laboratories by the penetration test are to be mainly attributed to variations in the methods of preparing the samples and in controlling the temperature. It is recommended that the melted samples should be cooled for at least 2 hours, and should be tested the same day, preferably after 2 to 3 hours. They should be maintained at the testing temperature for not less than 1 and preferably 1½ hours before applying the test. After standing exposed to the air, prepared samples give decreasing values in the test, but no definite limit is reached within 28 days. Cooling in ice-water offers no advantage in ordinary laboratory work. A variation of 0·5° C. in the temperature may cause decided differences in the results, and samples should be maintained within 0·1° C. of the desired temperature prior to and during the test. Tests made at 4° C. do not give the same results as those made at 0° C. The latter temperature should be attained by the use of a brine bath and not by immersion in crushed ice. Within certain limits the increase in the penetration is almost proportional to the load under given conditions of time and temperature. Variations of 1 grm. do not materially affect the results in the case of loads of 100 and 200 grms., but it is advisable that the load should not vary from the desired amount by more than 0·2 grm. The greater proportion of the penetration occurs within the first second. For example, in a 5 sec. test about half of the total penetration takes place in the first second. A variation of one half sec. may cause considerable differences in the results. The use of a calibrated metronome is recommended for accurate control of the time within ⅕ sec. of that desired.—C. A. M.

Utilisation of pitch. Glover. *See* III.

Mineral resources of Asia Minor. Frech. *See* X.

Patents.

Explosions in [coal] mines; Device for limiting ——. H. Wade, London. From Frölich und Klüpfel, Unter-Barmen, Germany. Eng. Pat. 951, Jan. 20, 1915.

In a device of the kind in which, by the shock of explosion, jets of water are caused to escape automatically from a system of sprayer-pipes and form a screen by which the point of explosion is isolated, the valve connecting the supply pipes with the sprayer system is arranged so that, when it is operated by the pressure preceding the flames, the supply pipes extending from the valve to the point of explosion are closed and those on the side remote from the point of explosion opened. Instead of water, the supply pipes may contain compressed air or carbon dioxide by which a quantity of dust, arranged in front of the sprayer-pipes, is blown into the flame-extinguishing zone.—W. E. F. P.

Coal; Process of and apparatus for washing and treating ——. *Process of and apparatus for treating and drying coal.* C. Burnett, Bath. Eng. Pats. (A) 472, (B) 14,021, and (C) 14,022, Jan. 12, 1915.

(A) The coal is separated by any suitable means into grades which are discharged on to parallel inclined washers of the travelling conveyor type, from which the coal is delivered on to shaking screens to be drained. The circulating water from the coarser grades passes direct to a settling tank, but that from the fine coal is delivered to a transverse trough at the head of a series of inclined troughs to which it is connected by sluice gates. The velocity of the water in these troughs is such that only the heavy impurities are deposited, and the water containing the fine coal passes on to a lower inclined trough and thence to a settling tank. (B) A portion of the effluent flowing from the settling tank to the pump well is pumped to a supplementary settling tank, and the very fine coal deposit is removed by a slowly moving scraper conveyor and delivered on to the coal which has been similarly removed from the main settling tank. The coal passes over drainage bars and is delivered on to shaking screens for further drainage. (C) The shaking screens have meshes of different sizes and are contained in a heated chamber to screen and dry the coal.—W. F. F.

Coal briquettes; Manufacture of ——. E. R. Sutcliffe, Leigh, Lancs., H. J. Phillips, London, and D. A. Thomas, Llanwern, Mon. Eng. Pat. 20,679, Oct. 7, 1914.

Carbonaceous substances, *e.g.*, coal, are reduced to fine flour such as would pass through a 200-mesh screen, and highly compressed in a mould which permits lateral expansion of the block.
—W. F. F.

Combustion of powdered fuel [coal]; Process of modifying the ash resulting from the ——. *Process of protecting metal articles heated by the combustion of powdered coal.* W. P. Barba, Assignor to The Midvale Steel Co., Philadelphia, Pa. U.S. Pats. (A) 1,167,470, (B) 1,167,471, and (C) 1,167,472, Jan. 11, 1916. Dates of appl., Aug. 17, 1914.

(A) An inorganic acid substance is added to the powdered coal to the extent of more than 20 % of the ash-forming constituents, so as to combine with the alkali in the coal, and also with the scale on metal articles which are being heated, to form a protective coating. (B) An inorganic neutral substance, such as powdered refractory clay, is added to the extent of 10 % of the ash-forming constituents so as to raise the melting point of the ash; the modified ash forms a protective coating on the articles. (C) The neutral substance in (B) is replaced by an inorganic basic substance in suitable proportion, for the same purpose.—W. F. F.

Internal-combustion-engine fuels; Composition of matter to be added to —— *and to be used for other purposes.* W. F. C. M. McCarty, East-Pleasantville, N.Y. U.S. Pat. 1,167,770, Jan. 11, 1916. Date of appl., Aug. 19, 1913.

A mixture of acetone, ether, hydrogen peroxide, and methyl nitrate, with or without nitroglycerin.
—W. E. F. P.

Chequer-bricks as used in the chequering chambers of carburetted water-gas plants or coke-oven chambers. E. J. Davison, Cricklewood, and C. P. Tooley, Leeds. Eng. Pat. 745, Jan. 18, 1915.

To prevent the lodgment of dust or carbon in the passages of chequer-brick work, it is constructed with alternate square pedestals and double-bevelled recesses, both on its upper and lower surfaces.—J. B. C. K.

Gas-producers. S. Glover, St. Helens, and J. West, Southport. Eng. Pat. 5315, Apr. 8, 1915.

The lower part of the producer is provided with a chamber surrounding the furnace grate, and having apertures controlled by slides for supplying the primary air. A water spray to prevent fluxing of the ash is obtained from a channel, provided with slots, running round the underside of the lower part of the furnace and on the upper wall of the chamber. The mechanical ash extractor comprises a vane-like element, slowly rotated over the surface of the grate. This vane projects slightly beyond the periphery of the grate, and the rate at which the ash is discharged can be adjusted by suitable means to suit the character of the coal being used. The ash falls from the grate into a water-sealed bath, which forms the lower part of the container.—J. B. C. K.

Gas-producers. P. B. Morgan, Worcester, Mass., U.S.A. Eng. Pat. 6999, May 10, 1915.

THE automatic discharge of ashes from gas-producers is effected by means of a revolving ash-pan, carrying a scraper which rotates with it. When it is desired to remove ashes, a latch carried on a rocking-shaft is lowered into the path of the scraper, thereby holding it stationary. By the continued rotation of the ash-pan the ashes are carried against the curved scraper and warped blade, and are thus pushed towards the periphery, moved up the inclined wall of the ash-pan, and discharged over the top. Mechanism may be provided for withdrawing the latch from the path of the scraper, at regular intervals, or at each revolution of the pan.—J. B. C. K.

Gas-generating apparatus. R. B. Brown, Milwaukee, Wis., Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,168,055, Jan. 11, 1916. Date of appl., Oct. 14, 1914.

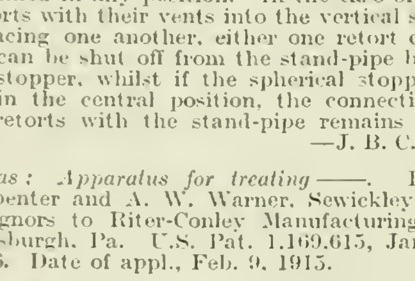
THE mouthpieces of a series of gas-retorts, arranged one above the other, open into a common vertical stand-pipe, and each can be closed by means of a ball-shaped stopper, carried at the end of an arm operated from outside the pipe and capable of being fixed in any position. In the case of pairs of retorts with their vents into the vertical stand-pipe facing one another, either one retort or the other can be shut off from the stand-pipe by the same stopper, whilst if the spherical stopper be fixed in the central position, the connection of both retorts with the stand-pipe remains open. —J. B. C. K.

Coal-gas; Apparatus for treating ——. H. A. Carpenter and A. W. Warner, Sewickley, Pa., Assignors to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,169,615, Jan. 25, 1916. Date of appl., Feb. 9, 1915.

GAS is discharged from a retort-bench stand-pipe into a gas container, which is included in a closed system in which liquid is circulated in contact with the gas to cool it. A thermostat is placed in the path of the gas for regulating the flow of the liquid according to the temperature of the gas. —B. N.

Gas-washer. T. McDonald, Youngstown, Ohio. U.S. Pat., 1,167,909, Jan. 11, 1916. Date of appl., June 1, 1912.

THE washer (see fig.) comprises a chamber having gas-inlet and -outlet openings at opposite ends, and provided with a series of tanks of V-shaped section containing the washing liquid. By means of partitions and baffles the gas is made to take a zig-zag course over the surface of the separated pools of liquid. The partitions separating the tanks have openings through which the liquid can pass from one tank to the other, and the level of liquid in the tanks is thus regulated.—J. B. C. K.



Gas; Method of burning ——. W. K. Twomey, Chicago, Ill. U.S. Pat. 1,167,147, Jan. 11, 1916. Date of appl., Dec. 12, 1914.

THE gas is burnt in successive stages: after the first combustion of the gas and air mixture, the combustion gases and unburned portions are collected, heated, and projected against a surface to secure their better intermixture, and a second combustion is obtained in this way, without the addition of more air. These operations may be repeated a third time.—J. B. C. K.

Crude oils; Distillation of —— *and apparatus therefor.* S. J. Ross and H. Schofield, London. Eng. Pat. 15,538, Dec. 21, 1914.

IN an oil still having a furnace similar to that in a Cornish boiler, heat-insulating saddles with hoods are provided over the furnace to induce a longitudinal circulation. The saddles may be composed of sheet metal enclosing a layer of mica or other insulating material, and may have separate draw-off pipes for vapour.—W. F. F.

Oils; Processes of treating —— *for the production of gasoline and other products of low boiling point. Processes of treating mineral oils for the purpose of obtaining products of lower boiling points.* A. M. McAfee, Bayonne, N.J., U.S.A. Eng. Pats. (A) 22,243 and (B) 22,244, Nov. 9, 1914.

(A) CRUDE petroleum or a distillate or residuum of high b.pt. is heated to boiling point with aluminium chloride, the resulting vapours cooled to not above 350° F. (177° C.), and the uncondensed portion returned to the still. The volume of oil may be kept constant by fresh additions until the aluminium chloride becomes a granular coke-like mass. An alternative method consists in heating a charge containing 5% of aluminium chloride over a period of 48 hours. By keeping the condensation temperature above about 300° F. (about 150° C.) the distillate will consist in the main of gasoline. (Reference is directed to Eng. Pat. 17,839 of 1913; this J., 1914, 1011.) (B) Mineral oils are heated with finely divided aluminium, *e.g.*, "aluminium bronze," or aluminous material, or other metal capable of forming a chloride with chlorine or hydrochloric acid, a current of which is passed into the oil, and the resulting vapours are continuously removed and condensed as described in (A).—C. A. M.

Purifying [mineral] oils. A. M. McAfee, Bayonne, N. J., U.S.A. Eng. Pat. 22,922, Nov. 23, 1914.

HIGH boiling mineral oils are heated with aluminium chloride to a temperature not above 212° F. (100° C.), preferably 150° F. (65° C.), to induce condensation with deposition of carbon and saturation of unsaturated compounds. The oil is allowed to cool and the sludge recovered and used for treating fresh oil till it becomes granular. The oil is treated with fresh aluminium chloride at about 150° F. (65° C.) and then successively with sulphuric acid and fullers' earth. Oils may thus be obtained which are tasteless and odourless and of minimum iodine value. The process may also be applied to mineral oils which have been boiled with aluminium chloride and the low-boiling product removed. The residual oil after the first treatment with aluminium chloride may be steam distilled so as to provide a distillate of high flash point and viscosity about 185—250, and this oil may then be treated as above.—W. F. F.

[Mineral] oils; Process of improving ——. A. McD. McAfee, Bayonne, N.J., U.S.A. Eng. Pat. 22,921, Nov. 23, 1914. Under Int. Conv., Feb. 12, 1914.

See U.S. Pat. 1,127,465 of 1915; this J., 1915, 268. Aluminium and chlorine may be used instead of aluminium chloride, and the treatment may be continued for 36—48 hours.

Petroleum product. W. M. Burton, Chicago, Ill., Assignor to Standard Oil Co., Whiting, Ind. U.S. Pat. 1,167,884, Jan. 11, 1916. Date of appl., Feb. 20, 1915.

Claim is made for a petroleum distillate having a density about 15° B. (sp.gr. 0·965) and viscosity about 130 at 100° F., as measured by the Saybolt viscometer, and obtained from an oil having a b.pt. above 500° F. (260° C.), by distilling at 650°—850° F. (343°—454° C.) under a pressure exceeding 3 atmospheres until about 35% remains in the still, and then distilling the residue at atmospheric pressure. The fractions of which the distillate is composed are mainly of the paraffin series and have densities between 10° and 20° B. (sp.gr. 0·93—1·0) and viscosities between 50 and 200.—W. E. F. P.

Emulsion products [mineral oils, tar oils, etc.]; Process for solidifying ——. L. Berend, Amöneburg, Germany. U.S. Pat. 1,167,373, Jan. 11, 1916. Date of appl., June 4, 1914.

Mineral, tar, and other oils, hydrocarbons, asphalt, waxes, rosin, etc., are emulsified with a small amount of a colloidal substance (*e.g.*, sulphite-cellulose waste liquor) and the product mixed with sufficient dehydrating agent (quicklime) to prevent its conversion by water into an emulsion solution. Loading material may also be introduced.—C. A. M.

Paraffin wax; Emulsified —— and process of making same. G. W. Miles, Belmont, Assignor to Ross Chemical Co., Boston, Mass. U.S. Pat. 1,168,534, Jan. 18, 1916. Date of appl., Feb. 4, 1915.

The wax is heated with soap and sufficient water to form a viscous paste, and more water is then added. Alternatively, excess of water may first be added, and the excess evaporated.—W. F. F.

Fuel piping arrangements for coke ovens. Foundations for coke ovens. A. Roberts, Chicago, U.S.A. Eng. Pats. 9763 and 9764, Feb. 1, 1915.

Coke ovens or the like; Method of and apparatus for heating ——. A. Roberts, Chicago, U.S.A. Eng. Pat. 1570, Feb. 1, 1915.

See U.S. Pat. 1,132,685 of 1915; this J., 1915, 482.

Vertical retorts; Discharging ——. A. McD. Duckham, Ashtead. U.S. Pat. 1,169,017, Jan. 18, 1916. Date of appl., July 28, 1915.

See Eng. Pat. 21,191 of 1914; this J., 1915, 860.

Gas; Apparatus for scrubbing ——. R. Maclaurin, Stirling. Eng. Pat. 1380, Jan. 28, 1915.

See U.S. Pat. 1,158,066 of 1915; this J., 1915, 1200.

Method and means for indicating suspended matter in gases. U.S. Pat. 1,168,227. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Utilisation of wood waste. Little. *See* V.

Patent.

Arc-light electrode. G. Egly. Assignor to Gebr. Siemens und Co., Berlin. U.S. Pat. 1,169,942, Feb. 1, 1916. Date of appl., Apr. 22, 1910.

See Fr. Pat. 414,707 of 1910; this J., 1910, 1195.

III.—TAR AND TAR PRODUCTS.

Pitch [; Utilisation of ——]. T. Glover. J. Gas Lighting, 1916, 133, 249—250.

The carbonisation of coal with 5% of added disintegrated pitch has been found to give satisfactory results both in gas retorts and coke-ovens, and the pitch obtained from the tar of the Norwich Gas Works is now utilised in this manner for making gas. A trial working showed that the yields of gas and coke, per ton of mixture carbonised, were not appreciably different from those obtained with coal, whilst the calorific value and illuminating power of the gas produced, and the proportions of benzene and toluene present, were also about the same in each case. The yields of gas and coke from 1 ton of pitch are calculated as 10,666 cb. ft. and 12·14 cwt. respectively. Some trouble was experienced in working with 10% of pitch, and with 15% pipes became blocked. In coke-oven works, an addition of pitch to lean coals would probably give a denser, purer coke.—F. Sodn.

Benzol production at coke plants in the United States. U.S. Geol. Survey.

The output of benzol and other light oils in the by-product coke plants of the United States in 1915 amounted to 13,942,763 gals., in connection with which there was produced 761,256 lb. of naphthalene. Some of the plants were in operation at the beginning of the year, but many were built during the early months of 1915 under contracts calling for great speed in erection. At the end of 1915 there were 19 new benzol recovery plants in operation, mostly in connection with steel works. Several of the plants are not equipped to separate the different oils found in the crude, and 7,322,670 gals. was shipped to refineries connected with powder works and other chemical industries. In the 6,620,093 gals. of oils refined at the place of recovery, there were 4,833,939 gals. of 100% benzol, 1,315,727 gals. of toluol, and 470,425 gals. of solvent naphtha. Thirty-one coke-making establishments with 4933 by-product ovens contributed to this total, and it is estimated that between 8,000,000 and 9,000,000 tons of coal was carbonised in these ovens. The annual capacity of the benzol-recovery plants now in operation is estimated at over 20,000,000 gals., and with the completion of plants now building will probably exceed 22,000,000 gals.

Benzol extraction in Italy. Chem. Trade J., Feb. 19, 1916.

The Italian Government has issued regulations for the compulsory washing of all coal gas to extract benzol, etc., for military and naval purposes. Works making more than 35,000,000 cub. ft. are to put in plant at their own expense; works making less are to receive a subsidy of 8s. per 350,000 cub. ft. of gas made. Subject to orders to be issued by the Munitions Department, the amount of oil (benzol, toluol, xylol) to be extracted is limited to from 15 oz. to 20 oz. per 1000 cub. ft., or such an amount as will not reduce the heating value below 517 B.Th.U. per cubic foot or the lighting value to less than two-thirds. The benzol produced must be 55% benzol with an allowance of 5½% either way; payment for it will be on a 55% basis, being reduced if the percentage falls below this, and proportionately raised if the percentage be higher. Works which cannot distil their own oil, being too small, may have this part of the work done for them. The responsibility for accidents rests with the gasworks. The Munitions Department may advance one-third of the capital required for plant; this will be set off against the price of the oil supplied. The price to be paid for the oil will be adjusted with each gasworks on the basis of the outlay necessary for the plant, and will be readjusted every three months on the basis of the current price of coal: the sinking fund for the plant will be reckoned on a five years' basis if the works renounces right to the plant on the termination of the war. All works which distil coal, whether gasworks or not, must report the amount of tar they make; and all tar-distilling plant must be reported for the information of the authorities.

Effect of temperature on the formation of benzene, toluene, xylene, naphthalene, and anthracene from petroleum at atmospheric pressure. Egloff and Twomey. *See* IIA.

Patent.

Process of solidifying emulsion products [*mineral oils, tar oils, etc.*]. U.S. Pat. 1,167,373. *See* IIA.

IV.—COLOURING MATTERS AND DYES.

Anthocyanins. R. Willstätter. Ber. Deutsch. Pharm. Ges., 1915, **25**, 438—449. (See this J., 1914, 18.)

The anthocyanins constitute a group of basic plant colouring matters widely prevalent in nature; they belong to the class of oxonium salts, containing the basic, quadrivalent oxygen atom. Their isolation from fruits and flowers was achieved by treatment of the aqueous solutions with dilute acids, or by conversion into easily crystallisable compounds with picric acid. The author and his pupils have isolated twenty of these colouring matters in the form of oxonium salts, of which six were obtained from fruits and the remainder from flowers, and in every case they occurred as glucosides containing one or two molecules of dextrose, galactose, or rhamnose. By boiling for a very short time with 20% hydrochloric acid the anthocyanins are hydrolysed into sugar and the colouring matter proper, which is called anthocyanidin. In some cases, however, additional products of hydrolysis, *e.g.*, *p*-hydroxybenzoic acid and malic acid, are also obtained. Most of the natural colouring matters are formed from the same fundamental ingredients. The parent anthocyanidins are: cyanidin (from the cornflower), pelargonidin (from the pelargonium), and delphinidin (from the larkspur), and their hydrochlorides are represented by the formulæ, $C_{15}H_{11}O_5Cl$, $C_{15}H_{11}O_6Cl$, and $C_{15}H_{11}O_7Cl$. Structurally, they differ only as regards their hydroxyl content, and increase in the latter has been proved to be associated with a deepening in the colour. They all lose their colour in dilute solution owing to the production of isomeric compounds, carbinols, which result from the hydrolytic dissociation of the salts. Chemically, the anthocyanidins are very similar to the anthocyanins, but may be distinguished by their behaviour towards amyl alcohol in presence of dilute acid: the former are completely dissolved by the alcohol, the latter only to a very small extent. By heating with alkali the anthocyanidins are resolved into phloroglucinol and a phenolcarboxylic acid or a methyl derivative, in which respect they resemble the flavones. The anthocyanidins are derivatives of phenopyrylium, and as such should be reduction products of flavones. Experiment has shown that pure cyanidin chloride is one of the products obtained when quercetin is reduced by magnesium and acid in presence of mercury. The artificial synthesis of pelargonidin, identical with the colouring matter of the scarlet pelargonium, was effected by the introduction of hydroxyl into the nucleus of phenopyrylium. Although the parent cyanidins are few in number, the actual number found in nature is much greater. Thus delphinidin occurs as five distinct methyl ethers united with sugar as glucosides; and the manner of attachment of the sugar molecule results in the occurrence of different compounds, which vary in colour and in fluorescence. The mode of appearance of an anthocyanin in nature is conditioned by its quantity, its concentration, the character of the cell-fluid, and by the presence of other substances, *e.g.*, flavones, tannins, and iron compounds. The dried bloom of the blue cornflower contains 0·7% of the colouring matter, the dark-red garden variety contains 11%; the same cyanidin-glucoside is contained in the yellow-red bilberry and in the black wild plum. The anthocyanins are extremely widely distributed in plants; cyanin, the di-glucoside of cyanidin, is the colouring matter of the cornflower, the rose, the dahlia, and of certain pelargoniums; an isomer, mecocyanin, is responsible for the scarlet of the poppy. Cherries and blackthorn berries contain rhamno-glucosides of cyanidin; asters and chrysanthemums, isomeric dextro-mono-glucosides. Glucosides of pelargonidin are found in pelargoniums, in the orange-red dahlia, in red cornflowers, and in asters. Pelargonidin and cyanidin glucosides have also been isolated from radishes. The larkspur, the wild mallow, and the perennial pansy contain delphinidin, and the colouring matter of wine (œnin) is principally the monoglucoside of delphinidin dimethyl ether. Delphinidin is also found in bilberries, hollyhocks, and in certain petunias.—E. H. T.

Azo-compounds and their salts; Colour of ——. Constitution and colour. IV. F. Kehrmann. Ber., 1915, **48**, 1933—1938.

With the azo-compounds, as with the azines, when salt formation occurs by addition to the chromophore, a deepening of the colour results, whilst salt formation at the nitrogen of an amino group produces the reverse effect. For example, azobenzene dissolves in fuming sulphuric acid with a deep red colour, and in ordinary concentrated acid with an intense golden-yellow. Similarly *p*-aminoazobenzene gives deep red and golden yellow solutions, and the latter on dilution with water gives a bluish-red shade before the final precipitation of the base. The salts formed in the instances quoted are formulated as follows: Deep red salts as diacid salts of the azo-nitrogen, $C_6H_5.NH(HSO_4):NH(HSO_4).C_6H_5$ and $C_6H_5.NH(HSO_4):NH(HSO_4).C_6H_4.NH_2.H_2SO_4$; golden yellow salts as monacid salts of the azo-nitrogen, *e.g.*, $C_6H_5.NH(HSO_4):N.C_6H_4.NH_2.H_2SO_4$. In the bluish-red salt of the aminoazobenzene the amino group is free, whereby the colour-lightening effect of salt formation at the amino-group in the previous compound disappears and the azo-salt formation comes to its full effect, thus: $C_6H_5.N:NH(HSO_4).C_6H_4.NH_2$.—G. F. M.

Erythrosin and Rose Bengal; Valuation of ——. A. Leys. Ann. Chim. Analyt., 191 , **21**, 25—32.

The absence of fluorescence from aqueous solutions of Erythrosin (sodium salt of tetraiodofluorescein)

compared with the dichroic nature of aqueous solutions of Rose Bengal (sodium salt of tetraiododichlorofluorescein) makes it desirable to be able to distinguish these two dyestuffs. The samples of these dyestuffs found in commerce are of varying degrees of halogenation, and vary in the amount of iodine replaced by chlorine, rarely being the tetraiodo-derivatives. The determination of the relative amounts of iodine and chlorine hence becomes of importance in deciding not only the character of the dyestuff, but also its value, as based on the iodine content. The method of analysis recommended is as follows: The moisture content is determined at 100° C. A known weight of the sample is extracted in a Soxhlet apparatus with absolute alcohol until the liquid siphoning off is colourless. The mineral matter remains in the extraction thimble and may be dissolved in boiling water and the amount determined by evaporating the solution in a platinum capsule and igniting at a dull red heat. The total halogen content of the pure dyestuff obtained from the alcoholic solution, dried at 100° C., is found by heating on a water-bath with caustic potash until the syrup formed solidifies on cooling, adding dry sodium carbonate, and heating until the mass is fused. An aliquot portion of the solution of the melt acidified with sulphuric acid is titrated by means of silver nitrate and potassium thiocyanate; the number of c.c. of $N/10$ silver nitrate required for 100 grms. of the pure dyestuff is calculated. By reference to a table given in the original, the probable nature of the dyestuff in the sample is found, *e.g.*, 4·545 c.c. or less indicates a dyestuff of the Erythrosin class, which will have a negligible fluorescence in aqueous solution, whereas over 5·076 c.c. indicates a dyestuff of the Rose Bengal class. The iodine content of an aliquot portion of the acidified solution of the melt is determined by liberating the iodine by addition of potassium nitrite, extracting with carbon bisulphide, and separating the carbon bisulphide solution; the iodine extracted is found by shaking the solution with water, adding several c.c. of bicarbonate solution, and titrating with $N/10$ thiosulphate. The ratio of the chlorine content to the iodine content is calculated, and multiplied by 127; reference to the table given in the original gives a further indication of the nature and hence the value of the dyestuff.
—F. W. A.

Patents.

Indigoid colouring matters: Manufacture of ——. S. Sokal, London. From Kalle und Co., Biebrich, Germany. Eng. Pat. 22,287, Oct. 3, 1913.

Vat dyestuffs are obtained by condensing pheno-5-hydroxy-1.2-naphthocarbazole with α-derivatives of *p*-chloroisatin, *e.g.*, *p*-chloroisatin-α-*p*-chloroanilide. The black dyestuffs obtained are of greater fastness and their leuco-compounds are more soluble than is the case with that from dibromoisatin-α-anilide (Ger. Pat. 241,997; this J., 1912, 223). Blue to violet-black vat dyestuffs are produced by condensing pheno-, toluo-, xylo-, or naphtho-5-hydroxy-2.1-naphthocarbazole, derived from β-naphthylamine, with α-derivatives of isatin, and, if desired, halogenating the products. In place of pheno-hydroxynaphthocarbazoles, other aminohydroxy derivatives of naphthalene substituted in the amino-group may be used, *e.g.*, arylaminohydroxynaphthalenes or arylhydroxynaphthiminazoles, or acidyl or urea derivatives of heterocyclic aminonaphthols. Vat dyestuffs are also obtained by the condensation of the pheno-5-hydroxynaphthocarbazoles with 2-substitution products of 2.3-diketodihydro(1)-thionaphthene: the products may subsequently be halogenated to improve the fastness. *Example:* 6 kilos. of 5-chloroisatin-2-*p*-chloranilide is heated with 4·7 kilos. of 5-hydroxy-1-phenylnaphthylamine and 30 kilos. of acetic anhydride until the condensation is complete; the mass is filtered and washed with alcohol. With alkaline reducing agents the resulting colouring matter gives a yellow vat from which wool is dyed brownish black shades.—F. W. A.

Acid wool dyestuffs indifferent to copper; Manufacture of ——. O. Imray, London. From Soc. Chem. Ind. in Basle. Eng. Pat. 1611, Feb. 1, 1915.

o-Hydroxyazo-dyestuffs, which are particularly sensitive to copper, are converted into soluble complex copper salts. The products are stable to acids, and may be used for dyeing animal fibres in an acid bath. The dyeings contain copper, and are of good fastness to washing and excellent fastness to light. *Example:* 30 grms. of the sodium salt of the dyestuff from diazotised picramic acid and H-acid (in alkaline solution) is stirred with 900 grms. of water at 70°—80° C., the mixture just acidified with dilute hydrochloric acid, and a solution of 16 grms. of copper sulphate added. After stirring for 1—2 hrs. sodium carbonate is added to neutralise the sulphuric acid formed, the copper compound is separated, pressed, and dried. It forms a dark brown powder which dyes wool black shades from an acid bath.
—F. W. A.

[*Metachrome*] *colouring matters; Manufacture of* [*olive*] ——. C. Mensching and E. F. Ehrhardt, Birkenhead. Eng. Pat. 10,716, July 23, 1915.

Azo dyestuffs prepared from diazotised picramic acid and unsulphonated amino-derivatives of naphthalene, *e.g.*, β-naphthylamine or acetyl-*p*-naphthylenediamine, when dyed on metachrome mordant on wool, give a violet coloration developed by prolonged boiling to fine olive shades fast to milling and to light. *Example:* An amount of picramic acid corresponding to 7 parts of sodium nitrite is diazotised in 400 parts of water, and added to 15 parts of β-naphthylamine dissolved as hydrochloride in 300 parts of water. The solution is stirred with addition of sodium acetate until the formation of the dyestuff is complete, or sufficiently so; sodium carbonate is added until the mass is alkaline, and the colouring matter separated.—F. W. A.

[*Anthracene*] *vat dyes: Blue-grey to green-grey* ——. M. H. Isler, Mannheim. Assignor to Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,169,401, Jan. 25, 1916. Date of appl., Apr. 24, 1914.

See Eng. Pats. 12,817 and 27,010 of 1913; this J., 1914, 638.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wood waste; Utilisation of ——. A. D. Little. Amer. Inst. Chem. Eng., Jan. 12, 1916. Met. and Chem. Eng., 1916, 14, 133—135.

It is estimated that in the United States at least 75,000,000,000 ft. board measure (about 112,000,000 tons) of wood waste is produced annually. Numerous experiments have been made under the author's direction on the utilisation of long-leaf yellow pine waste, the annual production of which is equivalent to 30,000,000,000 ft. board measure, and it is estimated that this amount would provide sufficient raw material for the daily production of 40,000 tons of paper, 3000 tons of rosin, 300,000 galls. of turpentine, and 600,000 galls. of alcohol, together with sufficient fuel to manufacture these products. Long-leaf pine logging waste, "bone dry," weighs about 39·1 lb. per cb. ft. The length of the fibres varies from 3 to 7·4 mm., average 4·6 mm., as compared with 3—3·5 mm. for spruce. An excellent pulp for "kraft-paper" can be obtained from the wood by the sulphate process, the yield being about 1 ton of paper from 1½ cords of round waste, as compared with 2 cords in the case of spruce wood. Alcohol has been produced on a commercial scale from the waste by the Ewen-Tomlinson process (see Von Demuth, this J., 1914, 71); the yield is 10 galls. of 95 % alcohol per cord of sawdust or hogged wood waste containing 50 % of water, and the alcohol can be produced at a cost, including cooperage and fixed and manufacturing charges, of not more than 20 cents a gallon. By using hydrochloric instead of sulphuric acid, removing most of the acid from the digested material by heating or by a blast of air, and neutralising the remainder with sodium carbonate, then extracting the juice and concentrating it to a syrup, the process may be adapted to the production of a carbohydrate cattle food (see U.S. Pat. 1,092,221 of 1914; this J., 1914, 563). Stump wood may be treated by a solvent extraction process, yielding 6 galls. of turpentine, 2½ galls. of pine oil, and 380 lb. of rosin per cord, and the extracted chips can be used for the production of paper pulp or alcohol; or the stump wood and other highly resinous waste may be destructively distilled, yielding 6 galls. of light oils, 6 galls. of turpentine, 16 galls. of heavy oil, 48 galls. of tar, and 35 bushels of charcoal per cord. The various processes proposed for the recovery of turpentine, pine oil, and resin from the waste by extraction with dilute aqueous alkali have not proved successful commercially owing to the difficulty of separating from the resin the "humus" produced by the action of the alkali on the wood. In a process devised by Whitaker and Bates (this J., 1914, 477) this difficulty has been overcome by increasing to 3½ % of free alkali the concentration of the alkaline solution after the initial treatment of the wood, and thereby salting out the resin soap.—A. S.

Collodion membranes of differential permeability: Preparation of ——. W. Brown. Biochem. J., 1915, **9**, 591—617.

Collodion thimbles of regularly increasing permeability may be prepared by soaking air-dried thimbles in alcohol-water mixtures of increasing alcohol content. The air-dried membranes were prepared by dipping a test-tube (1 cm. in diam.) into an 8 % solution of Schering's celloidin in a mixture of equal parts (by vol.) of absolute alcohol and ether. After a few seconds' draining, the test-tube was placed in a vertical position inside an inverted conical flask of 500 c.c. capacity. The tube was manipulated so as to ensure an even film of collodion. Drainage was allowed to proceed for 5 minutes and the tube then immediately immersed in water for 1 minute, when the film was stripped off, washed in water, and allowed to dry in the air. The membranes were then soaked in the various alcohol-water mixtures for 24 hours at 20° C., transferred to water, and washed over a period of 1 day. It is suggested that the diffusive capacity of any substance through collodion may be expressed in terms of the alcohol strength required to produce the membrane which just prevents its passage. This may be termed the "alcohol index" of the substance. (See also Brown, this J., 1915, 1118.)—W. P. S.

Paper and pulp industry in Canada. Board of Trade J., Feb. 17, 1916.

Canada should become a comparatively large producer of paper, especially for the newspaper press. It is estimated that the production of paper for newspapers in Canada has been increased to about 2000 tons a day and that there is a surplus for export of 1500 tons a day. During the first twelve months of the war (August, 1914, to July, 1915) exports of all kinds of paper from Canada were valued at 17,043,000 dols., as compared with 14,280,000 dols. in the corresponding period of 1913-14, and exports of pulp were valued at 9,367,000 dols., an increase of nearly 2,000,000 dols. over the preceding twelve months. Exports of chemical pulp will, it is estimated, amount to 110,000 tons in 1916. In the first half of 1915 the Canadian output of pulp and cheap papers was about 25 % less than full capacity. The following table shows the values of the exports from Canada of paper and pulp for the years ended 31st March, 1913, 1914, and 1915:—

—	1912-13.	1913-14.	1914-15.
	Dols.	Dols.	Dols.
Paper and manufactures of paper	6,351,037	12,752,933	15,588,253
Wood pulp (chemical)	2,100,842	2,923,083	4,806,622
Wood pulp (mechanical)	3,408,702	3,441,741	4,459,539

Production and use of yeast as foodstuff and fodder. Hayduck. *See* XIXa.

Patents.

Cellulose derivatives; Manufacture of —. Soc. Chim. des Usines du Rhône, anc. Gilliard, P. Monnet et Cartier, Paris. Eng. Pat. 7773, May 25, 1915. Under Int. Conv., June 22, 1914.

Esterified derivatives are prepared by treating cellulose or cellulose derivatives with acids and anhydrides of the fatty series and a catalyst in the presence of trioxymethylene. The treatment with trioxymethylene and the esterification of the cellulose may be either successive or simultaneous. *Example*: 10 parts of cellulose is treated with a mixture of 60 parts of glacial acetic acid, 4 of acetic anhydride, 0·5 of 100 % sulphuric acid, and 1 of trioxymethylene. After standing for some hours at 30° C., acetic anhydride (21 parts) is added to the mass and the acetylation is continued.—J. F. B.

Artificial silk and like threads; Apparatus for treating ——. H. de Chardonnet, Paris. Eng. Pat. 10,858, July 27, 1915. Under Int. Conv., Aug. 1, 1914.

The bobbins consist of a core with detachable end-discs carrying longitudinal bars forming a cylindrical winding surface; longitudinal rods of inert material are placed between and parallel to the bars, the ends being bent inwards and fixed in the core. The bobbins are also provided with two (or more) rings of radiating rods of inert material, one ring being permanently fixed in the core; the rods of this ring have points all bent over in one and the same plane perpendicular to the bobbin axis, so that the thread may slide over them without catching when being unwound. The other ring, also attached to the core, carries removable rods with straight points. When the filled bobbins are to be subjected to liquid treatment, the end discs and longitudinal bars are removed, leaving the thread supported only by the longitudinal and radiating rods. A number of such bobbins are threaded on a self-centreing rotary spindle suspended vertically and hanging freely from its driving gear. Several of these spindles are arranged on a hinged frame in two rows and lowered into a tank divided into a middle longitudinal compart ment containing water and two series of side compartments, intercommunicating at the bottom, of circular or polygonal cross-section, one compartment to each spindle; these side compartments contain the liquid reagent. The spindles are then rotated so as to produce a vigorous circulation of the reagent through the threads supported by the rods. After treatment and washing, the rods with straight points are removed from the mass of threads prior to unwinding.—J. F. B.

Pulp washing machines. L. Chew and W. F. Jennings, London. Eng. Pat. 13,491, Sept. 22, 1915.

The apparatus consists of a steam-jacketed vertical cylindrical tank, having a centrifugal pump attached externally to its base, which circulates the pulp and water, the material being withdrawn from the tank at the periphery by the pump and delivered again to the tank at the centre through a tangential discharge which imparts a whirling motion. Water is introduced through a central stand-pipe into the suction of the circulating pump and overflows from the upper part of the tank through a conical screen mounted above the jacketed portion. A two-way cock and a branch pipe, fitted in the delivery pipe of the circulating pump, permits the discharge of cleansed pulp.
J. F. B.

Wood-pulp; Apparatus for cooking ——. L. B. Decker, Assignor to J. Ball, Kenogami, Quebec, Canada. U.S. Pat. 1,167,800, Jan. 11, 1916. Date of appl., Feb. 23, 1915.

A main digester is connected with an acid-cooler, and a wood-waste digester, provided with a heating coil, is connected with the main digester and with the cooler, in such a manner that the gas and liquor may pass from the main digester to the cooler either directly or through the heating coil of the waste digester.—J. F. B.

Wood pulp; Method of preparing ——. C. Bache-Wüg, Berlin, N.H., Assignor to Berlin Mills Co., Portland, Me. U.S. Pat. 1,169,597, Jan. 25, 1916. Date of appl., Dec. 14, 1912.

Blocks of wood are packed in a digester, the air is then withdrawn and gaseous sulphur dioxide forced under pressure into the blocks to a substantial depth, whereby the outer portions are bleached and softened. A solution of sodium chloride is then injected and the mass is cooked, whereby a salt is formed by the interaction of the sodium chloride and sulphur dioxide, having a softening and bleaching action on the fibres. The blocks are subsequently ground to a pulp.
—J. F. B.

Paper making apparatus; Apparatus employing steam both for motive power and for drying or other analogous purpose, intended more especially for use in connection with ——. T. D. Nuttall, Bury, Lancs. Eng. Pat. 3286, Mar. 1, 1915.

The various paper machines, together with their appertaining preparatory and finishing machinery, are grouped as complete units or pairs, each group being operated by its separate steam engine, which is used partly to transmit power mechanically (*e.g.*, to the beating engines, etc.) and partly to generate electricity, which is transmitted to the electrically driven elements of the group through a switch-board common to all the groups. The separate steam engines derive their power from a steam supply pipe common to all and discharge into a common exhaust main from which branches lead to the drying cylinders of all the groups; the pressure in the main is maintained constant by means of automatic make-up and relief valves. The separate steam engines are so situated relatively to one another, that in the event of the breakdown of one, the load of its group can be temporarily thrown upon the others by the manipulation of suitably arranged clutches in its transmission. An alternative device relates to the case in which the power of the separate engines is used entirely for the generation of electricity and all portions of the respective groups are driven electrically through the common switchboard.—J. F. B.

Wood and vegetable substances; Process and apparatus for "harvesting" the volatile constituents of ——. W. K. Freeman, Oscawana, N.Y., Assignor to Hydrolose Process Corporation. U.S. Pat. 1,169,325, Jan. 25, 1916. Date of appl., Sept. 18, 1912.

See Fr. Pat. 471,620 of 1913; this J., 1915, 419.

Wood pulp and half-cellulose from resinous kinds of wood; Manufacture of brown ——. J. Aktschourin, Aktschourin-Tupik, Russia. U.S. Pat. 1,169,592, Jan. 25, 1916. Date of appl., Dec. 18, 1911.

See Fr. Pat. 433,424 of 1911; this J., 1912, 225.

Plastic compositions; Art of making ——. R. Adler, Assignor to Naamlooze Vennootschap "Hollandsche Proteine Maatschappij," Amsterdam, Netherlands. U.S. Pat. 1,169,756, Feb. 1, 1916. Date of appl., Mar. 29, 1913.

See Fr. Pat. 457,130 of 1913; this J., 1913, 984.

Method and apparatus for preparing dilute solutions of resin soap. Eng. Pat. 2142. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching [vegetable fibres]; New process of ——. S. F. Peckham. Amer. Inst. Chem. Eng., Jan. 14, 1916. Met. and Chem. Eng., 1916, **14**, 160.

Instead of the usual lime and soda boils, the material is boiled in a solution prepared by dissolving benzol or light oils from coal tar, coke-oven tar, blast-furnace tar, or certain kinds of petroleum, especially California petroleum, in soap solution. A suitable solution, for 100 lb. of flax, consists of 50 galls. of water, 10 lb. of soap, and 3 galls. of benzol. After removal from the soap solution, the material is thoroughly washed and then subjected to the usual "chemicking" operation, but using, preferably, a solution prepared by treating a bleaching powder solution with a slight excess of sodium carbonate solution and allowing to stand for at least four days.—A. S.

Weighting of silk; Tin phosphate ——. *H.* H. Ley. Chem.-Zeit., 1915, **39**, 973—975, 986—987.

Irregularities in the weighting of silk have been noted which could not be explained by the author's chemical theory of silk weighting with tin phosphate (this J., 1913, 81). The effects of the mechanical processes used have been examined on the large scale. The wash liquors obtained after treatment of the silk with pink salt, after treatment with phosphate, after acidifying, and from the centrifuge, have been examined. Assuming that the stannic chloride is more or less completely hydrolysed, and the hydrochloric acid formed then neutralised by the sodium phosphate, the acidity or alkalinity and chloride content of these liquors have been determined. In agreement with practice it was found that the stannic chloride is only slowly hydrolysed. The amounts of stannic chloride removed by washing after each treatment are practically the same. The wash liquors after the phosphate treatment gradually became less alkaline, due to gradual neutralisation of hydrochloric acid in the fibre. The acidifying bath used after the phosphate treatment became less acid with use, due to neutralisation by the sodium phosphate, the same behaviour being shown by the centrifuge liquors after this process. Part of the alkalinity of the sodium phosphate is neutralised by the hydrochloric acid from the pink salt; the more rapid the revolution of the centrifuge, the more this hydrochloric acid penetrates the fibre and the greater is the acidity of the centrifuge liquors.

In contradiction to the view previously expressed by the author, washing after the phosphate treatment is not considered to exert any chemical influence on the weighting. The only important process is the washing after treatment with pink salt to cause its hydrolysis. Washing and acidifying after the phosphate process only facilitate the removal of the excess of phosphate. If the centrifuging after washing the silk impregnated with pink salt is more rapid, the acidity of the wash water is increased; apparently the hydrolysis of the stannic chloride is promoted, as a similar effect is not shown by centrifuging material which has been acidified after the phosphate treatment. In the first treatment with pink salt only a small amount of tin is taken up chemically by the silk, the amount of chloride in the centrifuge liquors increasing with subsequent treatments; when the centrifuging is slow, the amount of chloride is smaller than if rapid, in which latter case more oxychloride is formed by interaction of the stannic hydroxide in the interior of the material and the stannic chloride in the outer layers, and this combined chlorine does not pass into the centrifuge liquor. The neutralisation of the hydrochloric acid from the stannic chloride by sodium phosphate inside the fibre is greater the slower the centrifuging.

It is evident that the chemical nature of the weighting is influenced considerably by the amount of washing, the amount of decomposition products retained and only removed by centrifuging, etc. Heermann's theory involving the decomposition of a double salt of stannic oxide and sodium phosphate by washing after the phosphate treatment, and necessitating the formation of free caustic soda, is again refuted.—F. W. A.

Acid dyebath; Theory of the ——. M. Fort. J. Soc. Dyers and Col., 1916, **32**, 33—40.

The author summarises the results established in his previous papers (this J., 1913, 907; 1915, 488, 1087), in which it is shown that the sulphuric acid employed in the dyebath combines with the wool base to form an additive salt, which reacts by double decomposition with the salt of the colour acid of the dyestuff. This theory has been supported by experimental observation of the course of the reaction and identification of the products; by quantitative estimation of the interacting quantities of dyestuff and acid; by variation among the factors of equilibrium in the equations assigned to express the mechanism of dyeing, showing that dyeing and its reversal, stripping, are adequately expressed by these equations. These considerations have now been extended by observations carried out on simple bases in place of the complex protein base. A solution of Crystal Scarlet colour acid has little or no action on magnesium oxide suspended in water in the cold, but when mixed with a solution of magnesium sulphate, the magnesium salt of the colour acid is separated almost quantitatively and free sulphuric acid appears in the solution. Similarly, the sodium salt of Crystal Scarlet does not react with magnesium or magnesium oxide, but on the addition of sulphuric acid, and consequent formation of magnesium sulphate, double decomposition takes place with formation of the magnesium salt of the colour acid in a manner analogous to that postulated for the dyeing of wool. A further extension of the theory relates to the fixation of acid dyestuffs on cotton through the intermediary of a simple base. The process of "animalising" cotton by means of a coating of gelatin belongs to this category, but the author supports his theory more conclusively by mordanting the fibre with benzidine. Cotton is treated with tannic acid, which is fixed in the usual way with tartar emetic and rinsed. Such tannin-mordanted cotton absorbs benzidine when steeped in a hot 15% solution of the hydrochloride. The base is fixed as the nearly insoluble sulphate by treatment with warm 10% sodium sulphate solution and the cotton rinsed in a cold weaker solution of the same salt. The cotton thus mordanted is dyed at 60° C. with acid dyestuffs in presence of 1% sulphuric acid. The results are good, although not entirely satisfactory in every commercial sense. The baths do not exhaust well, probably owing to loss of benzidine from the fibre, which becomes greater at higher temperatures; the dyed products give off an irritating dust on shaking and are not very fast to hot washing or milling.—J. F. B.

Patents.

Dyestuffs [on the fibre]: Preparations useful in the production of ——. A. G. Bloxam, London. From Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. Eng. Pat. 6663, May 4, 1915.

In the production of dyestuffs on the fibre by means of the alkali salts of nitrosamines and arylamides of 2.3-hydroxynaphthoic acid (see Eng. Pat. 9102 of 1914; this J., 1914, 611), it has been found that the addition of a thickening substance or diluent, such as Turkey-red oil, as stabilising agent is unnecessary. Concentrated mixtures of the alkali salts of nitrosamines and of 2.3-hydroxynaphthoic acid arylamides form stable preparations in the paste or powdered forms, which on dissolving in water form printing colours, and may be used for producing fast colours on cotton and for the production of pigment colours. Suitable nitrosamine-alkali salts are obtained from *p*-nitraniline, nitro-*o*-anisidine, *m*-nitro-*p*-toluidine, and other bases which can be diazotised; diluted solutions of these compounds and naphtholates are not stable, whereas stable solutions are obtained, for example, with the anilide or *m*-nitroanilide of 2.3-hydroxynaphthoic acid.—F. W. A.

Dyeing artificial silk. F. Kunert, Offenbach, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,169,267, Jan. 25, 1916. Date of appl., Aug. 5, 1914.

See Eng. Pat. 17,272 of 1914; this J., 1915, 957.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Chilean nitrate industry. U.S. Comm. Rept., No. 303, Dec. 28, 1915.

By decree No. 2157 of the Ministry of Hacienda, the scope of the loans to nitrate producers is extended to include nitrate works renewing operation and which have not a quantity of stored nitrate on hand. The law, No. 2918, promulgated in August, 1914, provided for a loan by the Government of 3 pesos (2s. 3d.), per Spanish quintal (101·4 lb.) of stored nitrate held by the producers, and of 4 pesos (3s.) per Spanish quintal of nitrate at ports, ready for shipment. Decree

No. 2157 authorises a Government advance to nitrate producers at the former rate, even though the oficinas have no stock on hand, on the basis of the average production in periods of three months prior to the closing of the works.

The "Compañia de Salitres de Antofagasta" proposes to construct new reduction works in the district of Salinas Norte, not far from Baquedano. It is estimated that the capacity of the new oficina will be about 2,000,000 quintals per annum. The same company has also recently purchased the oficina "Riviera," which has not been operating for a long time. This plant has a production of about 600,000 quintals per year. Completion of the new plant "Oficina Aguste Victoria," under construction for the firm of Gildemeister & Co., of Antofagasta, is now going on. Plants of other companies which have been idle since the outbreak of the war are again resuming operations, so that the nitrate supply will be able to supply any probable demand in the near future. Early estimates of the probable exportation in 1916 set the figure at 60,000,000 quintals.

Bromine; American production of——. U.S. Comm. Rept. No. 6, Jan. 8, 1916.

The photographic trade of the United States is suffering seriously from the lack of adequate supplies of bromine, and the scarcity of bromides for use in therapeutics is likewise felt. The bromine wells in and about Pomeroy, Ohio, and Mason City, W. Va., have again been put into operation, after remaining idle for a number of years. The present monthly production will amount to 5 or 6 tons. The American output of bromine has largely been concentrated in Michigan and Pennsylvania, in connection with the salt industry of those States. The total output reached its maximum in the years 1905 to 1907, inclusive, when it averaged 642 short tons. In 1910 it fell to 122 tons. During the years 1911 to 1914, the average output was 306 short tons. There has not been any very notable importation of bromine or of bromides from Europe. There has, however, been a very large importation of photographic paper from Germany. The annual imports, prior to the war, amounted to about $730,000.

Boric acid in presence of litmus solution. F. Fichter. J. Chim. Phys., 1915, **13**, 399—401.

The change of colour of litmus solution from red to blue when a concentrated solution of borax acidified with acetic acid and coloured with litmus is diluted with water, is not due to the increased hydrolysis of the salt, for that would rather decrease the absolute concentration of hydroxyl ions (compare this Journal, 1915, 1008). The colour change is to be ascribed to boric acid liberated by the acetic acid and the decrease in concentration of hydrogen ions on diluting its solution. A saturated solution of boric acid (0·64 N) is acid to litmus, but the colour changes through rose and violet-rose to blue on dilution, the latter stage being attained at a concentration of hydrogen ions equal to 1×10^{-8} N. The experiment is therefore a demonstration of the relation existing between the colour of an indicator and the absolute concentration of hydrion in the solution.—G. F. M.

Aqua ammoniæ; Continuous manufacture of—— [*from crude ammoniacal liquor*]. P. Plantinga. Gas Record [Chicago], Jan. 22, 1916. J. Gas Lighting, 1916, **133**, 262—263.

Salt prepared by fusion and its use as table salt and for cooking. K. B. Lehmann. Chem.-Zeit., 1916, **40**, 6—7, 28—29.

At the Heilbronn salt works, refined salt is prepared from rock salt by fusion in a Siemens' furnace with two hearths. The crude salt is melted on the upper hearth and then flows on to the lower hearth, leaving behind most of the impurities. On the lower hearth, the organic impurities are oxidised and iron or aluminium precipitated by adding a small quantity of lime and blowing air through the fused salt for 15—20 mins. The purified salt contains from 1·24—1·60 % $CaSO_4$, about 0·028 % CaO, and about 0·043 % Na_2CO_3. The presence of these small proportions of impurities in no way impairs the suitability of the salt for culinary and like purposes. The salt dissolves in water somewhat more slowly than that prepared by evaporation. (See also this J., 1910, 756, 1104; 1913, 1009.) —A. S.

Bromine and iodine; Determination of—— *in presence of chlorides.* L. W. Winkler. Z. angew. Chem., 1915, 28, 477—480, 491—496.

The determination of bromide in presence of either much or little chloride can be accurately made by means of the permanganate method, which needs to be slightly modified according to the bromine content. To estimate the bromine in potassium or sodium bromide for pharmaceutical purposes, 100 c.c. of a solution containing 1—1·5 grms. of the dried salt per litre is put into a 200 c.c. flask together with a pinch of coarse pumice powder and 25 c.c. of approximately 50 % sulphuric acid (2 : 3). The liquid is boiled vigorously and $N/10$ or $N/20$ permanganate solution is run in from a burette (provided with a curved jet) until a permanent rose colour is obtained. The permanganate is standardised against pure dry potassium bromide under the same conditions. If the solution contains more than 100 mgrms. chlorine per 100 c.c., the apparatus is modified by making the jet of the burette dip directly, and fit like a stopper, into the neck of a 150 c.c. distilling flask, the side-tube of which (situated near the top of the neck) is prolonged and bent so as to form a condensing tube, the latter being immersed in cold running water. After every addition of permanganate, 2—3 c.c. of liquid is distilled over into a test-tube (10 × 1 cm.), and this is continued until a colourless distillate, containing no bromine, is obtained. The permanganate is best dissolved in water containing 250 grms. of Glauber's salt per litre, thus admitting of its easy admixture with the liquid under titration. Sulphates, nitrates, and carbonates may be present, but reducing agents and ammonium salts must be previously removed. If iodide be present, iodine distils over before the bromine and can be collected separately. Solutions containing much chloride and relatively very little bromide, *e.g.*, sea-water, must be first concentrated, as follows: 100 c.c. of the solution is coloured with 2—3 drops of methyl orange, acidified with hydrochloric acid, and then boiled with pumice and sulphuric acid, and the bromine liberated on addition of potassium permanganate is collected in a solution of sulphurous acid made by diluting 1 c.c. of saturated solution with 5 c.c. of water. To waters poor in chloride, about 1 grm. of purest sodium chloride must be added. The connection between the burette and the distilling flask is greased with syrupy phosphoric acid. The distillate is collected in a 50 c.c. conical flask and the end of the condensing tube must touch its bottom. The distilling flask is first heated with a small flame, and only when the air has been expelled is the permanganate solution run in, at first quickly, then more slowly, but an excess must be present. The results are most accurate when a little chlorine (5—10 mgrms.) passes over into the distillate, about 25 c.c. of which is required for the subsequent bromine determination. If a considerable amount of iodine is present, the greater part of it should be first distilled off by adding 5 c.c. sulphuric acid and 5 c.c. of ferric chloride solution (containing 5 grms. $FeCl_3,6H_2O$ per 100 c.c.); residual traces do not affect the bromine estimation. The distillate, containing hydrobromic acid and excess of sulphurous acid, is returned to the distilling flask, diluted with water to about 120 c.c., and distilled with 5 c.c. of 50 % sulphuric acid and pumice, a cork stopper being inserted in the neck of the flask. In this way the sulphurous acid is eliminated. Another 20 c.c. of the sulphuric acid is added, and the distilling flask connected with the burette containing permanganate as before. The actual bromine determination is then made according to one or other of the following two methods. 1. After the air has been driven out the permanganate is run into the distilling flask containing the bromide, and the liberated halogen is distilled over into a tall 50 c.c. flask containing 5 c.c. distilled water free from carbon dioxide and 2—3 c.c. of pure 30 % hydrogen peroxide. The permanganate supply is stopped when the pink colour due to it persists unchanged for 2—3 minutes. The distillation is conducted over a small flame until 10—15 c.c. of the liquid has gone over. The colourless liquid in the small flask then contains all the bromine as hydrobromic acid, which is determined by one or more of the three following methods. (A). The cold hydrobromic acid solution is titrated with standardised lime-water: when the methyl orange indicator (1 drop of a 1 : 1000 solution) is turned yellow, 1—2 drops of methyl red (1 : 10,000) are added, and the titration continued until a pure yellow is produced. (B). The liquid containing a slight excess of lime-water is diluted to about 100 c.c., and titrated with $N/20$ silver nitrate solution, in presence of 1 c.c. potassium chromate as indicator. (C). The residual liquid from (B) is acidified with nitric acid, a few more drops of silver nitrate solution are added, and then the whole warmed on a water-bath in the dark until all oxygen has been expelled and the silver bromide has settled. After standing for a few hours the bromide is filtered off, washed, and weighed. Such small amounts of silver bromide are best collected and washed on a filter 3—4 cm. diameter contained in a funnel (2·5—3·0 cm.), previously dried, enclosed in a weighing-bottle for 2 hours at 150° C., and then weighed. The bottle and contents are not weighed until they have stood on the balance pan for 10 minutes. This method gives lower results than (B) but is more accurate: it is, however, advisable to perform all three, but in case one only is used (B) may be adopted and the volume of $N/20$ silver solution diminished by 0·1 c.c. In determining the bromine in sea-water, 500 c.c. of the latter is taken, and 15—20 c.c. of the permanganate solution is used for the concentration. 2. The bromine in mineral waters is more accurately determined by collecting the original distillate containing free bromine in alkali. The method is similar to 1, except that the distillate is collected in a 50—100 c.c. flask with a glass stopper containing 5—10 c.c. $N/1$ caustic soda. (A). The alkaline distillate (20—30 c.c.) is treated with 0·2 grm. purest potassium iodide and 10 or 20 c.c. $N/1$ hydrochloric acid. After standing 15 mins. in the dark the separated iodine is titrated with $N/100$ sodium thiosulphate. (B). A few c.c. of pure carbon tetrachloride is added to the alkaline liquid, which is then acidified with 2—3 drops of fuming hydrochloric acid and shaken vigorously. After 15 mins. $N/100$ arsenious oxide solution is added, little by little, with frequent agitation, until the tetrachloride is colourless. Extremely small quantities of bromine are determined very accurately by distilling into a scent bottle of about 30 c.c. capacity, of square section, in which 2—3 c.c. of the alkali is placed. The distillation is continued until the bottle is half full, a small flame being used, and then 5 c.c. of carbon tetrachloride and about 2 c.c. of fuming hydrochloric acid are added. After shaking, as little as 0·2 mgrm. of bromine can be detected by the colour imparted to the tetrachloride. The liberated iodine is titrated as above with arsenious oxide solution. The tetrachloride changes from brownish-yellow to colourless, and then becomes rose-red, at which point the titration is stopped. The colour changes are best observed against a background of translucent glass. Method 2 (B) is the most accurate of those described.

Determination of iodine. The principle of the two methods recommended consists in liberating the halogen with acid and nitrite, removing excess of the latter with urea, extracting the iodine with carbon tetrachloride, and titrating it with thiosulphate. 1. 50 c.c. of the iodide solution is placed in a glass-stoppered flask (150 c.c.), and to it 25 c.c. of tetrachloride, 10 drops of 10 % hydrochloric acid (to acidify), and 2 drops of a 1 % sodium nitrite solution are added. After standing with occasional shaking for 30 mins., 1 grm. of the purest urea is introduced, and after again standing and shaking for 1 hour, the free iodine is titrated with thiosulphate solution. This method is accurate for solutions containing 20—1000 mgrms. of iodine and not more than 25 grms. of chlorine and 1·0—1·5 grms. of bromine per litre. If very little or no bromine is present the method is much accelerated by using 5 c.c. of 10 % hydrochloric acid and 5 drops of nitrite solution; the titration can then be performed after 15 mins. The results obtained when greater quantities of chlorine and bromine are present are too high owing to the action of nitrous acid on the hydrobromic acid, and to a slight extent on the hydrochloric acid. This method is not affected by the presence of carbonates, sulphates, or nitrates, and it is particularly well adapted for the analysis of commercial potassium and sodium iodides. 2. *An improvement of the Grange-Fresenius method.* A tube, 10 cm. × 1—2 mm., is blown on to the lower end of a stoppered cylindrical separating funnel of 150—200 c.c. capacity; and the tap is greased with syrupy phosphoric acid. Some carbon tetrachloride is sucked up into the funnel and a further 10 c.c. added: the liquid to be analysed is added together with 2—3 drops of methyl orange and 1 c.c. of 10 % hydrochloric acid. If carbonates are present, 2—3 drops of the indicator, and sufficient sulphuric acid to cause an acid reaction, are necessary. After a strong current of air has been passed through the liquid for 10 mins., 1 c.c. of 10 % hydrochloric acid and 5 drops of 1 % sodium nitrite solution are added, the mixture well shaken, and again shaken after standing 10 mins. The clear solution of iodine in carbon tetrachloride is run off and a further 2—3 c.c. of the latter used for rinsing: 10 c.c. of tetrachloride is added, the liquid again shaken and left to stand, and so on until the solution is colourless. For 50 mgrms. of iodine, 5 or 6 extractions, for smaller amounts 3 or 4, are necessary. The extracts are collected in a 100 c.c. glass stoppered bottle into which 5 c.c. water, 0·1 grm. urea, and 5 drops of 10 % hydrochloric acid, have been previously introduced. After vigorous agitation and 15 mins. rest, the iodine is titrated with $N/100$ sodium thiosulphate. 1—50 mgrms. of iodine in 100 c.c. of solution can be determined in this way, but not more than 5 grms. of chlorine or 0·5 grm. of bromine should be present. The bromine in the liquid left in the funnel can be estimated by acidifying with 5 c.c. of 50 % sulphuric acid, distilling off 20 c.c., adding 20 c.c. more acid and permanganate as described above. 3. The method of determining iodine in very small quantities, devised by the author in 1887, has been improved as follows: 2—3 drops of methyl orange is added to 100 c.c. of the clear solution (*e.g.*, a mineral water), which is then neutralised with dilute sulphuric acid and acidified with 10 c.c. *N*/10 hydrochloric acid. The addition of 2—3 c.c. fresh chlorine water oxidises the iodine to iodate, the indicator being decomposed and any nitrite present converted into nitrate. A few small crystals of Iceland spar are put into the liquid, which is then boiled vigorously over a free flame to expel chlorine and any bromine that may have been originally present as bromide. The complete expulsion of these halogens is ascertained by adding a drop of methyl orange, which is decolorised so long as they are present. The cooled liquid is treated with 5 c.c. of 25 % phosphoric acid solution and 0·2 grm. of pure potassium iodide, and after standing in the dark for 15 mins., the iodine is titrated with thiosulphate. By this method 0·1 mgrm. of iodine, or less, can be determined in 100 c.c. of solution; smaller quantities, *e.g.*, 0·01 mgrm., can be estimated only after concentration by evaporating in presence of alkali.

E. H. T.

Thiosulphate; Volumetric determination of ——, in presence of sulphide, sulphite, and bisulphite. A. Sander. Chem.-Zeit., 1915, **39**, 945—947.

Thiosulphate is determined in presence of sulphide by precipitation with mercuric chloride, each molecule of the thiosulphate liberating 2 mols. of hydrochloric acid, which can be titrated.

A. 1. $2Na_2S_2O_3+3HgCl_2+2H_2O = 2Na_2SO_4+4HCl+2HgS.HgCl_2.$

2. $3HgCl_2+2Na_2S=4NaCl+2HgS.HgCl_2.$

The total of thiosulphate and sulphide is first found by titration with iodine solution. A second portion is treated with excess of mercuric chloride, shaken until the dark precipitate has become a pure white, then ammonium chloride is added (to prevent the precipitation of mercury by the alkali), and the cloudy liquid titrated with *N*/10 caustic soda in presence of methyl orange. The alkali consumed divided by 2 gives the iodine consumption of the thiosulphate alone, and the difference between this and the first titration gives the iodine consumed by the sulphide. The determination is very rapid, and is also suitable for estimating traces of thiosulphate in presence of sulphide. For determining thiosulphate in presence of sulphite, Bosshard and Grob's method (this J., 1913, 532) is recommended, although the explanation of the reactions given by the authors is erroneous. The correct equations are:

B. 1. (a) $Na_2SO_3+HCl=NaHSO_3+NaCl.$

(b) $NaHSO_3+HgCl_2=HgCl.SO_3Na+HCl.$

2. as A. 1 above.

After the solution has been titrated with hydrochloric acid to convert sulphite into bisulphite, excess of mercuric chloride is added, and then the liberated acid titrated with alkali. Alternatively, the combined thiosulphate and sulphite can be found iodometrically, and the former estimated separately by the mercuric chloride method. A delicate test for bisulphite in presence of sulphite consists in adding methyl orange and an excess of mercuric chloride: traces of bisulphite cause the indicator to change colour. Thiosulphate, sulphide, and sulphite can be determined accurately in less than 10 mins. by the following method: (1) 10—20 c.c. of the solution is run into a measured excess of *N*/10 iodine solution acidified with 5—10 c.c. *N*/10 hydrochloric acid, and the excess of iodine titrated with *N*/10 thiosulphate. This gives the total thiosulphate, sulphide, and sulphite [x]. (2) The hydriodic acid liberated by the sulphite in (1) is directly titrated with caustic soda and 1—2 drops of methyl orange. On subtracting the value of the acid introduced in (1), the iodine-value of the sulphite is obtained [y]. (3) The iodine-value of the thiosulphate [z] is found with mercuric chloride as above, and the sulphide is then deduced by subtraction, $\left[x-(y+\frac{z}{2})\right]$.

—E. H. T.

Lead sulphate; Reduction of ——. G. A. Perley and C. W. Davis. J. Phys. Chem., 1916, **20**, 151—163.

When sodium hydroxide solution, lead, and lead sulphate are in contact simultaneously, crystals of lead are deposited, and it is found that the reaction is not dependent upon impurities in the lead, nor upon fluctuation of temperature, as is the case when lead reacts with hot lead acetate solution. Experiments with pure lead and caustic soda under reduced pressure and in the absence of air proved that there is no appreciable production of hydrogen, so that the plumbite formed cannot be reduced to lead by hydrogen evolved, and it was also ascertained that by the action of caustic soda on lead sulphate only lead monoxide is obtained. The three substances are therefore necessary: the caustic soda dissolves the lead sulphate, and the denser solution thus formed flows to the bottom of the container while fresh caustic soda flows in from above to replace it, thus setting up concentration differences. On long standing large crystals of lead are formed, which continue to grow after all the lead sulphate has disappeared. On rotating lead strips containing grooves filled with pure lead sulphate in a 3*N* solution of sodium hydroxide the reduction is more rapid and uniform.—W. G. C.

Sulphur in commercial antimony sulphides; Determination of free ——. A. Hutin. Ann. Chim. Analyt., 1916, **21**, 32—33.

On account of the tendency of Sb_2S_5 to form Sb_2S_4 at the boiling-point of carbon bisulphide, acetone is recommended as a solvent for the free sulphur, the extraction requiring 6 to 8 hours.

—F. W. A.

Silicates of the system $2FeO,SiO_2+2CaO.SiO_2$; Artificial preparation, fusibility and other properties of ——. B. Sélivanoff. Rev. Soc. Russe Métall., 1915, **11**, 328. Rev. Mét., 1915, **12**, Extraits, 309—318. (See also this J., 1916, 112.)

Mixtures of pure silica, lime, and iron peroxide containing 60 % FeO, were melted in an iron crucible in a cryptol electric resistance furnace, and cooling curves taken. The cooled product was in each case analysed, and from the results obtained the equilibrium diagram was constructed. Fe_2SiO_4 melts at about 1260° C.; there is a maximum at about 1260° C. corresponding to the combination $2Fe_2SiO_4.3Ca_2SiO_4$, and between these two points there is a eutectic point at about 33 % (molecular) Ca_2SiO_4 and about 1160°C. Heated in a current of hydrogen, reduction began at the following temperatures:—

Fe_2SiO_4	100%	85%	65%	50%	40%	30%
Temp., ° C.	225	210	205-210	170	180	250

—T. St.

Asbestos from South Africa. Bull. Imp. Inst., 1915, **13**, 557—558.

Two samples of blue crocidolite asbestos were examined, viz., a small one, free from rock impurity, with fibres varying in length up to 1½ ins., and a larger one containing a considerable amount of rock impurity. The chief market for crocidolite asbestos hitherto has been in Germany, and the demand for it in the United Kingdom is somewhat limited in comparison with that for white chrysotile asbestos. The samples were valued at prices ranging from £28 to £50 per ton, according to the length and colour of the fibres.—A. S.

Hydrazoic acid [azoimide]; Two important analytical reactions of ——. F. Sommer and H. Pineas. Ber., 1915, **48**, 1963—1969.

A gasometric method for the determination of azoimide is based upon its conversion, even in dilute solution, into nitrogen and water on treatment with ceric salts, according to the equation, $2N_3H + 2CeO_2 = 3N_2 + H_2O + Ce_2O_3$. The reaction is complete at the end of a minute and proceeds either in neutral or acid solution. Cerium ammonium nitrate is most conveniently employed, but in presence of much chlorine ion, ceric sulphate must be used and free hydrochloric acid removed by the addition of sodium acetate, otherwise chlorine may be evolved along with the nitrogen. The mutual decomposition of nitrous acid and azoimide may be utilised for the determination of the former, a known excess of a solution of sodium azide being added to the nitrite, and the mixture acidified with acetic acid when the following reaction occurs :—$N_3H + HNO_2 = N_2 + N_2O + H_2O$. After two minutes the solution is rendered alkaline, boiled to expel nitrous oxide, and the excess of azide determined by the cerium method above. Since the decomposition of nitrous acid occurs quantitatively, even in dilute solution, and without any possibility of the formation of nitric acid, the method is also available for the detection of nitric acid in presence of nitrous acid. The solution, to which a slight excess of sodium azide has been added, is acidified with acetic or sulphuric acid, and after some minutes the excess of azoimide boiled off, and the odourless product, which after neutralisation should give no red coloration with ferric chloride, is tested for nitric acid by the diphenylamine reaction.—G. F. M.

Hydrazoic acid [azoimide]; Oxidation of —— by iodine. F. Raschig. Ber., 1915, **48**, 2088—2092.

A neutral or acetic acid solution of sodium azide remains unaltered when mixed with a solution of iodine; on addition of a crystal of sodium thiosulphate, a vigorous gas evolution takes place, the azide being quantitatively converted into nitrogen and sodium iodide. The catalyst bringing about this reaction is not sodium tetrathionate, but an unstable compound, probably $NaIS_2O_3$, which readily parts with its iodine to the azide, with formation of sodium tetrathionate. If no azide is present the compound $NaIS_2O_3$ decomposes rapidly into iodine and tetrathionate. The course of the reaction is readily demonstrated by adding to a neutral or acetic acid solution of sodium azide (a) a solution of tetrathionate prepared by mixing equal volumes of $N/10$ iodine and thiosulphate solutions, when no gas evolution occurs; (b) a mixture of 2 vols. of $N/10$ iodine solution and 1 vol. of thiosulphate solution, when vigorous gas evolution occurs if the mixture is freshly prepared but no gas evolution if the mixture is allowed to stand 2 to 3 mins. before adding to the azide; (c) a mixture prepared by adding 2 vols. of $N/10$ iodine solution to 1 vol. of $N/10$ thiosulphate solution, the iodine being added in two separate portions of 1 vol. with a slight interval between, when no gas evolution takes place. Sodium azide is the only substance which shows this reaction, but the iodine can be replaced by bromine and the thiosulphate by sodium sulphide with similar results, the intermediate catalyst in the latter case being probably a substance NaIS. —T. C.

Chlorine; Physical constants of ——. M. Pellaton. J. Chim. Phys., 1915, **13**, 126—464.

The physical constants of chlorine prepared by the thermal decomposition of auric chloride, and carefully purified, have been determined. The critical temperature determined by the optical method was 144° C., the corresponding critical pressure being 76·1 atm. (Dewar found 83·9 atm., and Knietsch 93·5 atm.), and the density 0·573. Tables are given showing the vapour tension of liquid chlorine from —80° C. to the critical temperature, and its latent heats of vaporisation have been calculated from 0° to 144° C. Values of the dissociation tension of auric chloride were also obtained. The author concludes, as the result of the determinations, that gaseous chlorine behaves as a normal substance and that there is no question of polymerisation.—G. F. M.

Oxygen; Absorption of —— in alkali solutions, and a new absorbent for oxygen. F. Henrich. Ber., 1915, **48**, 2006—2009.

The rate of absorption of oxygen by alkaline solutions of pyrogallol and sodium hydrosulphite is influenced by the nature of the alkali employed, potassium hydroxide determining a more rapid absorption than sodium hydroxide in equivalent amount. Pyrogallol solutions should therefore always be made up with potash rather than soda. The use of hydroxyquinol instead of pyrogallol as an absorbent for oxygen is recommended on account of its more rapid absorption, better keeping properties, and activity in more dilute solutions of alkali hydroxide. To prepare the reagent, 11·4 grms. of triacetylhydroxyquinol, obtained by the action of acetic anhydride on quinone (Thiele, Ber., 1898, 1247), is suspended in 20 c.c. of water and shaken in an atmosphere of hydrogen with a strong aqueous solution of 17·5 grms. of potassium hydroxide until all is dissolved, and the resulting solution of hydroxyquinol diluted with 130 c.c. of water and introduced into the Hempel pipette.—G. F. M.

Methods of sulphate of ammonia manufacture at by-product coke-ovens. Riley. *See* IIa.

Patents.

Sulphuric acid; Concentrating ——. J. W. Leitch, Huddersfield. Eng. Pat. 1495, Jan. 29, 1915.

In a three-stage process for concentrating sulphuric acid continuously in large quantities, lead pans are used for concentrating the acid up to 75—80 %, and highly heated iron vessels for the final stage of the concentration process. The lead pans are open to the air: the iron pans are separately enclosed in a muffle type of furnace, under and over which the hot gases are circulated. The intermediate evaporating vessels may be constructed of silica, glass, porcelain, or one of the known acid-resisting iron alloys such as tantiron, duriron, or ironac. These vessels are enclosed, in order to recover the dilute acid carried away by the vapour. The pans and other vessels are arranged on the cascade principle, the flow of the hot gases and of acid being on the counter-current principle. The acid passes from the final vessel of the series with a concentration of 96—98 %. Suitable hoods over the intermediate pans collect the acid vapours, and these are led to a condensing tower. This tower can be used for the preliminary heating of the dilute acid before feeding it into the first pans of the series.—J. B. C. K.

Hydrochloric acid and the like; Furnace for making ——. W. M. Krickbaum, Cleveland Heights, Assignor to The Grasselli Chemical Co., Cleveland, Ohio. U.S. Pat. 1,167,763, Jan. 11, 1916. Date of appl., June 17, 1915.

The furnace has a circular working chamber, the outer portion of the floor of which serves as a calcining bed, whilst the central portion is in the form of a shallow pot. There is a circular heating chamber situated centrally below the floor, another above the chamber, and a third of an annular shape beneath the outer portion of the floor, traversed by heated gases which maintain that portion at a higher temperature than the centre.—E. H. T.

Metalliferous compounds and gases; Apparatus for separating and recovering —— from liquids. F. L. Wilson, Berkeley, Cal. U.S. Pat. 1,167,460, Jan. 11, 1916. Date of appl., Mar. 18, 1914.

A NUMBER of closed containers or stills are joined together in series by connecting pipes which pass from the bottom of one vessel to the top of the next, a pump and a filter being arranged between each successive pair of stills. Means are provided for charging the stills, for removing the precipitated solids together with a little liquid, for conveying this liquid mixture to the filters, and for transferring the filtrate to the next still. In the last container is a steam coil by means of which the liquid in it is boiled, and the vapours produced are passed out through a pipe into the liquid contained in the next still, and so on, the vapour passing through the series in the opposite direction to the liquid. The connections are fitted with valves for shutting off the vapours from any one of the stills when required.—E. H. T.

Phosphorus: Apparatus and process for oxidising ——. I. Hechenbleikner, Charlotte, N.C. U.S. Pat. 1,167,755, Jan. 11, 1916. Date of appl., Nov. 6, 1914.

PHOSPHATIC material, a silicious flux, and a carbonaceous substance are heated together in a furnace; the carbon monoxide and phosphorus vapour evolved are made to preheat the charge of comminuted phosphate and flux on its way to the furnace. Air or oxygen is supplied to these gases whilst they are passing through the preheating chamber, whereby the phosphorus is oxidised to phosphoric acid and the carbon monoxide to carbon dioxide. The carbonaceous material is fed directly and separately into the furnace.—E. H. T.

Phosphorus and phosphorus compounds: Blast-furnace process of producing ——. J. J. Gray, jun., Rockdale, Tenn. U.S. Pat. 1,168,195, Jan. 18, 1916. Date of appl., Sept. 7, 1915.

BY heating together in a blast furnace a mixture in suitable proportions of a natural phosphate, silica, a metal (iron), and carbon, the greater part of the phosphate is reduced to metallic phosphide and phosphorus, in a ratio dependent on the relative quantities taken. The necessary heat is obtained by the combustion of the carbon, the air supply being regulated so as to maintain a reducing atmosphere. If necessary a small quantity of a basic material may be added to render the slag more fluid.—B. V. S.

Ammonium phosphate: Process of making ——. F. S. Washburn, Nashville, Tenn., Assignor to Ammo-Phos Corporation. U.S. Pat. 1,167,788, Jan. 11, 1916. Date of appl., Aug. 17, 1915.

THE liquid obtained by treating crude phosphoric acid solution with ammonia is divided into two parts. The first is treated with steam and ammonia in excess, causing the production of di-ammonium phosphate, and the unabsorbed gases are passed into the second portion, which is capable of absorbing more ammonia than it receives, whereby the mono-ammonium salt is produced. Any uncondensed steam escaping from the second portion is utilised to preheat the first portion. The mono-phosphate liquor is then treated with steam and excess of ammonia to obtain a further quantity of the di-ammonium salt, and the di-ammonium salt is completely converted into the mono-salt by adding slightly more phosphoric acid than is needed to effect the conversion.—E. H. T.

Lead chromates; Process of preparing ——. A. S. Ramage, Buffalo, N.Y., Assignor to International Color and Chemical Co., Detroit, Mich. U.S. Pat. 1,168,417, Jan. 18, 1916. Date of appl., Apr. 16, 1915.

A LEAD-BEARING material is dissolved in an acid, and the lead is precipitated as sulphate by addition of sulphuric acid. The precipitated sulphate is washed and digested with an alkali chromate, *e.g.*, sodium bichromate, in the presence of an alkaline reagent, *e.g.*, caustic soda, during the last stage of the process. The process can be made cyclic, the solvent acid being used again for dissolving fresh portions of lead-bearing material.
—J. B. C. K.

Lead sulphate; Process for preparing ——. A. S. Ramage, Buffalo, N.Y., Assignor to International Color and Chemical Co., Detroit, Mich. U.S. Pat. 1,168,418, Jan. 18, 1916. Date of appl., Apr. 16, 1915.

ORES containing lead sulphide are roasted and then treated with nitric acid, which acts on the mixture of lead oxide, lead sulphate, and lead sulphide produced by the roasting, with evolution of nitrous fumes. The nitrous gases are combined, in presence of air, with the sulphurous acid gases from the preliminary roasting operation, and are then employed to complete the conversion of the lead oxide and of lead sulphide into sulphate. A restricted access of air is necessary during the first, and a free access of air during the later stages of the process.—J. B. C. K.

Lead arsenate: Method of manufacturing ——. E. O. Barstow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,169,114, Jan. 25, 1916. Date of appl., Aug. 1, 1912.

LEAD arsenate is produced by the reaction, in the presence of water, between arsenious oxide, a halogen, *e.g.*, chlorine, a compound, *e.g.*, an alkali, which will form a halide with such halogen, and a lead compound adapted to produce lead arsenate upon being added to a solution of arsenic acid.—J. B. C. K.

Kelp; Process for treating ——. J. W. Cheney, Los Angeles, Cal. U.S. Pat., 1,168,785, Jan. 18, 1916. Date of appl., Dec. 15, 1913.

KELP is dried and then roasted at a temperature below the incineration point, in order to drive off the volatile products. The temperature is then raised to the combustion point and the ash kept agitated during the incineration. The mineral salts are dissolved from the ash, and the salts separated from the solution by crystallisation, while the remaining liquid is used for the extraction of iodine.—J. B. C. K.

Hydrogen and carbon black: Process for the manufacture of ——. R. H. Brownlee and R. H. Uhlinger, Assignors to American Nitro-Products Co., Pittsburgh, Pa. U.S. Pat. 1,168,931, Jan. 18, 1916. Date of appl., Mar. 12, 1915.

A SUITABLE hydrocarbon is brought into contact with highly heated refractory material in absence of air, and under pressure, and the resulting mixture cooled to separate the hydrogen from the carbon.—B. V. S.

Sulphur from sulphur gases: Process for recovering elemental ——. W. F. Lamoreaux, Isabella, Tenn. U.S. Pat. 1,169,726, Jan. 25, 1916. Date of appl., Feb. 8, 1915.

GASES containing sulphur oxides are heated to the reaction temperature and then maintained in contact with incandescent carbon for a definite time, the waste heat of the outflow gases being utilised for heating the inflow gases before passing them into the reaction chamber.—B. V. S.

Reduction products of sulphurous acid and salts thereof [alkali formaldehyde-sulphoxylates]: Manufacture of ——. H. Speketer and E. Marburg, Griesheim, Assignors to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,169,365, Jan. 25, 1916. Date of appl., Feb. 2, 1914.

See Fr. Pat. 467,443 of 1914; this J., 1914, 865.

Production of nickel hydroxide [for storage batteries]. U.S. Pat. 1,167,484. *See* XI.

VIII.—GLASS; CERAMICS.

Patents.

Glass; Colouring ——. H. Rosenthal, Camden, N.J. U.S. Pat. 1,169,571, Jan. 25, 1916. Date of appl., Jan. 21, 1914.

The glass is tinted by subjecting it to light rays of short wave-lengths from an X-ray tube or other vessel containing metallic electrodes.—A. B. S.

Vitrified surfaces; Decorating ——. J. W. Hasburg, Chicago. U.S. Pat. 1,168,882, Jan. 18, 1916. Date of appl., Dec. 22, 1914.

A solution of ammoniated mercury, water, or other liquid, and an adhesive soluble in water or in the other fluid, and volatilisable below the firing temperature of the vitrifiable colours, is applied to the article to be decorated, so as to produce a paper-like surface. The vitrifiable decorative material having a vehicle repellent to the material in the first coating, is then applied and the article is fired to volatilise the undercoating and fuse the decorative material.—A. B. S.

Clay; Method of nullifying discoloration in substances such as ——. W. Feldenheimer and W. J. Gee, London. Eng. Pat. 894, Jan. 19, 1915.

Discoloration in impure substances is nullified by treating a portion of the impurity or impurities to produce from them a colouring agent which neutralises the remaining discoloration. In the case of china clay the colouring effect of iron or iron compounds is nullified by treating the clay with a very dilute solution (say less than 1 %) of potassium or sodium ferrocyanide, or other suitable cyanogen compound, whereby some of the iron is converted into Prussian blue.—W. C. H.

Clay purifiers. O. O. Erfurth, Teuchern, Saxony, and Internationale Patentverwertungs Ges. m.b.H., Berlin. Eng. Pat. 14,358, Oct. 11, 1915.

The purifier consists of two cylindrical sieves arranged in line, within which equally pitched right and left handed conveying worms work, mounted on the same horizontal shaft. The clay is introduced at a central point, and according to the direction of rotation of the shaft, is carried by the conveying worms either one way or the other and passes through one sieve, while stones, etc., collect in a receptacle at the end of the cylinder. By reversing the direction of rotation of the shaft the clay is made to pass through the other sieve, so that the first can be cleaned without interrupting the process.—W. C. H.

Refractory vitreous substances; Manufacture of ——. H. J. S. Sand, Nottingham. U.S. Pat. 1,169,681, Jan. 25, 1916. Date of appl., June 6, 1914.

See Eng. Pat. 15,629 of 1913; this J. 1914, 258.

Method of utilising waste heat in kilns. U.S. Pat. 1,167,637. *See* I.

IX.—BUILDING MATERIALS.

Concrete; Note on the destruction of —— by sulphates. A. Sartori. Chem.-Zeit., 1915, **39**, 957.

Some concrete troughs, planted with wild vine, showed on the under side after about 2 years, white, hollow structures like stalactites, and the concrete itself at several points became crumbly. Between loose lying pieces a light, moist, plastic mass resembling lime mortar was found. Chemical analysis showed that the stalactitic structures consisted mainly of calcium carbonate and sulphate, the apparently unaltered concrete was normal in composition and contained only about 1 % SO_3, while the decomposed concrete mass contained diminished quantities of silica and lime but nearly 15 % SO_3. The troughs contained a layer of peat mould at the bottom, then a layer of household rubbish, and an upper layer of vegetable mould. An aqueous extract of the peat mould contained no nitrates, a trace of chloride, and only 0·086 % SO_3 in the form of sulphates, whilst it had a very strong acid reaction. The household rubbish gave a neutral solution containing 2·44 % SO_3 in the form of sulphates, besides chlorides and small quantities of nitrates. Evidently rain water dissolved the sulphates out of the household rubbish, and in course of time, as the solution penetrated porous parts of the concrete, it combined with the lime of the cement and gave rise to the soft plastic mass found. At points where the liquid soaked through cracks in the underlying concrete, evaporation would occur and calcium sulphate would be deposited together with calcium and magnesium oxides dissolved out of the cement; the oxides would be converted by atmospheric carbon dioxide into carbonates which formed the stalactitic masses mentioned.—W. C. H.

Plaster of Paris and the effect of foreign substances. E. L. Troxell. Amer. J. Sci., 1915, **41**, 198—210.

Plaster of Paris is largely used for making casts and restoring palæontological specimens, and the experiments described were made mainly with a view to that particular use. Plaster of Paris has a tensile strength of about 400 lb. per sq. inch and is strongest when mixed with a minimum amount of water, preferably hot water at about 80° C. The tensile strength was practically unaltered when the briquettes were soaked in water and re-dried. For museum purposes bone black, raw and burnt sienna, and Venetian red are probably the most convenient pigments but decrease the strength of plaster. Liquid colours, such as ink, can be used, but do not penetrate deeply. Adhesive materials are often mixed with plaster of Paris, but on the whole do not increase the tensile strength when added to the original plaster mixture, though they give it a good smooth surface when applied to the finished plaster. Dextrin reduces the tensile strength in proportion to the amount added; gum arabic and glue also produce the same result: all three tend to decompose, and the last has the further disadvantage that it is hygroscopic and as the amount of water varies the volume increases or decreases, and lessens the grip of the plaster. Shellac must be dissolved in spirit and therefore is applied only to the surface of plaster, but gives it a good surface and increases the tensile strength. Water-glass with plaster produces an insoluble calcium silicate and sodium sulphate which forms hair-like crystals on the surface; it also diminishes the tensile strength. Magnesium oxychloride promises to be a good substitute for plaster of Paris, but is more expensive.—W. C. H.

Effect of controllable variables upon the penetration test for asphalts and asphalt cements. Hubbard and Pritchard. *See* IIa.

Patents.

Timber and other porous material ; Impregnating —— with a preservative. O. P. M. Goss, Seattle, Wash. U.S. Pat. 1,167,192, Jan. 11, 1916. Date of appl., Feb. 10, 1915.

The material is immersed in the preserving fluid contained in a closed vessel, and the fluid heated to about 230° F. (110° C.). The fluid is withdrawn and a vacuum of from 23 to 28 inches created in the vessel, the interior of which is simultaneously heated to from 150° to 230° F. (66°—110° C.) for over half an hour. The vacuum is then destroyed by re-introducing the fluid and applying sufficient pressure to force from 5 to 20 lb. of it into each cubic foot of the material ; the fluid is then re-heated for 6 hours continuously at from 200° to 240° F. (93°—116° C.) after which it is withdrawn while it is still hot and a vacuum of from 23 to 28 inches is created in the vessel.
—W. C. H.

Wood ; Method of impregnating ——. R. Lamb, New York. U.S. Pat. 1,169,944. Jan. 18, 1916. Date of appl., Feb. 17, 1915.

Wood or other porous material is subjected to steam under pressure in a hermetically sealed cylinder and then injected with the impregnating material, which is at a high temperature and at a pressure higher than that of the steam. Any surplus impregnating material is ejected by the pressure of the steam, and by creating a vacuum in the cylinder.—A. B. S.

Woods ; Process of treating ——. C. H. Shattuck, Moscow, Idaho. U.S. Pat. 1,169,289, Jan. 25, 1916. Date of appl., Sept. 12, 1914.

Wood is lightened and coloured by heating it under pressure or in a retort, in an acid liquor derived from the distillation of wood.—A. B. S.

Wood ; Method of treating —— and product thereof. J. Pinal é Icaza, Mexico. U.S. Pat. 1,169,319. Jan. 25, 1916. Date of appl., Aug. 28, 1915.

Wood or the like is impreguated with a solution of magnesium chloride having a density of at least 15° B. (sp.gr. 1·116) and then provided with a water-resistant coating containing magnesium silicate.—A. B. S.

Furnace-brick. W. J. Hillis, Assignor to Hillis-Simler Brick Co., Johnstown, Pa. U.S. Pat. 1,168,211, Jan. 11, 1916. Date of appl., Nov. 2, 1914.

The brick is composed of about 20 % of ground flint, 10 % of plastic clay, 30 % of carborundum, and 40 % of binding clay.—W. C. H.

X.—METALS ; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steels ; The gases contained in liquid ——. L. Baraduc-Muller. Rev. Mét., 1915, **12**, 804—818.

About 500 kilos. of molten Thomas steel was poured from the ladle into a preheated brick-lined vessel provided with a refractory clay cover, and the gases evolved from the steel were continuously withdrawn by means of vacuum pumps until the steel was solid. The gas was collected in portions which were measured and analysed. In one test, the steel treated weighed 550 kilos, and the total volume of gas obtained measured 1159·8 litres at 760 mm. and 20° C. This gas contained 30·5 % of carbon monoxide and 52·2 % of hydrogen. The volume of gas obtained was found to be markedly greater in damp weather, the hydrogen being derived from the moisture in the air passing through the converter.—T. St.

Pig iron production of Germany in 1915. Board of Trade J., Feb. 17, 1916.

The following table, from the "Börsen Zeitung" (Berlin) of Jan. 21, shows the production of pig iron in Germany in 1914 and 1915 :—

——	1914.	1915.
	Metric tons.	Metric tons.
Foundry pig iron	2,494,832	2,283,538
Bessemer pig iron	237,988	187,522
Thomas pig iron	9,289,989	7,244,017
Spiegeleisen	1,996,786	1,793,865
Puddled bars	370,257	278,684
Total	14,389,852	11,787,626

Copper ; The cold-working of ——. L. Guillet, Rev. Mét., 1915, **12**, 819—828.

Rectangular copper bars of 8 × 10 mm. cross-section were placed in a rectangular groove 8 mm. wide, and a hard steel bar 8 mm. wide placed on top. This was then hammered, whereby the heights of different copper bars were reduced from 10 mm. to 9, 8, 7, 6, and 5 mm. respectively. The flattened bars were then subjected to tensile and Brinell hardness tests, preliminary tests having shown that the bars were uniformly strained across the whole section. The hardness was found to increase rapidly with the degree of "working," attaining a value not far removed from the maximum with a small amount of deformation. As a measure of the degree of "working" the hardness figure has no significance except for low degrees ; the microscopic appearance is, however, an accurate index of the degree of straining, even for high values. There is no relationship in worked copper between the hardness and the tensile strength, the hardness increasing with the amount of working at a much greater rate than the tensile strength. Preliminary experiments showed that the Brinell figure for copper is not independent of the pressure or the size of ball employed ; also that the care with which the surface of the metal is prepared influences the hardness figure.—T. St.

Lead and silver ; Reactions of gases with ——. W. Stahl. Chem.-Zeit., 1915, **39**, 885—886.

Lead and oxygen :—The reaction $2PbO \rightleftarrows 2Pb + 2O$ reaches equilibrium at about 2075° C. At the temperature of the reverberatory furnace in lead smelting, the oxide is not reduced in the absence of reducing substances, and all oxygen present gradually combines with the lead without any physical solution occurring. *Lead and sulphur dioxide* :—At sufficiently high temperatures and partial gas pressure lead sulphide is formed. The reactions

$$PbS + PbSO_4 \rightleftarrows 2Pb + 2SO_2 \text{ and}$$
$$PbS + 2PbO \rightleftarrows 3Pb + SO_2,$$

which form the basis of the Kärntener reverberatory furnace smelting process, occur above 750° C., and at correspondingly higher pressure and lower temperature are reversible. Under certain conditions an intermediate basic sulphate is formed. At low temperatures (500° to 900° C.) and higher pressures (up to 850 mm.) the following reactions may occur :—

$$2Pb + 2SO_2 = PbSO_4 + PbS,$$
$$7Pb + 5SO_2 = 2(PbO.PbSO_4) + 3PbS,$$
$$3Pb + SO_2 = 2PbO + PbS,$$
$$4PbO + 4SO_2 = 3PbSO_4 + PbS,$$
$$4(PbO.PbSO_4) + 4SO_2 = 7PbSO_4 + PbS, \text{ etc.}$$

No physical solution of sulphur dioxide in lead appears to occur. No indications of the solution of hydrogen, nitrogen, carbon monoxide of

dioxide, or hydrocarbons in fused lead or silver have been observed. *Silver and oxygen* :—Oxygen is most soluble in silver at its m.pt., and the solubility decreases with the rise in temperature. A small proportion of copper in melted silver checks but does not entirely prevent spirting. *Silver and sulphur dioxide* :—The metal does not spirt on solidifying in sulphur dioxide, and the gas is apparently insoluble in fused silver. Silver sulphide is stable in melted silver, in the absence of oxidising agents. At a moderately high temperature the following reaction probably occurs :—$4Ag + 2SO_2 \rightleftarrows Ag_2SO_4 + Ag_2S$,
or in the presence of atmospheric oxygen :—
$4Ag + 2SO_2 + 4O \rightleftarrows 2Ag_2SO_4$.—C. A. M.

Zinc ores ; Occurrence and utilisation of ——. *Part I.* Bull. Imp. Inst., 1915, **13**, 611—631.

After the outbreak of war the demand for zinc increased enormously, whereas the British supply, most of which had previously come from Germany and Belgium, was considerably reduced. Very large quantities of ore were awaiting shipment in New South Wales, but the processes in use at most of the British smelting works were not suitable for this class of ore. The capacity of the works at Seaton Carew, Durham, where ore from New South Wales is smelted, is being increased, and additional zinc smelting works are being erected in Canada and in the United States. The output of ore from New South Wales would be sufficient to supply the entire demand of the United Kingdom for zinc. It has been proposed to erect large smelting works under Government subsidy to render the United Kingdom independent of foreign supplies of zinc, and a special committee has been appointed by the Secretary of State for the Colonies and the President of the Board of Trade to elaborate a scheme. The imports of crude zinc, in cakes, into the United Kingdom, during 1912–14, were as follows :

A table is given showing the production of zinc ore in different countries and a brief description of the more important occurrences in the United Kingdom, the Colonies, and India. The chief producing countries, together with the amounts produced in 1913, are :—Germany, 637,308 metric tons ; New South Wales, 506,660 ; United States, 293,847 (in 1912) ; Spain, 174,831 ; Italy, 158,278 ; Algeria, 82,256 metric tons. The most important deposits in the British Empire are those at Broken Hill, N.S.W., where by concentration and separation processes, two chief products are obtained, viz., zinc ore containing about 45 % Zn and 5 % Pb, and lead ore containing 65 % Pb, 6 % Zn, and varying quantities of silver. Except for the ore smelted at the plant of the Broken Hill Proprietary Co. at Port Pirie, S. Australia, and about 20,000 tons exported to England and smelted at the Sulphide Corporation's works at Seaton Carew, the whole of the zinc concentrates, in the past, has been sold under long-term contracts to smelters in Belgium and Germany. The enormous quantities of tailings and slimes accumulated in the earlier years when the ore was worked only for lead and silver, are now being treated by flotation processes. In the United Kingdom about 15,500 to 17,700 tons of zinc ore is produced per annum, chiefly in Cumberland, Northumberland, Isle of Man, Wales, and Dumfriesshire and Lanarkshire. Deposits of zinc ores occur in various parts of Canada, and efforts are now being made to develop the zinc smelting industry (see this J., 1915, 966). An important deposit of silver-lead-zinc ore occurs at Bawdwin, Tawnpeng State, Upper Burma, and there is a prospect of this district becoming an important producer of zinc. Zinc ore is also found in Queensland, Tasmania, New Zealand, Newfoundland, Egypt, Nigeria, Rhodesia, and S. Africa, and, associated with copper ore and galena, at Tsumeb, in the former German colony of South-West Africa (see this J., 1915, 874).—A. S.

From	1912		1913		1914	
	Tons	£	Tons	£	Tons	£
Germany	54,686	1,429,655	64,179	1,503,023	33,491	730,441
Netherlands	9,992	264,572	13,301	320,091	12,189	284,691
Belgium	57,207	1,495,850	53,500	1,291,011	27,312	615,538
France	5,983	150,879	5,915	144,921	3,183	69,876
United States	4,915	129,223	4,670	116,292	35,068	939,199
Canada	997	19,712	962	18,514	1,319	25,526
Other countries	3,188	84,239	2,477	56,826	3,297	84,536
Totals	137,268	3,574,130	145,004	3,450,678	115,859	2,749,807

In the first eleven months of 1915, the imports of crude zinc amounted to 71,145 tons, value £3,707,371, as compared with 131,271 tons, value £3,221,155 in the corresponding period of 1913.

The imports of zinc ore into the United Kingdom during 1912–14 were :—

From	1912		1913		1914	
	Tons	£	Tons	£	Tons	£
Australia	20,611	113,500	16,772	83,892	78,503	411,586
Italy	13,963	121,191	13,801	106,826	23,280	152,706
Algeria	8,707	62,429	9,302	61,821	6,929	35,662
Germany	5,004	47,742	7,169	58,227	5,190	39,938
France	3,408	31,779	4,337	28,875	3,175	20,362
Spain	8,417	44,512	6,348	27,162	6,474	29,295
Russia	21	270	315	1,443	6,436	36,737
Japan	—	—	1,190	10,020	5,191	44,380
Other countries	7,208	60,206	5,436	39,362	9,073	46,337
Totals	67,339	481,629	64,670	417,628	141,251	817,003

[Ore] flotation ; Oils and other reagents in ——. R. J. Anderson. Met. and Chem. Eng., 1916, **14**, 135—137.

There are probably now 200 ore flotation plants in active operation in the United States. Of the oils used mainly for their froth-producing properties the most successful are pine oil, eucalyptus oil, cresol, turpentine, and essential oils ; kerosene, gasoline, and a mixture of 1 part of castor oil and 4 parts of kerosene have also been used with good results. Mineral oils and tar oils are used as collecting oils, *i.e.*, mainly on account of their selective action on sulphide minerals ; in general wood creosote and oils from wood distillation give the best results with galena and zinciferous minerals, whilst coal tar products are more satisfactory in the case of copper-bearing minerals. Oleic acid has a marked power of separating silica by flotation. In experiments on an ore (60-mesh) from the Joplin district, containing pyrite and galena in a calcareous gangue, satisfactory results were obtained with a mixture of

5 parts of wood creosote. 2 of pine oil. and 0·5 part of coal tar : part of the pine oil could be replaced by soap solution. The effect of temperature was negligible. and the results were not improved by addition of sulphuric acid. Addition of alkali sulphate or ferric sulphate promoted the production of clean concentiates. and potassium bichromate "deadened" the galena. thus permitting a preferential flotation of the pyrite. Successful flotation could not be achieved in presence of ferrous sulphate or copper sulphate. —A. S.

Stibnite : Behaviour of —— in an oxidising roast. H. O. Hofman and J. Blatchford. Bull. Amer. Inst. Min. Eng., Jan., 1916. Met. and Chem. Eng.. 1916. **14,** 163—164.

On roasting stibnite in an oxidising atmosphere in an electric resistance furnace. a faint odour of sulphur dioxide was observed at 196° C.. and visible formation of antimony trioxide. with evolution of white fumes, was perceived at 336° C. The formation of the trioxide takes place slowly, but it is possible to oxidise all the sulphides slightly below 400° C.. without a large loss of antimony. Oxidation of antimony trioxide to the tetroxide begins only when all the sulphide has been decomposed.—A. S.

Antimony in roasted stibnite : Determination of ——. W. T. Hall and J. Blatchford. Amer. Inst. Min. Eng.. Feb.. 1916. Met. and Chem. Eng.. 1916. **14,** 164.

Roasted stibnite may contain unoxidised sulphide. antimony trioxide. and antimony tetroxide. To determine the total antimony. 0·25 grm. is treated with 4 grms. of tartaric acid. 2 grms. of potassium iodide. and 40 c.c. of concentrated hydrochloric acid in a trapped flask, the solution is boiled gently for 5 mins., cooled, the iodine colour exactly discharged by addition of *N*/20 thiosulphate. the solution nearly neutralised with ammonia. poured into 200 c.c. of water containing an excess of sodium bicarbonate, and titrated with *N*/10 iodine solution. Antimony sulphide is determined by dissolving in concentrated hydrochloric acid and absorbing the hydrogen sulphide in ammoniacal cadmium chloride solution. the sulphur in the precipitated cadmium sulphide being determined iodometrically. The hydrochloric acid solution from the determination of the sulphide is treated with 4 grms. of tartaric acid, diluted with 100 c.c. of water. nearly neutralised with ammonia. poured into a solution of 5 grms. of sodium bicarbonate in 200 c.c. of water. and titrated with *N*/10 iodine solution. This gives the total trivalent antimony. and by deduction from the total antimony. the amount of quinquevalent antimony is obtained. Each atom of quinquevalent antimony corresponds to 1 mol. of antimony tetroxide. and by deducting from the total antimony the quantities present as tetroxide and as sulphide. the amount present as trioxide is obtained.—A. S.

Mineral resources of Asia Minor. F. Frech. Chem.-Zeit.. 1916. **40,** 17—18, 55—56.

Brief descriptions are given of the deposits of chrome iron ore. iron and manganese ores. auriferous arsenical pyrites, mercury. copper. argentiferous zinc-lead and antimony ores. complex sulphide ores. emery stone. meerschaum. pandermite (a calcium borate). salt. petroleum. lignite. and coal. Trustworthy statistics as to the production of the various minerals are almost entirely lacking. Some of the minerals. such as meerschaum and pandermite. are peculiar to Asia Minor, and the deposits of some of the others, *e.g.*, chrome iron ore and emery stone. are of such a character that they must be classed among the most important deposits of the kind in the world. According to Schneisser the chrome iron ore deposits would suffice to meet the world's demand for a very long time. They occur in the Broussa Vilayet near Mt. Olympus. in the south-west near Denisly and Makri. and in the south-east near the Gulf of Alexandretta. Emery stone deposits occur in several places and the mineral (mostly containing 40—57 % of corundum) is mined to the extent of 17.000—20.000 tons per annum. The utilisation of the various minerals depends in the first place upon the provision of adequate transport facilities. At present only the deposits situated near ports or adjacent to the few railways can be worked profitably. apart from exceptionally rich deposits. such as the argentiferous lead-zinc ores of Balia-Maden. which. according to Simmersbach. contain 82 % Pb and 1·25—4 % Ag. The most important oil-fields are those of Gajara. Guil. Tuz-Charmati. and Zahru in the Vilayet of Mossul. and those of Hit. Ramadi. and Mendeli in the Vilayet of Bagdad. The Mendeli field extends over more than 40 kilometres. with oil coming to the surface in various places. and is probably one of the richest petroleum deposits in the world : the oil is almost identical in chemical composition with Baku petroleum. The Bagdad railway will pass through the whole of the Gajara oil-field, and will soon be completed near Mendeli. whilst there will be branch lines to the Tuz-Charmati, Chanikin. and Kasr-i-Schirin oil-fields.—A. S.

Artificial preparation. fusibility and other properties of silicates of the system. $2FeO,SiO_2+2CaO.SiO_2$. Sélivanoff. *See* VII.

PATENTS.

Iron or steel article ; Metal-coated ——. Method of applying protective coatings to metallic articles. C. Mark, jun.. and C. Mark. Evanston, Assignors to The Mark Manufacturing Co.. Chicago. Ill. U.S. Pats. (A) 1.168.663 and (B) 1.168.664. Jan. 18, 1916. Date of appl., Apr. 22, 1915.

(A) The metallic coating is an alloy. electropositive to iron. composed of Pb 92 % or less, Sb 1 to 8 (4·5). and Zn 1 to 6 (3·5) % : the percentage of antimony is always at least as high as that of zinc. (B) The article to be coated is immersed in the molten alloy. the bath being maintained at 750°—900° F. (about 400°—480° C.) and covered with a flux composed of sal ammoniac and salts of zinc and iron. to produce on the surface of the object a zinc-iron alloy on which the lead alloy is subsequently deposited. The zinc content of the bath is maintained by the periodic addition of zinc in such quantity that a portion of the latter floats upon the surface.—W. E. F. P.

Furnaces heated by oil fuel for melting metals. J. Ward. A. P. Townsend. and R. G. Forgham. Birmingham. Eng. Pats. 22.789. Nov. 20. 1914. and 7494. May 19. 1915.

An open-hearth furnace has a hydrocarbon-gas producer connected with its gas inlet. which consists of a movable chamber into which the gas mixed with heated primary air is forced under pressure through a burner, and mixed with heated secondary air admitted through inlets adjacent to the burner. A movable waste-gas flue box connected with the outlet end of the furnace leads into regenerators for heating the primary and secondary air. The body of the furnace has rockers mounted on rollers by which it is tipped sideways for pouring. The inlet and outlet ends are moved close against the furnace during the melting operation. and moved away when tilting the furnace.—W. R. S.

Annealing furnace. C. F. Kenworthy, Waterbury, Conn. U.S. Pat. 1,169,491, Jan. 25, 1916. Date of appl., Sept. 28, 1914.

The furnace comprises an externally heated annealing-chamber provided with two automatic valves, one for freeing it from steam or vapour at a certain pressure, the other for breaking a vacuum. The chamber, which contains several platforms, is fixed above a liquid tank into which the platforms can be lowered: each platform has a thermo-couple with wires protected from contact with the liquid during immersion.—W.R.S.

Tin: Process for facilitating the extraction of —— from cassiterite and oxidation products of tin. G. Michaud and E. Delasson, Montreuil-à-Bois, France. Eng. Pat. 644, Jan. 11, 1915.

A homogeneous mixture of the finely-divided ore with half its weight of fine coal or coke dust and 1—2 % of liquid fat or similar agglomerating material, is heated in a retort furnace for 10—12 hrs. at a temperature sufficient to effect reduction of tin oxide without forming a slag. After being cooled, the mixture is treated in a dust-separating apparatus to recover the finely divided metal, the latter being subsequently dissolved in hot, dilute hydrochloric acid for purification by electrolysis. Alternatively, tar is used as the agglomerant and the mixture compressed into thin plates, which, after being heated in the retort furnace, are employed as anodes in the electrolytic process. —W. E. F. P.

Metal alloy. J. H. Sayles, Sheffield. Eng. Pat. 7973, May 29, 1915.

The alloy is composed of Cu 10, Ni 8½, Zn 5, and Sn 1 parts by weight, and is preferably made by mixing the nickel, zinc, and tin together while molten, then gradually adding the copper, and finally heating the product to about 1850 F. (1010 C.). The alloy is similar to German silver in appearance and ductility, but retains its polish and colour and does not tarnish or crack when rolled or stamped.—W. E. F. P.

Copper alloy. W. C. Pease, Marietta, Ohio. U.S. Pat. 1,168,962, Jan. 18, 1916. Date of appl., Jan. 25, 1915.

The alloy contains Cu 88·4, Al 6·6, Fe 1·96, and Si 1·60 parts, with or without 1·26 parts of Sb. —W. R. S.

Copper alloys; Composition of —— and process of manufacturing the same. F. C. Frary, Minneapolis, and S. Temple, St. Paul, Minn. U.S. Pat. 1,169,392, Jan. 25, 1916. Date of appl., Sept. 22, 1915.

A hard alloy of copper with an alkaline-earth metal (calcium).—W. E. F. P.

[*Copper*] *alloy.* E. D. Gleason, New York, Assignor to New Metals and Process Co., Brooklyn, N.Y. U.S. Pat. 1,169,536, Jan. 25, 1916. Date of appl., Jan. 20, 1915.

An alloy containing approximately 99 % of copper and an appreciable amount of boron.—W. E. F. P.

Precious-metal alloy. R. J. Peschko, York, Pa. U.S. Pat. 1,169,753, Jan. 25, 1916. Date of appl., Mar. 12, 1915.

The alloy contains platinum, palladium, and an excess of gold (*e.g.*, Pt 10, Pd 30, and Au 60 parts), and 0·1—2 % of a hardening metal such as iridium.—W. R. S.

Zinc from its ores; [Electrolytically] extracting ——. F. Laist and F. F. Frick, Anaconda, Mont. U.S. Pats. (A) 1,167,700 and (B) 1,167,701, Jan. 11, 1916. Dates of appl., (A) Aug. 13, and (B) Sept. 9, 1915.

(A) A sulphide zinc ore, containing also iron, is roasted, and then leached with dilute sulphuric acid in presence of a manganese compound in a state of oxidation higher than the manganous state, or the manganese compound may be added during the roasting operation. The dissolved ferrous salt is oxidised and the ferric compound precipitated. The zinc is deposited electrolytically from the purified solution containing the manganese compound, using insoluble anodes, and the resulting acid solution containing manganese in its higher states of oxidation is again used for the extraction of zinc. (B) The solution, after oxidation of the ferrous salt, is purified by adding an excess of "calcine" in presence of manganese dioxide, and the zinc is deposited electrolytically with simultaneous regeneration of manganese dioxide.—B. N.

Blast-furnaces: Method of charging ——. A. J. Boynton, Lorain, Ohio. U.S. Pat. 1,167,883, Jan. 11, 1916. Date of appl., Aug. 21, 1915.

The raw materials used in forming the furnace burden are classified according to size, each charge being composed of materials of the same class. —W. E. F. P.

Electroplating pipes and other articles of magnetic material. Electroplating apparatus. N. W. Buch, New Castle, Pa., Assignor to Safety Armorite Conduit Co., Pittsburgh, Pa. U.S. Pats. (A) 1,168,280 and (B) 1,168,281, Jan. 18, 1916. Date of appl., June 23, 1913.

(A) Several articles are stacked in prearranged position, and a lifting frame, having portions magnetised by a current and acting as cathodes suitably spaced apart, is brought over them, thus causing the articles to adhere to the magnetised portions. The suspended articles are moved into the bath, coated, then removed, and the current cut off to release them. (B) A cathode member is supported longitudinally within the electrolyte in a tank, above and at a distance from the anodes, so as to leave a passage between the electrodes for the articles to be coated. The cathode member is magnetised by electromagnets, and the articles, whilst suspended from the under side of it, are moved through the electrolyte by a conveyor, the space below the articles being unobstructed to the passage of current to the articles.—B. N.

Bimetallic composite objects or bodies; Process of manufacturing ——. H. Seidler, Berlin-Dahlem, Germany. U.S. Pat. 1,168,752, Jan. 18, 1916. Date of appl., Aug. 16, 1915.

A metal of lower melting point is applied in the molten state to a solid body of higher melting point, and the whole is first heated to the welding temperature of the body-metal, and then allowed to cool slowly in such a manner that the enveloping metal, in solidifying and contracting, subjects the body-metal to high pressure.—T. St.

Ore-reducing process. L. S. D. Roylance, San Francisco, Cal. U.S. Pat. 1,168,678, Jan. 18, 1916. Date of appl., Jan. 26, 1915.

The ore is simultaneously scoured and subjected to electro-chemical action to disintegrate it, and the resulting pulp, after being neutralised, if necessary, is amalgamated.—W. R. S.

Ores [finely-divided]; Desulphurising and smelting ——. Apparatus for and process of ore treatment. Apparatus for sintering and smelting ores. A. S. Dwight, New York. U.S. Pats. (A) 1,169,069, Jan. 18, 1916. Date of appl., June 25, 1908; renewed May 12, 1913. (B) 1,169,139, Jan. 25, 1916. Date of appl., June 30, 1911. (C) 1,169,381, Jan. 25, 1916. Date of appl., Mar. 31, 1910; renewed June 12, 1915.

(A) A continuous stream of the finely-divided ore is roasted and sintered whilst on the upper surface of an endless-band conveyor, and the resulting porous cake is fed continuously, through a side opening, beneath the burners or tuyères of an adjacent horizontal smelting hearth. (B) A closed, vertical chamber, having inlet and outlet pipes for reducing gases below and above a horizontal grate, is interposed between the sintering and smelting parts of the apparatus, a current of reducing gas being thus caused to pass through the hot cake before smelting. (C) The smelting is conducted in an electric furnace, terminals adapted to contact with the top and bottom of the travelling cake being disposed between the sintering and smelting parts of the apparatus, so that the projecting end of the cake within the furnace is converted into a horizontal electrode.—W.E.F.P.

Sulphides; Treating metallic ——. U. Wedge, Ardmore, Pa. U.S. Pat. 1,169,444, Jan. 25, 1916. Date of appl., June 5, 1913.

The material is subjected, at a temperature sufficient to vaporise the sulphur, to an atmosphere which will oxidise the metal but not the sulphur, and the resulting oxide is converted into metal in a reducing atmosphere at a suitable temperature. The process is carried out in a vertical cylindrical furnace of the multiple-hearth type subdivided into two zones in which the two reactions take place in succession.—W. R. S.

Volatilising ores: Process of ——. S. I. Clawson, Salt Lake City, Utah. U.S. Pat. 1,169,530, Jan. 25, 1916. Date of appl., May 24, 1911.

The crushed ore is treated in a closed heated chamber with chlorine and an inert carrier gas, such as nitrogen. The resulting gases are passed through a closed fume arrester where the bulk of the volatile compounds is deposited, while the nitrogen carrying the remainder is mixed with fresh chlorine and returned to the volatilisation chamber.—W. R. S.

Furnaces for melting metals; Open-hearth ——. E. Bosshardt, Emmenbrücke, Switzerland. Eng. Pat. 2621, Feb. 16, 1915. Under Int. Conv., Mar. 13, 1914.

See U.S. Pat. 1,164,983 of 1915; this J., 1916, 260.

Ores: Apparatus for the treatment of ——. E. Langguth, Neerpelt, Belgium. U.S. Pat. 1,169,270, Jan. 25, 1916. Date of appl., Oct. 4, 1912.

See Ger. Pat. 244,535 of 1911; this J., 1912, 524.

Drying air for metallurgical uses; Method of ——. W. Wense, Griesheim, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,169,371, Jan. 25, 1916. Date of appl., June 13, 1912.

See Fr. Pat. 444,365 of 1912; this J., 1912, 1134.

Oxidation of smooth iron surfaces: Process for the ——. B. Guerini, Brescia, Italy. U.S. Pat. 1,169,397, Jan. 25, 1916. Date of appl., May 10, 1915.

See Eng. Pat. 7097 of 1915; this J., 1915, 1149.

Sherardising; Process of ——. E. F. Collins and J. A. Capp, Schenectady, N.Y., Assignors to General Electric Co. U.S. Pat. 1,169,529, Jan. 25, 1916. Date of appl., Mar. 17, 1914.

See Eng. Pat. 9367 of 1914; this J., 1915, 234.

Process of modifying the ash resulting from the combustion of powdered fuel. Process of protecting metal articles heated by combustion of powdered coal. U.S. Pats. 1,167,470—1,167,472. *See* IIa.

XI.—ELECTRO-CHEMISTRY.

Storage cells; Regeneration of sulphated ——. G. A. Perley and C. W. Davis. J. Phys. Chem., 1916, 20, 164—167.

Grids of sulphated storage cells may be reduced in whole or in part by a solution of sodium sulphate, sodium carbonate, sodium phosphate, or sodium sulphite. The rate of reduction is most rapid and the anode corrosion least with sodium sulphate; a $N/1$ solution of this salt is used and dummy positive grids on the outside of the negative plates shorten the time of reduction. With sodium phosphate the rate of reduction is quite rapid but there is perceptible anode corrosion, while with sodium sulphite a hard crystalline deposit of lead is formed which causes buckling of the grids. Hydrolysis of the lead salts in solution when using sodium hydroxide gives large and troublesome quantities of lead monoxide and the active material of the grids is removed to a considerable extent. (See also page 307.)
—W. G. C.

Electrolysis of the alkali salts of aliphatic sulphocarboxylic acids. Fichter and Lichtenhahn. *See* XX.

Electrically heated bomb furnace. Calhane and Levene. *See* XXIII.

Patents.

Air or gas: Treatment of —— *with an electric arc.* M. R. A. Samuel, London. Eng. Pat. 1670, Feb. 2, 1915.

The arc furnace, or an extension of it, is immersed in a liquid seal, the furnace being closed except for an opening near the bottom for the supply of air; the working pressure may be varied by varying the head of liquid. Air may also be passed through the liquid seal for cooling the treated gases.—B. N.

Carbon electrodes; Manufacture of ——. G. Mendheim, Munich, Germany. Eng. Pat. 3442, Mar. 3, 1915. Under Int. Conv., Mar. 4, 1914.

Moulded carbon or carbonaceous matter, agglomerated with tar, is baked in a series of oven chambers, which are provided with a channel for collecting the tar vapours, and the latter are used as fuel.—B. N.

Nickel hydroxide [for storage batteries]; Production of ——. T. A. Edison, Assignor to Edison Storage Battery Co., West Orange, N.J. U.S. Pat. 1,167,484, Jan. 11, 1916. Date of appl., Apr. 8, 1911.

Nickel hydroxide is precipitated by mixing a solution of a nickel salt and an alkali hydroxide in considerable excess of the amount necessary to effect complete precipitation. The precipitate, together with the excess of alkali and some or all of the soluble reaction product, is evaporated to a creamy consistency, and the mixture then slowly dried. The excess of alkali and the soluble reaction product are removed by washing and the residue dried.—B. N.

Storage battery. T. A. Edison, Assignor to Edison Storage Battery Co., West Orange, N.J. U.S. Pat. 1,167,485, Jan. 11, 1916. Date of appl., Apr. 30, 1912.

The electrode is formed from a perforated tubular receptacle of conducting material, packed with cerium oxide and flake nickel in alternating layers, to form the active material for the depolarising element of an alkaline storage battery.—B. N.

Electrolytic cell. L. E. Porter, Los Angeles, Cal., Assignor to H. E. Stock, Casper, Wyo. U.S. Pat. 1,167,594, Jan. 11, 1916. Date of appl., May 11, 1914.

A CYLINDRICAL metal cathode is provided with a series of insulating strips on its outer surface, dividing it into a series of rectangular areas, and is surrounded by a porous diaphragm, which in turn is enclosed in a cylindrical insulating shell. The latter, which is provided with a series of anode conductors, is rotated on a horizontal axis, the ends of the shell making a tight joint with the shell itself and forming a stuffing-box casing about the diaphragm. A tight joint is maintained between the end of the cathode and the diaphragm, by packing placed inside the stuffing-box casing and compressed about the diaphragm. Liquid is conducted into and out of the shell by swivelled pipes, passing through one of the ends and through the wall of the cathode.—B. N.

Cathode for electrolytic cells. F. McDonald, Roaring Spring, Pa. U.S. Pat. 1,167,705, Jan. 11, 1916. Date of appl., Aug. 5, 1915

THE upper ends of the graphite plates serving as cathodes are rabbeted and the portion below the rabbet on each plate is provided with transverse slots. The reduced upper ends of the cathodes are connected by a bus-bar, and insulating gaskets are arranged between the plates.—B. N.

Electric battery. F. S. Bandeira de Mello, Rio de Janeiro, Brazil. Re-issue No. 14,051, Jan. 25, 1916, of U.S. Pat. 1,148,152, July 27, 1915. Date of appl., Nov. 20, 1915.

SEE Eng. Pat. 24,471 of 1913; this J., 1914, 601.

Gas reactions in an electric furnace; Method of carrying out ——. A. Helfenstein, Vienna. U.S. Pat. 1,169,817, Feb. 1, 1916. Date of appl., Nov. 18, 1911.

SEE Fr. Pat. 436,828 of 1911; this J., 1912, 499.

Carbon electrodes; Process of burning ——. F. Nagelschmitz, Assignor to G. Mendheim, Munich, Germany. U.S. Pat. 1,170,313, Feb. 1, 1916. Date of appl., Feb. 15, 1915.

SEE Eng. Pat. 3442 of 1915; preceding.

Treatment of mercury sludge formed in the production of acetaldehyde by passing acetylene into acid solutions of mercury salts. Eng. Pat. 10,140. *See* XX.

Thermo-electric couple. U.S. Pat. 1,169,611. *See* XXIII.

XII.—FATS; OILS; WAXES.

Copra from Queensland. Bull. Imp. Inst., 1915, **13**, 550—552.

A SAMPLE of copra from the Kamerunga State Nursery, Cairns, North Queensland, contained 4·4 % of moisture and yielded 64·6 % of oil of good quality. Since the outbreak of war, several British firms have undertaken the crushing of copra and there is now a good market for copra in the United Kingdom. Queensland copra, if dried so that it contained not more than 3 % of moisture, could be sold readily in London at good prices. The area under the coconut palm in Queensland was 549 acres in 1913 as compared with 365 acres in 1912. In 1912, 31 tons of copra was produced.
—A. S.

Fish-liver oils; Hydrocarbons in ——. H. Mastbaum. Chem.-Zeit., 1915, **39**, 889.

EXPERIMENTS undertaken to elucidate a case of alleged heavy adulteration of fish-liver oil with mineral oil, showed that the oils obtained from the livers of certain large fish may contain 80—90 % of unsaponifiable oil. Oils prepared by the author from the liver of *Centrophorus granulosus* (Portuguese, Barroso) and of *Scymnus lichia* (Port., Carocho) had the following characters, respectively:—Sp. gr. at 15°/15 C., 0·8637, 0·8711; butyro-refractometer reading at 25° C., 102, 93; optical rotation in 200 mm. tube, —0·3°, —2·33°; saponif. value, 15·1, 36·7; acid (calculated as oleic acid), 0·097, 0·165 %; the Barroso oil was still liquid at —7° C., and the Carocho oil began to become turbid at that temperature. The unsaponifiable oil from the Carocho oil began to distil at 205° C., and yielded nearly 70 % between 205° and 330° C.; the distillate was at first colourless and later yellow; the residue in the distilling flask solidified to a dark mass resembling paraffin wax.—A. S.

Vegetable oils; Customs examination of —— by means of the hydrometer. E. Fischer. Chem.-Zeit., 1915, **39**, 975—977.

THE surface tension of the majority of commercial vegetable oils is practically the same; the capillarity constants at 18° C. average 3·58, practically the same as for the heavy mineral oils. Hence the same hydrometer may be used for these oils as for mineral oils. The coefficients of expansion also differ very slightly, and when working at a temperature different from 15° C., the same correction factor can be used, viz., ±0·00007 for each 1° C.—F. W. A.

Fats; Detection of —— by means of Schiff's reagent. M. François. J. Pharm. Chim., 1916, **13**, 65—77.

THE reaction of acrolein with Schiff's reagent (this J., 1915, 248) is distinctive, and may be used as a test of the presence of glycerol or glycerides. About 1 grm. of the substance is mixed with 10 grms. of fine sand and heated for 10 mins. over a Bunsen flame. The vapours are led into a second tube containing 3 c.c. of Schiff's reagent, prepared by mixing 220 c.c. of water recently saturated with sulphur dioxide, 30 c.c. of 0·1 % aqueous magenta solution, and 3 c.c. of sulphuric acid (sp.gr. 1·84). After standing for 5 mins. for the red coloration characteristic of aldehydes to develop, this second tube is immersed for 15 mins. in boiling water, and again cooled for 5 mins. If the original substance contained glycerides an indigo-blue coloration will be observed. No such reaction is given by fatty acids, waxes, colophony, vaseline, tolu balsam, or indiarubber. The formation of the red coloration by aldehydes with Schiff's reagent is attributed to the production of a coloured sulphonation derivative containing the carbon chain of the aldehyde. The subsequent blue coloration with acrolein appears to be due to the fixation of H_2SO_3 on to the ethylenic bond with the formation of a new sulphonic grouping.
—C. A. M.

Philippine oil nut; New ——. U.S. Comm. Rept. No. 303, Dec. 28, 1915.

A NEW oil nut has recently been received from Catanduanes and identified by the Bureau of Science as *Chisochiton cumingianus* (Harms), natural family *Meliaceæ*; the nut produced 45 % of a dark, fatty, non-drying oil that made very good soap. The fruit grows in very large numbers on large forest trees, each fruit containing four seeds or "nuts." The Philippine Manufacturing Co., of Manila, has used two shipments of the nuts for soap, with satisfactory results. Over 30 years ago this oil was largely used as an illuminant, but when petroleum was introduced it was gradually abandoned and has apparently been lost sight of.

Patents.

Reduction of organic compounds [e.g., fatty acids and esters]. E. B. Higgins, Wallasey, Cheshire. Eng. Pat. 4665, Feb. 23, 1914.

By the action of formates and similar compounds (see Eng. Pat. 23,377 of 1912; this J., 1913, 989), reduction is effected without heating under pressure. For example, cottonseed oil may be reduced by heating at 210° C. with 60% of its weight of nickel formate, air being excluded.
—B. V. S.

Oil or the like; Apparatus for extracting —— from materials, by means of a volatile solvent. C. Downs and R. A. Bellwood, Hull. Eng. Pat. 2238, Feb. 11, 1915.

The material is extracted in a rotating drum provided with one or more openings in addition to those in the trunnions, for the rapid escape of the vaporised solvent, steam, and air. These openings may be diametrically opposite apertures, which are normally closed, but the uppermost of which can be readily connected, when the drum is at rest, with the condenser, *e.g.*, by means of a vertical pipe sliding in a joint.—C. A. M.

Oil from seed, meal and the like; Apparatus for expressing —— and for simultaneously producing cattle-feeding cake. C. Benson, jun., Kingston-upon-Hull. Eng. Pat. 11,311, Feb. 8, 1915.

In the type of press claimed in Eng. Pat. 18,270 of 1914 (this J., 1915, 970) the metal mould box is open at the front and top, and has a thick metal base a portion of which projects beyond the walls, and is grooved to receive the upper portion of the walls of the box next below, as the boxes are moved upwards by the ascending ram of the press. The mould in which the material is placed is preferably made of aluminium, or tinned iron, etc., and has its walls in one piece and connected to the base by means of hinges, so that they can be raised independently of the bottom. The upper surface of the base is ribbed in such a way as to give the effect of "bagging" to the press-cake, and a similar ribbed plate is attached to the under side of the base of the mould box. The bottom of the mould projects beyond the walls and end, and is grooved to receive these, while the walls have an inward projection on which will rest the ends and sides of the cake, so that when the walls are raised the cake is lifted off the bottom of the mould.—C. A. M.

Oil; Method of refining ——. G. M. Holbrook, Assignor to Armour and Co., Chicago, Ill. U.S. Pats. (A) 1,169,154 and (B) 1,169,155, Jan. 25, 1916. Date of appl., Nov. 15, 1915.

(A) Crude cottonseed oil, etc., containing about 1% of free fatty acids, is agitated with a mixture of about 4% of its weight of an aqueous solution of caustic alkali (sodium hydroxide solution of 18° B.) and about 0·75% of a silicate solution (sodium silicate solution, 44° B), the temperature being gradually raised until the soap stock settles. The proportions of the mixture are such that the caustic alkali neutralises wholly or in part the free fatty acids before the silicate fixes the colouring matter of the oil. (B) The free fatty acids are substantially neutralised with caustic alkali prior to the treatment of the oil with a mixture of caustic alkali and silicate as described in (A). The temperature is gradually raised to about 115° F. (46° C.) and the refined oil separated from the resulting soap-stock.
—C. A. M.

Glycerin; Production of ——. H. B. Stocks, Birkenhead. Eng. Pat. 5469, Apr. 12, 1915.

The yellow tint of partly purified glycerin is corrected by the addition of a trace of a complementary colouring matter, such as Methyl or Ethyl Violet.—C. A. M.

Albuminous products from the residues obtained in oil manufacture. V. Grafe and K. Peche, Vienna. U.S. Pat. 1,169,634, Jan. 25, 1916. Date of appl., Mar. 23, 1915.

The residues are saponified with hot alkali, the soap solution neutralised, and the precipitated proteins separated and washed.—C. A. M.

Sulpho-fatty-aromatic acid salt. E. Twitchell, Wyoming, Ohio. U.S. Pat. 1,170,468, Feb. 1, 1916. Date of appl., Jan. 29, 1913.

See Fr. Pat. 456,956 of 1913; this J., 1913, 1118.

Process of solidifying emulsion products. U.S. Pat. 1,167,373. *See* XIa.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Utilisation of wood waste. Little. *See* V.

Patents.

Resin soap; Method of and apparatus for preparing dilute solutions of ——. J. A. De Cew, Montreal, and R. J. Marx, London. Eng. Pat. 2142, Feb. 10, 1915.

Rosin soap containing free rosin is heated in a closed tank under a pressure which subsequently forces it through small apertures into an aqueous medium at a lower temperature. Emulsification is thus effected at the point of contact of the soap and the water.—C. A. M.

[*Artificial resin.*] *Composition of matter and process of making same.* B. B. Goldsmith, New York. U.S. Pat. 1,168,626, Jan. 18, 1916. Date of appl., Jan. 10, 1913.

A phenol is heated with a definite formaldehyde compound of an amine (anhydroformaldehyde-aniline), until a resinous mass is produced. Any aniline produced in the reaction is separated from the remainder of the mass.—E. W. L.

Process of preparing lead chromates. U.S. Pat. 1,168,417. *See* VII.

Process of preparing lead sulphate. U.S. Pat. 1,168,418. *See* VII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Determination of free sulphur in commercial antimony sulphides. Hutin. *See* VII.

Patents.

Rubber substitute and process for manufacturing same. G. M. Boddy, London. Eng. Pat. 2669, Feb. 19, 1915.

Kapok, 1 oz., is mixed with cottonseed oil, 10 oz., and to the mixture is added a solution of sulphur chloride, $\frac{3}{4}$ fluid oz., in paraffin, $\frac{3}{4}$ fluid oz. The mixture is stirred and allowed to stand for about 14 hrs., when a further quantity of sulphur chloride, 1 oz., dissolved in paraffin, 1 oz., is added. The mixture becomes hot and fumes; it is stirred and allowed to cool, when it solidifies and can be cut out from the containing vessel. It may then be mixed with rubber and other ingredients, the mixing being afterwards vulcanised in the usual way.—E. W. L.

Rubber or similar material: Machines for reducing —— to an impalpable powder. C. E. Gardner, Gloucester. Eng. Pat. 10,015, July 9, 1915.

The rubber is forced against the periphery of the abrading cylinder by means of a mechanical feed arrangement, consisting of a travelling band provided with a toothed or roughened surface, forming the bed, and a set of three or more pairs of adjustable pressure rollers, which can be tilted to compensate for inequalities of thickness. The abrading cylinder is provided on its periphery with a series of saws; the interspaces between the saws are provided with openings communicating with the interior of the cylinder, in which are arms acting as fan blades, and arranged so as to produce a continuous current of air inwards through openings in the ends of the cylinder, and outwards through the openings between the saws. This arrangement serves to keep the cylinder cool. Mechanism is provided for producing a longitudinal oscillation of the cylinder, at right angles to the direction of feed of the material. The whole is surrounded by a casing, from which the rubber dust is drawn off and collected in a cyclone apparatus, any unreduced portions falling into a receptacle at the bottom of the casing.—E. W. L.

Rubber: Process of recovering —— from vulcanised rubber waste. G. Staunton, Muskegon, Mich. U.S. Pat. 1,168,230, Jan. 11, 1916. Date of appl., June 20, 1912.

The waste material is finely divided, mixed with a dry powdered reagent having chemical affinity for the vulcanising agent in the rubber, and the mixture is heated by means of dry heat to a temperature not exceeding 300° F. (150° C.)
—C. A. M.

Rubber; Process of devulcanising ——. G. Staunton, Muskegon, Mich. U.S. Pat. 1,169,437, Jan. 25, 1916. Date of appl., June 13, 1914.

Ground rubber waste is mixed with dry powdered potassium carbonate and the mixture, spread out in thin layers, is exposed to the direct action of steam at a pressure of 60 lb. or less.—E. W. L.

XV.—LEATHER; BONE; HORN; GLUE.

Chrome solutions; [Determination of] basicity of one-bath ——. F. N. Harrap and H. Hayes. Collegium (London), 1915. 305—312. J. Amer. Leather Chem. Assoc., 1916, 11, 66—71.

The determination of the basicity of a one-bath chrome liquor (*i.e.*, the ratio of the chromium to the sulphuric acid combined with it) involves the estimation of chromium and of the sulphuric acid present in the hydrolysable basic salt. The chromium is usually estimated by oxidising to chromate, then acidifying and adding potassium iodide, and titrating the liberated iodine with sodium thiosulphate solution. Six methods have been proposed for the estimation of the hydrolysable sulphate: (1) The Procter-McCandlish method (this J., 1907, 458), in which the boiling liquor is titrated with $N/2$ sodium hydroxide, using phenolphthalein (3—4 c.c. of 1% solution) as indicator; (2) boiling the liquor with excess of standard sodium hydroxide solution, according to Körner, and titrating back the clear liquor with acid; (3) Alden's method, where sodium carbonate is substituted for the hydroxide used by Körner; (4) Stiasny's method (this J., 1907, 540), by which the chrome liquor is boiled with a mixture of potassium iodide and iodate and sodium thiosulphate, and the excess of thiosulphate determined with iodine solution: (5) Bateson's method (this J., 1911, 38), in which the solution is boiled with excess of ammonia to form ammonium sulphate, treated with formaldehyde to liberate free sulphuric acid, which is then titrated; and (6) Kopecky's method (this J., 1907, 213) of boiling the chrome liquor with magnesium carbonate, filtering, and estimating the magnesium in solution. Kopecky's method is very tedious, and Alden's very like that of Körner, and neither was used by the authors. The other four methods tried with the same chrome liquor gave results varying from $Cr/SO_4 = 52/113$ (Bateson) to 52/140 (Körner). The Procter and Stiasny methods gave 52/116 and 52/121 respectively. The high result given by Körner's method is due to adsorption of sodium hydroxide by the precipitated chromic hydroxide, the error being greater with greater excess of sodium hydroxide, but always present. The Procter method (which is much the simplest and most rapid), probably gives results slightly too low, owing to the precipitation of some insoluble basic sulphate with the hydroxide. Results by the Stiasny method are probably rather too high, owing to impurities in the iodide and iodate which react with the thiosulphate, and also to decomposition and loss of thiosulphate on boiling. The Bateson method does not give good results if amino-acids are present, as in old liquors, and is quite inapplicable if ammonium salts are present.
—F. C. T.

Tan liquors; Fermentation of ——. H. Kuhl. Ledertechn. Rundschau, Sept. 2, 1915. J. Amer. Leather Chem. Assoc., 1916, 11, 85—86.

Butyric fermentation often takes place in old liquors, causing the leather to be less firm than is desirable. It is therefore uneconomical to use such liquors again after strengthening, but better to use relatively fresh liquors. Putrefactive bacteria may be introduced into tan liquors by hides that have been unhaired by sweating and afterwards insufficiently washed, though growth of the bacteria is hindered by acid in the liquors. Tanning materials extracted with a culture of lactic acid organisms give a notably better yield than when extracted with water alone, and a tanning process involving the use of materials fermented by a mixture of water and whey has been patented, for which a 60% saving in tannin and a brighter coloured leather have been claimed. If, however, it is desired to work with liquors in which acids are produced by fermentation, it is best to ferment by pure cultures.—F. C. T.

Patent.

Hides and skins: Preparing —— for tanning processes. E. D'Huart, Luxemburg. U.S. Pat. 1,170,426, Feb. 1, 1916. Date of appl., June 18, 1914.

See Eng. Pat. 23,841 of 1913; this J., 1914, 326.

XVI.—SOILS; FERTILISERS.

Soils; Relation between certain bacterial activities in —— and their crop-producing power. P. E. Brown. J. Agric. Res., 1916, 5, 855—869.

A series of experiments extending over several years was undertaken to ascertain if the crop yield of a soil bore any relation to the processes of ammonification, nitrification, and azoification (nitrogen fixation by azotobacter) taking place within it, in the hope of discovering a practical means of testing and of predicting soil fertility from laboratory tests. In 1907, fourteen plots ($\frac{1}{10}$ acre) of Carrington loam soil (Wisconsin) were laid down to cultivation as follows, corn (maize) and oats being used for the 2-year rotation, and the same plus clover for the 3-year rotation : (*a*) continuous corn, (*b*) 2-year rotation, (*c*) 3-year rotation, (*d*) 2-year rotation with clover ploughed in after the corn, (*e*) 2-year rotation with cowpeas turned under, (*f*) 2-year rotation with rye as green manure, (*g*) continuous clover, and (*h*) 4-year rotation—corn, corn, oats, clover. The soils were first investigated in 1911, when under corn. The ammonifying power of the soil samples, which were taken on four different dates, was found by determining the extent to which the nitrogen in dried blood, in cottonseed meal, and in casein could be converted into ammonia : dried blood and ammonium sulphate were used for the nitrification tests, and mannitol, to determine the activity of the azotobacter. The difference in moisture content of the various samples was in every case inappreciable. The ammonification, nitrification, and azoification results were in complete accord with the crop yields, which were, in ascending order of magnitude : *e*, *a*. *f*. *b*, c, *d* ; and the individual ammonification, etc., results showed only slight differences. The superiority of crop (*d*) over crop (*e*) was not in accord with the laboratory determinations, but the discrepancy was very small. The results for 1912 were similar, the yields, etc., in this case being in the order : *a*, *f*, *b*, *h*, *c*, *e*, *d*. In 1913, ammonification tests only were performed, but the result was the same —bacterial activity varied directly with crop-producing power. The fact that both varied in order in the three successive years is explicable on the ground of seasonal variation, particularly rainfall ; and the variation in the effects of 2-year and 3-year rotations is ascribed to the same cause. Five similar plots placed under cultivation in 1907 were manured in 1910 with 8, 12, 16, 20, and 0 tons of manure per acre, and the soils investigated in 1912 when under corn. It was found that manuring increased the ammonifying, nitrifying, and crop-producing powers to the same extent, 16 tons per acre giving the best result. The crop yields were 77·62, 86, 87, 81, and 50·5 bushels per acre, respectively. On a third series of plots ($\frac{1}{10}$ acre) the effects of liming were investigated, the dressings being at the rate of 2, 3, and 0 tons of ground limestone per acre, and applied before the corn was sown. The crop yields—55, 55, and 52·5 bushels—were in accord with the ammonification and nitrification tests. It is concluded that the bacterial conversion of organic nitrogen into ammonia and nitrate is considerably affected by the method of soil treatment adopted, and that the ammonification and nitrification tests indicate accurately the crop-producing power of a soil.—E. H. T.

Sand and vegetable soil ; Presence of a moisture-resisting film at the surface of particles of——. H. Devaux. Comptes rend., 1916, **162**, 197—199.

Sand, when dry or very slightly moist, tends to float upon water, but sinks at once if moistened to the extent of 1 % or more, or after ignition. Floating is accompanied by imperfect wetting of the grains, and is attributed to the presence of a superficial impurity, which is expelled on heating and is more or less completely given up at the surface of water, where it may be detected owing to its low surface tension. Fine soil, especially humus, exhibits the same phenomena in a striking manner, and clay possesses similar properties, but in a very small degree.—F. Sodn.

Boron : Absorption and distribution of —— in plants, and its effect on growth. F. C. Cook. J. Agric. Res., 1916, **5**, 877—890.

Pot and plot experiments were undertaken at Arlington Farm, Vancouver, in order to test the effect upon plant growth of horse-manure that had been treated with calcined colemanite or with borax to kill the larvæ of the house fly (see this J., 1915, 675) ; the soils were mostly treated with more material than was necessary to ensure the larvicidal effect. The boron absorbed by the plant was determined by digesting the dried sample with lime water, drying, burning off the organic matter, leaching with dilute hydrochloric acid, immersing strips of curcumin paper in the extract, and comparing the coloration obtained with that produced by immersion in boric acid solutions of known strength. The manner of combination of the boron found in plants is unknown : in soils, some of it is present as insoluble silica compounds, but most of the soils used contained boron that was removed by hydrochloric acid. The amount of this element absorbed by plants was practically the same whether borax or colemanite was used, and the addition of lime did not appreciably affect the absorption. Leguminous and succulent plants absorb most, wheat and oats very little. Greenhouse pot tests on wheat, beets, cowpeas, and tomatoes, showed that the boron taken up was chiefly concentrated in the tops of the plants, but beets contained a considerable amount in the roots. The fruit of the cowpea contained large quantities (0·01—0·02 % of boron as boric acid on an ash-free basis), and in this case the absorption was diminished by lime ; tomatoes contained only very small traces. The amount absorbed by lettuce varied directly with the amount present in the soil. Mature potatoes, grown in the open, contained a little boron in the tops but much more in the roots and tubers. String beans, soya beans, and cowpeas were very sensitive to boron dressings and the element was found more equally distributed in them than in other plants. With radishes, the tops contained much more than the leaves. Wheat, maize, peas, and oats grown in the open in Louisiana and Texas, all absorbed boron, particularly the wheat : all the control plants contained the element. A wheat crop grown at Arlington on soil dressed with manure containing 3—4 times the amount of borax necessary to act as larvicide, amounted to 90 % of that obtained with untreated manure : the grain was healthy and contained only a trace of boron. In several cases the borax-treated soils were richer in nitrite and nitrate than the untreated soils. It is recommended that the manure should not contain more than 0·62 lb. of borax or 0·75 lb. of colemanite per 10 cub. ft. (8 bushels), and that it should be mixed with fresh dung when applied to legumes : for other plants the dressings of manure should not exceed 15 tons per acre.—E. H. T.

Sulphur and calcium sulphate ; Effect of —— on higher and lower forms of plant life. W. Pitz. J. Agric. Res., 1916, **5**, 771—780.

Investigation of the action of sulphur and of sulphates on plant life having hitherto led only to contradictory results, their effect upon soil bacteria, upon pure cultures of legume bacteria, and upon the growth of red clover was undertaken. Using agar plates it was found that calcium sulphate had no marked effect upon the micro-organisms in a Miami silt loam soil. Sulphur decreased the bacterial number after 44 days when present to the extent of 0·05—1·0 %, probably owing to the production of acid ; it promoted ammonification when 0·05 % was present but hindered nitrification. The growth of red clover bacteria was stimulated by calcium sulphate both in artificial and in soil solution, 0·01 % of the salt producing the same effect as 0·1 %. The root development, the number of nodules, and the yield of red clover, were likewise beneficially affected by the sulphate, but sulphur, although slightly increasing the crop, had no influence on the root or nodule development.—E. H. T.

PATENT.

Fertiliser containing potassium, nitrogen, and phosphorus compounds; Process of manufacturing —— from molasses refuse. E. Herzka, Arecibo, Porto Rico. Assignor to A. I. Kaplan, New York. U.S. Pat. 1,168,255, Jan. 11, 1916. Date of appl., Jan. 25, 1915.

WASTE molasses is concentrated *in vacuo* to 44° B. (sp.gr. 1·41). 30—50% of its weight of finely ground mineral phosphate, *e.g.*, calcium phosphate, is added, and the mixture treated with sufficient sulphuric acid of 66° B. (sp.gr. 1·84) to decompose the phosphate and to convert the potassium carbonate in the molasses into sulphate.—E. H. T.

XVII.—SUGARS ; STARCHES ; GUMS.

[*Sucrose : Determination of —— in the sugar beet.*] *Influence of basic and of normal lead acetate, added before and after heating, upon the results obtained by Pellet's hot aqueous digestion method.* H. Pellet. Bull. Assoc. Chim. Sucr., 1915, **33**, 34—36.

LE DOCTE has shown that in analysing deteriorated beets containing reducing sugars by the hot aqueous digestion method, with addition of basic lead acetate solution previous to heating, the results obtained are too high, owing to the action of the reagent upon the lævulose; and he has therefore specified that a solution of normal lead acetate should be used, and added before placing the flask in the boiling water-bath. It has, however, recently been suggested that when the material under examination contains much reducing sugars basic lead acetate solution may be added to the cooled liquid after digestion. This procedure is faulty, especially when the reducing sugars are high, as in the case of frozen and thawed roots, since it gives a lower polarisation than does Pellet's cold aqueous digestion method, due to the formation from the pulp of optically active substances, non-precipitable by the lead reagent. Even when analysing sound roots untrustworthy results are obtained; and it is concluded that for clarification in the hot aqueous digestion method a solution of normal lead acetate exactly neutralised should be added to the extract before heating. Results are thus obtained equal to those found by the cold aqueous digestion method; but in order to ascertain the exact sucrose content, instead of single polarisation, double polarisation using the sulphurous acid direct reading should be employed.—J. P. O.

[*Sucrose; Determination of —— by double polarisation using invertase as hydrolyst.*] *Formation of alcohol on adding yeast directly to the sugar solution, previous to heating to 55° C.* R. Gillet. Bull. Assoc. Chim. Sucr., 1915, **33**, 21—28. (Compare this J., 1915, 1023.)

IN his examination of the modification of the double polarisation method of determining sucrose in which invertase is used as hydrolyst (this J., 1914, 878), owing to a misunderstanding of the procedure specified by O'Sullivan and Tompson, Ling and Baker (this J., 1898, 111), Ogilvie (this J., 1911, 62), and others, the author had added yeast to the sugar solution without previously heating it to 55° C. However, it is now shown that although a slight formation of alcohol takes place when operating in this way, no appreciable error results, the reducing sugars only being attacked. Sometimes, in fact, the sucrose content was found to be higher than when the solution was first heated to 55° C., this being due to the fermentation of more dextrose than lævulose, a greater inversion reading thus being obtained. In addition to the amount of yeast employed, and the time taken to reach 55° C., the amount of fermentation depends upon the kind of yeast used English top fermentation yeast inducing practically no formation of alcohol, whereas Paris bakers' yeast is more active in this respect.—J. P. O.

[*Sucrose; Determination of —— by double polarisation, using invertase as hydrolyst.*] *Use of yeast liquefied by sodium salicylate to effect hydrolysis.* H. Pellet. Bull. Assoc. Chim. Sucr., 1915, **33**, 29—33, 36—37, 39—40.

IN order to reduce the time necessary to effect inversion in the modification of the double polarisation method of determining sucrose, in which the sugar solution is heated with yeast at 55° C. for about 4½ hours, the author suggests the use of yeast liquefied by 7% of sodium salicylate. If 3 grms. of Paris bakers' yeast, liquefied by 0·2 grm. of sodium salicylate, be added to 50 c.c. of a cold solution containing 3·0—3·5 grms. of sucrose, and the temperature be rapidly raised to 55°C., hydrolysis is completed in 20—30 minutes. After cooling, 2—3 c.c. of normal lead acetate (exactly neutralised) is added, the volume made up to 100 c.c., and the liquid diluted, a little decolorising carbon and kieselguhr being also added when necessary. By working in this way, the use of specially prepared extracts of yeast is obviated, and the time required is not much greater than in acid hydrolysis. Although yeast liquefied by sodium salicylate retains its hydrolysing power practically unchanged for many months, optically active substances may develop; and it was observed that yeast and sodium salicylate in the presence of water yielded a lævo-rotatory substance, whereas the same yeast with the same amount of sodium salicylate but without water gave rise to the formation of a dextro-rotatory substance. Optically active substances are formed to a greater extent in bottom than in top fermentation yeasts.

—J. P. O.

Double polarisation method [*of determining sucrose*]; *Steuerwald's modification of the ——.* H. Pellet. Intern. Sugar J., 1916, **18**, 83—87.

IN Steuerwald's modification of the double polarisation method of determining sucrose (this J., 1913, 1025), inversion is carried out at 20°—25° C., using three times the quantity of hydrochloric acid employed in the ordinary Herzfeld process. Owing to the direct reading being taken in a solution rendered alkaline by the excess of basic lead acetate used for clarification, and the inversion reading in one strongly acid, the change of rotation is not due solely to hydrolysed sucrose, but partly to a difference in the rotation of the reducing sugars. Under these conditions, as Ogilvie and Gillet have shown, an error is introduced, which may be 0·5 to 1·5%, according to the purity of the product examined.—J. P. O.

Sugars; Determination of reducing —— in presence of an excess of sucrose. L. Maquenne. Comptes rend., 1916, **162**, 207—213. (See also this J., 1915, 1263; 1916, 268.)

THE author discusses means for attaining the maximum of accuracy in the determination of small quantities of reducing sugars in presence of sucrose by heating the reaction mixture at a definite temperature for a definite time and estimating the copper reduced. The reduction due to the sucrose can be minimised but not entirely eliminated by heating at temperatures between 65° and 75° C. for 10 mins. or longer (cp. this J., Pellet, 1914, 35; Saillard, 1915, 1220), and slight fluctuations of temperature do not affect the results appreciably. In operating at ebullition, it is advisable to carry out a blank determination every time, to correct for alterations in barometric pressure (see this J., 1916, 268), and the standard conditions of heating must be very strictly observed; one advantage of operating at ebullition is that for a certain concentration of sucrose in the reaction mixture, the total reduction is an additive function of the amounts of invert sugar and sucrose present (see this J., 1915, 1263). Every operator should compile his own table under the conditions of working selected, and a simple double-column table will suffice if he always works with about the same quantity of sucrose in the reaction mixture, adding pure sucrose for this purpose if necessary. With sugars containing less than 0·2 % of invert sugar the precipitation of the reduced copper is liable to be incomplete, and it is best to determine the unreduced copper; the author does this iodometrically without removing the cuprous oxide (*ibid.*), but the iodometric method cannot be safely used with molasses. The unreduced copper should be determined immediately after the reaction mixture has been cooled, especially when the heating has been carried out at low temperatures, *e.g.*, 65°—75° C. Only when the amount of cuprous oxide precipitated is large should it be filtered off and weighed. The degree of accuracy attainable appears to be about 1 part in 50 of the invert-sugar determined, when there is a large excess of sucrose present.—J. H. L.

Starch; Some properties of —— considered from a colloid-chemical standpoint. W. Harrison. J. Soc. Dyers and Col., 1916, 32, 40—44.

The characteristic cross and rings shown by certain starch granules under polarised light are due to pressure within the granules. The cross is very indistinct with dry granules but becomes distinct in presence of a little moisture, owing to the pressure created by the swelling of the interior portions against the more resistant outer portion. When the granules are broken by grinding no pressure is produced on moistening and no cross is observed. Further swelling produced by warming on the microscope slide or treatment with alkalis, causes the centre of the cross to expand until ultimately it occupies the whole granule. Dehydration with alcohol restores the original condition. The author has shown that the outer envelope of the granule is not impervious to solutions, *e.g.*, iodine solutions, also that the soluble starch of the interior forms a colloidal solution. The outer envelope of the granule is less readily attacked by hydrolytic agents than the main interior portion and may be separated as a residue by suitable treatment of starch paste. This substance is coloured yellow by iodine and has been called starch cellulose or amylopectin. The outer and the interior portions of the granule are, however, not chemically different, but are mutually interconvertible by simple physical treatments. A solution of the interior portions, freed from the outer envelopes by centrifuging, yields a modification of starch, having all the properties of the latter, merely on dehydration with alcohol or simple drying on a glass plate. Conversely, vigorous shaking of starch paste, while hot, considerably diminishes the amount of residual starch cellulose after treatment with malt extract. Thus, starch granules consist of one substance in different physical states. In the fractional precipitation of a boiled 1 % potato-starch paste by alcohol, the percentage of ash in the successive fractions diminishes. A solution with 52·5 % of alcohol still contains 0·16 % of unprecipitated starch, and further large additions of alcohol cause no further precipitation of starch unless a trace of inorganic salt be added. By using ammonium carbonate for this purpose, a very pure form of starch may be prepared. When a 2 % solution of this product is allowed to stand in a glass tube, it loses much of its viscosity and pseudo-granules of starch are deposited on the walls of the tube below the surface of the liquid. These granules are much smaller than the original potato starch granules. Such a deposit does not occur in quartz tubes, so that the formation of granules is attributed to the influence of traces of dissolved salt acting as nuclei. The composition of the precipitate formed by barium hydroxide in starch solutions varies with the concentration in a manner corresponding to the laws of adsorption.—J. F. B.

Production and use of yeast as foodstuff and fodder. Hayduck. *See* XIXa.

Patents.

Rollers for sugar cane mills. H. W. Aitken, Glasgow. Eng. Pat. 6029, Apr. 22, 1915.

Sugar; Manufacture of ——. L. Naudet, Chelles, France. Eng. Pat. 5650, Mar. 5, 1914. Under Int. Conv., Mar. 6, 1913.

See Fr. Pat. 466,590 of 1913; this J., 1914, 878.

Process of manufacturing fertiliser containing potassium, nitrogen, and phosphorus compounds from molasses refuse. U.S. Pat. 1,168,255. *See* XVI.

XVIII.—FERMENTATION INDUSTRIES.

Apples; Use of cider —— in beetroot distilleries. E. Saillard. Monit. Scient., 1916, 6, 25—29.

In consequence of the demand for alcohol for the manufacture of explosives, and the inadequacy of last season's beet crop, attempts have been made in France to employ cider apples for the production of spirit. This has been successfully accomplished at a beetroot distillery at Oisemont, where apples (25—30 francs per ton at the distillery) have been worked together with beetroots and also alone. The apples vary greatly in sugar-content (*e.g.*, 7—12 %) and acidity. When beets are worked with a small proportion of apples, *e.g.*, 36 % or less, the mixed charge is sliced in the ordinary way, and a quantity of sulphuric acid, regulated according to the acidity of the apples, is added in the diffusers. The temperature during extraction must not exceed a certain value (65°—70° C. when 25 % of apples is used) or else the circulation of juice in the battery is seriously impeded. The juice contains 8—8·5 % of sugar before fermentation, and 0·05—0·07 % of sugar and 0·15—0·17 % of acid (reckoned as sulphuric acid) afterwards. The raw spirit obtained from the first distillation may possess an acidity (to phenolphthalein) of 0·065 % calculated as sulphuric acid, and it is necessary to add 7—8 times the calculated quantity of sodium hydroxide before rectification in order to obtain a rectified spirit which satisfies the military test for acidity (200 c.c. must not require more than 0·8 c.c. of $N/5$ sodium hydroxide in presence of phenolphthalein). The author states that the greater part of the acidity of rectified spirit is due to dissolved carbon dioxide and disappears when the spirit is exposed for some time to the air or boiled under a reflux condenser. In working apples alone they are cut in discs, 4 mm. thick. Sulphuric acid and a small quantity of sodium fluoride are added in the diffusers, and the temperature is not allowed to exceed 50°—60° C. Data are lacking as to the value of the exhausted slices; they resemble discs of caoutchouc or gelatin and have no flavour of apples. Fermentation of the juice is sluggish unless salts are added, *e.g.*, 30—50 grms. each of potassium sulphate, ammonium phosphate, and sodium phosphate per hectolitre. This extra expense may be reduced by working beets and apples together (in the ratio 2 : 1) for several hours per day, to supply the necessary salts.—J. H. L.

Yeast; Plastic masses from ——. H. Blücher. Chem.-Zeit., 1915, **39**, 931.

Krause and Blücher's patents (this J., 1913. 223, 972) for the manufacture of a plastic material ("Ernolith") from yeast and formaldehyde, related originally to the utilisation of the cell-residue from the preparation of yeast extracts. The process has now been extended to waste yeast of all kinds, and the original black colour of the product has been modified, so that coloured or marbled masses can be produced by the introduction of mineral or organic colouring matters. It is no longer necessary to mould the articles at the time of manufacture. The yeast, mixed with certain reagents and loading materials, is converted into a plastic mass with formaldehyde, the product is dried and ground, in which form it can be kept indefinitely until it is moulded by dry pressure into any desired shape. Several brands of "ernolith" powder are produced, differing in their properties and suitable for different purposes. These powders can be incorporated by the users with any desired colouring matters, etc. The moulding of the crude "ernolith" is done in heated hydraulic presses, the articles being capable of reproducing the finest details of the mould. Waste is almost entirely eliminated, as the quantity of dry powder can be measured in the mould with great accuracy. Compressed "ernolith" has a very dense structure and conchoidal fracture; it can be worked with tools and in the lathe; it may be made hard and brittle or softer and more elastic, according to the mixture employed. It takes a polish and is almost non-inflammable; the density of the unloaded material is 1·33—1·35. A valuable property is the fact that it can be attached very firmly to metals when the latter are pressed together with it in the moulds: textile fibres may also be combined with it in a similar manner.—J. F. B.

Urease of soya beans; Effects of various substances (electrolytes, non-electrolytes, alkaloids, etc.) on ——. N. Onodera. Biochem. J., 1915, **9**, 511—574.

The inhibitory effects of inorganic and organic acids on urease are due mainly to the hydrogen ion concentration and are influenced by the physical properties, especially the surface tension, which the acids possess. Total inhibitory effects are considered to be the combined effects of chemical and physical properties. If the dissociation of the acids is equal, the acid having the greater influence on surface tension has the greater effect; even a deficiency of hydrogen ion concentration can be masked by great effect on surface tension. Sodium hydroxide inhibits the action of urease to a greater extent than does ammonia. It is shown that M/1 methyl, ethyl, and propyl alcohol solutions and M/40 amyl alcohol solution accelerate urease action, but a 3·3-M solution of the former and an M/12 solution of the latter retard it. Isocapillary alcohol solutions have equal effects. The dilute alcohols which lower the surface tension of the solvent accumulate on the surface in contact with the solvent and thus facilitate adsorption between urease and urea and accelerate the urease action. Concentrated alcohols disturb the adsorption and retard the action. Aldehyde has a marked inhibitory effect. The effects of neutral salts are merely those of their metallic bases; they retard in *N*/10 strength because metallic bases displaced by ammonia produce greater hydroxyl ion concentration than the equivalent of ammonia. In accordance with this, alkaloid salts accelerate urease action in the first stage of hydrolysis, but alkaloid bases themselves (quinine, atropine, and pilocarpine) have a distinct inhibitory effect. The effects of atropine and pilocarpine are additive and not antagonistic.—W. P. S.

Urease of soya beans and its co-enzyme. N. Onodera. Biochem. J., 1915, **9**, 575—590.

The fact that the urease of soya beans loses its activity on dialysis and that this lost activity is restored by the addition of a small amount of fresh urease, indicates that fresh urease contains a co-enzyme; the latter has not been separated, and its nature is not yet known. It is probable that the co-enzyme is a system consisting of two groups of components, one of which is dialysable and the other undialysable. It consists of two parts, one fixed and the other free. Heating and dialysis destroy the free co-enzyme first, then the fixed co-enzyme. The last portion of the fixed co-enzyme is found in the precipitate produced by dialysis, and tenaciously resists the effects of heating and dialysis. Heat, acids, and alkalis have an inhibitory effect on the co-enzyme but not on the urease proper. During germination, urease accumulates in the germs of the soya beans, but the co-enzyme is absent. Although ox-serum has an accelerating action on urease, it does not contain any substance which can be compared with the co-enzyme.—W. P. S.

Thermodynamics and fractional distillation. Chenard. *See* I.

Utilisation of wood waste. Little. *See* V.

Fermentation of tan liquors. Kuhl. *See* XV.

Production and use of yeast as foodstuff and fodder. Hayduck. *See* XIXa.

Patents.

Fermentation gases; Method of and apparatus for collecting and compressing natural ——. L. Chew and W. F. Jennings, London. Eng. Pat. 12,573, Sept. 1, 1915.

The apparatus consists of a cylinder adapted to be alternately filled with water and emptied, having a float working within, closely approximating the diameter of the cylinder. When the liquid contents of the cylinder recede, the float operates mechanism whereby a pump is set in motion for hydraulically compressing the gas within the cylinder; and when the cylinder becomes full the float operates mechanism in the reverse direction, by which the pump is stopped so as to allow the liquid contents to recede for the introduction of a further supply of gas. A liquid reservoir placed beneath the cylinder is connected with the suction side of the pump which forces the liquid into the cylinder for the hydraulic compression of the gas. A balanced air-outlet valve is provided in the reservoir actuated by a diaphragm which is operated by the pressure of the gas at the source of supply, to control the escape of air from the water reservoir and automatically control the flow of water from the cylinder to the reservoir in proportion to the quantity of gas collected.—J. F. B.

Fermenting sugars; Process for ——. K. Delbrück and K. Meisenburg, Elberfeld, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,169,321, Jan. 25, 1916. Date of appl., June 23, 1911.

See Ger. Pat. 283,107 of 1913; this J., 1915, 729.

Yeast from molasses; Manufacture of ——. G. Roth, Olmütz, Austria-Hungary. U.S. Pat. 1,170,110, Feb. 1, 1916. Date of appl., Mar. 28, 1914.

See Fr. Pat. 470,925 of 1914; this J., 1915, 194.

Food for cattle. U.S. Pat. 1,169,322. *See* XIXa.

XIXa.—FOODS.

Bread ; Influence of salts on the amylolytic digestion of ——. J. Effront. Monit. Scient., 1916, **6**, 5—12.

Whilst the hydrochloric acid present in gastric juice rapidly arrests the salivary digestion of pure starch, it does not have so great an effect on the starchy constituent of bread ; this is due to the presence of phosphates in the bread. In the case of whole meal bread the phosphates are present in quantity sufficient to balance the acidity during the first stage of the digestion, and the conversion of the starch proceeds ; white bread, which contains a smaller quantity of phosphates, is digested with greater difficulty. The di- and tri-basic phosphates in bread tend to neutralise the hydrochloric acid, whilst the mono-basic phosphates render the amylolytic enzyme of the saliva more resistant to the effect of free acids and also favour peptic digestion, thus indirectly influencing amylolytic digestion.—W. P. S.

Milk ; Present status of the pasteurisation of ——. S. H. Ayers. U.S. Dept. Agric., Bull. No. 342, Jan. 8, 1916. 16 pages.

By far the greater part (from 85 to 95%) of the milk supplied to the large cities of the United States is now pasteurised before reaching the consumer. Three processes of pasteurisation are in use. The first is known as the flash, or continuous process, the milk being heated rapidly to 160° F. (71° C.), kept at this temperature for 1 min., and then cooled quickly. In the second or holder process the milk is maintained at 145° F. (63° C.) for 30 mins. and then cooled. The third process consists in pasteurising the milk in bottles. Any one of these methods gives satisfactory results provided re-infection of the milk is prevented ; it is desirable however that milk be pasteurised at a low temperature (63° C.). Pasteurised milk is not sterile, about 1 % of the number of total bacteria surviving, and it should be cooled to about 40° F. (4° C.) and kept at this temperature until delivery. Although certain varieties of streptococci are able to survive pasteurisation at 63° C., investigation has shown that the streptococci associated with or responsible for septic sore throat are among the varieties which have a low thermal death point. Some strains of *B. coli* also exhibit resistance towards pasteurisation (see this J., 1915, 373). One of the greatest objections to pasteurised milk has been that the lactic acid bacteria were destroyed whilst the peptonising (putrefactive) bacteria were left, and that the latter, when free from the restraining influence of the former, would develop rapidly. Pasteurisation does not, however, destroy all the lactic acid bacteria, and those which survive play an important part in the souring of the milk. The use of low temperatures in the pasteurising process overcomes the objection that beneficial enzymes are destroyed or that the milk is rendered less digestible owing to changes produced in the proteins, etc.—W. P. S.

Milk proteins ; Transmission of —— through a Pukall [clay] filter. G. Diesselhorst and F. Reiss. Chem.-Zeit., 1915, **39**, 901—902.

The use of Pukall clay filters has been suggested for the filtration of milk in order to distinguish between heated and unheated milk, since the uncoagulated albumin in unheated milk passes into the filtrate and may be detected by suitable tests. This may have been the case with the filters manufactured some years ago, but as now made the filters do not allow any of the milk proteins to pass through. The filtrate exhibits a slight turbidity when heated, but this is due to the calcium phosphates present being less soluble in the hot serum than in the cold ; the turbidity disappears when the solution is cooled, and does not consist of albumin.—W. P. S.

Milk ; Agglutination test for the presence of Bacterium abortus in ——. L. H. Cooledge. J. Agric. Res., 1916, **5**, 871—875.

Bacterium abortus was grown on ordinary agar for 48 hours, and after the growth had been washed off with a solution containing 0·9 % of sodium chloride and 0·5 % of alcohol, the suspension was passed through a coarse filter paper and standardised so that the turbidity was equal to that of tube 1·5 of McFarland's nephelometer. Portions of 4 c.c. were then added to milk or milk serum and dilutions varying from 1—50 to 1—1000 were prepared. On inoculating this antigen into the milk cistern of a cow's udder, agglutinins appeared in the milk. In every case where the bacteria were found in milk by inoculation, the agglutinins were also observed, but the latter were sometimes detected when the germs were not visible. The test is of especial value when a large number of samples have to be studied, and it would be valuable for testing milk for human consumption if, as has been suggested, the disease can be transmitted.—E.H.T.

Fermented milks. L. A. Rogers. U.S. Dept. of Agric., Bull. 319. Price 5c.

A résumé of present knowledge of buttermilk, kephir, koumiss, yoghourt, and other fermented milks.

Yeast ; Production and use of —— as foodstuff and fodder, with special reference to present conditions [in Germany]. Hayduck. Polytechn. Ges., Berlin, Nov. 18, 1915. Z. angew. Chem., 1915, **28**, Wirtschaftl. Tl., 697—699.

The author refers to the various applications of waste beer yeast, and gives particulars relating to the new process for the manufacture of "mineral yeast" as a source of protein (cp. this J., 1916, 138). The yeast employed produces no alcohol, but multiplies twice as rapidly as distillers' yeast. It is grown in diluted molasses containing added ammonium and other salts, in immense vats of the size of public swimming baths, at the bottom of which are tubes for aerating the liquid. The product gives satisfactory results as fodder, and can also be used for the preparation of "nutrient yeast" for human consumption, being more palatable than beer yeast which has been treated to remove bitter substances. There is a large and rapidly increasing demand for "nutrient yeast" for the army and other public services, and the manufacture of dried yeast by plants capable of producing 400—15,000 tons a year is to be organised by the Government. The Institut für Gärungsgewerbe, which has been mainly responsible for the inception of the new process, aims at the eventual replacement of all imported albuminous fodder by dried yeast, and for this an annual production of 300,000 tons will be necessary. Besides molasses, other waste liquors from sugar, potato starch, and cellulose factories, will probably serve for the cultivation of the yeast, the only organic matter necessary being sugar.—J. H. L.

Plant globulins ; Method for the preparation of ——. G. Reeves. Biochem. J., 1915, **9**, 508—510.

Globulins are much more soluble in solutions of those salts which lower the surface tension of water than they are in sodium chloride solution, and relatively large quantities may be separated by means of small amounts of solution. To prepare edestin from hemp seed, the seed is first ground, extracted with petroleum spirit, air dried, and freed from husks. 500 grms. of the material is then mixed with 500 c.c. of 7 % sodium benzoate solution; after 30 mins., torn-up blotting paper is pressed into the mass in quantity sufficient to make it appear almost dry, the whole is then wrapped in filter paper and submitted to great pressure. About 400 c.c. of liquid can be expressed. The residual mass is again treated with 500 c.c. of the sodium benzoate solution and a further 500 c.c. of liquid expressed. The united extracts are now poured into 10 litres of cold water and, after standing over-night, the clear liquid is decanted and the sediment centrifuged. The compact mass thus obtained is mixed with water and again centrifuged, washed once with 95% alcohol, once with absolute alcohol, twice with dry ether, and dried under reduced pressure. The product is almost completely soluble in 10% sodium chloride solution and can be obtained in a crystalline form in the usual way. The yield is about 130 grms. Excelsin may be prepared from fat-free Brazil-nut meal in a similar way, the yield being about 20% of the weight of the meal. The crude excelsin, while still moist after being washed with water, may be dissolved in 6% ammonium sulphate solution, centrifuged to remove a small amount of insoluble matter, and the solution then dialysed for 3 days. Excelsin separates out from the solution and is washed and dried as described. A perfectly white powder is obtained, the yield being about 12% of the weight of the meal. A mixture of legumin and vicillin is obtained by subjecting horse-bean meal to the above process. —W. P. S.

Vitamines and accessory foodstuffs. Boruttau. Ber. Deuts. Pharm. Ges., 1915, **25**, 468—486.

After the occurrence of beri-beri had been attributed to a diet consisting mainly of polished rice, Suzuki and others extracted from rice bran a basic substance, oryzanin (cp. this J., 1915, 810), which even in very small quantities was found to exert a remarkable remedial action on this disease and on polyneuritis produced artificially. Funk later isolated from the same material very small quantities of the active constituent, which he termed vitamine. It appears to belong to the pyrimidine group, which also includes thymine, a constituent of certain animal nucleic acids. Funk isolated similar substances from yeast and lime-juice, and attributed various diseases, including beri-beri and scurvy, to diets deficient in vitamines. The author discusses these and other "deficiency diseases" and suggests that many of them arise from the inability of the animal body to synthesise certain atomic groupings which are necessary to the organism. A basal diet of carbohydrates, fats, mineral matters, and protein (without respect to the nature and proportions of the amino-acids present) is insufficient without "accessory foodstuffs," of which vitamines are only particular instances. Among the most important of these accessory foodstuffs are cyclic compounds of various types, viz., the more or less hydroxylated benzene ring (tyrosine, tyramine, adrenine), the indole ring (tryptophane), the pyrrolidine ring, the purine complex, the pyrimidine ring (see above), and finally the iminazole group which is represented by histamine, a substance of great physiological activity. Abderhalden has demonstrated the necessity of tyrosine and tryptophane in foodstuffs, and Osborne and others have found that lysine is essential to animal growth and tryptophane to the maintenance of normal metabolism. In an investigation of the comparative values of different plant proteins as accessory foodstuffs, the author found that the arginine-histidine fraction was invariably present in the valuable ones. Many plant proteins are almost or entirely free from lysine and histidine, and correspondingly rich in glycine and glutamic acid, which are of less value to the animal organism. Feeding experiments carried out at the Rubner Institute to ascertain the relative amounts of different nitrogenous matters required to maintain metabolic equilibrium, showed that the nitrogenous substances of cows' milk (as a whole), potatoes, and rice, and particularly those of vegetables and fruits, have a high value, but casein is much less valuable, and the nitrogen of wheat flour and maize flour can only replace 30—40% of its weight of animal nitrogen. The nitrogen of fine wheat meal bread is of greater value, possibly owing to the added yeast.—J. H. L.

Behaviour of amino-acids towards neutral salts in aqueous solution. Pfeiffer. *See* XX.

Patents.

Meat; Sterilisation of ——. W. H. Hurtley, London. Eng. Pat. 23,666, Dec. 7, 1914.

Freshly killed meat is subjected for not more than 1 minute to the action of steam under pressure or of superheated steam at 110°—150° C., then placed in a cooling chamber where the temperature is reduced to about 0° C., and finally transferred to a refrigerating chamber.—W. P. S.

Margarine; Manufacture of ——. K. Erslev, Nijmegen, Holland. Eng. Pat. 2013, Feb. 8, 1915.

From 0·5 to 2% of sodium lactate is added to the margarine for the purpose of preserving the buttery aroma of the substance.—W. P. S.

Food products from amylaceous materials; Manufacture of ——. M. Franzie, The Hague, Holland. Eng. Pat. 2607, Feb. 18, 1915. Under Int. Conv., Feb. 19, 1914.

A mixture of 2 parts of rice and 3 parts of water is boiled, then cooled to 65° C. and mixed with 1 part of banana pulp. The mixture is fermented at 50° C. for 12 hours, concentrated under reduced pressure and at a temperature below 40° C. until it has lost 75% of its moisture, then spread into thin layers and dried for some hours at 75°—80° C. The dry product is ground to a powder.—W. P. S.

Cheese; Manufacture of ——. S. H. Hartmann, Melbourne, Australia. Eng. Pat. 16,560, Nov. 23, 1915. Under Int. Conv., July 6, 1915.

The curd is separated from the whey and pressed, whilst the whey is concentrated to a semi-liquid condition or to a dry powder. When the cheese has developed its flavour and aroma, it is disintegrated, mixed with 33% of its weight of the dry whey powder or 45% of its weight of the semi-liquid whey, and the mixture pressed into shape. —W. P. S.

Casein and product thereof: Process of producing ——. L. H. Reuter, Torreon, Mexico. U.S. Pat. 1,167,434, Jan. 11, 1916. Date of appl., Dec. 12, 1914.

Butter-milk is treated with an alkali and a formate, filtered, and the casein in the filtrate precipitated by the addition of a mixture of sulphuric acid and formic acid; the precipitated casein is collected, washed with water containing formic acid, dried, and ground. The product is mixed with alkalis or lime.—W. P. S.

Cocoa; Process of treating ——. J. Walker, Assignor to Massachusetts Chocolate Co., Boston, Mass. U.S. Pat. 1,167,956, Jan. 11, 1916. Date of appl., May 16, 1914.

Cocoa cake is broken up, heated, and the particles are then chilled by means of successive blasts of cold air, which also serve to transport the material. —W. P. S.

Alimentary paste [*macaroni*] *; Apparatus for drying* ——. E. Guano, Chelsea, N.J. U.S. Pat. 1,168,722, Jan. 18, 1916. Date of appl., May 29, 1914.

A rotating frame is mounted in a casing and carriers bearing a series of detachable rods for supporting the macaroni strips are pivoted to the frame.—W. P. S.

Liquids [*milk*] *; Art of pasteurising* ——. L. J. Crecelius. Assignor to J. H. Sasseen, A. A. Forbes, E. G. Bornemann, J. W. O'Brien, and G. F. Kerwin, St. Louis, Mo. U.S. Pat. 1,168,789, Jan. 18, 1916. Date of appl., Mar. 3, 1915.

The liquid (*e.g.*, milk) is filled into bottles which are placed in a covered tank containing a liquid in quantity sufficient to cover the lower part of the bottles. The liquid is then heated. The bottles and their contents are cooled subsequently by admitting a cold liquid to the lower part of the tank until the bottles are almost completely submerged.—W. P. S.

Food for cattle. K. Delbrück, Elberfeld, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,169,322, Jan. 25, 1916. Date of appl., Nov. 5, 1914.

A food for cattle consists of a residue obtained by distilling a carbohydrate mixture which has been fermented by means of *Bacillus macerans* (see Ger. Pat. 283,107 of 1913 and Eng. Pat. 14,371 of 1914; this J., 1915, 729, 976); the residue contains proteins, unchanged starch, and inorganic salts. —W. P. S.

Fluids containing fat globules, casein, and sugar [*milk or cream*] *; Method and means for the treatment* [*sterilisation*] *of* ——. N. J. Nielsen, Aarhus, Denmark. U.S. Pat. 1,168,823, Jan. 18, 1916. Date of appl., Feb. 27, 1914.

See Fr. Pat. 467,373 of 1914; this J., 1914, 882.

Manufacture of albuminous products from the residues obtained in oil manufacture. U.S. Pat. 1,169,634. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Water of the municipal water-conduit of Thann: Installation for treating the whole of the —— *with bleaching powder liquor.* H. Grosheintz. Comptes rend., 1916, 162, 199—202.

Bleaching powder liquor is introduced into the water supply through the agency of a small plunger pump, the piston of which is connected to that of the elevator pump in such manner that a constant volume of liquor is drawn in and thoroughly mixed with the water at each stroke of the pistons. The body of the pump is lined with tin, and the piston and valves are of hard lead, with valve seatings of tin. Fifty c.c. of liquor (of 7° B., 1·05 sp.gr.) per cb.m. of water has been found a slight excess and sufficient to reduce the germs from 1 million to 200—300 per c.c., without rendering the water disagreeable. About 1000 cb.m. of water is pumped daily. —F. Sodn.

Rare earths; Physiological actions of the ——. C. R. Boehm. Chem.-Zeit., 1915, 39, 895—897.

Salts of the rare earths in dilute solutions have no injurious action on higher plants, but possess fungicidal and bactericidal power. The use of the waste liquors from the manufacture of thorium compounds for the impregnation of wood and as a protective agent against potato disease (*Peronospora infestans*) has been proposed. The growth of bacteria capable of liquefying gelatin is prevented by 0·5—2% of commercial didymium chloride, whereas that of yeast is only retarded. Colloidal hydroxides of zirconium and other rare earth metals act similarly to ferric hydroxide in clarifying sewage and effluents and precipitating the greater part of the putrescible substances, and the use of the waste products of the thorium industry for this purpose is worthy of consideration. Thoria in admixture with kieselguhr has been used successfully as a substitute for bismuth compounds in working with X-rays, and the relatively cheap zirconia, placed on the market under the name "Kontrastin," has also proved very satisfactory for this purpose. Attention is also drawn to the properties of thorium-X and its possible application for therapeutic and other purposes. A freshly prepared radiothorium salt attains its maximum activity after one month, owing to gradual accumulation of thorium-X, and the activity then continuously diminishes. Thorium-X has a short life-period and yields other radio elements with short life-periods on disintegration; hence minute quantities exhibit very high activities. For an activity corresponding to one million Mache units only about 0·000001 mgrm. of thorium-X is required, as against 0·3 mgrm. of radium bromide. —A. S.

Determination of bromine and iodine in presence of chlorides. Winkler. *See* VII.

Testing of distilled water to be used for the preparation of salvarsan solutions. Tillmans and Mildner. *See* XX.

Patents.

Water: Apparatus for supplying chemical or like solutions to ——. J. Taylor and L. Whyte, Manchester. Eng. Pats. 384, Jan. 9, and 9995, July 9, 1915.

The reagent is supplied from the main reagent tank to a shallow vessel having a slot in its base, the width of which can be regulated by a movable slotted plate. The thin stream of the reagent issuing from the slot falls into a gutter suspended beneath and delivering into a vessel with a sloping bottom and divided transversely into two portions by a partition. The bottom of the gutter slopes towards the higher end of the lower vessel and delivers the reagent into that end, from which it flows away by a pipe and is pumped into the water main. The gutter is suspended by a light framework connected by a cord with the cam of a recording meter of a Venturi tube placed in the water main. As the cam rotates with a decreased flow in the Venturi tube, so the gutter is drawn from under a portion of the slot, and a corresponding portion of the reagent is delivered beyond the gutter and flows into the lower end of the vessel underneath, from which it runs back to the main reagent tank. In another form of the apparatus, the reagent leaves the upper vessel by a nozzle and impinges on a sloping board, over which it is spread in a thin sheet and falls into the gutter below.—J. H. J.

Water, sewage, and other liquids; Apparatus for adding chemical reagents to ——. A. J. and P. A. G. Bell, Ravensthorpe, Yorks. Eng. Pat. 754, Jan. 18, 1915.

A reciprocating ram provided at one part with a number of pockets operates in a cylinder, which communicates with the pipe supplying the liquid to be treated. A pipe, for supplying the reagent, and an open drain are in connection with the cylinder. On the inward stroke of the ram, the pockets come under the reagent pipe and are filled with the reagent which, at the end of the stroke, is delivered into the liquid flowing through the pipe. On the return stroke, the pockets, which are now filled with liquid from the pipe, are carried past the reagent pipe and brought over the drain into which they empty. The pockets are now filled with air, and when they come under the reagent pipe again, the air escapes through an annular space around the reagent pipe. —J. H. J.

Water, sewage, and other liquids: Apparatus for adding chemical reagents to ——. A. J. and P. A. G. Bell, Ravensthorpe, Yorks. Eng. Pat. 17987, Jan. 18, 1915.

The reciprocating ram of the apparatus described in Eng. Pat. 754 of 1915 (see preceding abstract) is replaced by a horizontal rotatory disc, a pocket in which comes successively under the reagent pipe, the pipe containing the liquid to be treated, and the open drain.—J. H. J.

Sewage and other liquids; Purification of ——. W. Jones, and Jones and Attwood, Ltd., Stourbridge. Eng. Pat. 1141, Jan. 23, 1915.

Air is supplied to the sewage mixed with sludge, not uniformly as is usual, but intermittently, or in varying volumes or at varying pressures, or both, during the period of aeration. By supplying a relatively small volume of air over a long period, the aeration of the sewage may be effected, and by increasing the volume or pressure for a short period, the sludge and sewage are thoroughly mixed. In this way a smaller quantity of air is used than for a uniform supply. An automatic valvular apparatus is provided which consists of a bucket-wheel in a tank of water, to which compressed air is supplied, causing the wheel to rotate. The spindle of the wheel carries a cam which operates a valve in piston form in connection with an air chest: when the piston is raised air passes from the chest to a pipe leading to a main air valve which it actuates. This valve passes compressed air either directly to the diffusing pipes in the sewage tank, in which case a pulsating effect is produced in the sewage, or first to an air receiver which after being filled is allowed to empty into the diffusing pipes, in which case a gradually decreasing volume of air is applied to the sewage. Other methods of varying the air supply are also described.—J. H. J.

Sewage; Treatment of ——. C. H. Cooper, Wimbledon, Surrey. Eng. Pat. 3831, Mar. 10, 1915.

A proportion of sewage which has been activated is mixed with raw sewage in an enlargement of the mouth of a vertical pipe up which the raw sewage is conveyed. The mixture passes out through a nozzle in the side of the enlargement and below the surface of the sewage: at the same time compressed air is blown through the nozzle with the sewage mixture. In this way the sewage mixture is atomised as it leaves the nozzle, and afterwards is mixed further with air drawn in through louvres against the lower sides of which the atomised sewage impinges.—J. H. J.

Manganese and iron; Elimination of —— *from water.* Deutsche Filtercompagnie, Berlin. Eng. Pat. 405, Jan. 9, 1915. Under Int. Conv., Jan. 10, 1914.

A very small quantity, not more than 0·0003%, of a soluble permanganate is added to the water, which is then filtered through a porous catalytic material, such as trachytic tuff, whereby iron and manganese are precipitated. The precipitated oxides may be left in the filter to increase the catalytic effect. A peroxide may be added to the filter material with the same object.—J. H. J.

Destructor furnaces; Refuse ——. H. N. Leask, Wallasey. Eng. Pat. 3013, Feb. 24, 1915.

The furnace chamber is formed with double walls of metal, and may be cooled by air, steam, or water. It is closed below by a movable hearth, underneath which is a pit to receive the clinker, which is at once covered with water, or the pit may be filled with water first and the clinker allowed to fall into it. The clinker may be removed by hand or there may be a conveyor at the bottom of the pit to remove it. Cross-bars are placed above the conveyor to break the fall of the clinker. A ventilator, which may be sealed by the water in the pit, is provided for the removal of steam and other gases. The pit may be extended to the back of the furnace, so as to permit of the removal of the clinker by a grab. —J. H. J.

Disinfecting agents. M. Engelmann and B. Merkel,* Elberfeld, Germany, Assignors to Synthetic Patents Co., Inc., New York. U.S. Pat. 1,167,642, Jan. 11, 1916. Date of appl., Nov. 5, 1914.

The disinfectant consists of mercurichlorophenol and caustic soda; it is a yellowish white powder, soluble in water, and is decomposed by heating with hydrochloric acid into mercuric chloride and chlorophenol. Mercury is precipitated from the aqueous solution by hot ammonium sulphide. —J. H. J.

Drying and sterilising air; Apparatus for ——. R. P. van Calcar, Oegstgeest, and J. Ellerman and H. J. Martijn, The Hague, Netherlands. U.S. Pat. 1,170,469, Feb. 1, 1916. Date of appl., Jan. 6, 1914.

See Eng. Pats. 24,159 of 1913 and 4018 and 4020 of 1914; this J., 1915, 245.

Device for limiting explosions in [coal] mines. Eng. Pat. 951. *See* IIa.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Indian opium. Bull. Imp. Inst., 1915, 13, 507—546.

The results of the analyses of 44 samples of Indian opium collected in 1896 and 102 samples collected in 1909 are given in detail. The percentage of morphine (referred to the dried opium) in the various samples collected in 1909 was as follows:—14—15%, 2 samples: 13—14%, 3; 12—13%, 3; 11—12%, 8; 10—11%, 5; 9—10%, 14; 8—9%, 24; 7—8%, 16; 6—7%, 9; 5—6%, 11; 4—5%, 6; and 3—4%, 1 sample. In one-half of the samples the average morphine content was 10·26%, and these could be utilised as medicinal opium containing 10% of morphine. A further 20% of the samples could be used medicinally for purposes restricted to opium containing 7·5% of morphine. The codeine content varied from 2·18 to 4·04%, average 3%. Indian opium is quite suitable for the manufacture of morphine or codeine and is now being used in the United Kingdom for that purpose. Considerable improvements are possible in the methods of production and preparation at present practised, and would result in a still larger amount of Indian opium becoming suitable for medicinal purposes. The area devoted to opium cultivation in India has decreased gradually from about 769,000 acres in 1903—04 to about 241,000 in 1912—13. The exports of opium from India were: 1911—12, 52,945 cwt., value £8,726,060; 1912—13, 43,505 cwt., £7,481,088; 1913—14, 16,858 cwt., £2,280,031. The quantities and value of the imports of opium into the United Kingdom in 1913 and 1914 were :—

From	1913		1914	
	cwt.	£	cwt.	£
Hong Kong............	339	38,102	267½	26,426
Persia	1,219	142,852	2,330	247,464
Asiatic Turkey	1,940	174,878	2,690	242,045
European Turkey	1,387	133,858	1,362	126,588
Other countries	176½	17,572	1,030½	94,159
Totals	5,061½	507,262	7,680	736,682

—A. S.

Yohimbine, meso-yohimbine, and yohimboic acid: Formulæ and reactions of ——. L. Spiegel. Ber., 1915, 48, 2077—2083.

Yohimboic acid, $C_{20}H_{24}N_2O_3$, on esterification with methyl alcohol is converted into yohimbine having the formula $C_{22}H_{28}N_2O_3$ (see also this J., 1912, 44 ; 1915, 888). Specimens of apparently pure yohimbine were in many cases found to contain a small amount of a new alkaloid, meso-yohimbine, having the formula $C_{21}H_{28}N_2O_3$, which has frequently been attributed to yohimbine itself. Meso-yohimbine remains in the mother liquor when yohimbine containing it is crystallised from 50% alcohol, but separates in the first fractions if absolute alcohol be employed, hence apparently pure specimens of yohimbine may contain meso-yohimbine if the latter solvent be employed. Meso-yohimbine, m.pt. 247°—248° C., crystallises from absolute alcohol or from benzene in white needles. It contains one methoxyl group and is readily hydrolysed to yohimboic acid, but the latter cannot be reconverted into the former by esterification. Yohimbine can be converted into meso-yohimbine by prolonged boiling with alcoholic potash. Meso-yohimbine is dextro-rotatory and resembles yohimbine in chemical and physiological properties. Yohimbine free from meso-yohimbine melts at 234·5° C.—T. C.

Yohimbine and quebrachine ; The supposed identity of ——. L. Spiegel. Ber., 1915, 48, 2084–2087.

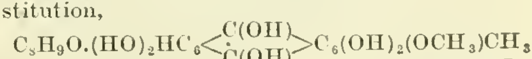
The identity of yohimbine from *Corynanthe yohimba* and quebrachine from *Quebracho blanco* cannot be regarded as definitely proved, as the quebrachine employed by Fourneau and Page (this J., 1914, 373) did not agree in its reactions with the alkaloid originally discovered by Hess in *Quebracho blanco* (Annalen, 1882, 211, 265), whilst the quebrachine preparation, m.pt. 225°—226° C., obtained by Ewins from *Quebracho blanco* (this J., 1915, 100) as well as the yohimbine preparation of Barger and Field (this J., 1915, 888) of the same m.pt., had a much lower melting point than pure yohimbine free from meso-yohimbine (see preceding abstract). Attempts to prepare quebrachine from 2½ kilos. of *Quebracho blanco* yielded only a few small crystals, m.pt. 201° C. giving colour reactions similar to those of yohimbine. It is suggested that many barks of *Quebracho blanco* contain alkaloids, including yohimbine, belonging to the yohimbine group and that quebrachine may be a mixture of such alkaloids.—T. C.

Scopoline : Degradation products of ——. K. Hess and A. Suchier. Ber., 1915, 48, 2057—2067.

Scopoline obtained by the action of warm baryta solution on scopolamine (hyoscine) is converted by oxidising agents into nor-scopoline (scopoligenine), from which scopoline can be regenerated by the action of formaldehyde. On heating scopoline with hydrobromic acid in glacial acetic acid solution for 4 hours in a sealed tube at 115°— 120° C., it is converted into hydroscopoline bromide hydrobromide ; on reduction with zinc dust and sulphuric acid at ordinary temperature this is converted into hydroscopoline hydrobromide, m.pt. 260° C., which can be readily isolated in the form of a well-crystallised zinc double salt, m.pt. 215°—216° C., from which hydroscopoline is obtained by the action of concentrated caustic soda solution. Hydroscopoline, $C_8H_{15}NO_2$, m.pt. 165° C., crystallises best from a mixture of equal parts of acetone and methyl alcohol. It is readily soluble in water, giving a solution strongly alkaline to litmus, which reduces ammoniacal silver nitrate on boiling. It gives a crystalline picrate, m.pt. 232° C., and a crystalline gold salt, m.pt. 200° C., and on oxidation with chromic acid is converted into scopolinic acid, $C_8H_{13}NO_4$, crystallising with 1 mol. H_2O, m.pt. 225° C. Scopolinic acid is isomeric with tropinic acid and is identical with αα′-N-methylhexahydrolutidinic acid (Ber., 1915, 48, 1907), indicating that scopoline is an alkaloid of the piperidine series.—T. C.

Lichens and their characteristic constituents. XIII. O. Hesse. J. prakt. Chem., 1915, 92, 425—466.

In continuation of earlier work (see this J., 1898, 807 ; 1901, 161 ; 1905, 42 ; 1906, 281 ; 1907, 889) the author has investigated specimens of the following lichens and isolated from them the substances named :—*Aspicilia calcarea*, L., Kbr., aspicilin, erythrin, and erythritol ; *Evernia prunastri*, L., atranorin, evernic acid, and usninic acid (the last only in specimens from oak trees) ; *Evernia furfuracea*, L., evernuric acid and physodylic acid (Zopf's "isidic acid"), but neither is present in the variety *olivertorina* ; *Parmelia caperata*, L., capraric, caperatic, and *d*-usninic acids, caperin and caperidin (the last two only in specimens from oak trees) ; *Solorina crocea*, L., Ach., solorinic and soloric acids, hydrosolorinol, and mannitol ; *Cladonia macilenta*, Ehrh., Hoffm., cocellic, thamnolic, and rhodocladonic acids ; *Cladonia tenuis*, Floerke, fumarprotocetraric and *d*-usninic acids : *Cladonia fimbriata*, L., Fr., var. *chordalis*, Ach., and var. *radiata*, Schreber, protocetraric acid in the former and probably in the latter, but no fumarprotocetraric acid ; *Cladonia crispata*, Ach., var. *gracilescens*, Rabenhorst, squamatic acid and a new substance, cladonin, somewhat resembling cornicularin but melting at 228° C. ; *Cladonia condensata*, Floerke, Zopf, *l*-usninic acid and cornicularin ; *Pycnothelia papillaria*, Dufour (*Cladonia papillaria*, Ehrh.) var. *molariformis*, Hoffm., atranorin, cladonin, and proto-α-lichesterinic acid ; *Cornicularia aculeata*, var. *acanthella*, Ach., dimannitol ether, $C_{12}H_{26}O_{11}$; *Pertusaria ocellata variolosa*, Fw., atranorin and gyrophoric acid, $C_{32}H_{28}O_{14}$. Various derivatives of evernic, everninic, and solorinic acids are described ; solorinic acid probably has the constitution,



$$C_8H_9O.(HO)_2HC_6{<}{\begin{matrix}C(OH)\\ \vdots\\ C(OH)\end{matrix}}{>}C_6(OH)_2(OCH_3)CH_3.$$

—J. H. L.

Distilled water to be used for the preparation of salvarsan solutions ; Testing of ——. J. Tillmans and H. Mildner. Z. angew. Chem., 1915, 28, 469—474.

Occasionally death takes place after an injection of salvarsan solution, and this has been ascribed by Ehrlich to autoxidation of the salvarsan with the production of poisonous products. Neo-salvarsan is still more subject to such autoxidation than salvarsan. The autoxidation is caused by impurities in the distilled water used for making up the solution. These impurities may be of three kinds : bacteria in large numbers, constituents of the glass, heavy metals. The presence of large numbers of bacteria may be inferred from the result of the oxygen absorption test of the water, for which the following method is recommended: 100 c.c. of the water is acidified with dilute sulphuric acid, 8 c.c. of $N/100$ permanganate added, and the mixture boiled for 10 mins. The excess of permanganate is determined by addition of 10 c.c. of $N/100$ oxalic acid and titrating back. A control test is made with very carefully purified distilled water. A difference of more than 0·2 c.c. of $N/100$ permanganate between the two results indicates the presence of much organic matter, and therefore the water should not be used. The distilled water should be free from traces of ammonia and nitrite. To determine whether the water contains any dissolved constituents of the glass, 100 c.c. is boiled for 15 mins. in a beaker of Jena glass and a few drops of rosolic acid solution added; if a red colour is produced, sodium silicate is present in solution and the water should not be used. Of the heavy metals likely to be present in the water, iron can be excluded, as its presence is not injurious, and tin also, as it is not dissolved by water. For the remaining metals, Pb, Cu, Ni, Zn, a general method of procedure has been worked out. 100 c.c. of the distilled water is mixed with ammonium chloride, acetic acid, and a few drops of sodium sulphide solution; if no colour nor turbidity is produced, the water is free from the above metals in amounts exceeding 0·3 mgrm. of lead, 0·3 mgrm. of copper, 2 mgrms. of nickel, and 3 mgrms. of zinc per litre. If the water becomes coloured, lead, copper, and nickel may be present. The test is then repeated in an alkaline solution in presence of potassium cyanide; if the colour produced is equal to that in the acid solution, lead is present; if less, then lead is absent. The next examination is for copper, by the ferrocyanide reaction, the blue colour with ammonia, or Marks' reaction with a colouring matter prepared from nitroso-R-acid, which gives a blue colour with copper, not changed by addition of acetic acid. Nickel is tested for with dimethylglyoxime and sodium acetate. Finally zinc is tested for with ferrocyanide and sodium acetate: if nickel be present, the test must be applied to the filtrate from the nickel precipitate. None of the foregoing heavy metals should be present.—J. H. J.

Amino-acids; Behaviour of —— towards neutral salts in aqueous solution. P. Pfeiffer. Ber., 1915, **48**, 1938—1943. (See also this J., 1915, 976.)

THE increase in the solubility and specific rotation of amino-acids in presence of neutral salts indicates the existence in aqueous solution of molecular compounds of the type $(NH_2.R.COOH...)_mMX_n$, the isolation of which in the solid state has already been described. Thus for example glycocoll is considerably more soluble in solutions of calcium, barium, strontium, and lithium salts than in pure water, and molecular weight determinations by the cryoscopic method confirmed the decrease in molecular concentration due to the formation of complex molecules in equilibrium with their constituents. The presence of neutral salt compounds in blood serum and other protein solutions is postulated.—G. F. M.

Sulphocarboxylic acids; Electrolysis of the alkali salts of aliphatic ——. F. Fichter and T. Lichtenhahn. Ber., 1915, **48**, 1949—1963.

THE electrolysis of the sulphonic derivatives of aliphatic acids in concentrated alkaline solution resulted in the production to only a very small extent of the disulphonic acids of the aliphatic hydrocarbons, the reaction comparable with the production of ethane, for example, from potassium acetate:

$$2SO_3H.CH_2.CO_2H + O \rightarrow SO_3H.CH_2.CH_2.SO_3H + 2CO_2 + H_2O.$$

The main products of the anodic oxidation of sulphoacetic acid were sulphuric acid, carbon dioxide, and in smaller quantity formaldehyde, carbon monoxide, ethylene, and methanedisulphonic acid. With sulphopropionic acid no synthetic action was observed, only degradation products, of which ethylene, carbon dioxide, and sulphuric acid were the most important, being detected.—G. F. M.

Esters of tertiary trichlorobutyl alcohol; Chemical and physiological properties of the ——. R. Wolffenstein, A. Loewy, and M. Bachstez. Ber., 1915, **48**, 2035—2043.

THE esters of tertiary trichlorobutyl alcohol are not hydrolysed in the organism and hence do not necessarily show the typical narcotic action of the alcohol itself, but generally possess characteristic physiological properties. The acetate is less narcotic than the alcohol but is more poisonous, the propionate, a yellowish oil, b.pt. 88°—90° C. at 14 mm., has similar but more marked properties, whilst the isovalerate, b.pt. 108°—110° C. at 20 mm., in common with all the substituted isovalerates, such as the bromoisovalerate and the diethylaminoisovalerate, has no narcotic action but is a powerful tetanic poison. The monochloroacetate, m.pt. 48° C., crystallising readily from alcohol, and the trichloroacetate, m.pt. 40° C. crystallising from alcohol in beautiful, long needles, have properties similar to the acetate though less marked, but when the halogen is replaced by basic groups such as the dimethylamino or diethylamino group, the narcotic action is greatly intensified. When such dialkylamino-groups, however, are replaced by the piperidyl group, the resulting ester has no narcotic action but is a powerful tetanic poison, similar properties being possessed by the pyruvate and the allophanate. The esters prepared from trichlorobutyl alcohol and malonic and substituted malonic acids have neither narcotic nor tetanic action but have a sedative action, whilst the cinnamate and dibromocinnamate have no specific action. Attempts to prepare an alkyl oxide (alcoholate) from trichlorobutyl alcohol and finely divided sodium were unsuccessful and gave rise to a violent explosion.—T. C.

Essential oil of Greek black mustard. D. E. Tsakalotos. J. Pharm. Chim., 1916, **13**, 78—80.

FIVE samples of Greek black mustard seed (*Brassica nigra*) yielded 1·13 to 1·19%, and a sample of mustard flour 1·21% of essential oil. The oil had sp.gr. 1·019 at 11° C.; refractive index at 11° C., 1·537; and boiled at 149° to 152° C. It was practically pure (99·4%) allyl mustard oil (isothiocyanate).—C. A. M.

PATENTS.

Formaldehyde; Manufacture of ——. G. Calvert, London. Eng. Pat. 814, Jan. 18, 1915.

A MIXTURE of air and methyl alcohol is obtained by dropping the alcohol on the revolving blades of a fan, the air inlet being heated. The mixture passes through a reaction chamber, the temperature of which can be controlled, containing copper gauze or the like, and from there through a cooling chamber to the saturator. This chamber is provided with a central revolving shaft with blades, on to which water drips from a distributing tank to which it is returned by a pump. The reaction, cooling, and saturating chambers are continuous.—B. V. S.

Mercury sludge formed in the production of acetaldehyde by passing acetylene into acid solutions of mercury salts; Treatment of ——. J. E. Pollak, London. From Chem. Fabr. Griesheim Elektron, Frankfort, Germany. Eng. Pat. 10,140, July 12, 1915.

(1) THE sludge is freed from water and liquid

mercury by decantation and then heated in an open vessel, with vigorous stirring, until the organic matter is carbonised. Almost the whole of the mercury separates and is easily freed from carbon. (2) After clearing by treatment with hot water a 10% solution of caustic soda is added to the sludge, and the mixture, constantly stirred and maintained at 40°—60° C., is subjected to electrolysis by a current of 3—6 volts and 1 amp. per sq.cm. The mercury separates in fairly pure condition.—B. V. S.

Oxyphenylquinoline-dicarboxylic acid and derivatives thereof; Manufacture of ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. Eng. Pat. 15,752, Nov. 8, 1915. Addition to Eng. Pat. 22,828 of 1914 (this J., 1915, 889).

In the method previously described, a solution of an alkali carbonate or an alkaline earth may be used instead of caustic alkali solution. Also derivatives of isatinic acid such as methylisatinic acid or methylenedioxy-isatinic acid may be used, and homologues of acetosalicylic acid such as acetocresotinic acids. The latter are obtained by condensing acetylchloride with *o*-, *m*-, or *p*-cresotinic acid in presence of aluminium chloride and carbon bisulphide. Several examples with different derivatives and conditions are given.
—B. V. S.

Menthyl-salicylic methyl ester; Method of making ——. A. W. Mathys, London. From New York Salesthyl Corporation, New York. Eng. Pat. 4409, Mar. 20, 1915.

See U.S. Pat. 1,133,832 of 1915; this J., 1915, 575.

Camphor compounds. J. Callsen, Elberfeld, and R. Stüsser, Dentz, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,169,316, Jan. 25, 1916. Date of appl., Dec. 29, 1914.

See Ger. Pat. 287,796 of 1914; this J., 1916, 198.

Alkali-metal acetones. G. Merling, O. Chrzesciuski, and O. Pfeffer, Elberfeld, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,169,341, Jan. 25, 1916. Date of appl., July 7, 1914.

See Fr. Pat. 474,745 of 1914; this J., 1915, 1116.

Therapeutic preparation. M. Engelmann, Assignor to Farbenfabr. vorm. F. Bayer und Co., Elberfeld, Germany. U.S. Pat. 1,170,056, Feb. 1, 1916. Date of appl., Jan. 30, 1913.

See Eng. Pat. 4571 of 1913; this J., 1913, 1169.

Reduction of organic compounds. Eng. Pat. 4665. *See* XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Diapositives for use in producing intaglio printing surfaces; Preparation of ——. Rotophot Akt.-Ges. für Graphische Industrie, Berlin. Eng. Pat. 738, Jan. 16, 1915. Under Int. Conv., Jan. 17, 1914.

In making diapositives for the production of intaglio printing surfaces of subjects containing, for example, both pictures and type, the pictures are reproduced in silver or carbon and the type by the hydrotype (pinatype) process. For example, an ordinary silver positive of the picture is made, the interspaces being protected during the exposure. The gelatin film is then sensitised by bichromate and exposed behind a suitable print of the type; after washing out the bichromate the unexposed parts, *i.e.*, the copy of the type, are stained by any suitable dye, preferably carmine in ammonia solution. Several other examples of combinations of the two processes are given, in some cases two superposed films being used.
—B. V. S.

Colour photography. P. D. Brewster, East Orange, N.J., U.S.A. Eng. Pat. 1073, Jan. 22, 1915. Under Int. Conv., Jan. 29, 1914.

A film or plate is used coated with emulsion on both sides, and this is exposed in a camera in which, by a suitable arrangement of mirrors, in conjunction with one or two lenses, an image is formed on each side of the plate. The two emulsions may differ in light sensitiveness or light filters may be used so that the images are produced by complementary colours. The negatives so obtained may be reversed and stained, or coloured positives may be made from them by the usual processes.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Permissible explosives (United States); Supplementary list. U.S. Bureau of Mines, July 1, 1915.

The following list contains the names of all permissible explosives tested by the Bureau between March 1 and July 1, 1915. The definition of a "permissible explosive," "unit deflective charge," and "rate of detonation," and definitions of the classes of permissible explosives are given in Technical Paper 100.

Brand	Unit deflective charge *	Rate of detonation in 1¼ by 8 inch cartridge. Feet per second.	Manufacturer
	grms.		
Bituminite No. 8-L. F.	303	9,300	Jefferson Powder Co., Birmingham, Ala.
Cameron mine powder No. 5-A	299	8,900	Cameron Powder Manufacturing Co., Emporium, Pa.
Tunnelite AA	253	7,690	G. R. McAbee Powder and Oil Co., Pittsburgh, Pa.
Tunnelite No. 3	291	10,110	Do.
Tunnelite No. 4	309	10,620	Do.

* When used with detonators, preferably electric detonators, of not less efficiency than No. 6.

All the above explosives are classed as nitroglycerin explosives, with the exception of Tunnelite AA, which is an ammonium nitrate explosive.

Patents.

Detonating explosive charges; Composition for ——. W. Runge, Chester, Pa., Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,168,746, Jan. 18, 1916. Date of appl., June 12, 1913.

A priming charge for blasting caps consists of a mixture of 70—95 (preferably 80) parts of lead azide and 5—30 (20) parts of trinitrotoluene.—T. St.

Match-splint; Treated —— *and process of producing the same.* W. A. Fairburn, Short Hills, N.J., Assignor to The Diamond Match Co. Chicago, Ill. U.S. Pat. 1,168,869, Jan. 18, 1916. Date of appl., June 18, 1913.

Boric acid is ground with "petrolatum" and the mixture added to melted paraffin wax heated to about 250° F. (120° C.). Splints are dipped into the molten mixture to impart to them flaming and non-glowing properties.—T. St.

Match-splints: Process of treating ——. J. R. Nolan, Yonkers, N.Y., Assignor to The Diamond Match Co., Chicago, Ill. U.S. Pat. 1,168,901, Jan. 18, 1916. Date of appl., Mar. 9, 1915.

The splints are heated, coated with a finely-divided anti-glowing material with which is incorporated a finely-divided wax, and reheated. The wax melts and serves as a vehicle to carry the anti-glowing material into the splints.—T. St.

XXIII.—ANALYSIS.

Bomb furnace; An electrically heated ——. D. F. Calhane and H. A. Lavene. Met. and Chem. Eng., 1916, **14**, 140—143.

The furnace contains eight small iron pipes arranged around a central pipe of 1¼ in. diam., and two heating elements, an inner one around the central pipe and an outer one enclosing the set of smaller pipes, which serve as receptacles for the sealed glass tubes to be heated. Each heating element consists of nichrome wire of the ribbon type, wound on an iron pipe and insulated from the pipe by alundum cement. The wire on the inner element is covered with a thin layer of alundum cement and enclosed in a jacket of thin sheet iron; that on the outer element is also covered with alundum cement and is enclosed in two jackets, an inner removable one of alundum cement composition and an outer one of magnesia insulation as used for steam pipes. The furnace is fitted at each end with an explosion door of a new type, the door proper consisting of an iron disc fastened by screws to cross-strips on the hinged door-frame and held in position against the end of the furnace by springs on the shanks of the screws. The door frame is fastened by means of a catch, and in the event of an explosion the door is forced backwards against the action of the springs until the pressure is relieved and then returns to its original position. Hoods are fitted over the doors to prevent danger from fragments of glass which may be projected from the furnace.—A. S.

Melting points above 270° C.; Apparatus for determining ——. P. Rassfeld. J. prakt. Chem., 1915, **92**, 467—468.

A tubular ⊥-piece, with open ends, is fixed in a small bath of molten tin or other metal in such a way that the ends of the horizontal tube project through the walls and the top of the vertical tube is above the surface of the molten metal. The capillary tube containing the substance is attached to a thermometer, lowered down the vertical tube and observed through the horizontal tube whilst the bath is heated.—J. H. L.

Source of error in the elementary analysis of coal. Knublauch. *See* IIa.

Effect of controllable variables on the penetration test for asphalts and asphalt cements. Hubbard and Pritchard. *See* IIa.

Valuation of Erythrosin and Rose Bengal. Leys. *See* IV.

Preparation of collodion membranes of differential permeability. Brown. *See* V.

Boric acid in presence of litmus solution. Fichter. *See* VII.

Volumetric determination of thiosulphate in presence of sulphide, sulphite, and bisulphite. Sander. *See* VII.

Determination of free sulphur in commercial antimony sulphides. Hutin. *See* VII.

Two important analytical reactions of azoimide. Sommer and Pincas. *See* VII.

Absorption of oxygen in alkaline solutions and a new absorbent for oxygen. Henrich. *See* VII.

Determination of bromine and iodine in presence of chlorides. Winkler. *See* VII.

Determination of antimony in roasted stibnite. Hall and Blatchford. *See* X.

Customs examination of vegetable oils by means of the hydrometer. Fischer. *See* XII.

Detection of fats by means of Schiff's reagent. Francois. *See* XII.

Determination of basicity of one-bath chrome liquors. Harrap and Hayes. *See* XV.

Influence of basic and of normal lead acetate, added before and after heating, upon the results obtained by Pellet's hot aqueous digestion method [of determining sucrose in the sugar beet]. Pellet. *See* XVII.

Formation of alcohol on adding yeast directly to the sugar solution, previous to heating to 55° C. [in the determination of sucrose by double polarisation, using invertase as hydrolyst]. Gillet. *See* XVII.

Use of yeast liquefied by sodium salicylate to effect hydrolysis [in the determination of sucrose by double polarisation, using invertase as hydrolyst]. Pellet. *See* XVII.

Steuerwald's modification of the double polarisation method [of determining sucrose]. Pellet. *See* XVII.

Determination of reducing sugars in presence of an excess of sucrose. Maquenne. *See* XVII.

Agglutination test for the presence of Bact. abortus in milk. Cooledge. *See* XIXa.

Testing of distilled water to be used for the preparation of salvarsan solutions. Tillmans and Mildner. *See* XX.

Patents.

Suspended matter in gases; Method and means for indicating ——. W. A. Schmidt, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,168,227, Jan. 11, 1916. Date of appl., Jan. 30, 1913.

Suspended matter in a gas is indicated and measured by measuring the effect on the strength of a silent alternating electric discharge across a gap between two electrodes, through which the gas is passed.—B. V. S.

Thermo-electric couple. W. H. Bristol, Assignor to The Bristol Co., Waterbury, Conn. U.S. Pat. 1,169,611, Jan. 25, 1916. Date of appl., Apr. 28, 1915.

The thermo-electric couple is composed of a primary portion, one part of which is an alloy of Ni and approximately 2% Al, and the other an alloy of Ni and approximately 10% Cr, and an extension portion, one part of which is Cu combined with the Ni-Cr part of the primary portion, and the other an alloy of Cu and 40% Ni combined with the Ni-Al part of the primary.—B. N.

XXIV.—MISCELLANEOUS ABSTRACTS.

Pressures and temperatures; Simultaneous action of very high —— *on chemical phenomena; cosmic applications; chemical origin of solar radiations; discussion of the theory proposed by Arrhenius.* E. Briner. J. Chim. Phys., 1915, **13**, 465—487.

From theoretical considerations the author concludes that substances which, at very elevated temperatures and moderate pressures, would be entirely resolved into atoms, could under the influence of intense compression still exist as chemical combinations, and by extrapolation he calculates, for example, that hydrogen, which at the assumed solar temperature, 6000° C., would be entirely atomic, is nevertheless in the solar interior, at a pressure say of 100,000 atm., only dissociated to the extent of 2 %. The theory of Arrhenius of the chemical origin of solar radiation, namely the dissociation in the photosphere of the exothermic compounds existing in the solar interior, is shown to be inadequate. The combination of atoms to form molecules, although producing much more energy than that available on Arrhenius' theory, would still provide but one fifty-thousandth part of that required to maintain the solar radiation, even supposing the mass of the sun was originally atomic hydrogen, and it must therefore be supposed that the atom is not the last stage of the thermal dissociation of the molecule, and that the enormous energy per gram required to account for the rate of solar radiation is derived from the combination of proto-atomic particles.—G. F. M.

Trade Report.

Prohibited exports. Order in Council, Feb. 23, 1916.

THE heading "Haematite pig iron" in the list of goods the exportation of which is prohibited to all destinations, is replaced by the heading:—Pig iron of the following descriptions:—(*a*) Pig iron containing less than 0·1 % of phosphorus, including haematite pig iron; (*b*) all other pig iron containing more than 0·1 % of phosphorus, but less than 1·5 % of silicon together with less than 0·09 % of sulphur. The exportation of the following goods is prohibited to all destinations:—Cerium, oxide and salts of; cerium and its alloys (except ferro-cerium); sugar, refined and candy; sugar, unrefined. The exportation of ferro-cerium is prohibited to all destinations abroad other than British Possessions and Protectorates. The exportation of bleaching-powder and of oleaginous kernels, nuts, and seeds, such as are not already prohibited to be exported to any destination, is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal.

Chemical exports from the United States. Oil, Paint, and Drug Rep., Feb. 11, 1916.

	1914		1915	
	Quantity.	Dollars.	Quantity.	Dollars.
Alcohol, pt. gls.	155,647	66,799	363,769	174,830
Alcohol, wood, gls.	1,160,721	479,121	1,224,496	632,242
Asphaltum—				
Unmanufactured, tons	37,246	845,838	38,163	735,952
Manufactures of	—	401,182	—	478,685
Baking powder, lb.	2,857,902	778,632	3,543,591	856,299
Bark, extract of, for tanning	—	1,084,088	—	4,163,352
Bauxite concentrates, tons	5,374	240,084	16,082	717,186
Calcium carbide, lb.	32,750,320	988,641	37,379,995	1,154,982
Candles, lb.	3,153,244	307,660	5,301,433	497,333
Celluloid and manufactures of	—	1,108,503	—	1,402,044
Chemicals, drugs, dyes, and medicines—				
Acids—				
Sulphuric, lb.	13,175,795	140,375	77,812,029	998,124
All other	—	619,591	—	9,055,875
Copper sulphate, lb.	7,387,236	327,967	13,952,839	680,541
Dyes and dyestuffs	—	537,539	—	2,511,065
Ginseng, lb.	155,029	1,265,390	—	210,415
Lime, acetate of	47,896,901	832,526	19,767,874	552,862
Petroleum jelly, etc.	—	639,848	—	1,034,256
Soda, salts and preparations	—	734,908	—	7,114,205
Sulphur or brimstone, crude, tons	98,153	1,807,225	37,312	732,697
Washing powder and fluid, lb.	12,683,223	533,066	12,901,710	584,355
Other	—	11,287,208	—	39,923,700
Celluloid and manufactures of	—	—	—	1,402,044
Dynamite, lb.	11,303,315	1,213,600	11,446,368	1,502,450
Ferrovanadium, lb.	—	—	840,265	741,085
Fertilisers—				
Phosphate rock, ground or unground, not acidulated—				
High-grade hard rock, tons	281,806	2,818,060	34,322	334,954
Land pebble, tons	618,241	3,948,079	218,620	1,269,789
All other, tons	1,067	5,513	357	4,326
All other fertilisers, tons	63,554	1,311,227	113,965	2,778,916
Glucose, lb.	127,201,099	2,895,189	151,643,990	4,107,547
Glue, lb.	2,248,252	242,582	3,775,160	383,666
Grape sugar, lb.	35,681,124	775,036	36,836,296	945,260
Graphite—				
Unmanufactured, lb.	3,920,693	277,386	1,065,704	53,016
Manufactures of	—	215,878	—	536,662
Grease—				
Lubricating	—	2,058,364	—	3,272,942
Soap stock and other	—	1,420,766	—	4,064,434
Gunpowder, lb.	866,569	289,893	83,884,703	66,346,770
Ink—				
Printers'	—	421,086	—	436,999
All other	—	152,497	—	202,127
Lard, lb.	438,015,898	48,610,269	451,053,321	48,340,868
Lard compounds and other substitutes, lb.	63,355,911	5,686,980	63,567,385	5,519,039
Lard, neutral, lb.	21,797,521	2,429,926	35,386,318	4,006,840
Lead, manufactures of—				
Pigs and bars—				
Produced from domestic ore, lb.	—	—	171,177,377	7,797,006
Produced from foreign ore, lb.	—	—	41,783,126	1,663,326
All other manufactures of	—	—		2,270,889
Oil cake and oil cake meal—				
Corn, lb.	59,076,805	904,561	31,157,289	562,889
Cottonseed cake, lb.	467,401,631	5,746,255	1,292,742,008	17,524,319
Cotton-seed meal, lb.	151,684,173	2,085,461	165,707,667	2,296,349
Linseed, lb.	509,415,386	7,978,743	606,356,587	10,764,834
All other, lb.	11,211,008	130,207	17,771,393	212,215

	1914		1915	
	Quantity.	Dollars.	Quantity.	Dollars.
Oil—				
Animal—				
Fish (except whale), gls.	155,196	46,880	134,500	54,575
Lard, gls.	102,229	81,087	351,284	210,015
All other, gls.	613,279	413,708	636,772	457,137
Oleo, lb.	85,144,527	8,918,130	109,395,763	13,011,789
Oleomargarine, lb.	2,292,060	246,914	6,774,278	783,321
Vegetable—				
Corn, lb.	16,203,673	1,127,146	16,942,737	1,509,873
Cottonseed, lb.	216,308,961	14,683,798	352,623,678	25,245,317
Linseed, galls.	265,781	154,317	1,358,599	735,697
All other	—	—	393,263	1,839,798
Volatile—				
Peppermint, lb.	119,037	309,450	196,648	403,027
All other essential	—	228,736		601,818
Mineral—				
Crude, gls.	124,735,553	4,958,838	158,263,069	4,282,827
Refined or manufactured—				
Illuminating, gls.	1,010,449,253	64,112,772	836,996,731	49,957,273
Lubricating and heavy paraffin oils, gls.	191,647,660	26,316,313	239,719,488	32,441,794
Naphthas and all lighter products of distillation—				
Gasoline, gls.	162,669,038	19,897,613	169,770,999	20,762,599
All other, gls.	47,023,617	5,390,801	112,560,475	13,141,390
Residuum (including tar and all other from which the light bodies have been distilled)—				
Gas oil and fuel oil, gls.	634,297,337	18,019,333	799,646,145	22,010,458
All other, gls.	69,209,777	1,204,917	12,616,712	364,381
Paints, pigments, and varnishes—				
Lampblack	—	389,081	—	392,997
All other dry colours	—	684,222	—	1,448,582
Ready mixed paints, gls.	771,879	974,400	906,128	1,125,351
Varnish, gls.	863,363	834,320	820,208	735,203
White lead, lb.	17,645,538	1,017,376	25,313,239	1,409,713
Zinc oxide, lb.	31,183,369	1,408,525	39,960,899	2,066,992
All other (including crayons)	—	1,595,651	—	2,156,876
Paraffin and paraffin wax, lb.	188,822,971	6,434,831	386,863,193	12,532,520
Quicksilver, lb.	108,426	70,753	252,852	225,509
Rosin, brls. (280 lb.)	1,748,500	8,068,224	1,382,837	6,597,614
Soap—				
Toilet or fancy	—	1,801,226	—	2,330,225
All other, lb.	59,514,401	2,863,323	75,006,993	3,578,053
Starch, lb.	62,023,590	1,484,647	178,635,301	5,031,963
Stearine from animal fats lb.	3,239,469	279,859	16,870,824	1,648,421
Tallow, beef, lb.	9,980,066	621,296	26,568,003	1,902,189
Tar, turpentine, and pitch, brls. (280 lb.)	419,331	541,300	67,048	286,157
Turpentine, spirits of, gls.	11,118,379	5,188,509	10,624,031	4,844,243
Vulcanised fibre and manufactures of	—	—	—	459,888
Zinc and manufactures of—				
Ore, tons	9,920	388,464	743	35,276
Dross, lb.	5,051,067	240,914	8,335,417	507,132
Pigs, bars, plates and sheets—				
Produced from domestic ore, lb.	—	—	25,303,584	4,010,369
Produced from foreign ore, lb.	—	—	14,814,410	2,086,301
Plates and sheets, lb.	—	—	81,551,212	13,607,854
All other manufactures of	—	210,974	—	16,063,495

German chemical companies during war-time; Profits of the ——. Chem.-Zeit., 1915, **39**, 931.

A list of 20 important limited companies which have shown a reduced but still substantial dividend is quoted from the "Berliner Tageblatt" (see this J., 1916, 200). The dividends declared by some of the most successful concerns do not, however, afford an accurate estimate of the position of the whole trade, and there are many undertakings, and even entire branches, where the losses have been considerable. To this class belong, above all, the cement factories, the glass, porcelain, and earthenware works, and the paper and wood pulp trade; even the powerful Norddeutsche Cellulose Fabrik has reduced its dividend from 15 to 3%, but, on the other hand, the Ammendorfer Papier Fabrik and the Königsberger Zellstoff Fabrik are able to continue their rates of 17 and 15% respectively. It is expected that all these branches of industry will show a rapid recovery when the end of the war removes the present obstacles to their activity. The Ver. Glanzstoff Fabriken at Elberfeld is able to distribute 27% as against 34% in the previous year. It will not be possible to gauge the full damage caused to the industry by the cutting off of foreign communications and the suspension of branch factories in enemy countries until after the war. Without underestimating the considerable foreign competition which is being built up in enemy countries, it is hoped that by wise political administration after the war, German industry will be enabled to develop freely and resume its previous position in the world.—J. F. B.

German colonies; Economic resources of the ——. *IV. Pacific possessions.* Bull. Imp. Inst., 1915, **13**, 559—581.

In the German New Guinea Protectorate, comprising the Bismarck Archipelago, part of the Solomon Islands, Kaiser-Wilhelmsland (part of New Guinea proper), the Caroline Islands, the Pelew and Marianne Islands, and the Marshall Islands, copra is by far the most important agricultural product, 73,000 acres, out of a total cultivated area of 80,800 acres, being devoted to coconut palms. A small amount of rubber is also grown. The exports of copra in 1912 amounted to £300,513, and of rubber to £8145. The chief mineral is phosphate rock, produced by phosphatisation of the coral limestone. The deposits are very extensive in Nauru (Marshall Islands); it is estimated that Nauru and Ocean Island together contain not less than 50,000,000 tons of phosphate rock; smaller deposits (about 2,500,000 tons) occur in Angaur (Pelew Islands); the content of calcium phosphate is about 80% and in some cases as much as 87%, and iron oxide and alumina are present only in small quantities. The tot exports of phosphate from Nauru and Angau during 1912 amounted to about 193,000 tons valued at about £250,000. Among the minera deposits of less importance are gold, petroleum brown coal, limestones, and clays in Kaiser-Wilhelmsland. In Samoa copra (exports 11,02 tons, value £203,496, in 1912) and rubber (exports 12 tons, value £5538 in 1912) are produce A table summarising the exports and trade of of the German colonies is given.—A. S.

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Edinburgh Section.

Meeting held at Edinburgh, on Wednesday, February 16th, 1916.

MR. D. B. DOTT IN THE CHAIR.

CARBONISATION OF COAL IN GAS WORKS.

BY J. W. NAPIER.

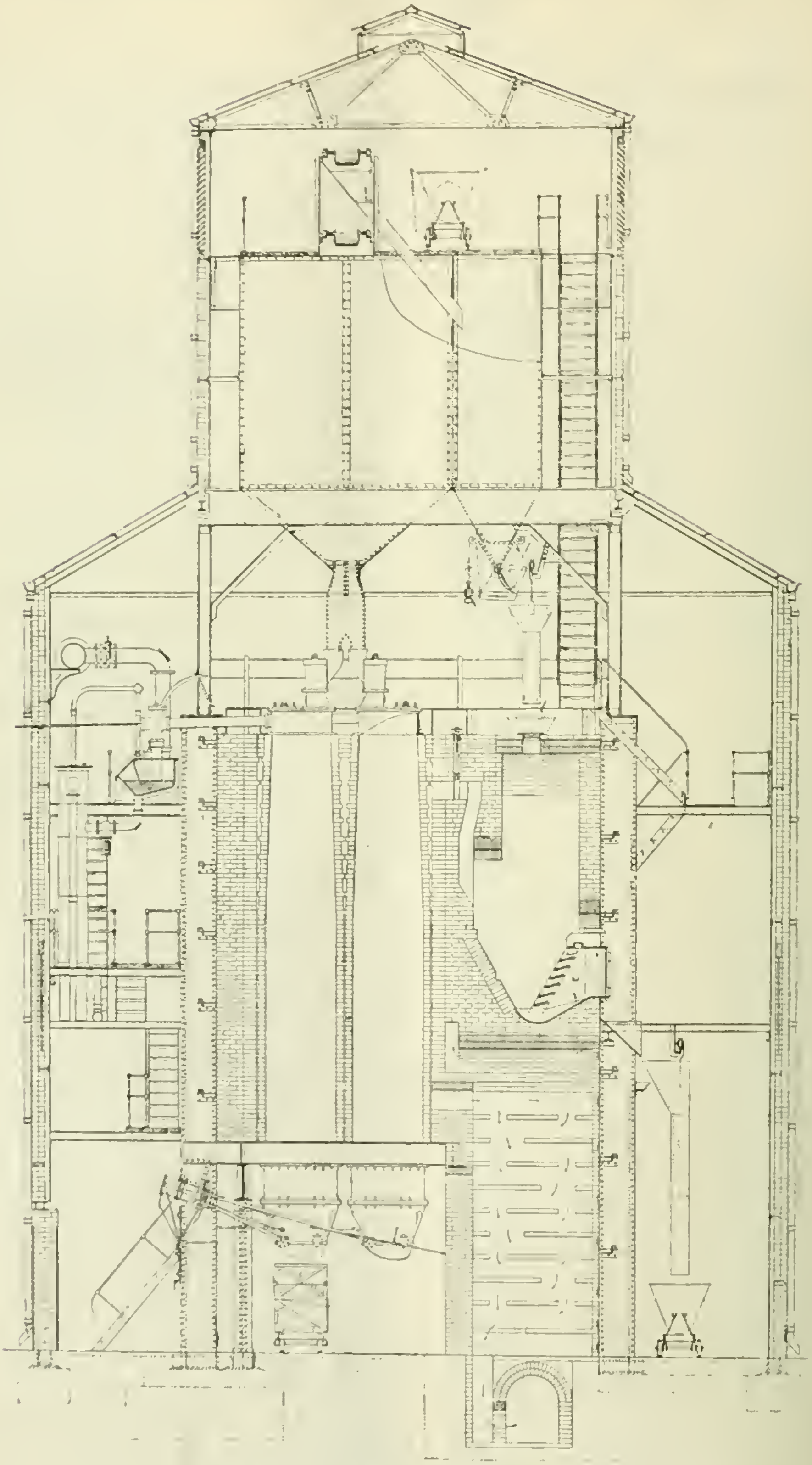
In the manufacture of coal gas and by-products, as regards especially the economics of the industry, very considerable and real progress has been attained during recent years. The vertical retort has solved the labour problem in gas works, giving conditions of labour that make the workman agreeable with his work, and content. Taking advantage of the law of gravity in the handling of the bulk material—coal and coke—machinery in the modern retort house has been abolished. To have served these ends the vertical retort is a consummation in the practice of gas manufacture that has brought with it one of the most radical and complete changes in gas making since the days of the discovery of coal gas for lighting purposes. With the plant now available, and cost of handling material at a minimum that is not likely to be much reduced by alteration in general design, the problem of the constructional engineer in labour saving appliances may be said to have been largely solved.

I venture to assert that the economics of gas production, and of residuals, for the future, lie almost entirely in the domain of the chemist. It has been imputed that in gas manufacture the chemist has not succeeded in any very measurable degree in enhancing the values of gas works methods, and that his investigations are only explanatory of what is taking place, and not inventive of new methods. This declaration bears a false meaning because undoubtedly the chemist has given knowledge and understanding without which there would not be the same high degree of efficiency already reached. Between the pure scientist and the manufacturer there arises too frequently, as a barrier, the commercial side of the business, and this aspect of the situation accounts for much.

The installation of vertical retorts at the Alloa Gas Works has been in operation supplying the whole requirements of gas since May, 1914. There are 24 retorts in all, in 6 separate beds of 4 retorts each. The retorts are 25 feet high, 40 in. by 10 in. at top and 48 in. by 18 in. at bottom. The taper on the retort permits of the easy discharge of the coke at the bottom, as well as allowing for the swelling of the charge of coal in its passage down the retort as it becomes subjected to the increasing temperatures. The overhead storage hoppers for coal have a capacity equal to 48 hours requirements, and from experience in the general working of the plant I should not advise hoppers of a less size, while he provision of the requirements of coal over a week end from Saturday to Monday is a distinct advantage. Overhead coke hoppers are provided or the supply of fuel to the producers, and in this ase the same ample capacity has been arranged or. Elevating the coal and coke to hoppers is arried out by a gravity bucket conveyor capable of dealing with 30 tons per hour. If required, and in the event of breakdown of the bucket conveyor, he electric hoist can be immediately put into use, the coal being carried in small bogie trucks. There is the usual receiving hopper, 15 tons capacity, into which the coal is tipped from wagons, and large coal is dealt with by the coal breaker. Electricity is the motive power for working the coal and coke handling plant. It is unnecessary to enter into a detailed description of the whole plant as the object of this paper is rather to deal with the working results of the system, and its economies, as contrasted with the old system of horizontal retorts. The plan on page 334 shows clearly the disposition and arrangement of the plant.

The outstanding feature of coal carbonising plant on the vertical system is the absence of machinery for the charging and discharging operations. The law of gravity has been fully taken advantage of, and the result is a combination of conditions of working and economy in labour costs, never before approached. The shale oil retort of Scotland for more than 25 years furnished to the gas industry an example of economical methods of handling carbonising material in bulk, and it is fit and proper to state that the vertical gas retort has been largely borrowed from this source. The delay in adoption of the vertical retort in gas works was largely due to questions of illuminating power, but it is reasonable to suggest in view of the greatly improved results now experienced that the retort ought to have been installed in gas works many years ago. The explanation of the great economy in labour is understood when it is stated that in the horizontal system a large number of small size units of retorts are employed capable of a throughput of coal per diem of approximately 15 cwt. and demanding a great many separate operations, while the vertical retort is a much larger unit and is able to deal with a quantity of coal from 3 to 5 tons according to size, and consequently a very considerably less number of retorts is needed. In my own case instead of 88 horizontal retorts requiring to be in operation, only 12 vertical retorts are needed to meet a similar output of gas. The operation of discharging the coke at the bottom of the retort, which is water sealed, is expeditious, and the coke being already cooled this work is performed with an entire absence of heat or steam arising from quenching of the red-hot material as is the case with horizontal or sloping retorts. The discharge of coke takes place at intervals of 3 or 4 hours, according to the demand for gas. Immediately following upon the discharge of coke, the whole contents of the retort are displaced, and the space left at the top of the retort is filled with fresh coal. It may be observed that the coal valve in use for passing the coal into the retort is operated in the most simple manner possible, and is a distinct feature in the simplicity of the plant. It should be pointed out that no measured or definite quantity of coke requires to be discharged from the retort at each operation, and the quantity may be increased or decreased at will. The quantity of coal put into the retort is altered as a matter of course in the same manner.

There is very considerable flexibility in the working of the retorts as regards throughput, and the writer's experience for the past year is of interest in this respect. In the summer months 12 retorts were in use for a daily output of 320,000 to 350,000 cubic feet, the make of gas per retort per 24 hours being from 27,000 to 30,000 cubic feet. During the past winter the same 12 retorts have sufficed to meet the daily demand of 600,000 to 650,000 cubic feet, the make of gas per retort per 24 hours having increased to 53,000 as a maximum,



Vertical Retort Installation at Alloa Gas Works.

the average figure for November being 48,967 cubic feet. It is of striking interest to note further that the same number of men were employed at the maximum time of output as at the minimum. These results were effected by increasing the temperature of the retorts giving a larger throughput of coal and by judicious admission of steam whereby a quantity of water-gas was made, the amount of steam used being governed by the necessity of preserving a certain standard of quality of gas.

As has already been emphasised, the labour saving and economy in wages is very considerable. For a complete working year with horizontal retorts and machine charging only, with hand drawing of coke, stokers' wages amounted to £1825 10s. 4d., being 2s. 2¾d. per ton of coal carbonised, and 2·82 pence per 1000 cubic feet of gas made. For a 12 months' working of vertical retorts the stokers' wages amounted to £701 18s. 5d., being 1s. 0½d. per ton of coal carbonised, and 1·10 pence per 1000 cubic feet of gas made, or a saving of £1123 11s. 11d. The amount of gas made for the two complete years under comparison was practically the same. It ought to be stated for the purpose of comparison with costs in other works that the wages cost for the vertical retorts includes all handling of coal and coke, labour at boiler for steam raising for the whole works supply, cleaning of producers, and other details of work necessary for the working of the installation. As exhibiting the ease of working, two men only are employed per shift of 8 hours, and during night time and on Sundays these two men are the only employees in the works, they giving attention to other parts of the plant, exhauster, etc. These conditions also obtain throughout the winter months.

The following are the results of a 48 hours' test of the plant carried out by an independent expert :—

Results of working tests on vertical retort installation at Alloa.

Coal carbonised (Blairhall nuts)	82·08	tons.
Gas made, corrected for barometer, temperature, holder pressure, and error of meter	999,400	cub. ft.
Gas made per ton of coal, corrected as above ..	12,180	,,
Gas made per mouthpiece per 24 hours, corrected as above	38,440	,,
Calorific value, gross, B.Th.U. per cub. ft.	574	
do. net, ,, ,, ...	516	
Candle power, by No. 2 Argand burner	15·45	
Coal carbonised per retort per diem	3·16	tons.
Coke used as fuel in generators, lb. per 100 lb. of coal carbonised (dry)	11·6	
Yield of tar, gallons per ton of coal	14·5	
Sulphate of ammonia, lb. per ton of coal	33·4	
Sulphur in gas, purified by iron oxide only, grains per 100 cub. ft.	4·4	
Naphthalene in purified gas	a mere trace.	

Analysis of gas: CO_2, 2·0%; unsaturated hydrocarbons, 2·6; O_2, 0·9; CO, 11·5; CH_4, 31·0; H_2, 45·8; N_2 (by copper oxide), 6·2%.

Analysis of tar: Specific gravity, 1·073; free carbon, 3·4% by weight. Distillation: Up to 130° C., 2·2% by volume; 130° to 170°, 0·1; 170° to 230°, 12·4; 230° to 270°, 15·3; 270° to 330°, 11·4; above 330° (soft pitch), 58·6%.

A comparison of the chief results of working s between horizontal and vertical retorts is here given, the data being that obtained for a complete 12 months working :—

	Verticals.	Horizontals.
oal carbonised	13,349	16,410
as made	152,925,300	155,379,600
Do. per ton of coal	11,455	9468
oke used in producers—lb. per 100 lb. coal carbonised ..	11·60	18·2
ar made per ton	15·14	9·10
ulphate of ammonia do. do.	25·88	21·50

If real progress in the manufactures is to be measured by the additional wealth actually realised from a ton of raw material, then the gas manufacturer may rest satisfied that his achievement has marked a big step forward. I have made a careful calculation of the exact amount increased value obtained from a ton of coal, including wages economy, which is as follows: Gas, 2½d.; tar, 8¾d.; ammonium sulphate, 4¾d.; coke, 1s. 1½d.; wages, 1s. 2¼d.; total, 3s. 7¾d. The figures given do not take note of economy in repairs and maintenance of plant. In this matter, as far as the author is able to judge, the life of the retorts as a minimum should reach 2200 working days, and, by good management in the control of heats, there is no reason why this period should not be exceeded. The life of the horizontal retort varies between wide limits and is from 500 days to 1100 days but the latter figure is rarely reached.

There are three distinct types of vertical retorts, viz.: intermittent, continuous, and continuous-intermittent. The author decided in favour of the continuous-intermittent, but the system to be followed is to some extent determined by local circumstances, *e.g.*, quality of coke required. The continuous-intermittent system gives constant gas making from the retorts, but intermittent times of charging with fresh coal, as compared with the continuous system in which the coal is fed into the retort continuously. Shortly stated, the advantages which the author has observed with the continuous-intermittent retort are: simplicity of arrangement for charging or discharging of retorts, the operations being quite independent of automatic arrangements; low costs of operating the plant, and where a water supply is available in the works for filling the bottom buckets sealing the retorts, the costs in this regard are practically nil; each individual retort can be controlled within wide limits as to extent of charge and discharge; the operations are positive, that is to say, a definite discharge of coke and charge of coal is made at the same time, and no further attention is needed until the next period. The outstanding feature of advantage is undoubtedly with the quality of coke produced as regards its physical condition. It is conceded that in order to make a coke of high quality, as, for example, in the coke oven, a period of rest for the material in the retort is a necessity. The quality of the coke as regards appearance, size, and small quantity of breeze made, is distinctly in favour of this system, and the advantage in this respect in the experience of the writer is considerable.

The quality of the gas produced from vertical retorts is generally from 2 to 3 candles lower. Candle power can be altered at will, and made to vary from 12 to 17 candles. The calorific value, as the most important quality of the gas, can also be regulated within wide limits from 500 B.T.U. to 600 B.T.U. according to conditions of working and quality of coal. The true value of coal gas to all classes of users—except for the naked flame—is measured by its heating value whether for incandescent lighting, cooking and heating, and for engines. Recent legislation has been in the direction of requiring gas supply authorities to supply gas on the basis of heating value only, with the abolition of the illuminating power test.

For the purpose of this paper the author will leave out of consideration discussion of the quality of the tar produced, as the subject is a wide one and requiring extended reference. It may be shortly stated that the quality of vertical retort tar shows it to be more a product of low temperature distillation, and it contains a large amount of paraffins and less benzene and toluene. Horizontal-retort tar, being a product of a higher temperature, contains a much larger percentage of aromatic hydrocarbons, and the necessity of changing the character of the vertical tar in view of the present urgent necessity for benzene and toluene is a subject demanding experimental investigation.

The coke produced in horizontal retorts where the coal is carbonised in comparatively thin layers, not being in mass or packed together, is small, friable, and soft. The amount of breeze or small coke produced is much greater. The horizontal coke moreover contains an undue amount of volatile matter. Samples tested from time to time show volatile matter present to the extent of from 1½% to 4%. Further, having regard to the coke as drawn from the horizontal retort being red hot and requiring to be quenched with water, the moisture content is large and may amount to as much as 20% in weight. Coke produced in the vertical retort of the continuous-intermittent type, with time and mass as factors which improve the physical characteristics, may be compared with coke produced from the continuous type, where the coal is fed into the retort constantly in a slow stream. In the latter system the coke contains more breeze, the single pieces being also smaller, and more particularly when semi-coking or common splint coal is used. Further, the coal being in continuous movement inside the retort, the coking qualities of the coal are not fully realised in the resultant coke. The author was able to note in practical working even of the intermittent retorts, that when the coke was discharged more frequently in small quantities in from one to two hours instead of four to five hours there was a marked difference in the size of the coke, due undoubtedly to the aosence of the rest period of time. This difference of result between the two present-day types of vertical retorts is not without its importance when the difference in the selling value of breeze and coke is considered. As regards physical characteristics, the coke is dry, of greater density, and of a steel grey colour. The moisture content is not more than 1%, and in this regard the less quantity of water per ton compared with horizontal retort coke is equal to from 1 to 2½ cwt. per ton. The following are analyses of vertical coke and malting coke produced from a well-known coal:—

	Malting.	Vertical.
	%	%
Moisture	4·73	0·80
Volatile matter	0·42	0·70
Fixed carbon	82·79	89·59
Sulphur	0·48	0·42
Nitrogen	1·40	1·54
Ash	10·18	6·95
	100·00	100·00

	Grains per lb.	Grains per lb.
Arsenic:—		
Non-volatile	faint trace	nil.
Volatile	0·014	0·0028
Total	0·014	0·0028

It will be observed that the quality of vertical coke compares most favourably with the special coke prepared for malting purposes. The amount of arsenic present is low, but this result is not due to the particular process under review, but to the quality of coal used. The coke has been in use during the past twelve months in a number of breweries and there is no reason why gas works having vertical retorts in use should not be able to meet the requirements of brewers for coke. The small amount of volatile matter and the low percentage of sulphur are points in its favour.

For suction gas producers the coke is a suitable fuel, more especially as the extremely small quantity of volatile matter present obviates tar troubles in the working of the gas engines.

It will be recollected that Young and Beilby succeeded in increasing the ammonia yield from shale by the adoption of the vertical retort in shale oil manufacture, in which the author had some experience in earlier years. The increased yield of this by-product was the result of the bulk carbonisation of the shale in mass as opposed to carbonisation in thin layers in the horizontal retort. Steam admitted to the retort, by decomposition yielded with the nitrogen in the shale more ammonia, while there was the protective influence of a large excess amount of steam in preventing the ammonia once formed from decomposition. The similarity of the process in shale oil works and gas works in the endeavour to increase the ammonia yield abruptly ceases when the object of the gas manufacturer is considered. In the case of shale, the steam used causes a gas to be produced of practically no illuminating power, and of low heating value, while the carbon value of the spent shale is reduced to nil. Such conditions of working are opposite to those obtaining in gas works where a gas of moderate illuminating power is required but of high heating value, while the carbon value of the spent charge of coal, viz.: coke, is fully preserved. So far therefore as coal gas manufacture is concerned, it is not possible to follow the method of shale oil works in the endeavour to increase ammonia yield, as the process would require to be carried out in separate retorts and at the sacrifice of the coke and the production of a low value gas which could not be put to practical use.

From the results obtained in the estimation of nitrogen in a number of Scotch coals it was thought that the varying percentage amount present might prove a guide to the relative value of the several coals in yield of ammonia. This, however, was not proved; indeed a number of the samples tested were coals from a particular coalfield, and while the nitrogen present was higher than the average the yield of ammonia in gas retorts was consistently low. Experiments have shown that dealing with coals in Scotland the strong coking coals contain the largest percentage of nitrogen, semi-coking coals next in order, while non-coking coals are lowest on the scale of nitrogen value. Gas works accustomed to the use of coals from the Fife coalfield, for example, which are largely non-coking, have experienced low results in ammonia recovery. The results of the tests of coal for nitrogen made by the author from time to time have shown, and this has been pointed out by other observers, that the nitrogen content of a coal is not a reliable guide to the ammonia yield on carbonisation. By far the larger amount of the original nitrogen content of the coal is left in the coke, to an extent varying from 50% to 65% of the amount of nitrogen in the original coal. The distribution of nitrogen in coal in the products of distillation is shown in the investigation made by Mr. James McLeod: Nitrogen in coke, 58·3%; in tar, 3·9%; in liquor, 17·1%; in cyanogen, 1·2%; in gas, 19·5%.

An analysis of vertical retort coke gave 1·54% of nitrogen, which is equal to 34·49 lb. of nitrogen or 162·6 lb. of sulphate of ammonia per ton of coke.

The results of the work of different investigators goes to show that the nitrogen in coke is difficult of recovery as ammonia, and this, it is assumed, is due to the stability of its combination in the carbonaceous mass. Embraced with this circumstance is the fact that in gas manufacture the desired temperatures for the making of a good gas are opposed to the preservation of ammonia when once formed. The problem which now presents itself is the possibility of the recovery of a larger proportion of the nitrogen left in the coke under gas works conditions. It may be stated quite safely that any attempt to recover a large amount of the total available can only be done by complete combustion of the coke. The laboratory process of the estimation of nitrogen in coke by combustion with soda lime has long ago been tried with the "Cooper" process in which the coal was mixed with lime before carbonisation. The process was never successful except to a very limited degree, and while slightly improved results in ammonia yield were got at some works the method has long since been discontinued.

The nitrogen in coke is generally assumed to be in the from of a highly stable nitrogen compound. The nitrogen so combined is extremely difficult to separate for the purpose of recovery in manufacture of ammonia, and after prolonged exposure to high temperatures the amount remains practically the same, The conspicuous experiments of Tervet (this Journal, 1883, 2, 445), however, have shown that the fixed nitrogen can be gradually and almost completely converted into ammonia by passing hydrogen gas over a long period at a given temperature, and under other conditions of dilution of gases. The experiments of Tervet were carried out as long ago as 1883, the series of tests giving results equal to 60 lb. sulphate of ammonia per ton, while the coke value, it was stated, was in no way destroyed. No practical application of these experiments on the large scale has met with the success that would make a satisfactory commercial process. With the "Mond" type of producers, guarantees are given of a production of 70 lb. of sulphate of ammonia per ton of coke, which may be in the form of breeze. With coke containing 1·4% of nitrogen this shows an efficiency of ammonia recovery equal to 70 lb. out of a possible theoretical 148 lb., or 47%. By this method, it has been possible to get the best results so far obtained in the quest after the harnessing of the inert nitrogen.

In consideration of what has been stated the gas manufacturer is rudely brought back to his own coal retort and the problem of increasing the ammonia yield from the coke ere it leaves the retort. In studying the gasification of coal in retorts for the production of an illuminating gas, and having regard to high ammonia yield, it must be observed that the temperatures, while at one stage favourable, at a later stage are destructive. In a single piece of coal which is undergoing the process of gasification, one can conceive of the molecule of ammonia being formed, but destroyed almost immediately ere it passes through the outside crust of coke at a high temperature. While a high temperature is favourable to the synthetic production of ammonia the valuable product may be almost immediately destroyed. Ammonia gas begins to decompose at a temperature of 500° C., and under certain conditions of exposure to heat as regards surface and time contact the complete decomposition takes place about 900° C. These conditions of temperature of destruction do not necessarily obtain in gas retorts where the temperature may reach to from 1000° C. to 1100° C., as owing to the diluting influence of the other gases the decomposition is retarded. At the same time, a considerable quantity of ammonia is undoubtedly destroyed from naked contact with red hot coke and the heated sides of the retort.

In order to ascertain what higher yield of ammonia was possible by passing steam into the mass of red hot coke at the bottom of the vertical retort, the author was able to carry out the following experiment. The heating of the retorts was adjusted so as to have a comparatively low temperature at the top for a distance from 6 to 8 feet down, while the temperature near to the bottom of the retorts, except for the last 3 to 4 feet, was increased so as to ensure the decomposition of the water vapour in the mass of red hot coke. The amount of steam used was limited by the amount of water gas produced, and the necessity of maintaining a proper illuminating gas without the expense of too much enrichment. The use of steam, therefore, was intermittent, and it was not possible to obtain the advantage of anything like an excessive amount which would have helped to protect the ammonia. Even under these conditions the yield of ammonia for a complete month's working showed but a small increase. Under normal conditions without steam 25·88 lb. sulphate of ammonia was produced per ton of coal, and with steam 27·86 lb. The make of gas per ton of coal increased to 13,164 cubic feet.

To summarise the position of the gas manufacturer in the matter of increasing the yield of ammonia under present conditions of gas supply, with restrictions as to illuminating power and heating value of the gas, it is fairly evident that the conditions existent in the retort are opposed to anything like a satisfactorily large increase in yield being obtained. The writer is of opinion, and the subject has long been one of unusual interest to him, that catalysis will probably in the end afford a surprising result. Surmise of this kind may not be very hopeful, but in not a few technical processes on the large scale has it been found that the presence of a suitable catalyst has yielded results most unexpected.

As bearing upon the subject of the decomposition of ammonia in the retorts with formation of cyanogen the following practical experience of the author on the large scale will be interesting. During the last three years of working of the horizontal retorts the amount of cyanogen found in the gas was exceptionally large, and evidence of this was seen in the corrosive action on the iron of the purifier covers, the working parts of the station moter, particularly the measuring drum which at places was pitted into holes, and most serious of all the gas holder sheets, particularly those on the bottom lifts. The presence of iron compounds of cyanogen was exhibited in the colour of the water in the purifier lutes, station meter, and gas holder tanks, it being of a distinct blue colour. The production of cyanogen was due to the high temperature in the retorts which were being forced in order to increase the yield of gas owing to shortage of retort power, and probably an uneven thickness in the layers of coal in the retorts. Another unsatisfactory, and unprofitable, feature was the less amount of sulphate of ammonia realised from the coal. The trouble arising from cyanide was due in part at least to the decomposition of the ammonia at a high temperature due to the interaction of the nitrogen of the ammonia and the red hot carbon. It may be stated shortly that during the 21 months working of the vertical retorts all traces of an excess amount of cyanide have disappeared. The vertical retort with mass carbonisation in respect of cyanogen trouble has shown an improvement and saving doubly beneficial.

DISCUSSION.

Mr. J. D. **BRUNTON** said that the retorts described must be very hot where the gasification took place and fairly cool at the top: in his own experience, where such variations of temperature occurred, the greater the number of joints in the furnace bricks the better it was. Bricks in large sections had always cracked, and now they were using what were known as "scones." Six years seemed a very long life for a retort subject to such variation of temperature.

Mr. G. H. **GEMMELL** said he believed that since the vertical retorts had been put in at Alloa, there had been no trouble, whilst the coke was of a much higher quality than that from horizontal retorts, and there was a further advantage in the fact that the temperatures and working conditions could be varied much more readily to meet requirements than was the case with horizontal retorts. He thought that if ever conditions became favourable for the gas manufacturer to make fuel similar to "coalite," it could be done much more satisfactorily in a vertical than in a horizontal retort.

Mr. NAPIER agreed entirely with Mr. Brunton as to the necessity of building vertical retorts with single bricks: retorts built in that way would probably last longer than those made up of large sections, in which case the possibilities of cracking were greater. Whilst the difference in temperature between the top and bottom of the retort was very great, that difference did not vary from time to time. No fireclay material could withstand great differences of temperature without disintegration after a short time.

Meeting held at Edinburgh on Wednesday, January 19th, 1916.

MR. D. B. DOTT IN THE CHAIR.

THE FUNCTIONS AND ORGANISATION OF A TECHNICAL LABORATORY.

BY B. D. PORRITT, B.SC. (LOND.), F.I.C.

A factory generally must be considered as a highly organised and intricate machine, and, save in special industries of a purely chemical character or depending on the development of new processes, the chemist cannot be considered as the mainspring, but rather as one of the several parts essential to the smooth working of the whole mechanism. Consequently, it is generally found that a considerable proportion of the activity of a technical laboratory is occupied in work associated with the engineer, the buyer, and the salesman.

The chemist, like the other members of the executive staff, cannot demonstrate his value to the business by any profit and loss statement, and the efficiency of all such employees must be judged by the smooth working of the factory, the improvements effected, and the value of the business sales judged by the commercial conditions of the period.

It is evident that the organisation of the laboratory will vary greatly according to the nature of the particular industry, the size and complexity of the factory, and the variety of the articles manufactured. The subsequent details of organisation are suggested for the laboratory of a large factory of a complex character requiring very thorough scientific control, and no doubt considerable simplification would be possible in cases where there is little variety in the raw material purchased and the products manufactured. Any simplification of the organisation will not, however, affect the following primary objects for which a works laboratory should exist.

1. To assist the chief engineer in power, water, and lighting control, to examine metals, lubricants, paints, and materials generally used in constructional work. 2. To co-operate with the buyer in securing the cheapest satisfactory raw materials, and to supervise deliveries of supplies. 3. To investigate any difficulties in the manufacturing departments which seem to require a scientific examination beyond the capabilities of the superintendent or foreman in charge. 4. To test the finished goods before despatch from the factory. 5. To examine and report on the value of competitors' products, to assist the sales department in any technical questions raised by customers, and to suggest new commercial applications for the products of the works. 6. To carry out investigations with a view to devising new processes and improving existing methods of manufacture. 7. To control, where necessary, manufacturing operations by means of tests made in the laboratory.

In order to carry out its varied functions satisfactorily, it is customary when a large scientific staff is employed to subdivide the laboratory into several sections, amongst which the following departments will generally appear:—Research laboratory, general laboratory, experimental testing laboratory, routine laboratory, library and office. The success or failure of the laboratory as a determining factor in the prosperity of a works largely depends on the judgment of the chief chemist in selecting a capable staff of assistant chemists, in directing their energies and enthusiasm into profitable channels, and in securing the best results from their work.

In designing, organising, and staffing a laboratory for commercial purposes, both efficiency and cost must always be kept in view, so that while equipment and staff must be thoroughly adequate in quality and quantity for the work required in order to secure the best results, time and labour-saving devices and methods must be installed wherever possible, and all unnecessary work carefully eliminated. As it is particularly important that the trained staff should not be encumbered with routine and clerical work, it is customary to employ unqualified men or women to carry out all the routine analyses and tests of a simple straightforward character, suitable precautions being taken to check periodically the accuracy of their work. Such laboratory assistants are usually divided into two classes according to their proficiency. The staff of the laboratory may therefore consist of the following grades:—Chief chemist, departmental chief chemists, assistant chemists, typist, and first and second class laboratory assistants. The selection of the trained chemical staff should be influenced by the following considerations:—Only fully trained and qualified university and technical college men should be considered for appointment, with preference for those possessing some research experience. Appearance, tact, energy, and business ability must be considered as well as scientific attainments. It is desirable to draw the staff from varied schools of science to ensure variety of training, ideas, and methods. A uniform salary scheme should be drawn up on a liberal scale for the various grades and departments of the laboratory. The hours of work should be reasonable and adequate holidays allowed.

Appointments to the permanent staff should be made only after a period of probation has shown the applicant likely to prove satisfactory in all ways. When an applicant for a post as assistant chemist enters on his period of probation, it is customary in some establishments to attach him to the routine laboratory with a view to his securing a general acquaintance with the daily work passing through the laboratory. More satisfactory results are likely to be secured by the adoption of the system of employing the probationer on work bringing him into intimate daily contact with the chief chemist, who will then be able to form an opinion on scientific, business, and personal grounds as to the desirability of confirming the appointment. Should the decision be favourable the new assistant chemist can then be transferred to the section of the laboratory for which his temperament, training, and abilities seem to render him most fitted.

The selection of laboratory assistants frequently does not receive the careful attention which its importance merits, having regard to the way in which the work of the trained staff can be lightened by an efficient routine laboratory staff.

Considerable difference of opinion exists regarding the suitability of women for such work, and undoubtedly considerable objections exist to the employment of a mixed laboratory staff. However, in cases in which there is no necessity for assistants to come in contact with the workers in the factory and suitable arrangements can be made for their control by a trained chemist of their own sex, the results which have been obtained by women in other spheres of commercial and industrial activity would seem to indicate the works routine laboratory as another field in which they might be introduced with advantage.

The selection of assistants from boys employed in factory departments, which is a course frequently adopted, is open to two serious objections. In the first place it results in a staff of assistants possessing an inferior school education, and secondly it increases the possibility of the leakage of confidential information regarding work in progress in the laboratory. In any laboratory in which extensive use is made of unqualified assistants it is therefore desirable to introduce a scheme with sufficiently attractive prospects to secure the best of the boys leaving the local middle class schools at the age of 16—17 years, with the intention of entering commercial life. Such a scheme will require to embody an initial salary equal to that which such a boy's services would command in an office, rising by regular increments, subject to satisfactory progress and conduct, to a maximum equal to the initial salary of an assistant chemist. Every inducement, moreover, should be offered by the payment of fees, train fares, etc., to secure the regular attendance of such assistants at evening classes in approved subjects bearing on their work, since it is manifestly almost impossible to give during business hours any systematic instruction regarding theoretical foundations on which their work is based.

The laboratory typist will require some acquaintance with elementary chemistry, together with French, German, and indexing, in addition to the usual qualifications. The possession of a good modern school education should therefore be considered the essential in a candidate for this post.

The equipment of a technical laboratory will naturally greatly depend on the nature of the industry with which it is concerned, and this part of the subject can be treated only in a general way. Every technical laboratory should be equipped with the most efficient plant and apparatus obtainable, and kept throughout scrupulously clean and in good order. Salaries are the largest item in the maintenance costs of the department, and no omission of equipment or organisation is an economy when it reduces the output of useful work in either quality or quantity. For this reason a laboratory should be roomy, well-lighted, well-ventilated, maintained at a comfortable temperature, and equipped with all the necessary apparatus and reagents. To secure co-operation and unity of action, the different sections of the department should be accommodated in one building or in buildings as near together as can be conveniently arranged. The department should, moreover, be centrally situated in the factory, and be in telephonic communication with the manager and the other members of the senior staff.

Besides the laboratories proper, suitable provision will have to be made for space devoted to the balance room or rooms, store for apparatus and chemicals, store for samples which have been submitted for report, office and library, and chief chemist's office.

With a small laboratory, considerable simplification in the number of additional rooms can, of course, be effected by utilising the laboratory space for storage purposes. A separate balance room, in addition to the laboratory proper, should however always be provided, which may serve at the same time as office and library.

The work of the department may be said to fall under the three following headings:—1. Research. 2. General. 3. Routine.

1. *Research.* The work done under this heading may be either for the benefit of the works or for the improvement of the laboratory itself. Text-books on chemistry and technical handbooks are generally found very deficient as sources of analytical methods suitable for every industry or works. It is therefore necessary for each individual laboratory to devise analytical methods and apparatus capable of yielding results of sufficient accuracy and with sufficient speed for the general and routine work to be carried out without hitch. Consequently, the research work necessitated by the compilation of a "Method Book" should be the first consideration of the research chemist. It is unfortunate that the necessity for this special work is not obvious to those outside the laboratory, and therefore not realised by the business man, devoid of a thorough scientific training, who is so frequently found acting as works manager. He, perhaps naturally, will look for results to follow immediately on the completion of staff and equipment, and will be impatient of delay on what, to him, will appear a trifling detail compared with the important factory problems waiting investigation.

This latter aspect of the work of the research chemist has recently been the subject of many papers in our scientific periodicals, and it will suffice to say that for any industry of a chemical nature the success or failure of the research chemist will determine whether the business with which he is associated is progressive or merely content to follow the improvements introduced by its competitors.

While well-trained chemists of good scientific ability may be considered as a relatively numerous class, the true investigator who combines the qualities of originality and scientific imagination with thoroughness is indeed rare, and the success of the research laboratory will greatly depend on the discovery of such a man as chief.

Research work cannot be carried out in odd moments spared from other duties, and one investigation only at a time should be undertaken by each member of the staff.

A preliminary programme should be drawn up at the start indicating the end in view and the experiments which it is thought necessary to undertake in order to obtain the information desired. It is the practice in some works with large scientific staffs to appoint a "research committee" from the senior members to meet periodically in order to draft these schemes and to consider and offer suggestions regarding the work in progress. Finally, it is essential that the laboratory generally, and the research department in particular, should have easy access to a library containing the more important scientific periodicals and works of reference.

2. *General work.* This portion of the work of the laboratory is the one most obviously profitable and therefore likely to appeal to the manufacturer. By means of scientific control it is frequently possible to effect monetary savings amounting to large sums either in the supplies of raw materials or in the production of power and heat. Moreover, goods of a more uniform quality and consequently increased sales and decreased complaints should result from the regular inspection of both raw materials and finished products. The general work of the laboratory may be classified as follows:—

A. *Factory supplies control* (in co-operation with the purchasing department), with a view to securing the cheapest satisfactory raw materials and to supervise the delivery of supplies. B. *Engineering and power supplies control*, in collaboration with the chief engineer, to select the most suitable quality of fuel, etc. C. *General factory work.* Requests for information and assistance in minor difficulties may be received from the superintendents and foremen of departments: and, in addition, the more serious manufacturing troubles which are outside the scope of the factory staff will have to be investigated. In addition to this purely factory work the laboratory will often be required to give assistance to the sales department in consequence of customers requiring all their purchases to be supplied to specification, and in investigating complaints and examining material returned as defective.

The complexity of the work and the number of the samples will, in a large laboratory, necessitate the adoption of a regular system of reporting and indexing. When the nature of the work necessitates application of physical tests a small laboratory is frequently installed for this purpose, occasionally combined with a miniature factory plant, designed to carry out experiments on a small scale preparatory to tests in the factory.

3. *Routine work.* A considerable proportion of the experimental work resulting from the factory duties of the laboratories will consist of straightforward estimations carried out in accordance with instructions contained in the Method Book and well within the powers of a laboratory assistant. All such work, therefore, should be passed on to the routine laboratory, the trained chemist merely having to secure representative samples and to report the results of the analyses, thus leaving himself free to undertake more important and profitable work.

The value of the chemist to the manufacturer is unquestionable, but it should not be emphasised to the exclusion of other factors equally essential for commercial success, and we should not attribute our industrial shortcomings to neglect of research without realising that such neglect is only one manifestation of a lack of foresight, thoroughness, and organisation. While the institution of an efficient laboratory will certainly make a good business better, the chemist unaided will seldom transform a failure into a successful enterprise, since the manufacturer who has failed to appreciate the necessity for scientific assistance until his business is on the brink of disaster has generally committed many other vital errors of commercial judgment in addition to the omission of a laboratory. Not until a sound, far-sighted, and enterprising policy is pursued by the management, and the staff is efficient, loyal, and well-organised, can the laboratory exercise to the full its functions as a centre of intellectual activity in the works and a factor in the progress and prosperity of the business.

DISCUSSION.

The CHAIRMAN said that it was difficult sometimes to prove arithmetically that laboratories were of real advantage to the works. That had to be learned by experience. In the selection of a site, coal supplies, means of carriage, and so forth were considered, but an important point for any new industry to consider was the locality and the probable opposition to anything in the nature of the slightest odour which might of necessity be evolved. His own experience was that for routine work a woman chemist did very well, and he thought that they were adapted to learn a limited number of special tests. If anything required original consideration or initiative, as a rule they were weak in that direction.

Dr. J. P. LONGSTAFF said that in technical colleges there was usually a course of "technical chemistry" in which such things as pyrometry and calorimetry and so on were taught very fully; he had asked one or two heads of works whether they liked to take in a man who had had some experience of technical chemistry or not, and without exception those to whom he had spoken said they would rather have a man who had learned pure chemistry, and they would teach him technical chemistry themselves. He did not see the advantage of that to the works. He would have thought that a student who had gone through a course of technical chemistry would be of more use at once in a works than one who had not.

Mr. J. DIXON BRUNTON said that they had found it of advantage to hand the Government inspectors over to their laboratory, and let their scientific department show them the way to test, because a number of them were unable to test according to the specifications themselves. Formerly they had handed them over to the foreman of the department where the material was manufactured, but now they took them to the central scientific department, and had very much better results and not so many rejections as before. In their own laboratory they had for a number of years bought coal on calorific values, and saved a considerable sum of money by doing so, and also in various other departments, but it was sometimes difficult to estimate the amount saved by a laboratory.

Mr. J. RUTHERFORD HILL, Mr. J. F. BRIGGS, Mr. WILLIAMS, and Dr. JERDAN also spoke.

Mr. PORRITT, replying to Dr. Longstaff regarding the desirability of including some technical training in the chemical curricula of the universities and technical colleges, said he thought that depended on the length of time which the student had at his disposal. At the end of the usual three years' course it was highly desirable that the student should spend a further year on specialised scientific work, which might either take the form of general technical training in the control of fuel for the production of power and the general types of plant employed on a manufacturing scale, or research investigations in pure or applied chemistry. The student's choice would be influenced by individual inclination and aptitude. As to which training would prove the more important depended on the nature of the post which a chemist was called on to fill.

Mr. D. B. DOTT contributed a note on "The Permanence of Writing Ink."

Communication.

THE IODINE ABSORPTION AND TENDENCY TO SLUDGE FORMATION OF SOME HYDROCARBON OILS.

BY L. G. RADCLIFFE AND C. POLYCHRONIS.

Three well-known methods are available for determining the percentage of iodine absorbed by an oil, *viz.*, those of Hübl, Hanus, and Wijs. Unfortunately the results obtained when any of these reagents is applied to one and the same for the same length of time, do not agree with the figures resulting from the use of either of the other two solutions. If, in determining the iodine absorption of an oil by any of these methods, the experiments are carried out always under the same conditions, then concordant results are obtainable, but these results will be widely different from those obtained when using another reagent. The length of time an oil is submitted to the action of the reagent is a very important factor, as is also, but to a lesser extent, the temperature at which the experiment takes place; furthermore, to secure concordant results it is essential that at least double as much iodine should be added as the oil can absorb. The influences of the above conditions show themselves very clearly in the case of fatty oils and still more so in determining the iodine values of mineral lubricating oils. Therefore in determining the percentage of iodine absorbed by a mineral oil, some carefully defined method should be used, in which the exact nature and composition of the reagent, the length of time given, etc., should be specified.

The experiments recorded below exemplify the effects of different conditions and the variations due to the nature of the reagent when the test is applied to hydrocarbon oils. The following is a detailed account of the preparation of the three reagents used for the subsequent determinations.

To prepare Wijs' solution glacial acetic acid was fractionally distilled and the portion boiling at 118·5° C. collected for the preparation of the reagent. The acid used did not reduce chromic acid. Exactly 8·5 grms. of pure, resublimed iodine was added to about 400 c.c. of this acetic acid, contained in a dry flask fitted with a calcium chloride tube to exclude moisture, and to another 400 c.c. of the acid, contained in a similar flask, was added 7·8 grms. of pure iodine trichloride. The two flasks were gently warmed and shaken until everything was dissolved, then cooled, the contents mixed, and made up to one litre with the acetic acid used for rinsing the flask. The interaction which takes place is in accordance with the equation :—

$$ICl_3+I_2=3ICl.$$

Almost every text-book dealing with oils is in error as to the amount of iodine that should be used in preparing Wijs' solution. H. Dubovitz (Chem.-Zeit., 1914, **38**, 1111; this J., 1915, 305) deals at some length with this error and recommends the quantities given above, adding the statement that a solution made in this way is very stable. For further information on this subject a paper by Niegemann and Kayser (Chem.-Zeit., 1915, 78, 491) should be consulted.

Hübl's reagent was made as usual, by dissolving 25 grms. of pure iodine in 500 c.c. of 95% alcohol and 30 grms. of powdered mercuric chloride in a further 500 c.c. of the alcohol. The two solutions were preserved separately in well-stoppered bottles in a cool, dark cupboard. Equal volumes of the two solutions were mixed 12—18 hours before use and in every case a blank test was run at the same time as the absorption of the iodine by the oil.

To prepare the Hanus solution, 13·2 grms. of pure iodine was dissolved in one litre of glacial acetic acid, prepared as for Wijs' reagent, and finally 3 c.c. of bromine was added.

The following general method was used in determining the percentage of iodine absorbed by the oil, no matter which of the three reagents was being applied. The oil was weighed in a thin glass tube made by melting the closed end of a small test tube and flattening it so that it would stand upright on the balance pan. In every case the amount of oil taken was not less than 0·2 grm. nor did it exceed 0·3 grm. The tube and its contents were dropped into a clean, thoroughly dry, stoppered bottle of 500 c.c. capacity, then 10 c.c. of the solvent was added, chloroform for Hübl's reagent and carbon tetrachloride for Wijs' method. When the oil had dissolved, 25 c.c. of the reagent was added from a pipette. To ensure uniformity in the volume delivered, it is advisable to hold the pipette in a vertical position and to allow three drops to drain out. In all the experiments blank tests were done at the same time and under exactly the same conditions, and the figures recorded are those obtained from at least duplicate experiments. The stoppered bottles and their contents were then allowed to stand in a dark cupboard for the specified time, after which 20 c.c. of a 10% solution of potassium iodide was added and well mixed with the contents of the bottle finally 300 c.c. of cold water was added and the excess of iodine titrated with $N/10$ sodium thiosulphate solution with starch as indicator.

The following data indicate how different the results are when using different reagents for the same periods of time on the same oil. Two oils were used and each was ascertained to be free from saponifiable matter by heating with metallic sodium, when no frothing, etc., occurred. In each case the duration of the test was two hours.

TABLE 1.

	Sp.gr. at 15·5°.	Percentage of iodine absorbed.		
		Hübl.	Wijs.	Hanus.
Oil 1	0·905	10·8	23·7	30·9
Oil 2	0·925	14·0	34·4	36·0

Certain observations led the authors to investigate the influence of temperature on the percentage of iodine absorbed when using each of the three reagents. Oil 1. was used and the duration of the test was two hours.

TABLE 2.

Temperature	0° C.	10° C.	20° C.
Hübl's reagent	8·9	9·9	10·9
Wijs' "	20·9	22·6	23·7
Hanus' "	25·7	27·9	31·0

As will be seen, the effects were particularly noticeable in the case of the Hanus reagent.

The following experiments were conducted to ascertain how far the absorption of iodine was influenced by the length of time the oils were exposed to the action of the reagents, and for these experiments Oils 1 and 2 were used :—

TABLE 3.

No. 1 oil.

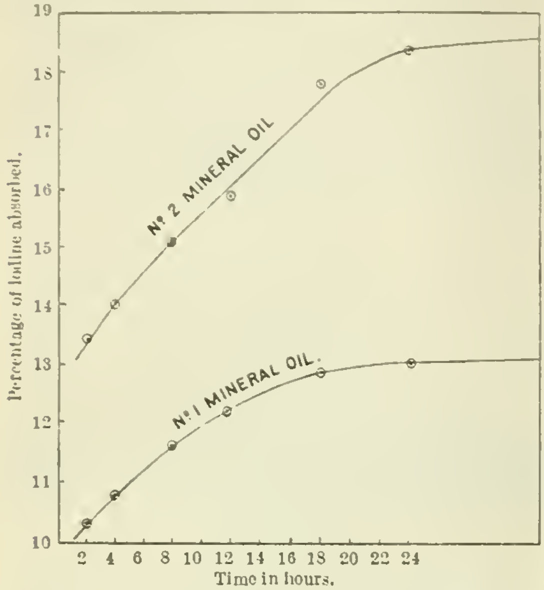
Time.	Hübl.	Wijs.	Hanus.
Hours.	% Iodine.	% Iodine.	% Iodine.
2	10·7	23·7	30·9
4	10·7	25·6	33·3
8	11·6	29·9	33·9
12	12·8	31·3	34·3
18	12·9	31·7	35·9
24	13·0	31·9	37·3
48	13·2	32·4	38·1

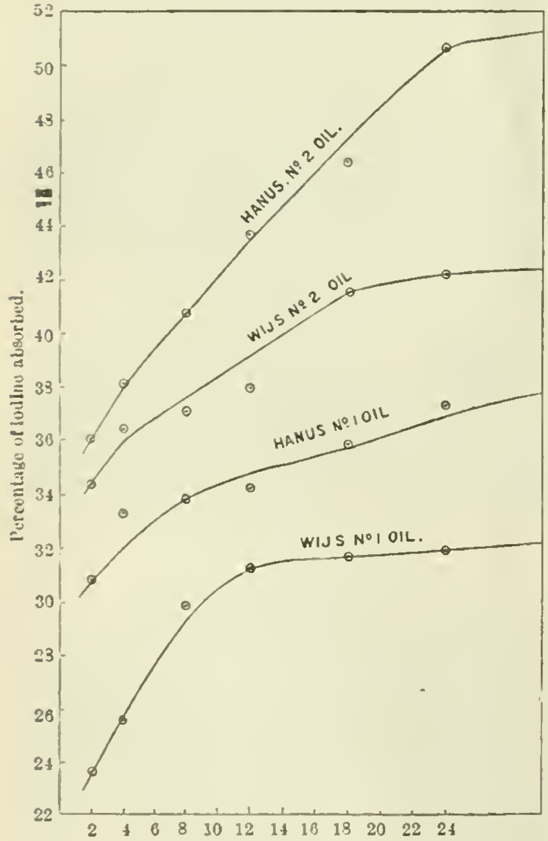
TABLE 4.

No. 2 oil.

Time.	Hübl.	Wijs.	Hanus
Hours.	% Iodine.	% Iodine.	% Iodine.
2	13·4	34·4	36·0
4	14·0	36·4	38·2
8	15·1	37·1	40·8
12	15·9	38·0	43·7
18	17·8	41·7	46·5
24	18·4	42·2	50·7
48	18·7	42·5	52·0

At this stage the use of Hanus solution was abandoned because it was found that very slight differences in the amounts of bromine used for making up the reagent, led to varying results being obtained. Thus, with a slight excess of bromine a high percentage was absorbed in two hours, whilst with very little less bromine present the same percentage was attained only after the mixture had stood for forty-eight hours.





It was thought interesting to investigate the action of Wijs' and Hübl's reagents under the usual conditions on a saturated hydrocarbon, and for this purpose, isopentane, C_5H_{12}, as used in the "Harcourt standard light photometer lamp," was chosen. The sample had a boiling point of 29·5° to 32·5° C. and sp.gr. of 0·626 at 15·5°. It was weighed in thin glass bulbs with long capillary points which were sealed in the flame, dropped into well-stoppered bottles containing the iodine reagent and the usual solvent. The bulbs were then broken by violently shaking the bottle and then allowing the mixture to stand as usual. As was anticipated, the pentane exposed under these conditions for two hours and for twenty-four hours did not absorb the slightest amount of iodine from either of the two reagents. Further experiments were made using as an example of an unsaturated hydrocarbon, pure iso-amylene, $(CH_3)_2C:CH{\cdot}CH_3$, this having about the same complexity as pentane. It was manipulated as described for pentane. The reaction was extraordinarily rapid ; in the first experiments the colour of the iodine solution was instantly discharged, but by using a suitable excess of the iodine reagent it was possible to determine the percentage of iodine absorbed by the iso-amylene by titrating as usual. Here a difficulty arose when using Wijs' reagent because the colour of the titrated solution repeatedly returned after standing a moment. The difficulty was not so apparent when using Hübl's solution. It was overcome by titrating immediately after adding the water ; under these conditions iso-amylene, C_5H_{10}, absorbed 357 % of iodine, the theoretical absorption corresponding to the formation of $C_5H_{10}I_2$ being about 363 %, these figures being obtained when using Wijs' reagent. The action of Hübl's solution was much slower and in two hours only 287 % of iodine had been absorbed. In carrying out the iodine absorption methods the necessity of using dry bottles was shown by the fact that when a bottle rinsed with water and simply drained was used, much lower percentages of iodine were absorbed. Experiments were also made to ascertain if the presence of a small quantity of carbon bisulphide in the carbon tetrachloride affected the strength of Wijs' solution. Carbon tetrachloride free from carbon bisulphide was made by shaking commercial carbon tetrachloride with alcoholic potash, whereby soluble potassium xanthate is formed. Water was added to cause the separation of the dissolved carbon tetrachloride, this was drawn off, dried over anhydrous calcium chloride and distilled. This sample was examined quantitatively by the method devised by one of us (this Journal, 1909, **28**, 229) and found to be free from carbon bisulphide, of which the commercial article contained 2·5 to 3 %. 10 c.c. of each sample was mixed with 25 c.c. of Wijs' solution and after two hours' standing titrated as usual. Identical results were obtained in each case.

Incidentally ethane tetrachloride (Westron) ethylene trichloride (Westrosol), perchlorethylene, and pentachlorethylene were examined for their action on Wijs' solution and were found to be very little if at all affected, after twenty-four hours' contact. Dichlorethylene showed a decided tendency to absorb iodine.

H. Moore has stated (Engineer, August 20, 1915) that a determination of the iodine value should provide an indication of the liability of an oil to form acids under air compressor conditions and in the lubrication of Diesel engines, but he is undecided as to whether the copper of the coolers acts as a catalytic agent or not. It is well known that hydrocarbon oils, such as are used in transformers for insulating, frequently deposit sludge, and tests have been devised in which the deposition of sludge by an oil is determined by passing a stream of air or, better, oxygen through the warm oil in the presence of sheet copper. There is therefore nothing improbable in his supposition, and furthermore he cites experiments which go to show that the acid-forming tendencies of oils vary greatly and are certainly to some extent dependent on the iodine value, though by no means proportional to this figure. The same worker further elaborates this suggestion in the "Petroleum World" (Vol. XII., No. 183, pp. 617—619).

The investigation of the phenomena of sludging is engaging the attention of the Research Committee of the Institution of Electrical Engineers and is admittedly a matter of great importance. A report on this subject is contained in the Jour. I.E.E., Vol. 53, No. 239, pp. 146 *et seq.* The authors have determined the percentage of iodine absorbed by some transformer oils and desire to express their indebtedness to The British Westinghouse Co., Ltd., for six samples of transformer oils to which they appended the amount of sludge which each oil deposited. The duration of the tests was two hours both for Wijs' and Hübl's reagent, and the results set forth below hint at there being a relationship between the percentage of sludge deposited and the percentage of iodine absorbed.

Table 5.

	Sp.gr. 15·5°.	Sludge by weight.	Hübl's.	Wijs'.
		%		
Oil 1	0·8582	0·70	14·5	29·3
,, 2	0·8848	0·10	1·7	7·7
,, 3	0·8441	0·05	1·7	6·1
,, A.B.2	0·8714	0·40	8·9	21·6
,, ,, 8	0·8618	0·50	10·6	26·5
,, ,, 9	0·8588	0·10	12·7	27·5

This application of the iodine absorption test is being further studied with a view to establishing, if possible, a relationship between the sludging of a transformer oil and its unsaturated character.

A pale, neutral, refined rosin oil, offered for electric insulation had a sp.gr. 0·985 and was free from rosin acids; it absorbed in a two hours test —Wijs' 127·2% of iodine, Hübl 54% of iodine.

Other qualities of rosin oils have been examined with the following results:—Crude rosin oil, for grease manufacture, sp.gr. 1·010, containing 50 to 60% of rosin acids, absorbed 129·7% of iodine (Wijs) and 76·9% (Hübl). A crude rosin oil, of the quality known as "Blue Billy," sp.gr. 0·994 and containing 15 to 20% of rosin acids, absorbed 93·1% iodine (Wijs) and 52·6% (Hübl). A refined rosin oil, used for printing ink, and having a sp.gr. 1·000 and containing 20 to 30% rosin acids, absorbed 103·0% iodine (Wijs'), 60·0% (Hübl). The authors have examined a number of American, Russian, and Scotch lubricating oils; in each case the duration of the test was two hours. Each oil was examined for saponifiable matter by the metallic sodium test and with one single exception, negative results were obtained.

Table 6.

Petroleum jellies.

White petroleum jelly	absorbed	5·1%	of iodine (Wijs).
Yellow	,, ...	21·2	,,
Dark greenish	,, ...	20·6	,,

Table 7.

American lubricating oils.

	Sp.gr. at 15·5°.	Hübl.	Wijs.
Cylinder oil	0·875	10·2	22·8
Valve oil	0·895	10·6	24·5
Lubricating oil	0·901	9·9	30·5
Cylinder oil	0·895	9·7	20·5
Cylinder oil (black)	0·900	13·9	30·9
Valve oil	0·904	9·2	32·3
Spindle oil	0·901	10·8	34·0

Table 8.

Russian lubricating oils.

	Sp.gr. at 15·5°.	Hübl.	Wijs.
Cylinder oil	0·914	9·9	22·0
Cylinder oil	0·915	11·4	23·3
Cylinder oil	0·902	13·2	27·6
Engine oil	0·904	6·4	16·8
Black oil	0·913	6·7	17·1
Spindle oil	0·899	4·5	14·4
Gas engine oil	0·908	7·0	12·1
Engine oil	0·909	6·5	17·1

Table 9.

Scotch lubricating oils.

	Sp.gr. at 15·5°.	Hübl.	Wijs.
Lubricating oil*	0.895	23·8	47·8
Spindle oil	0·901	25·2	48·8
Lubricating oil A...........	0·873	31·6	56·8
,, ,, B...........	0·890	24·5	49·8
,, ,, C.	0·9025	19·5	43·6

* This oil contained a small percentage of saponifiable oil.

We have to thank The Broxburn Oil Co., Ltd., for samples A, B, and C, these being pure hydrocarbon oils manufactured from crude shale oil; they are stated to be unsuitable for transformers.

The mechanical properties, such as lubricating value, tendency to gum, etc., of the oils, are also being studied and the results will be communicated in another paper.

School of Technology,
Manchester.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Feron 8, Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Drying gas; Apparatus for ——. H. A. Brassert, Chicago, Ill. U.S. Pat. 1,169,919, Feb. 1, 1916. Date of appl., Oct. 1, 1915.

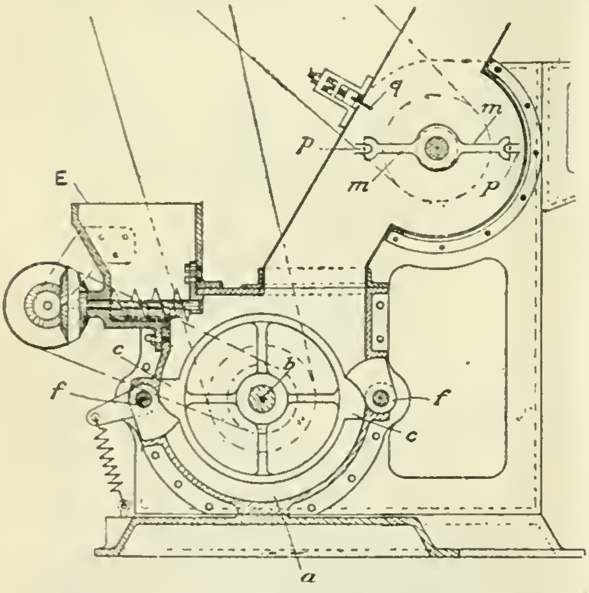
The dryer consists of a horizontal casing provided with a number of rows of baffles arranged vertically, the baffles of one row being fixed at an angle to the baffles of the next row. Means are provided for spraying the baffles in sequence, whereby the water taken up by the gas during the spraying operation will be deposited upon the baffles with which the gas comes into contact later. The rows of baffles may be arranged in pairs, and the baffles of adjacent rows may be fixed at right angles to one another. The diameter of the dryer must be twice that of the inlet pipe in order that the gas may pass through the dryer at a speed less than that at which the moisture will be carried along by the gas, and greater than that at which no water is deposited on the baffles.—J. B. C. K.

Grinding and crushing mills. E. Bouvier. Niederuzwil, Assignee of W. Bruderer, Flawil. Switzerland. Eng. Pat. 24,120. Dec. 15, 1914. Under Int. Conv., Dec. 18, 1913.

ONE or more grinding rollers, cylindrical or otherwise, are positively driven and mounted on fixed axes either within or without one or more grinding rings of suitable shape, which yield elastically upon the passage of the material which is being ground.—W. F. F.

Pulverising and sifting apparatus. W. A. Dawson, Hull. Eng. Pat. 3586, Mar. 6, 1915.

THE material is fed from the hopper, E, to the chamber, *a*, where it is ground between the rotating members, *c*, and the spring-controlled members, *f*. The material is then projected on to the rotary member, *m*, carrying small rotary brushes, *p*, which strike against fixed brushes, *q*. After passing *m*, the material is sifted successively through screens into collecting sacks.—W. F. F.



Dryer for grain and similar granular material. H. Fürmeyer, Cassel. Ger. Pat. 287,855, Aug. 23, 1913.

A VERTICAL screw conveyor, mounted in the centre of an upright cylindrical dryer, produces a circulation of the granular material upwards in the central zone and downwards near the periphery. A current of hot air is passed either upwards or downwards through the central zone of the dryer.—A. S.

Drying apparatus for liquids. E. Mader, geb. Heinrich, Stuttgart. Ger. Pat. 287,951, Aug. 19, 1913.

PLATES depending from an endless chain dip into the liquid and carry a film of it through the drying chamber. The dried material is removed from the plates by a pair of scrapers, so mounted that they bear like springs against the plate on either side. Above the scrapers is a pair of compound levers; as each plate passes upwards between the scrapers, the portion of the endless chain carrying the plate strikes against the levers, which thereupon cause the scrapers to swing apart.—A. S.

Centrifugal separator [cider mill]. O. Morath, St. Louis County, Mo. U.S. Pat. 1,170,551, Feb. 8, 1916. Date of appl., Feb. 11, 1915.

THE pulp container consists of a perforated vertical cylinder rotating within an outer perforated cylinder, the material being fed through by a helical conveyor to a rotary grater at the end. Two scraping edges are provided, one to receive the material from the container and the other that from the conveyor.—W. F. F.

Separation of liquids [oil and water]; Process for ——. O. H. Nonnenbruch, New Rochelle, N.Y., Assignor to De La Vergne Machine Co. U.S. Pat. 1,170,558, Feb. 8, 1916. Date of appl., Aug. 24, 1915.

THE oil is allowed to rise to the surface of the water and is displaced by introducing water below it in a continuous flow, the displacement being stopped automatically when the pressure of the mixture is equal to that of the displacing water.—W. F. F.

Cooling hot saturated solutions; Process and apparatus for ——. M. Mitreiter, Wathlingen. Ger. Pat. 287,586, Jan. 4, 1914.

THE hot solution flows through a series of superposed troughs, each provided at the bottom with a jacket through which a cooling liquid flows in the opposite direction. Scrapers, preferably arranged in the form of an endless chain, move through each trough in the same direction as the hot liquid but at a lower velocity; these remove crystals deposited on the bottom and sides of the trough, and raise them on to a flat portion at the top of the scraper, whence they are carried away by the more quickly moving hot liquid. The troughs are arranged in a casing closed at one end and connected, at the other end, with an exhauster for removing vapours.—A.S.

Crystallising apparatus. F. Fiedler, Leopoldshall, Stassfurt. Ger. Pat. 288,522, Jan. 23, 1914.

THE apparatus consists of a series of cells, of the same size, arranged side by side. The cooling liquid flows through alternate cells of the series in one direction, and the solution under treatment flows through the other cells in the opposite direction. The cells containing cooling liquid are provided with stirrers. In each of the other cells are scrapers which remove crystals deposited on the vertical walls, and a bucket conveyor which collects crystals from the bottom of the cell and removes them; in the first cell of the series the scrapers may be dispensed with, and a water-jet device provided, by which, at the end of the working period, the contents of the cell may be discharged into the next cell of the series.
—A. S.

Fire-extinguishing agents; Manufacture of —— and the fireproofing of solid and liquid bodies. L. Pink and F. Dannert, Berlin. Ger. Pat. 287,592, Feb. 21, 1914.

THE employment of the trihydrate of stannic chloride is claimed. This substance is decomposed at 120° C. into chlorine and stannic acid, the latter forming a protective incrustation over the burning material.—J. F. B.

Filtering apparatus for combustible gases carrying spontaneously inflammable dust; Method of operating ——. R. Böcking und Co., Brebach. Ger. Pat. 288,223, Apr. 30, 1914.

THE combustible gas is displaced by a non-combustible gas before introducing air to clean the filters, and before putting the filters into operation again, the air is displaced by a non-combustible gas. Waste combustion gases may be used as the non-combustible gas, preferably after using them first to heat the gas to be filtered.—A. S.

Suction filter; Rotary —— for hot liquids. P. H. Müller, Hanover. Ger. Pat. 288,337, Dec. 9, 1913.

A ROTATING filtering drum dips at its lower part into the mixture to be filtered, and a liquid is sprayed on to the upper part to wash the cake of solid matter collected on the surface of the drum. The wash-liquor is guided by fixed collectors in the interior of the drum into a pipe or pipes extending through the hollow axis to one end of the drum, whilst the filtrate collecting in the lower part of the drum is raised by a bucket conveyor, travelling at a higher rate of speed than the drum, and is delivered into the hollow axis, whence it is discharged at the opposite end to the wash-liquor.—A. S.

Centrifugal drier. F. B. Anderson, Assignor to C. O. and A. D. Anderson, Cleveland. Reissue No. 14,061, Feb. 15, 1916, of U.S. Pat. 1,122,460, Dec. 29, 1914.

SEE this J., 1916, 262.

Hydro-extractors or like centrifugal machines. T. K. Irwin. Fr. Pat. 476,855, Sept. 3, 1914.

SEE Eng. Pat. 13,508 of 1913; this J., 1914, 1041.

Drying wet materials; Process and apparatus for ——. G. D. Harris. Fr. Pat. 476,706, Dec. 9, 1914.

SEE Eng. Pat. 23,291 of 1914; this J., 1916, 241.

Fractionation; Process and apparatus for ——. M. A. Rosanoff, Worcester, Mass. U.S. Pat. 1,171,464, Feb. 15, 1916. Date of appl., Apr. 29, 1911.

SEE Fr. Pat. 443,054 of 1912; this J., 1912, 1020.

Lubricant. Pensacola Tar and Turpentine Co. Fr. Pat. 476,676, Aug. 18, 1914.

SEE U.S. Pat. 1,109,298 of 1914; this J., 1914, 1002.

Regenerative furnace. U.S. Pat. 1,170,397. *See* IIa.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Fuel oils from coal. H. Moore. Manchester Assoc. of Engineers, Feb. 26, 1916. [Advance copy.]

IN view of the serious shortage of petroleum, it is suggested that coal tars be used as fuel oils. Creosote oil is suitable for use in Diesel engines. Tars for use in Diesel engines must have high hydrogen content (due to aliphatic hydrocarbons), low free carbon content, preferably a high calorific value, low viscosity, less than 2 % of water, a coke value below 15 %, and ash below 0·15 % (see also Constam and Schläpfer, this J., 1913, 1096). Low temperature carbonisation yields tars most closely in accordance with these requirements; if necessary, motor spirit could be extracted before selling as fuel oil. The fractional condensation of tars (see Purves, this J., 1915, 329) affords a further possible source of fuel oil; it is suggested that three fractions should be collected, the middle fraction free from naphtha being used as fuel oil.

Analyses of fuel oils.

Description.	Sp.gr. 15° C.	Water.	Ultimate composition.				Ash.	Coke.	Net calorific value.		Free carbon.
			C.	H.	O. & N.	S.			Calories.	B.Th.U.	
Horizontal retort tar	1·180	1·75	91·5	5·2	2·6	0·5	0·20	24·0	8,645	15,561	18·2
Inclined retort tar	1·157	1·11	89·9	6·0	3·6	0·5	0·02	18·5	8,671	15,626	14·0
Vertical retort tar	1·089	2·25	88·0	6·8	3·8	0·6	0·03	6·1	8,664	15,613	1·7
Otto-Hilgenstock coke oven tar	1·208	6·00	90·0	5·4	3·8	0·8	0·02	26·8	8,624	15,523	23·9
Simon-Carvès coke oven tar .	1·090	0·50	88·1	5·6	6·1	0·2	0·07	6·0	9,261	16·670	traces
Chamber oven tar	1·082	1·29	88·2	6·9	4·6	0·3	traces	7·3	8,737	15,727	3·0
Low temp. carbonisation tar	1·058	3·00	85·8	8·1	5·49	0·09	0·11	8·2	8,776	15,797	2·2
Water-gas tar	1·054	0·59	92·2	6·8	0·4	0·6	traces	18·7	8,647	15,563	6·8
Blast-furnace tar	1·172	3·0	89·5	5·75	0·55	0·84	0·36	23·4	8,288	14,918	9·5
Blast-furnace tar oil	0·974	none	87·25	9·8	2·59	0·36	none	1·05	9,243	16,637	none
Oil distilled from low temp. tar	0·884	none	85·6	11·4	2·48	0·4	none	0·84	9,558	17,204	none
Horizontal retort tar oil	1·065	1·00	90·1	6·8	2·4	0·50	0·2	3·0	9,243	16,637	none
Pennsylvanian petroleum fuel oil	0·889	none	86·7	12·55	0·11	0·64	traces	0·60	10,108	18,194	none

—F. W. A.

Coke, lignite, and gas; Possibility of using —— for firing boilers. Braunkohle, 1915, **14**, 255—261. Z. angew. Chem., 1915, **28**, Ref., 622—623.

IN consequence of the scarcity of coal in Germany, several of the electrical power generating stations have made experiments with other fuels, and the results obtained have been published in a report to the German Home Office. It is stated that there is not much likelihood of utilising coke in large quantities. It is not suitable for use with mechanical stokers, owing to the lack of volatile constituents requisite for igniting the fuel, but it can be burnt on ordinary grates with hand-stoking. The coke should be in small pieces, of high porosity, low mechanical strength, and low content of ash and water. When mixed with coal the best results are given by a mixture of 20 % of porous gas-coke and 80 % of highly bituminous coal. Lignite cannot be used on an ordinary hand-stoked grate, but lignite briquettes can be used in place of coal without any considerable alteration of the grate or fire-arch; small briquettes are preferable. A mixture of lignite briquettes and coke can be used on mechanical stokers if the layer of fuel be not too deep, but is not to be recommended for fixed grates, because frequent poking is necessary, and the briquettes are thereby disintegrated.—A. S.

Methane and air; Limits of inflammability of mixtures of ——. G. A. Burrell and G. G. Oberfell. U.S. Bureau of Mines, 1915, Tech. Paper 119. 30 pages.

As determined in a closed box of 5·75 cub.ft. capacity, 5·75 ft. long, by 1 ft. square cross-section, and provided with a thin paper diaphragm at one end, the lower limit of inflammability of methane-air mixtures varied from 4·9 to 5·8 % CH_4. Ignition was effected by an electric flash produced by pulling apart two copper wires through which a current of 7 amp. at 220 volts was passing. The lowest result was obtained with the box in a vertical position, the diaphragm being at the top, and ignition effected from the bottom. By igniting the mixture from the top the values 5·4—5·5% and 5·7—5·8% CH_4 were obtained when the paper diaphragm was at the bottom and top of the box, respectively. With the box horizontal the result was between 5·5 and 5·6% CH_4, this figure being the most important as regards applicability to coal mining. Values of 5·5—5·6% and about 5% CH_4 were obtained by ignition from the top in a Hempel explosion pipette and by ignition from the bottom in a vessel 12 in. high, 5 in. wide, and of 2800 c.c. capacity, respectively. As determined in an iron pipe, 7 ft. long and 12 in. in diameter, arranged in a similar manner to the box, the upper limit of inflammability was 13·4—13·9% or 15·0—15·4% CH_4 according as ignition was effected from the top or bottom, the figure for horizontal propagation being thus about 11·9% CH_4 by interpolation. A value between 12·4 and 13·2% CH_4 was obtained by ignition from the top in a Hempel explosion pipette. From the examination of numerous samples of mine air, it is concluded that the variations occurring in the oxygen and carbon dioxide contents of the atmospheres of ventilated coal mines are seldom of sufficient magnitude to affect sensibly the inflammability of methane-air mixtures.—W. E. F. P.

Combination oven in gas-works practice ; Use of the ——. Schadeck. J. Gasbeleucht., 1915, **58**, 513—549. Z. angew. Chem., 1915, **28**, Ref., 623.

The Koppers combination oven (see this J., 1914, 410) is so designed that it can be fired with producer gas when making gas as the chief product, or with illuminating gas when worked chiefly for coke and by-products. It is stated that the yields of coke, tar, ammonia, and benzol can be increased by 70—80% over those obtained in ordinary gas-works practice, and estimates of cost for two gas-works with daily outputs of 100,000 and 15,000 cb. m. of gas respectively are given, showing the superiority of the combination oven over the chamber oven.—A. S.

Ammonia-formation in the gasification of coke and coal by steam and air. H. Markgraf. Stahl u. Eisen, 1915, **35**, 905—908. Z. angew. Chem., 1915, **28**, Ref., 624.

According to experiments by Salmang (Inaug. Diss., Techn. Hochschule, Aachen, 1914), the combined hydrogen of coke plays no part in the formation of ammonia during the gasification process. In the water-gas process (with steam) at 1050° C., 36% of the nitrogen of the coke is converted into ammonia, whilst by the mixed-gas process (with steam and air) at 900° C., 59% is thus converted. In both cases the yield of ammonia is increased materially by addition of 5% of lime, *e.g.*, up to 96% in the mixed-gas process ; ferric oxide also increases the yield of ammonia but not in the same degree. When coke is burnt with excess of air in presence of steam at 900° C., 8% of its nitrogen is converted into ammonia, and in presence of lime, 17%. The ammonia formation progresses uniformly with the combustion of the carbon throughout the whole of the gasifying process. In the gasification of different kinds of bituminous and semi-bituminous coal at 900° C. by air in presence of a large quantity of steam, the percentage of the nitrogen converted into ammonia ranged from 73 to 88 without lime and from 81 to 96 with lime ; with lignite 95% of the nitrogen was converted into ammonia both with and without lime ; and with anthracite, 82% without and 94% with lime. —A. S.

Ammonia ; Influence of steam on the yield of —— *in the pyrogenic decomposition of solid fuels.* K. P. Sachs. Stahl u. Eisen, 1915, **35**, 801—810. Z. angew. Chem., 1915, **28**, Ref., 624.

In addition to laboratory experiments, tests were made with a suction producer and an anthracite producer. The yield of ammonia increases with the amount of steam supplied. When a relatively small quantity of steam is used, the best temperature is 900° C., and with a large quantity of steam, 800° C. Experiments with a hot-cold tube to allow of sudden cooling of the reaction products showed that a higher yield of ammonia could be obtained in this way, even when using a smaller quantity of steam and working at a higher temperature (see Ger. Pat. 274,011 of 1912 ; this J., 1914, 710), and it is stated that results superior to those obtained by the Mond process can be attained on a large scale by working in accord with this principle. When a large quantity of steam is used it is possible to convert the whole of the nitrogen of the fuel into ammonia, and this is held to confirm the view of Rau and Christie (Stahl u. Eisen, 1910, **30**, 1235, 1282) that the nitrogen in coke is present in the form of a carbon nitride.—A. S.

Benzol in coal gas ; Estimation of ——. J. des Usines à Gaz, Feb. 20, 1916. J. Gas Lighting, 1916, **133**, 460.

The recent note by Neubeck (this J., 1915, 1198) is referred to and the methods used in France are described. In 1881 the Paris Gas Co. determined the weight, P, of benzol which condensed when a given volume of gas was passed through a tube cooled to —21° C. by a mixture of ice and salt. The benzol left in the gas at this temperature was taken to be practically constant and was called, K. By using methyl chloride a temperature of from —70° to —80° C. was obtained, and it was found that at —70° C., the vapour tension of benzol was nil, and also that the quantity of benzol left in the gas at —21° C. was 23·5 grms. per cub. metre, a figure which agreed with Regnault's measurements of the vapour tension of pure benzene at —21° C. Since 1884 the benzol in the gas has been reported as P+23·5 grms. per cub. metre. It is further assumed that the vapour which was condensed is a mixture of 3 parts of benzene with 1 part of toluene and that one litre of the vapour weighed 3·73 grms. Later on, trials made using carbon dioxide snow, but without a Dewar vacuum flask, gave slightly higher results, but the increased accuracy was not considered sufficient to compensate for the extra trouble involved. The trouble referred to was due to the want of an appliance similar to the Dewar vacuum flasks ; now that these are available the process at present in use is as follows :—25 to 30 litres of gas is passed at the rate of 10 litres per hour through a very small condenser tube cooled by carbon dioxide snow contained in a cylindrical Dewar tube, 35 mm. diam. and 100 mm. deep.—W. H. C.

[Coal gas] purification ; Notes on ——. W. Bennett. Scottish Junior Gas Assoc., Feb. 19, 1916. J. Gas Lighting, 1916, **133**, 419—422.

"Outside" revivification of partly spent oxide having resulted in loss of gas and decreased efficiency of the purifiers, of which one in four was always out of use, air was mixed with the gas before dry purification, with the object of effecting sulphiding and revivification of the oxide concurrently. When operating with the foulest box first and the cleanest last, it was impossible to get the theoretical quantity of oxygen absorbed, and it was found that sulphiding and re-oxidation do not occur side by side to any extent, hydrogen sulphide alone being absorbed in the first box and the oxygen passing through the series practically unchanged. Satisfactory results were attained by arranging the purifiers so that, after passing through the boxes actively sulphiding, the oxygen entered those already sulphided, unaccompanied by hydrogen sulphide. In present practice this is effected by operating the purifiers in "forward" or "backward rotation," the valves and connections being so arranged that the boxes may be used in any order. The gas is passed through series 1, 2, 3, 4 until showing foul at the inlet of 3, when the order is changed to 2, 3, 4, 1 in the forward or to 4, 1, 2, 3 in the backward rotation method, and so on. The first box absorbs about 95% of the hydrogen sulphide in the gas and continues to do so for a period (3 or 4 weeks) depending on the rate of flow; as a rule the absorption is completed in the third box in which, probably at the lower part (with a downward flow), oxidation also commences. When the quantity of oxygen absorbed by the purifiers shows a permanent decrease, a change is made in the order of the series, the oxide being well spent and requiring renewal when the box becomes quickly fouled in the first position. A downward flow is advantageous, and the gas should be free from tar fog before treatment. Acidification of the oxide, and consequent formation of iron pyrites which cannot be revivified normally, are prevented by mixing traces of ammonia with the scrubbed gas; the oxide is generally most efficient at about 80° F. (27° C.). By this system the oxide is not removed from the boxes until ready for sale. The results are given of tests made on purifiers operated on this system at Greenock; and attention is drawn to the reversible reaction, $CS_2+2H_2O\rightleftarrows CO_2+2H_2S$ as probably explaining how gas free from hydrogen sulphide at the works may become contaminated with this impurity before delivery to the consumer.—W. E. F. P.

Naphthalene [*in coal gas*]. H. Simmonds. J. Gas Lighting, 1916, **133**, 270.

Oil atomised directly into the mains by compressed air at 25 lb. per sq. in. pressure was found to give very satisfactory results in reducing the number of complaints of stoppages due to naphthalene. It was found that 200 cub. ft. of air at 25 lb. pressure was required to atomise one gallon of oil per hour. The most suitable oil was found to be shale naphtha of sp.gr. 0·770, distilling as follows: at 150° C., nil; at 160°, 21%; at 170°, 47%; at 180°, 67%; at 190°, 81%, and at 200° C., 90%.—W. H. C.

Producer-gas analyses; Method of ascertaining the accuracy of——. F. Hoffmann. Z. angew. Chem., 1916, **29**, 41—44, 54—56.

Ordinary producer gas may be regarded as composed of two portions, viz., carbonisation gases and producer gas proper, the latter consisting of a mixture of carbon monoxide and dioxide, hydrogen, and nitrogen, the composition of which can be calculated if the proportions of any two of the four constituents are known. The pure coal substance, disregarding the content of nitrogen and sulphur, may be assumed to consist of carbon, "combined water," and "available hydrogen," and the following formulæ may be deduced, where v = the percentage of hydrogen in the carbonisation gases, c = the sum of the percentages of carbon monoxide and dioxide and hydrocarbons in the mixed gas, w = percentage of hydrogen in the producer gas proper, C = the total percentage of carbon in the coal, and u = the sum of the percentages of hydrogen and of hydrogen equivalent to the hydrocarbons in the mixed gas:—

$$(1)\ v=c\times 6{\cdot}1\,\frac{\text{avail.}H_2}{C}\,;\ (2)\ w=u-v.$$

The portion of the mixed gas comprising w as calculated above and the carbon monoxide and dioxide and nitrogen, is then regarded as the producer gas proper and its percentage composition by volume is calculated. If the analytical results are correct the following relation should hold approximately: (3) $\%CO=34{\cdot}70+0{\cdot}306\times\%H_2-1{\cdot}65\times\%CO_2$. If the difference between the percentage of carbon monoxide in the producer gas proper calculated from the analytical results by the aid of formulæ (1) and (2), and that calculated by the aid of formula (3) be less than 2·0, the analytical results may be regarded as correct, whilst if it be more than 3·0, they must be regarded as inaccurate. Corrections must be applied for the content of hydrogen sulphide in the gas, and of oxygen, if present, and the method is rendered more accurate by taking into account the carbon and hydrogen content of the tar, dust, and ash produced in the gas producer. Application of the method to a large number of analyses of producer gas quoted in the literature showed that many of them were incorrect. In most cases the results for carbon monoxide and hydrogen are too low and those for methane too high. The methane content of producer gas from different kinds of fuels is usually of the following order: coke, 0—0·5%; anthracite and wood charcoal, 0·5—1%; lignite, 1·5—3%; bituminous coal, 1—2·5%; wood and peat, possibly up to about 5%.—A. S.

Acetylene; Colorimetric determination of——. E. R. Weaver. J. Amer. Chem. Soc., 1916, **38**, 352—361.

A colorimetric method for the determination of small amounts of acetylene depends on the formation of a red colloidal solution when the gas is absorbed in an ammoniacal solution of cuprous chloride containing 0·025% of gelatin, 0·125% of hydroxylamine hydrochloride, and 50% of alcohol. After absorption the solution is diluted to 100 c.c. and compared with a standard, which may be either a solution of a red dyestuff or a piece of ruby glass. A convenient standard is a 10 cm. column of a solution of azolitmin containing 1 part in 2500 of water, and with this the amount of acetylene in 100 c.c. of the colloidal solution may be calculated from the equation, $x=0{\cdot}13y+0{\cdot}03$, where x is the number of mgrms. of acetylene and y the reciprocal of the number of c.c. of colloidal solution required to match the standard. Quantities of acetylene as small as 0·03 mgrm. can be determined accurately by the method. Hydrogen sulphide and large amounts of oxygen or carbon dioxide interfere with the test and must be previously removed by passing through a hot alkaline solution of pyrogallol. In the gravimetric determination of larger quantities of acetylene as cuprous acetylide, it was found that the filtering and washing of the precipitate must be carried out in absence of air, otherwise some of the copper passes into solution.—G. F. M.

Benzene homologues; Presence of —— *in the high boiling distillates of petroleum.* B. T. Brooks and I. W. Humphrey. J. Amer. Chem. Soc., 1916, **38**, 393—400.

The cracking of the heavier portions of Jennings and Oklahoma petroleum oils boiling above 275° C. by distillation at temperatures not exceeding 420° C. and pressures not exceeding 100 lb., yields benzene, toluene, and *m*-xylene in small quantity, and the same hydrocarbons were detected in the light oil obtained by heating Oklahoma oil with aluminium chloride. From paraffin wax no aromatic hydrocarbons were obtained and the distillates were not fluorescent; a synthetic phenyl-paraffin, on the other hand, made by condensing pure benzene with chlorinated paraffin wax in presence of aluminium chloride, gave highly fluorescent distillates and both benzene and toluene on cracking. This supports the view previously advanced (see this J., 1914, 852) that the fluorescence of petroleum oils is attributable to the presence of aromatic derivatives. Since in these cracking experiments the temperatures were too low to admit of the profound decomposition of the hydrocarbons into acetylene from which aromatic substances could then afterwards be synthetically produced, the conclusion is drawn that the aromatic nuclei were present in the heavy high boiling fractions of petroleum.—G. F. M.

Patents.

Briquettes for firing installations operating under strong draught: Manufacture of ——. Staatsfiskus im Königreich Sachsen. Ger. Pat. 288,300, Apr. 30, 1914.

The lignite or the like before being made into briquettes is mixed with a suitable substance so that in the incombustible residue from the mixture the ratio of metallic oxides to silica is from 1 : 1 to 1 : 2. The risk of burning particles of ash being projected from the fire is hereby excluded, because the ash constituents form silicates fusible at the firing temperature. A small quantity of an easily fusible alkali salt is preferably added also to facilitate the formation of silicates. In making lignite briquettes for use in locomotives, for example, about 6 kilos. of sand and 0·5 kilo. of sodium sulphate are added for each 100 kilos. of lignite.—A. S.

Briquetting lignite or peat dust: Method of ——. E. Schimansky, Berlin. Ger. Pat. 288,301, Dec. 16, 1913. Addition to Ger. Pat. 287,157 (this J., 1916, 104).

The sawdust may be heated before being mixed with the lignite or peat dust.—A. S.

Fuel briquettes [from paper or cotton rag waste]; Manufacture of ——. C. T. Clarke, Anerley, Surrey. Eng. Pat. 4096, Mar. 15, 1915.

The briquette consists of a mixture of paper waste or paper and cotton rag waste 62 parts, small coal or coal dust 24 parts, tar 10 parts, and pitch 4 parts.—W. F. F.

Gas making or carbonising plants; Tile and method of setting same to be employed in the construction of the regenerator chamber in ——. H. E. Grove, St. Kilda, and F. G. Barker, Camberwell, Victoria, Australia. Eng. Pat. 1738, Feb. 3, 1915.

The tiles forming the walls of regenerator chambers are ribbed and dovetailed together to avoid cracking and separation.—W. F. F.

Ammonia from incandescent coke from gas retorts; Process for obtaining ——. A. Heckert, Kochel, Ger. Pat. 288,524, Mar. 24, 1914.

The incandescent coke is discharged from the retorts into a closed receptacle, wherein it is treated with steam and with gases containing free nitrogen, *e.g.*, combustion gases which have been purified to remove sulphur compounds.—A. S.

Regenerative furnace. J. E. Bell, New York. U.S. Pat. 1,170,397, Feb. 1, 1916. Date of appl., June 2, 1913.

Air is heated in a regenerator and divided into two parts. Pulverised fuel is added to one part and burnt at a regulated temperature to form producer gas, which is then led through a tortuous passage to deposit ash, and thence to the furnace where it is burnt with the remainder of the heated air.—W. F. F.

Gas-producer. J. E. Bell, New York. U.S. Pat. 1,170,496, Feb. 1, 1916. Date of appl., Mar. 6, 1912; renewed July 20, 1915.

A producer for the continuous manufacture of gas, consisting of a single central combustion chamber, in which combination of oxygen and carbon progresses continuously, surrounded wholly or partially by a regenerator, with means for reversing the direction of air and gas through the producer. Granulated or pulverised fuel is fed into the central combustion chamber, into which air and steam are also passed. Two regenerators may be used, one on either side of the producer, and each may possess a number of divisions formed of refractory material.—J. B. C. K.

Water-gas generator. Dellwik-Fleischer Wassergas-Ges., Frankfort. Ger. Pat. 287,252, July 26, 1914. Addition to Ger. Pat. 286,600 (this J., 1915, 1236).

In the water-gas generator described in the chief patent, a certain quantity of steam is introduced, during the gas-making period, through a pipe opening in the neck of the producer, in addition to the chief quantity introduced below one of the grates. The neck of the producer is thereby cooled and it becomes possible to seal it effectually. —A. S.

Gas producer in which the clinker is discharged in a molten condition. J. Pintsch A.-G., Berlin. Ger. Pat. 288,588, Sept. 18, 1914.

The molten clinker is discharged into a receptacle containing water, and the steam produced is led to the producer, where it is introduced above the clinker zone, the pipe being connected with a supply of compressed air by which the steam is forced to flow in the desired direction and is prevented from entering the producer at the bottom. —A. S.

Gas purifiers; Grids for ——. L. J. V. Tate, Edinburgh. Eng. Pat. 2644, Feb. 19, 1915.

The grid bars, which are arranged at right angles in alternate tiers, are supported on horizontal frame bars also at right angles in alternate tiers, and which in turn are supported on vertical bars.—W. F. F.

Gas-washing; Method of ——. *Gas-washer tower. Gas-washer.* (A) H. A. Brassert, (B) H. A. Brassert and C. J. Bacon, (C) H. A. Brassert, Chicago, Ill. U.S. Pats. (A) 1,169,764, (B) 1,169,765, and (C) 1,169,766, Feb. 1, 1916. Dates of appl., June 28, July 28, and Oct. 2, 1915.

(A) The gas enters at the bottom of a tower and passes upwards through a heavy rain to remove the coarser particles, then through a fine spray and simultaneously against baffles over which water flows, and finally through drying baffles where the entrained water is conducted out of the path of the gas. (B) The tower is provided in its lower part with a series of annular troughs on its inner wall, alternating with conical central troughs, so that the washing water overflows from one to the other. Superposed series of sets of wetted baffles are provided in the upper part of the tower, one series being disposed at right angles to another series. The gas flows upwards through the tower. (C) The tower contains a number of tiers of slats arranged in a vertical plane in its lower part and a similar series of tiers of inclined slats in its upper part. The washing water flows downwards against the flow of gas.—W. F. F.

Gas scrubber. H. A. Carpenter, Sewickley, Pa., Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,170,510, Feb. 8, 1916. Date of appl., Feb. 12, 1913.

A short cylindrical casing with horizontal axis is divided by an annular plate extending from the outer wall towards the centre. A central rotating shaft carries two series of plates nearly filling the casing on each side of the annular division plate and bounded on their two flat faces by circular plates perforated from the outer rim to the same width as the division plate. The rotating plates are mounted in separate compartments so that they can be withdrawn separately and dip into liquid in the lower part of the casing. The gas enters the upper part of the casing at one side, passes down through one series of rotating plates, and up through the other series to the outlet.—W. F. F.

Oil-distilling apparatus. S. H. Edwards, Assignor to Tide Water Oil Co., Bayonne, N.J. U.S. Pat. 1,170,884, Feb. 8, 1916. Date of appl., May 8, 1915.

The still comprises groups of inclined tubes heated by a furnace and connected to upper and lower drum compartments so as to form separate sections through which the oil circulates in succession. —W. F. F.

Gas retorts and the like; Apparatus for charging and discharging ——, and for conveying coal, coke, grain, ores, and like substances. W. J. Fiddes, Tottenham. Eng. Pat. 2340, Feb. 13, 1915.

Peat; Utilisation of ——. T. Rigby, Dumfries, Assignor to Wetcarbonizing, Ltd., London. U.S. Pat. 1,170,849, Feb. 8, 1916. Date of appl., July 11, 1914.

See Eng. Pat. 17,944 of 1913; this J., 1914, 909.

Briquettes; Manufacture of —— and apparatus therefor. J. Armstrong. Fr. Pat. 477,260, Jan. 15, 1915.

See Eng. Pat. 1188 of 1914; this J., 1915, 215.

Fuel for internal-combustion engines; Liquid ——. G. E. Heyl and T. T. Baker, London. U.S. Pat. 1,171,434, Feb. 15, 1916. Date of appl., Dec. 8, 1914.

See Eng. Pat. 21,738 of 1914; this J., 1915, 1200.

Fuel; Manufacture of ——. M. Rossi, Barcelona, Spain. U.S. Pat. 1,171,660, Feb. 15, 1916. Date of appl., May 17, 1913.

See Fr. Pat. 457,783 of 1913; this J., 1913, 1000.

Coke ovens. N. Schuster. Fr. Pats. 476,805 and 476,806, Dec. 19, 1914.

See Eng. Pats. 29,494 and 29,517 of 1913; this J., 1914, 410, 684.

Vertical [*gas*] *retort.* A. McD. Duckham, Ashtead. U.S. Pat. 1,171,183, Feb. 8, 1916. Date of appl., May 19, 1915.

See Eng. Pat. 17,667 of 1914; this J., 1915, 215.

Steam and combustion products under pressure; Production of mixtures of —— for power purposes. J. B. Kinnear. Fr. Pat. 476,858, Oct. 5, 1914.

See Eng. Pat. 22,775 of 1913; this J., 1914, 852.

Gaseous fuel from liquid fuels: Apparatus for producing ——. A. W. Southey. Fr. Pat. 477,802, Feb. 26, 1915.

See Eng. Pat. 5331 of 1914; this J., 1915, 166.

Coal gas; Process for purifying ——. R. Fabry. Fr. Pat. 476,912, Dec. 29, 1914.

See Eng. Pat. 29 of 1914; this J., 1914, 1148.

Coal gas; Recovering as ammonium salt the nitrogen of the hydrocyanic acid in crude ——. South Metropolitan Gas Co. Fr. Pat. 476,953, Aug. 18, 1914.

See Eng. Pat. 29,047 of 1913; this J., 1914, 953.

Producer-gas and other gases; Treatment and recovery of tar and ammonia from ——. Q. Moore, and Dowson and Mason Gas Plant Co., Ltd. Fr. Pat. 477,459, Feb. 1, 1915.

See Eng. Pat. 2650 of 1914; this J., 1915, 131.

Crude petroleum, shale oils, resin oils, and other liquid hydrocarbons; Conversion of —— into volatile hydrocarbons boiling below 150° C. P. Sabatier and A. Mailhe. Fr. Pat. 476,876, May 13, 1914.

See Eng. Pat. 16,791 of 1914; this J., 1915, 826.

Hydrocarbons; Purification of liquid —— and production of motor spirit and by-products. Optime Motor Spirit Synd., Ltd. Fr. Pat. 477,261, Jan. 15, 1915.

See Eng. Pat. 1878 of 1914; this J., 1915, 604.

Hydrocarbons; Process for improving the products obtained by destructive distillation of ——. Allgem. Ges. f. Chem. Ind. Fr. Pat. 477,409, Jan. 27, 1915.

See Eng. Pat. 3572 of 1914; this J., 1915, 1004.

Mineral oils and their residues; Treatment of —— to produce hydrocarbons of low boiling point. C. White. Fr. Pat. 477,771, Feb. 23, 1915.

See Eng. Pat. 5134 of 1914; this J., 1915, 651.

Combination of two stills for the distillation of tar, mineral oils, or oils and fats. Ger. Pat. 288,702. *See* III.

[*Carbon dioxide recorders, etc.*] *Instrument for recording percentage volumes of constituent gases* Eng. Pat. 5041. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Arcs in gases between non-vaporising electrodes. G. M. J. Mackay and C. V. Ferguson. J. Franklin Inst., 1916, **181**, 209—216.

To study electrical conduction through gases at comparatively high pressures tungsten electrodes are used, and enclosed arcs have been constructed which act as rectifiers of alternating current with very slight deterioration of the metal. The volt-ampère curve of the arc in hydrogen with a direct current, using a tungsten filament requiring about 20 amps. to heat it to 2800° abs., has a typical form with an unstable portion where the discharge changes with increasing current from an almost invisible glow to a very concentrated arc discharge. An arc in hydrogen at 400 mm. pressure, between tungsten electrodes 1 mm. apart, consumes 700 watts, operating at 25 ampères and 28 volts, and should be a very good source of ultra-violet radiation. The character of the arc is not affected by evaporation of electrode material as in the case of carbon and low-boiling metal electrodes. For a discharge to have this typical "falling" volt-ampère characteristic the cathode must be heated to a high temperature either by an external supply or by bombardment of positive ions from the gas. The external heating reduces sparking potential and enables the discharge to be started at a low voltage, the exciting current being shut off when the arc has started. Various gases show different characteristics and typical curves for arcs in hydrogen, argon, nitrogen, and air are given. All give complete rectification of current under proper conditions. Hydrogen rectifies as well at high pressures as at a few millimetres, while argon operates better at pressures less than 10 cm. —W. G. C.

Patents.

Wood: Recovering oil and other products formed during the destructive distillation of ——. L. Hanson, Wilmington, N.C. U.S. Pat. 1,169,956, Feb. 1, 1916. Date of appl., Dec. 16, 1915.

The wood is heated quickly to a temperature above 650° F. (about 340° C.) in a retort, and then superheated steam is injected upwards through the mass. The oil and other volatile products are carried off by the steam and are separately condensed. A uniform temperature must be maintained throughout the mass in the retort during the treatment with steam.—J.B.C.K.

Arc lamps with electrodes of highly refractory metals, tungsten in particular. Allgem. Elektricitäts-Ges., Berlin. Eng. Pat. 8272, June 3, 1915. Under Int. Conv., June 3, 1914.

THE tungsten electrodes are formed of wires, with ends in the form of small heads, or the wires themselves are coiled into helices at the ends, or pressed into the form of balls. The arc is sprung by the withdrawal of an intermediate piece, which at first bridges the gap between the fixed electrodes. This intermediate portion may be composed of a readily vaporisable metal, such as copper or zinc; or non-metals or oxides, electrically conducting when cold, *e.g.*, carbon, silicon, boron, or uranium oxide, or the latter mixed with tungsten; or oxides, which are non-conducting when cold, may be mixed with metals or other substances which are conductors in the cold state.
—B. N.

Charcoal kilns; Wood-——. A. R. Bellamy. Fr. Pat. 477,407, Jan. 26, 1915.

SEE Eng. Pat. 5858 of 1914; this J., 1915, 415.

III.—TAR AND TAR PRODUCTS.

Liquid hydrocarbons; Production of —— by the action of aluminium chloride on naphthalene under pressure. F. Fischer. Ber., 1916, 49, 252—259.

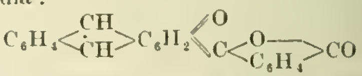
BY heating commercially pure naphthalene with 4% of powdered aluminium chloride in a sealed glass tube for 3 hours at 330° C., about 40% of the hydrocarbon was converted into an oil together with some gas. Under ordinary pressure the yield of liquid hydrocarbons is very much smaller. When 250 grms. of naphthalene and 10 grms. of aluminium chloride were heated in an autoclave at 330° C. for 20 minutes (pressure = 10 atmospheres), 92 grms. of naphthalene-free oil was obtained and the residue consisted mainly of pitch and carbon. With a less pure naphthalene, 10% of aluminium chloride was necessary to produce a yield of about 35%. A large scale experiment was made with 3250 grms. of a moderately pure commercial sample of naphthalene and 130 grms. of aluminium chloride, heated in the autoclave for 20 mins. at 330° C. The yield of oil was 1055 grms.: it was purified and fractionally distilled. The greater portion (79%) distilled between 150° and 300° C., and after removal of the naphthalene in it, the liquid represented 18% of the original weight of the raw material. The combustion analysis and the calorific value (9932 cals.) of the whole fraction indicated a composition intermediate between that of naphthalene and dihydronaphthalene. It is probable that one part of the naphthalene is hydrogenised at the expense of the other part. The viscosity of the liquid was 1·16 at 20° C., the ignition temperature 70° C., and a strong influx of air was necessary to make it burn without smoke. The price of naphthalene is so low that its conversion into liquid hydrocarbons is considered to be economically practicable.—E. H. T.

a-Methylnaphthalene; Conversion of —— into 1.2-di-a-naphthylethane and picene. W. Friedmann. Ber., 1916, 49, 277—284.

THE relatively high percentage (1·5) of sulphur in the tar from lignite and the co-existence of naphthalene in it, make a study of the interactions between sulphur and naphthalene compounds of considerable interest. By heating a-methylnaphthalene with an equal weight of sulphur at 300° C. for 3 periods of 24 hours each, and distilling the product *in vacuo*, three separate fractions were obtained, (1) unchanged a-methylnaphthalene, (2) a mobile red-brown oil distilling at 300°—320° C., which solidified on standing, and which after purification and crystallisation from benzene was identified as 1.2-di-a-naphthylethane, and (3) a product similar to (2) but of higher boiling point and less soluble in benzene. The soluble portion contained a-dinaphthostilbene, and the insoluble portion, which was crystallised from cumene, was proved to be picene. It is noteworthy that picene occurs with chrysene in the distillate from lignite tar and it is probable that these two hydrocarbons are genetically related. By heating a-methylnaphthalene with one-eighth its weight of sulphur in a sealed tube for 24 hours at 300°—310° C., a lustrous crystalline substance of m.pt. 298°—300° C., having the formula $C_{22}H_{16}S_3$, was obtained; it is believed to be an intermediary product in the conversion of a-methylnaphthalene into a-dinaphthostilbene.—E. H. T.

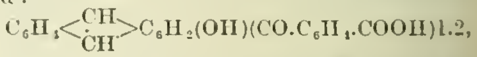
Anthracene; Introduction of acid radicals into the outer benzene rings of ——. Preparation of 1-hydroxy-2-anthracoyl-o′-benzoic acid. A. Schaarschmidt. Ber., 1916, 49, 381—385.

ATTEMPTS were made to introduce acid radicles into the outer benzene rings of anthracene by treating *meso*-dihydroanthracene with benzoyl chloride and aluminium chloride, and by heating 1-hydroxyanthracene with phthalic anhydride in the presence of boric acid. In the first method, anthracene is regenerated, and the acid radical goes by preference into the *meso*-position. The second method produces a red-brown substance of the formula :—



$$C_6H_4<\begin{matrix}CH\\ \dot{C}H\end{matrix}>C_6H_2\begin{matrix}\nearrow O\\ \searrow C<\begin{matrix}O\text{——}\\ C_6H_4\end{matrix}>CO\end{matrix}$$

m.pt. 246° C., which gives a green solution in concentrated sulphuric acid, and when boiled with water produces 1-hydroxy-2-anthracoyl-*o*′-benzoic acid :—

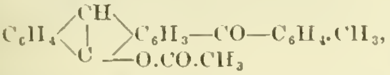


$$C_6H_4<\begin{matrix}CH\\ \dot{C}H\end{matrix}>C_6H_2(OH)(CO.C_6H_4.COOH)1.2,$$

which forms brownish yellow crystals, m.pt. 221° C., and crystalline salts, and dissolves in concentrated sulphuric acid to a blue solution which turns green on standing for a short time, probably owing to the formation of the previous compound. The same change takes place when the acid is treated with acetylating agents.—F. SP.

Benzoylanthraquinone; Reduction products of 1- and 2-——. A. Schaarschmidt and D. Irineu. Ber., 1916, 49, 386—396. (See also this J. 1915, 828.)

THE reduction products of 1- and 2-benzoylanthraquinone in acid and alkaline solution have been examined. *p*-Chlorobenzoyl-1-anthraquinone in acid solution gives a mixed blue reduction product from which no pure substance could be isolated. *p*-Toluyl-2-anthraquinone reduced in cold sulphuric acid solution with aluminium powder equivalent to 2 hydrogen atoms gave a product partly soluble in alkali with a red colour but on repeated crystallisation only the original material could be isolated. Increasing the aluminium to the equivalent of 6 hydrogen atoms led to a product almost completely soluble in alkali to a red solution, indicating phenolic hydroxyl. The alkaline solution is decolorised when shaken with air, and a solid of m.pt. 252° C. separates, which may be a condensation product of two molecules of the original compound. The crude reduction product on acetylation yields



m.pt. 154·5° C., which is the acetyl derivative of a *p*-toluyl-2-anthranol. The red colour of the alkaline solution of the crude product is due to the presence of small quantities of toluylanthrahydroquinone. By the reduction of *p*-chlorobenzoyl-1-anthraquinone by zinc dust and ammonia, a mixed blue product is formed giving a blue solution in alcohol, a red solution in toluene and ligroin, and a green solution in concentrated sulphuric acid. No pure substance could be isolated from it. The reduction of *p*-toluyl-2-anthraquinone in ammoniacal solution gave an oily mixture of products insoluble in alkali and in sodium hydrosulphite. Repeated crystallisation from boiling glacial acetic acid produced the acetyl derivative (m.pt. 164°—165° C.) of anthracyltolylcarbinol,

$$C_{14}H_9.CH(OH).C_6H_4.CH_3.$$

The anthraquinone residue has therefore been reduced to anthracene, and the toluyl keto group to carbinol.—F. Sp.

Chlorination [of aromatic compounds] with antimony pentachloride. K. Steiner. Monatsh. Chem., 1915, **36**, 825—829. J. Chem. Soc., 1916, **110**, i., 151. (Compare Eckert and Steiner, this J., 1915, 863, 864.)

When heated with antimony pentachloride, benzophenone gave hexachlorobenzene as the main product, together with a little perchlorobenzophenone, $CO(C_6Cl_5)_2$, colourless needles, m.pt. 318° C., and perchlorobenzoic acid. Benzil gave rise to hexachlorobenzene with a little perchlorobenzoic acid. 1.2-Naphthoquinone yielded tetrachlorophthalic acid and perchloronaphthoquinone. Under similar treatment, benzoic acid and benzoyl chloride yielded hexachlorobenzene, together with a mixture of chlorinated benzoic acids, whilst phthalic acid gave a mixture of the same nature. With benzoylbenzoic acid the chief products were perchlorobenzoylbenzoic acid and 1.2.3.5.6.7.8-heptachloroanthraquinone, accompanied by small quantities of tetrachlorophthalic acid and hexachlorobenzene. By using a suitable solvent, such as tetrachloroethane, the action of the antimony pentachloride can be moderated, and with a 10% solution of anthraquinone in this liquid the chief product is 1.4.5.8-tetrachloroanthraquinone.

Sulpho-groups; Direct replacement of —— by chlorine. H. Meyer. Monatsh. Chem., 1915, **36**, 719—722. J. Chem. Soc., 1916, **110**, i., 134—135.

In 1860 Carius observed that methane- and ethane-sulphonyl chlorides when heated at 150°—160° C. with phosphorus pentachloride underwent change according to the equation $R.SO_2Cl + PCl_5 = RCl + SOCl_2 + POCl_3$. The author has discovered that thionyl chloride is especially favourable to the scission of sulphur dioxide from sulphonyl chlorides, and he believes that thionyl chloride was largely instrumental in producing the results obtained by Carius. At 160°—180° C. in the presence of thionyl chloride, aromatic sulphonic acids, as also their chlorides and anhydrides, are converted into the corresponding chloro-compounds with liberation of sulphur dioxide. Thus *p*-chlorobenzenesulphonic acid quantitatively yielded *p*-dichlorobenzene, and sodium benzenesulphonate gave chlorobenzene. With derivatives of the anthraquinone group the necessary temperature is higher, and at 200°—220° C. the *α*- and *β*-sulphonic acids derived from anthraquinone were converted into the corresponding chloroanthraquinones. In the absence of thionyl chloride, whether other solvents, such as tetrachloroethane, are present or not, the decomposition of the sulphonyl chlorides is only partial and frequently more complex in nature.

Nitro-groups; Direct replacement of —— by chlorine and a new method of chlorination. H. Meyer. Monatsh. Chem., 1915, **36**, 723—730. J. Chem. Soc., 1916, **110**, i., 135. (Compare preceding abstract.)

4-Chloro-3-nitrobenzenesulphonic acid, *p*-chloronitrobenzene, 2.5-dichloronitrobenzene, and nitrobenzene when heated with thionyl chloride at temperatures between 140° and 180° C. lost their nitro-groups almost quantitatively with formation of 1.2.4-trichlorobenzene, *p*-dichlorobenzene, 1.2.4-trichlorobenzene, and chlorobenzene respectively. With *m*-nitrobenzenesulphonic acid the yield of *m*-dichlorobenzene was not so good, direct chlorination occurring simultaneously to some extent, so that the product also included a substance, m.pt. 165°—175° C. containing a high percentage of chlorine. A similar result was obtained with *o*-nitroanisole, which gave a trichlorophenol in addition to *o*-chloroanisole. 1.5-Dinitroanthraquinone at 180°—200° C. was converted into 1.5-dichloroanthraquinone, and with naphthalene compounds chlorination occurred very readily, naphthalene itself at 170°—180° C. reacting with thionyl chloride giving 1.4-dichloronaphthalene. The presence of certain groups facilitates direct chlorination even of the benzene nucleus; azobenzene reacts with thionyl chloride at 180°—200° C., giving 2.2′-dichloroazobenzene, together with its 4.4′-isomeride. At somewhat higher temperatures, namely, 230°—250° C., the successive substitution of the hydrogen atoms of a methyl radicle attached to an aromatic nucleus may be effected; thus toluene gave benzylidene dichloride and benzotrichloride, whilst α-methylanthraquinone yielded the monochloro- and dichloro-methyl derivatives. By the use of suitable solvents, however, the methyl group in such substances as toluenesulphonic acids may be protected, so that the action of the thionyl chloride is restricted to the replacement of the sulphonic group by chlorine.

Sulphonation of benzene. G. Mohrmann. Annalen, 1915, **410**, 373—385.

The catalytic influence of sodium, mercury, and iron on the sulphonation of benzene has been described by Behrend and Mertelsmann (this J., 1911, 124). The author has now examined the influence of aluminium, lead, arsenic, selenium, and manganese, and also of cadmium and bismuth. Benzene vapour was passed into 97% sulphuric acid at 235°—245° C. containing the catalyst, and the resulting *m*- and *p*-benzenedisulphonic acids (and in the case of lead the monosulphonic acid also) were converted through the sodium salts into the acid chlorides, the crystals of which were separated mechanically. The results show that none of the substances approaches mercury in its catalytic effect. Manganese has scarcely any influence and cadmium has but little more. The other catalysts produce about the same effects, with the exception of selenium, which in the form of selenious acid causes carbonisation (although at 160°—170° C. it has no effect, benzenesulphonic acid only being produced), and of lead, which in the form of lead sulphate brings about the formation of 80·8% of the meta-disulphonic acid, 9·7% of the para-acid, and 9·5% of the monosulphonic acid.

2-Aminopyridine; Diazotisation and diazo-reactions of ——. A. E. Tschitschibabin and M. D. Rjazancev. J. Russ. Phys.-Chem. Soc., 1915, 47, 1571—1589. (See this J., 1915, 863, 1240.)

By treating 2-aminopyridine with nitrous acid in hydrochloric acid solution, the authors were unable to obtain a higher yield than 50% of 2-chloropyridine, much 2-pyridone being always formed. In a similar manner, 2-fluoropyridine can be obtained in about 25% yield, whilst with hydrobromic acid, which must be used in dilute solution since the concentrated acid reacts with nitrous acid, very little 2-bromopyridine is obtained, the principal product being the pyridone. When diazotised with amyl nitrite and sodium ethoxide, 2-aminopyridine yields an isodiazotate, which may also be obtained by the action of amyl nitrite on the sodium derivative of 2-aminopyridine; it is extremely stable in the pure state and remains unchanged indefinitely, only decomposing at a high temperature. Decomposition of a concentrated aqueous solution of the diazotate (1 mol.) in the cold with not more than 1 mol. of acetic acid yields the crystalline diazo-hydroxide which, however, readily decomposes with formation of pyridone; the slightest excess of acid results in the rapid decomposition of the diazotate, which probably undergoes isomeric change into the unstable diazonium salt. Faint acidification of a solution of the diazotate containing potassium iodide yields 2-iodopyridine. Like the antidiazotates of the benzene series, the diazotate of pyridine exhibits little tendency to the formation of azo-dyes by coupling with phenols and amines; small yields of such dyes are, however, obtainable with naphthols and certain amines in alcoholic solution. 2-Fluoropyridine, C_5H_4NF, is a volatile liquid, boiling at 125·75° C. at 752·9 mm. pressure, and forms either no picrate or a highly unstable one; the extreme weakness of its basic properties is shown also by the instability of the platinichloride. 2-Iodopyridine, C_5H_4NI, is a liquid, b.pt. 93° C. at 13 mm. pressure, and forms a picrate and a platinichloride. Sodium pyridine-2-diazotate, $C_5H_4N{\cdot}N:N{\cdot}ONa$, is obtained as a yellow powder.—T. H. P.

Aluminium phenoxides; Products of the decomposition of —— by heat. R. Möhlau. Ber., 1916, 49, 168—171.

In addition to hydrogen, methane, aromatic hydrocarbons, phenols, and phenol ethers, the thermal decomposition of aluminium phenoxides gives rise by pyrogenic synthesis to small quantities of xanthene and its homologues. Thus by fractional distillation of the higher boiling products obtained by dry distillation of the phenoxide formed by dissolving aluminium shavings in boiling phenol, fractions boiling between 270° and 330° C. were obtained, which solidified on cooling, and on crystallisation from alcohol yielded xanthene in white leaflets, m.pt. 98·5° C. Dimethylxanthenes are similarly produced by the thermal decomposition of the aluminium compounds of cresol and thymol.—G. F. M.

Fuel oils from coal. Moore. *See* IIa.

Determination of benzol in coal gas. See IIa.

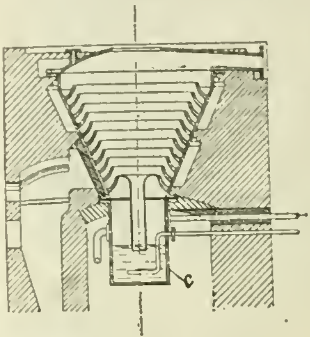
Presence of benzene homologues in the high-boiling distillates of petroleum. Brooks and Humphrey. *See* IIa.

Patents.

Crude tar for distillation; Process for the treatment of ——. Rütgerswerke A.-G., Berlin. Ger. Pat. 287,962, Nov. 14, 1914.

Before the tar is distilled, ammonium salts are removed by washing with water, or by heating with solutions of alkalis, alkaline earths, or alkali bicarbonates to 90°—100° C. until the ammonium salts are decomposed, distillation being carried out in the latter case before or after removal of the solution.—F. W. A.

Distillation apparatus: Continuous ——. Hoddick und Röthe, Weissenfels. Ger. Pat. 287,961, June 18, 1914. Addition to Ger. Pat. 201,372.

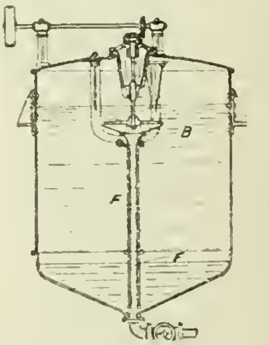


The apparatus originally claimed is modified by the introduction under the still of a container, *c*, which can be heated by means of steam coils, this provision being particularly adapted to the distillation of oil or tar containing a large content of water and hence liable to froth.—F. W. A.

Distillation of tar, mineral oils, or oils and fats; Combination of two stills for the ——. G. Krickhuhn, Lubeck. Ger. Pat. 288,702, Dec. 6, 1914.

Two stills are arranged in immediate contact and with the draw-off tube of the first still passing through the bottom of the second still, so that the heat of the furnace gases and of the residue from the first still are utilised in heating the second one, in which the crude distillate from the first is redistilled.—B. V. S.

Benzol; Apparatus for purifying ——. H. Koppers, Essen, Germany, Assignor to H. Koppers Co., Chicago. U.S. Pat. 1,157,988, Oct. 26, 1915. Date of appl., Sept. 2, 1913.



A mixing apparatus for purifying benzol by means of sulphuric acid contains a centrifugal mixing wheel, B, situated clear of the acid separating at the bottom and at a short distance above the open enlarged end of a stationary suction pipe, F. When the wheel is rotating, the acid at the bottom of the vessel is drawn up the suction pipe and intimately mixed with the benzol, whilst when the wheel is at rest, it is not exposed to the corrosive action of the acid.—F. W. A.

o-Chlorotoluene-p-sulphonic acid; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 287,932, Jan. 16, 1914. Addition to Ger Pat. 286,712 (this J., 1916, 170).

In place of pure toluene-*p*-sulphonic acid claimed in the main patent, mixtures of the *o*- and *p*-sulphonic acids obtained by the sulphonation of toluene are used; by adopting the method suggested in the main patent for the separation of the *o*-chlorotoluene-*p*-sulphonic acid, only this compound separates from the solution containing the mixed chlorinated sulphonic acids.—F. W. A.

N-substituted 4.4′-diaminodiarylthioketones and their derivatives; Preparation of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 287,994, Dec. 17, 1913.

N-substituted 4.4′-diaminodiarylmethanes are heated with polysulphides. *Example.* 25·4 parts of 4.4′-tetramethyldiaminodiphenylmethane is heated with 29 parts of sulphur and 24 parts of sodium sulphide crystals, with stirring, under a reflux condenser, until the methane base has almost or completely disappeared; to remove polysulphides and sulphur, the melt is boiled with dilute sodium sulphide solution, and any methane base present in the residue is then removed by means of alcohol or dilute hydrochloric acid; an excellent yield of 4.4′-tetramethyldiaminothiobenzophenone is obtained. In a similar manner the tetra-ethyl derivative may be prepared from 4.4′-tetra-ethyldiaminodiphenylmethane, and *sym.*-4.4′-dimethylamino-3.3′-diaminothiobenzophenone from the corresponding methane base.—F. W. A.

4.4′-Diamino-diaryl-ketones and their derivatives; Preparation of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 289.108, Feb. 24, 1914. Addition to Ger. Pat. 287,994 (see preceding abstract).

Instead of using N-substituted 4.4′-diaminodiarylmethanes or their derivatives, the methane-bases themselves or derivatives obtained by substitution in the aryl-residue are heated with polysulphides.—B. V. S.

Nitro-compounds; Reduction of aromatic ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 288,413, Dec. 23, 1913.

Dry spongy zinc, produced according to Ger. Pat. 282.234 (this J., 1915, 621), is used as reducing agent; the reduction of nitro-compounds in this manner is more easily controlled than if the moist electrolytic zinc is used direct.—F. W. A.

β-Amino-anthraquinones: Preparation of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 288.996, Feb. 16, 1913.

Meso-halogenanthracene-β-sulphonic acids or their salts are treated with ammonia in the presence of oxidising agents.—B. V. S.

Dichloroanthracene hexachloride and dichloroanthracene octochloride; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 289,133, Apr. 3, 1914. Addition to Ger. Pat. 284,790.

Sulphuryl chloride is used instead of carbon tetrachloride as in the chief patent. For example, by chlorinating a solution of 9.10-dichloroanthracene in sulphuryl chloride in the presence of a little iodine, the octochloride is precipitated and the hexachloride formed in solution.—B. V. S.

Arylamides of 2.3-hydroxynaphthoic acid: Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 289,027, Apr. 10, 1914.

An arylamide of 2.3-hydroxynaphthoic acid is obtained by heating the acid with the arylamide of a volatile organic acid. For example, the anilide is obtained by heating together hydroxynaphthoic acid and acetanilide.—B. V. S.

Sodium oxindole-p-sulphonate; Preparation of ——. J. Hausmann, Frankfort. Ger. Pat. 289,028, Oct. 15, 1913.

Phenylacetic acid is sulphonated at 70°—150° C. with three to five times its quantity of sulphuric acid of 66° B. (sp.gr. 1·84), the sulphonic acid is nitrated, the nitro-sulphonic acid reduced, and, if the reduction has not been carried out in the presence of free acid, the resulting product is treated with mineral acid. A mixture of oxindole-*p*-sulphonic acid with small quantities of *p*-amino-*o*-sulphophenylacetic acid is precipitated; these are easily separated either as acids or as sodium salts by reason of their different solubilities in water. The sodium salt of the former acid gives with nitric acid isatoxime-*p*-sulphonic acid, while that of the latter gives a diazo compound. Both compounds serve for the preparation of dyes.
—B. V. S.

Process for electrolytically reducing or oxidising organic substances. Eng. Pat. 15,750. *See* XX.

IV.—COLOURING MATTERS AND DYES.

Azo-dyes; Bisulphite compounds of ——. *II.* N. N. Voroshcov. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1669—1737. (See this J., 1911, 1107.)

The compounds obtained by the action of sodium bisulphite on sodium 1.5- and 1.8-naphtholsulphonates represent anhydrous esters, $NaSO_2.O.C_{10}H_6.SO_3Na$, whereas those obtained from 1.5- and 1.8-aminonaphthols, which are separable only with the hydrogen unsubstituted and not as salts, contain an extra molecule of water, $NH_2.C_{10}H_6.OH + H_2SO_3$. The stability of the latter compounds indicates that this molecule of water is constitutional and the conclusion is drawn that the naphtholic nucleus is first converted into the ketonic form, to which the sulphurous acid is then added. It may, indeed, be assumed that similar transformations take place with the naphtholsulphonates, the products thus formed then losing 1 mol. of water. There is no reason to expect that diazotisation should produce any change in the ring not containing the amino-group, and this is confirmed by analysis of the compound obtained by coupling the diazotised sodium bisulphite derivative of 1.5-aminonaphthol with phenol, the final product still containing the additional molecule of water; thus, such colouring matters cannot have the ordinary ester structures assigned to them by Bucherer and others. 1-Aminobenzene-2-carboxylic acid-azo-α-naphthylamine yields the same compound with sodium bisulphite as does 1-aminobenzene-2-carboxylic acid-azo-α-naphthol, the resulting colouring matter having after hydrolysis a hydroxyl group in its naphthalene component. Similar replacement of the amino group by hydroxyl takes place in the action of sodium bisulphite on 1-aminobenzene-4-sulphonic acid-azo-β-naphthylamine and on *p*-aminophenol-azo-β-naphthylamine. The constitution given above for the compounds obtained by the action of sodium bisulphite is confirmed in a number of other cases. Descriptions are given of the compounds formed with sodium bisulphite from:—1.4-naphtholsulphonic acid; 1.5- and 1.8-aminonaphthols, the products being diazotised and then coupled with phenol or α- or β-naphthol; azo-dyes derived from the three diazotised monosulphonic acids of aniline and the monoamino- or mono-hydroxy-derivative of naphthalene, $SO_3H.C_6H_4.N:N.C_{10}H_6.Aux(OH \text{ or } NH_2)$, the SO_3H occupying the *o*-, *m*-, and *p*-positions and Aux the α- and β-positions; the twelve azo-dyes represented by the scheme,

$$CO_2H.C_6H_4.N:N.C_{10}H_6.Aux(OH \text{ or } NH_2);$$

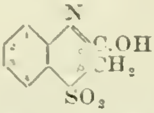
the dyes derived from diazotised *p*-aminophenol and α- or β-amino- or hydroxy-naphthalene; α-naphtholbisazobenzene, 1-naphthol-2-azobenzene, and 1-naphthol-2-azobenzene-4-sulphonic acid. Under the action of sodium bisulphite, *p*-dimethylaminoazobenzene, *p*-diethylaminoazobenzene, and *p*-nitrobenzene-azodiphenylamine first undergo scission; in the case of 1-benzeneazo-4-methoxynaphthalene, the methoxyl is replaced by hydroxyl.
—T. H. P.

Methylene Blue; Preparation of —— *as a lecture experiment.* F. Kehrmann. Ber., 1916, **49**, 53—54.

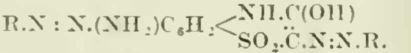
One or two grms. of thiodiphenylamine is shaken in acetic acid solution with a 5% solution of bromine in the same solvent until the precipitate has become brownish red and crystalline. After filtration, the residue of phenazthionium perbromide is suspended in 50 c.c. of 96% alcohol and treated with a 5% alcoholic solution of dimethylamine until excess is present. The perbromide rapidly disappears and from the blue solution Methylene Blue crystallises in glistening needles in almost theoretical yield.—G. F. M.

Sulphazone: Derivatives of ——. M. Claass. Ber. 1916. **49**, 350—363.

Sulphazone is an α-hydroxysulphazine, having the formula

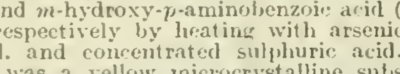


It has marked phenolic properties, forming salts with alkalis and alkaline earths, but gives no coloration with ferric chloride. Its basic properties are feeble: nitric acid forms a slightly soluble crystalline nitrate. Oxidation with alkaline permanganate produces oxanil-o-sulphonic acid, $C_6H_4(SO_3H)(NH.CO.COOH)(1.2)$. Halogens enter only the β-position, forming ββ-dichloro-, dibromo-, and mono- and di-iodo-derivatives. Nitric acid and fuming sulphuric acid attack the benzene nucleus, forming 3-nitro-α-sulphazone and α-sulphazone-3-sulphonic acid respectively. Nitrous acid produces yellow α-sulphazone-β-oxime (Ger. Pat. 288,682; following). The 3-nitro-derivative also gives a β-oxime and a ββ-dibromide, and the same compounds are produced by nitrating the oxime and dibromide of the original sulphazone. Methyl iodide forms a colourless methyl ether. 3-Nitrosulphazone on reduction in acid solution forms 3-aminosulphazone, which when twice coupled produces disazo dyes of unusual fastness, having the formula



$$R.N:N.(NH_2)C_6H_2<\begin{matrix}NH.\ddot{C}(OH)\\SO_2.\ddot{C}.N:N.R.\end{matrix}$$

The oxime and nitro-oxime of sulphazone form salts with metals. The blue iron lake may be produced directly on the fibre by warming the fabric in an aqueous solution of the oxime with iron filings. The fibre oxidises the ferrous salt to the blue ferric compound, the bath remaining colourless until the fibres are completely saturated with the dye. Mineral acids convert the oxime into oxanil-o-sulphonic acid. Reduction of the oxime led to unexpected results. With zinc and acetic acid, or with sodium amalgam in neutral solution or in presence of magnesium sulphate, the amine which is first formed is decomposed, ammonia is liberated, and the sulphazine ring breaks to form a sulphinic acid. With tin and hydrochloric acid, two molecules of the amine lose ammonia and form an imine, which condenses to an oxazine. The sulpho groups are then reduced, and the final product is dibenzothiazo-oxazine,



$$C_6H_4<\begin{matrix}NH.C—O—C.NH\\—S.\ddot{C}.NH.\ddot{C}.S—\end{matrix}>C_6H_4$$

—F. Sp.

8-Hydroxyquinolinecarboxylic acids and their derivatives. Dihydroxyanthraquinone-3-7-diquinoline. S. von Niementowski and E. Suchaida. Ber., 1916, **49**, 12—21.

8-Hydroxyquinoline-5-carboxylic acid, and 8-hydroxyquinoline-6-carboxylic acid were obtained from p-hydroxy-m-aminobenzoic acid (orthoform new) and m-hydroxy-p-aminobenzoic acid (orthoform) respectively by heating with arsenic acid, glycerol, and concentrated sulphuric acid. The former was a yellow microcrystalline substance, m.pt. 301° C., and decomposing at slightly higher temperatures into hydroxyquinoline and carbon dioxide. Oxidation with permanganate converted it into quinolinic acid. The hydroxyquinoline-6-carboxylic acid, m.pt. 284° C., was extremely stable towards heat, and sublimed without change. When heated with sulphuric acid and phosphoric anhydride at 240° C., water was eliminated with the formation of an anthraquinone derivative, probably 2-6-dihydroxyanthraquinone-3-7-diquinoline. This is a yellow substance of m.pt. 386° C., but slightly soluble in most solvents. It is reducible by hydrosulphite to the oxyanthranol derivative, which is soluble in water and is reoxidised by atmospheric oxygen. The substance possesses weak tinctorial properties both as a vat dye as above, and also, as a hydroxyanthraquinone, it imparts yellowish shades to mordanted cotton.
—G. F. M.

Mechanism of action of amines and metallic oxides on the vulcanisation of caoutchouc. [Formation of sulphur dyestuffs.] Ostromyslenski. *See* XIV.

Patents.

Vat dyestuffs: Production of ——. L. Kalb, Munich. Ger. Pat. 287,250, Mar. 26, 1913. Addition to Ger. Pat. 280,787 (this J., 1915, 545).

Instead of treating with acid condensing agents, *e.g.*, sulphuric acid or aluminium chloride, ring-substituted products of 1.1′-dinaphthyl-8.8′- or 2.2′-dicarboxylic acids or their derivatives, substituents are introduced into the dyestuffs, which need not be isolated for this purpose.—F. W. A.

Isatin derivatives [vat dyestuffs]: Production of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 287,373, Apr. 26, 1914.

α-Halogenides of isatin or its homologues or substitution products react with o-amino-ring-substituted-carboxylic acids, their homologues, substitution products, or derivatives to give carboxylated isatinanilides; the products are heated alone or in an indifferent solvent or with a condensing agent, *e.g.*, phosphoryl chloride or concentrated sulphuric acid, when ring-formation takes place, and compounds insoluble in alkali carbonates and caustic alkalis are produced. The products are generally yellow, and may be used as dyestuffs or for the production of dyestuffs. *Example:* A solution of isatin-α-chloride, produced from isatin and phosphorus pentachloride in benzene, is added slowly, at 70°—80° C., to a benzene solution of anthranilic acid, the mixture is heated for half-an-hour, treated with water, and the benzene removed by steam distillation. A suspension of a yellow product is thus obtained, which is reduced by alkaline hydrosulphite to a light brown leuco-solution from which cotton and wool are dyed lemon yellow shades. Isatin-α-chloride and benzidine-*m.m′*-dicarboxylic acid in benzene solution at 70° C. give a brownish yellow condensation product, a solution of which in concentrated sulphuric acid gives a greenish yellow substance on pouring into water; the product is insoluble in the usual solvents.—F. W. A.

Isatin derivatives [vat dyestuffs]: Production of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 288,055, May 12, 1911. Addition to Ger. Pat. 287,373.

Instead of commencing with isatin-α-halogenides and o-amino ring-substituted carboxylic acids or the isatin-α-anil-o-carboxylic acids obtained from them, as in the main patent (see preceding abstract), the isatin-α-anil-o-carboxylic acids are prepared by a process with which the condensation can be combined. By boiling isatin-α-anil and 5-bromo-2-aminobenzene-1-carboxylic acid with xylene, so that the water formed distils off, the intermediate isatin-5′-bromo-2-anil-1′-carboxylic

acid is converted into a golden yellow isatin derivative, which yields a brown vat with alkaline hydrosulphite from which wool and cotton are dyed yellow. By boiling under a reflux condenser a solution of benzidine-*m.m′*-dicarboxylic acid and sodium acetate in alcohol with isatin-α-anil, there is obtained the dark brown sodium salt of an isatin condensation product, which yields a light yellow vat with alkaline hydrosulphite from which fibre is dyed reddish brown; in the case of cotton if the dyestuff is diazotised on the fibre and coupled with β-naphthol, a bluish red dyeing is obtained.
—F. W. A.

β-Arylaminoanthraquinones; Preparation of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 288,464. May 19, 1914.

ANTHRAQUINONE-2-SULPHONIC acid, or one of its derivatives or substitution products, is heated with aromatic amines, other than aminoanthraquinones, and caustic alkalis or alkali alkyloxides, with or without the addition of oxidising agents, until the reaction is complete. On sulphonation the β-arylaminoanthraquinones thus obtained yield valuable wool dyestuffs. The preparation of 2-phenylaminoanthraquinone is described.—F. W. A.

Disazo dyestuffs for wool, fast to milling; Preparation of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 288,838, Nov. 25, 1913.

THE ether of 3.3′-diamino-4.4′-dihydroxydiphenylmethane is combined with 2 mols. of 2.6-naphtholsulphonic acid or with 1 mol. of this acid and 1 mol. of 1.4-naphtholsulphonic acid, or with 1 mol. of the 2.6.8-disulphonic acid and 1 mol. of β-naphthol. Valuable wool dyes are obtained which are specially fast to milling.—B. V. S.

Yellow dyes for wool; Preparation of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 289,111, Apr. 15, 1914.

A SULPHONIC acid of an aromatic aldehyde is condensed with *o*-nitraniline or a derivative having a free *para*-position, or the product obtained by condensing an aromatic aldehyde and *o*-nitraniline, etc., is sulphonated either directly or in some cases through one of its constituents. The dyes obtained give good level shades on wool and are fast to washing and milling.—B. V. S.

Quinizarinsulphonic acid; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,867, Mar. 8, 1914.

QUINIZARIN is heated with sulphites; the reaction is accelerated by addition of suitable oxidising agents, *e.g.*, manganese dioxide, lead dioxide, or sodium hypochlorite.—F. W. A.

Hydroxyanthraquinonesulphonic acids; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,474, Apr. 12, 1914. Addition to Ger. Pat. 287,867.

IN place of quinizarin mentioned in the main patent (see preceding abstract), the treatment of substituted 1.4-dihydroxyanthraquinones with sulphites is claimed. By this process purpurin gives the 3-sulphonic acid, whereas Alizarin Bordeaux, 1.4.5-trihydroxyanthraquinone, and other dihydroxyanthraquinone derivatives give new sulphonic acids differing in constitution from those obtained by the usual sulphonation process. The new products are apparently similar in constitution to quinizarin-2-sulphonic acid.—F. W. A.

Anthraquinone series; Preparation of sulphonic acids of the ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 289,112, July 19, 1914. Addition to Ger. Pat. 287,867.

INSTEAD of using quinizarin as in the chief patent, *p*-aminohydroxyanthraquinones, *p*-diaminoanthraquinones, and their derivatives are treated with sulphites, new sulphonic acids being obtained.—B. V. S.

Anthraquinone derivatives [vat and acid wool dyestuffs]; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,824, Jan. 29, 1914.

α-ARYLAMINOANTHRAQUINONES in which the *para*-position in the arylamino residue is occupied, and which contain an acylated amino-group in an α-position of the anthraquinone nucleus, are treated with oxidising agents. An alternative process consists in treating the arylaminoanthraquinones with sulphuric acid and allowing the products to oxidise in the air. The products are valuable vat dyestuffs, and, in the form of their sulphonic acids, acid wool dyestuffs.—F. W. A.

Methylaminoanthraquinone derivatives; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,825, Mar. 28, 1914.

AMINOANTHRAQUINONES and their derivatives are treated with methylating agents in presence of strong sulphuric acid, *e.g.*, with methyl alcohol in open vessels. Valuable wool dyestuffs are obtained by the methylation of aminoanthraquinonesulphonic acids in this manner.—F. W. A.

Acid wool dyes of the anthraquinone series; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,878, May 2, 1914.

BY treating with sulphurous acid or its salts a *p*-aminoarylamino-anthraquinone halogenated in the β-position, the halogen is easily replaced by the sulpho group, and acid dyes are obtained which are greener and brighter than the parent bodies.
—B. V. S.

2-Aminoanthraquinone: Preparation of a formaldehyde condensation product [vat dyestuff] from ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 287,907, June 24, 1913.

MINERAL acid salts of 2-aminoanthraquinone suspended in a suitable medium, other than concentrated sulphuric acid, are treated with formaldehyde. The condensation product is an orange powder, soluble in sulphuric acid. It is easily reduced by hydrosulphite and caustic soda; the vat gives brownish yellow shades on cotton. After washing and soaping orange dyeings very fast to chlorine and to washing are obtained.
—F. W. A.

2-Styril- and 2.4′-aminostyril-6-aminobenziminazole; Preparation of ——. O. Kym, Zürich. Ger. Pat. 288,190, Apr. 5, 1914.

2-METHYL-6-NITROBENZIMINAZOLE, or 1.2.4-triacetyltriaminobenzene or its anhydro-derivative, 2-methyl-6-acetylaminobenziminazole, is heated at 180°—250° C. with benzaldehyde or *p*-nitrobenzaldehyde respectively, with or without the addition of condensing agents, such as piperidine, dimethylaniline, or fused sodium acetate; the nitro-groups in the resulting condensation products are reduced, and acidyl groups if present eliminated by saponification. By introducing the styril or 4′-aminostyril group in place of the 2-phenyl group, benziminazoles are obtained which give azo dyestuffs of considerably increased affinity for cotton, the dyeings being of deeper and brighter shades than those from derivatives of known benziminazoles. Dinitro- and diaminostyrilbenziminazoles dye cotton from an alkaline bath chrome yellow and golden shades respectively.
—F. W. A.

Isonitrososulphazone; Preparation of ——. M. Claasz, Danzig-Langfuhr. Ger. Pat. 288,682, Mar. 3, 1915.

Sulphazone or one of its substitution products having a free 2-position is converted into the nitroso compound in the usual way at normal temperatures. The isonitroso-compound obtained, for example, by the action of sodium nitrite in acid solution gives indigo-blue shades on iron-mordanted wool, cotton, and silk. When sulphazone is nitrated the nitro group enters the benzene nucleus, whereas the nitroso group enters the azine nucleus. The nitrososulphazones give 2-aminosulphazones on reduction.—B. V. S.

Acridine series; Preparation of dyes of the ——. Akt.-Ges. f. Anilinfabr. Ger. Pat. 288,841, May 24, 1914.

Diaminodiarylmethane derivatives, having primary, secondary, or tertiary amino-groups, are condensed with thio-compounds obtained by the action of sulphur on *m*-diamines such as *m*-phenylenediamine, *m*-toluylenediamine, or *m*-diaminoanisol (see Ger. Pat. 86,096). A series of fast dyes is obtained, of great colouring power, and ranging in colour from yellow and orange to red and olive.—B. V. S.

Secondary disazo dyestuffs; Preparation of ——. Anilinfarben- u. Extraktfabr. vorm. J. R. Geigy. Ger. Pat. 289,030, Apr. 13, 1913. Addition to Ger. Pat. 286,091.

The diazo compound of an arylsulphonic ester of an aminonaphthol or an aminonaphtholsulphonic acid is combined with a suitable amine (or its sulphonic acid) of the naphthalene or benzene series, the product further diazotised and then coupled with β-naphthol or its sulphonic acid. Wool dyes, fast to milling, are obtained.—B. V. S.

[Azo] dyes; Fast yellow —— and process of making same. R. Schüle, Frankfort, Germany, Assignor to Cassella Color Co. U.S. Pat. 1,172,061, Feb. 15, 1916. Date of appl., Mar. 17, 1913.

See Fr. Pat. 474,561 of 1913; this J., 1915, 1085.

Trisazo dyestuff; Process for preparing a ——. L. Cassella und Co. Fr. Pat. 476,961, Mar. 12, 1914.

See Eng. Pat. 6900 of 1914; this J., 1915, 829.

Safranine dyestuffs; Manufacture of basic ——. Durand et Huguenin S. A. Fr. Pat. 477,725, Feb. 18, 1915.

See Ger. Pat. 282,346 of 1914; this J., 1915, 710.

Production of pigments containing copper. Ger. Pat. 287,149. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Balloon material; Prevention of damage to —— by ultraviolet rays. T. Schopper. Gummi-Zeit., 1915, **29**, 1250. Z. angew. Chem., 1915, **28**, Ref., 644.

Solutions of coumarin derivatives, *e.g.*, 1% solution of dimethylamino-β-methylcoumarin, may be used to absorb the ultraviolet rays and hence protect the fabric from damage by sunlight. —F. W. A.

Copper extraction from pyrites cinder at Pernau (Livonia). See X.

Patents.

Impregnation of fibrous material with vapour; Apparatus for the uniform ——. The Efficient Heating and Ventilating Co., Ltd., formerly Haggas, Ltd., and F. J. Sharr, Leeds. Eng. Pat. 1707, Feb. 3, 1915.

An operating chamber, containing the material to be treated (*e.g.*, yarn) is provided with a jacket and means for maintaining the temperature at a predetermined level, and below it is a vaporising chamber, with or without a jacket and pipes and valves for heating purposes, in which the substance to be vaporised is placed. The heating is carried out by any suitable means, *e.g.*, steam or gas, and is controlled by a thermostat. The temperature of the operating chamber is kept the same as, or a few degrees below that of the vaporising chamber. Air may be exhausted from the chambers, and there is also an arrangement for rapidly restoring the atmospheric pressure in the operating chamber containing the vapour. The chemical substance is maintained automatically in the liquid form at a regular and predetermined level in the vaporising chamber, the interior of the latter being divided into compartments provided with openings at opposite ends, thus forming a sinuous path for the passage of air over the liquid, and the chamber may have pipes and valves for conveying air to one or both of the chambers. An auxiliary or "hygrometer" chamber may be placed between the operating and vaporising chambers, with openings for admitting liquid or vapour from the latter, and is provided with a dry and a wet-bulb thermometer.—B. N.

Cork; Elastic artificial —— and process of producing same. F. Raschig, Ludwigshafen, Germany. U.S. Pat. 1,170,102, Feb. 1, 1916. Date of appl., Apr. 10, 1915.

Cork particles are bound together by a heat-hardened protein binder, under pressure and a high vacuum to remove occluded air, at a temperature not exceeding 70°—80° C. The product has a sp. gr. of about 0·220.—J. F. B.

[Sugar-cane] bagasse and product thereof. Packing or obturating material. M. W. Marsden, Assignor to Sugar Cane By-Products Co., Philadelphia, Pa. U.S. Pats. (a) 1,170,487 and (b) 1,170,488, Feb. 1, 1916. Dates of appl., Mar. 10 and Mar. 17, 1914.

(a) Sugar cane bagasse is dried by heat, and products of industrial value are obtained by dissolving and recovering the extractive matter and reducing the stock to useful fibre or else by subjecting it to dry distillation before digesting. (b) Bagasse deprived of its residual sugar and other fermentable bodies and separated from its fibre-bearing outer shell, is so treated as to render it non-inflammable, and converted into a packing or obturating material.—J. F. B.

Cellulose from wood or other raw materials; Manufacture of ——. A/S. Cellulosepatenter, Torderöd, Norway. Ger. Pat. 288,018, Mar. 25, 1915.

A suitable quantity of the hot digestion liquid is allowed to flow through the wood in the digester before the main operation takes place. The heating of the wood by this means may be effected in stages at increasing temperatures, to allow of the utilisation of exhaust steam in the earlier stages. If desired, the wood may be heated by circulation of liquor before it is packed in the digester. —J. F. B.

Cellulose esters; Preparation of solutions of ——. Chem. Fabr. von Heyden A.-G. Ger. Pat. 288,267, Apr. 28, 1914.

As solvents for cellulose esters, the alkyl or alkylidene ethers of glycerol-chlorohydrins are employed, alone or in combination with other liquids which gelatinise or dissolve the cellulose esters, or else with substances which have no solvent action. Cellulose acetate gives good solutions with methyl or ethyl glycerol-chlorohydrins and particularly with methylene-chlorohydrin.—J. F. B.

Insulating (cold-protective) material ; Manufacture of an ——. K. Kieser, Beuel. Ger. Pat. 288,318, Dec. 8, 1914.

Wood-wool is dusted over with a powdered solid hydrocarbon or other water-repellent substance and then heated to a temperature above the melting point of the substance employed, so that a thin layer of the latter is fixed on the surface of the material. Alternatively the proofing substance may be sprayed over the wood-wool in a fused condition by means of an atomising jet. The treated material may be used as a padding for clothing, bedding, etc.—J. F. B.

Waste paper : Manufacture of paper stock from ——. Röhm und Haas, Darmstadt. Ger. Pat. 287,884, Feb. 6, 1915.

The waste paper is treated in presence of water with the enzymes of the pancreatic gland, or similar enzymes, such as papayotin or the enzymes of castor beans. Disintegration takes place without discoloration of the mass, and the printing ink is loosened from the fibre.—J. F. B.

Fabrics : Process for applying a layer of adhesive material to ——. F. Stoffel, Paris, Assignor to W. H. and C. Edwards and J. E. Rierdan, New York. U.S. Pat. 1,170,699, Feb. 8, 1916. Date of appl., Jan. 21, 1914.

See Eng. Pat. 15,262 of 1914 : this J., 1915, 135.

Woollen fabrics ; Process for determining the resistance of —— *to wear.* L. Cassella und Co. Fr. Pat. 476,960, May 7, 1914.

See Eng. Pat. 4820 of 1914 ; this J., 1915, 956.

Wool-scouring and like liquors ; Concentration of —— *and recovery of grease and alkaline substances therefrom.* E. V. Chambers, T. C. Hammond, and G. G. Jarmain. Huddersfield. U.S. Pat. 1,170,962, Feb. 8. 1916. Date of appl., May 10, 1915.

See Eng. Pat. 13,005 of 1914 ; this J., 1915, 276.

Cellulose derivatives ; Preparation of ——. Soc. Chim. des Usines du Rhône. ancien. Gilliard, P. Monnet et Cartier. Fr. Pat. 477,620, June 22, 1914.

See Eng. Pat. 7773 of 1915 ; this J., 1916, 302.

Manufacture of fuel briquettes [from paper or cotton rag waste]. Eng. Pat. 4096. *See* IIa.

Process for rendering wood, textiles, etc., non-inflammable. Ger. Pat. 287,744. *See* IX.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Manufacture of dextrin and glycerin substitute from rotten potatoes. Esch. *See* XVII.

Patents.

Khaki colours on animal and vegetable fibres ; Preparations capable of developing ——. R. Vidal, Asnières, France. Eng. Pat. 1024, Jan. 21, 1915.

An improvement of the process described in Eng. Pat. 15,008 of 1908 (see Fr. Pat. 391,405 of 1907 ; this J., 1908, 1150) consists of melting two or four parts of a *m*-diamine with one part of a *p*-diphenol, *e.g.*, with *m*-phenylenediamine and quinol or toluquinol a light brown powder is obtained by crushing the melt. To obtain khaki colours animal or vegetable fibres are immersed in an aqueous solution of 35 grms. of potassium or sodium bichromate for 10 mins. at 90° C., the fibres wrung out, and immersed in an aqueous solution containing 1—1½% of one of the above preparations for 10 or more mins. at 70° C., and then washed. The dyeings are fast to washing and to milling, and are very level. The intensity of the colours on vegetable fibres is less than on animal fibres. Carded fleeces, slivers, yarns, threads, and simple or mixed fabrics may be dyed in this manner.—F. W. A.

Dyeing apparatus. D. M. Mey, Assignor to Vacuum Dyeing Machine Co., Chattanooga, Tenn. U.S. Pat. 1,172,240, Feb. 15, 1916. Date of appl., Apr. 5, 1910.

A vertical cylindrical dye-vat has an inlet at the bottom from which the liquid is circulated through the vat by a pump which is also connected to the overflow from the vat. Heating tanks divided lengthways by a suspended baffle, with means for heating the chamber below the baffle, are interposed on both sides of the pump.—F. W. A.

Raw goods ; Dyeing of ——. Chem. Fabr. Coswig-Anhalt. Ger. Pat. 288,687, May 23, 1914.

In dyeing raw goods, especially with substantive dyestuffs, compounds containing active oxygen, *e.g.*, perborates, are added to the dye-bath. More level dyeings are produced, particularly in the case of cotton goods, and the brightening of shade obtained is not only of a temporary character, as is the case when bisulphite is used. On account of the increased dyeing properties of the fibre caused by the action of the active oxygen, the exhaustion of the dye-bath is much more complete. The new process avoids the preliminary bleaching process, thus causing an improvement in the handle of the goods, particularly in the case of stockinet and similar woven goods. The addition of perborate to the amount of 1% of the weight of the goods is generally sufficient.—F. W. A.

Vegetable fibres ; Preparation of —— *for bleaching.* J. L. Jardine and T. A. Nelson. Fr. Pat. 477,511, Feb. 3, 1915.

See Eng. Pat. 802 of 1914 ; this J., 1915, 350.

Bleaching textile materials and other substances. J. E. MacIlwaine. Fr. Pat. 476,643, Dec. 2, 1914.

See Eng. Pats. 28,911 of 1913 and 6317 of 1914 ; this J., 1915, 75.

Weighting silk. Gebr. Schmid, Basle, Switzerland. Eng. Pat. 15,244, Oct. 28, 1915. Under Int. Conv., Oct. 31, 1914.

See Ger. Pat. 287,754 of 1914 ; this J., 1916, 174.

Ice colours on artificial silk : Production of ——. Chem. Fabr. Griesheim-Elektron. Fr. Pat. 476,852, July 20, 1914.

See Eng. Pat. 17,272 of 1914 ; this J., 1915, 957.

Dye vat. A. Kluge. Fr. Pat. 476,860, Oct. 15, 1914.

See U.S. Pat. 1,121,023 of 1914 ; this J., 1915, 76.

Dyestuffs ; Application of [sulphide] ——. E. Lodge and J. M. Evans. Fr. Pat. 477,015, Jan. 4, 1915.

See Eng. Pats. 29,852 of 1913 and 19,473 and 23,386 of 1914 ; this J., 1915, 135, 223, 277.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid; Impurities in chamber —— prepared from the gases from metallurgical furnaces. A. Hoffmann. Metall u. Erz, 1915, **12**, 290, 310. Chem.-Zeit., 1915, **39**, Rep., 443.

The gases from zinc blende roasting furnaces contain suspended dust and this forms the chief source of the impurities in the chamber acid. The incrustations which form in the chambers, etc., are as hard as stone and cannot be removed by washing with water. They are probably composed of acid ferric sulphates. A microcrystalline, greyish-white, very hygroscopic sludge from a settling tank for the 60° B. (sp.gr. 1·71) acid had the composition, $Fe_2(SO_4)_3.3H_2SO_4,8H_2O$; on exposure to air it absorbed moisture and yielded sulphuric acid and $Fe_2(SO_4)_3,H_2SO_4$. The incrustations contain a crystalline sulphate of the composition, $Fe_2(SO_4)_3,H_2SO_4,7H_2O$, and sometimes, when they are of a greenish-yellow colour, $Fe_2(SO_4)_3,H_2SO_4,11H_2O$ or $8H_2O$. The lead sulphate present in the chamber sludge is the normal sulphate. When aluminium sulphate is found in large quantities, it is present as acid sulphate, which can be obtained in the form of snow-white glistening leaflets, $Al_2(SO_4)_3,H_2SO_4,14H_2O$, easily soluble in water. Zinc sulphate mostly remains in solution in the Glover tower acid, but is present in the incrustation formed in the Gay-Lussac towers, which contains 63·7% $ZnSO_4,H_2O$, 9·7% $PbSO_4$, and 21·1% $Fe_2(SO_4)_3,H_2SO_4,8H_2O$. In the concentration of the acid porous yellowish-white amorphous crusts of $Fe_2(SO_4)_3, H_2SO_4$, and hard white crusts are formed; the latter probably consist of a pyrosulphate, $Fe_2(SO_4)_2(S_2O_7)$. A very hygroscopic acid zinc sulphate $ZnSO_4,3H_2SO_4$, may also separate during concentration.—A. S.

Solvents; Distribution of —— between solutes. Electrical conductivity of mixtures of acids. A. G. Doroschevski and V. I. Fridman. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1615—1626.

The observed conductivities of mixed solutions of hydrochloric and nitric acids are in agreement with the values calculated on the assumption that the solutions are isohydric at equivalent concentrations, the water in these solutions being, therefore, distributed between the solutes in proportion to their chemical masses. Mixtures of acetic, propionic, and butyric acids in comparatively high concentrations (5—10%) obey the same law.—T. H. P.

Potassium in potassium salts; Determination of —— by the perchlorate method. G. Hager and J. Kern. Landw. Versuchs-Stat., 1915, **87**, 365—380. J. Chem. Soc., 1916, **110**, ii., 114.

The solubility of potassium perchlorate in alcohol increases as the strength of the alcohol decreases. The presence of perchloric acid and of barium, sodium, and magnesium perchlorates decreases the solubility of the potassium salt. Alcohol of at least 96% by vol., and containing up to 1% of perchloric acid, should be used for washing the potassium perchlorate when dealing with a fairly pure potassium salt. The method yields low results when applied to the estimation of potassium in samples containing much sulphate, since potassium salts are occluded in the barium sulphate during the necessary preliminary removal of sulphates; other methods for the estimation should be used for such samples (compare this J., 1915, Thin and Cumming, 514; Davis, 1246).

Periodates, iodates, bromates, and chlorates; Determination of —— in presence of each other. Differential iodimetry. J. O. L. Barnebey. J. Amer. Chem. Soc., 1916, **38**, 330—341.

The oxidising action of periodates, iodates, bromates, and chlorates on potassium iodide depends upon the concentration of the reagents, the acidity, the temperature, and the time of reaction, and by suitably adjusting these conditions they may be determined differentially in the order named. In a saturated boric acid solution containing 2% of borax, periodate alone reacts with iodide, with formation of iodate and free iodine. The iodate is brought also within the compass of the reaction by working in $N/4$ acetic acid solution at 3°—4° C., and using $N/1$ potassium iodide; under these conditions bromates are but slightly attacked—for which a correction can be applied—and chlorates not at all. In presence of $N/5$ hydrochloric acid the periodate, iodate, and bromate are reduced, whilst all four halogen oxyacids are decomposed in presence of $6N$-hydrochloric acid, the chlorate being first converted into iodate. After standing 20 mins. the solution is rendered alkaline with sodium hydroxide, and then, after re-acidification, the liberated iodine is determined in the usual way. Perchlorates do not react with potassium iodide in acid solution at ordinary temperatures, and their presence therefore does not interfere with the above determinations.—G. F. M.

Magnesia in calcium carbide furnaces; Behaviour of ——. N. Kameyama. J. Chem. Ind., Tokyo, 1916, **19**, 41—68.

It is commonly accepted that magnesia when heated in calcium carbide furnaces is reduced to magnesium, which is immediately transformed into nitride, and that therefore the acetylene obtained from calcium carbide prepared from lime rich in magnesia will be rich in ammonia. The author's experiments, however, show that the magnesium is not converted into nitride, but is again oxidised to magnesia by the atmosphere in the furnace, consisting mainly of carbon monoxide. For example, the amount of nitrogen in carbide prepared from lime alone and mixed with magnesite was usually 0·12 to 0·42%, but in the case of one sample reached 0·9%. By distilling these carbides with water over lime under reduced pressure, it was found that ammonia was liberated only from nitride and not from calcium cyanamide. These samples contained 0·04 to 0·09% of nitride nitrogen, which did not show any relationship to the amounts of magnesia and total nitrogen. The non-nitride nitrogen consisted, in the main, of calcium cyanamide. As a further proof of the improbability of the formation of nitride the dissociation pressure of magnesium nitride vapour in the carbide furnace atmosphere was determined. In one experiment it was found to be 4·0 cm. of mercury at 730° C. Deviating results in other determinations were attributed to the formation of a solid solution of Mg_3N_2 and Mg.—C. A. M.

Sulphides of copper. E. Posnjak, E. T. Allen, and H. E. Merwin. Economic Geology, 1915, **10**, 491—535. J. Chem. Soc., 1916, **110**, ii., 103—104.

Cuprous sulphide prepared in a vacuum furnace melts at 1130° ± 1° C. No dissociation occurs when it is heated up to 1200° C. Synthetic cuprous sulphide has sp.gr. 5·785 at 25°/4° C., a value which is almost identical with that of the purest mineral sulphide examined. The copper sulphides formed by fusing together copper and sulphur are of variable composition and always contain more sulphur than is demanded by the ratio 2Cu : S. They are microscopically homogeneous and vary continuously both in colour and specific gravity with composition; as the sulphur increases, they become darker in colour and have lower specific gravities. All such products are solid solutions of the two sulphides. Cuprous sulphide melts at 1096° C. in an atmosphere of hydrogen sulphide and at 1057° C. in an atmosphere of sulphur vapour. The lower melting point as compared with that of cuprous sulphide in a vacuum is due to dissolved cupric sulphide, which increases in amount with the increase of pressure of the sulphur vapour surrounding it. When cuprous sulphide is heated in an atmosphere of hydrogen sulphide at various temperatures below its melting point, the sulphur content increases. For each temperature, the product contains a definite amount of sulphur. This sulphur content increases with decrease of temperature until at 358° C. the product becomes cupric sulphide. Solid solutions of cuprous-cupric sulphide can be prepared by heating compressed powders of the two sulphides at about 100° C. The analysis of a number of natural chalcocites showed that such solid solutions sometimes occur in nature. Cuprous sulphide is dimorphous; the inversion temperature (91° C.) is considerably influenced by the size of the grains of the sulphide. Increasing amounts of cupric sulphide, dissolved in cuprous sulphide, raise the inversion temperature until a concentration of cupric sulphide of 8 % is reached, after which an inversion is no longer observed. Crystals of chalcocite were repeatedly formed in the dry way at various temperatures, but only above about 250° C. were they large enough for crystallographic investigation. These crystals were isometric. Isometric crystals of cuprous sulphide were also obtained from solutions; at 250° C. by the reaction of cuprous chloride with sodium sulphide; and at 200°, 170°, and 125° C., by crystallisation of cuprous sulphide from solutions of hydrogen sulphide. Crystals formed by the action of ammonium sulphide on copper, which have generally been described as orthorhombic cuprous sulphide, are in reality a double polysulphide of the formula $Cu_7(NH_4)S_4$ and are tetragonal. Covellite has been prepared in many ways, and a crystallographic and optical study of its properties carried out. Two very pure samples of covellite have been found to have sp.gr. at 25°/4° C. 4·683 and 4·676 respectively, values higher than any value previously given for this substance. The highest value found for synthetic covellite was 4·652. Covellite can be heated in an atmosphere of hydrogen sulphide up to 358° C.; it is then in equilibrium with the gas, and at this temperature and below it, chalcocite can be completely converted into covellite.

Uranyl nitrate; Alleged explosibility of ——. A. Müller. Chem.-Zeit., 1916, **40**, 38—39.

From the results of experiments described in detail the conclusion is drawn that the decrepitation of certain preparations of uranyl nitrate separated from an ethereal solution is not, as claimed by Andrews (this J., 1913, 84) and Eichhorn (this J., 1914, 199), a property of the salt itself. Apparently it is due to the formation of an unstable addition compound of a lower oxide of nitrogen with a uranium-ether addition compound, such as has been described by Lebeau (this J., 1912, 772). The phenomenon only appears when the original aqueous solution contained some free nitric acid, and never in the case of products crystallised from water.—C. A. M.

Metallic oxides; Reduction of —— with hydrogen at high pressures. E. Newbery and J. N. Pring. Proc. Roy. Soc., 1916, A, **92**, 276—285.

By heating to 2500° C. in dry hydrogen at pressures up to 150 atmospheres, and partly removing the resulting water vapour by means of sodium, Cr_2O_3 and MnO_2 were reduced to metals, V_2O_5 o VO, Nb_2O_5 to NbO, U_3O_8 to UO_2, TiO_2 to TiO, nd CeO_2 to Ce_2O_3; Al_2O_3, MgO, ZrO_2, Y_2O_3, and ThO_2 were unchanged. The metallic chromium and manganese obtained are considered to be purer than any produced hitherto; their m.pts. were 1615°±15° C. and 1230°±5° C., respectively, each value being the average of 10 determinations corrected to "black body" temperature.—W.E.F.P.

Metallic oxides; Behaviour of some —— with phenylhydrazine. E. Puxeddu. Gaz. Chim. Ital., 1916, **46**, I., 71—76.

The yellow and red oxides of mercury are both reduced to metallic mercury by phenylhydrazine; the former reacts vigorously and the latter more slowly, but this difference vanishes if the red oxide be powdered very finely. If the yellow oxide be added to an ethereal solution of phenylhydrazine, mercury in the form of a greyish blue powder is obtained and mercury-diphenyl can be isolated from the reaction mixture. Mercurous oxide is also readily reduced to metallic mercury by phenylhydrazine. Lead dioxide reacts with phenylhydrazine at the ordinary temperature, red lead, on the other hand, only on heating. In both cases, black suboxide of lead, Pb_2O, is formed. In the case of the dioxide, lead monoxide and metallic lead may also be formed, according to the temperature employed.—A. S.

Azoimide; Mechanism of the reaction in the synthesis of —— from hydrazine and nitrous acid. F. Sommer and H. Pincas. Ber., 1916, **49**, 259—277.

Hydrazine and nitrous acid react in neutral aqueous solution to form the stable hydrazine nitrite, which is decomposed by heat as follows: $N_2H_5.NO_2 = NH_3 + N_2O + H_2O$, the change being greatly accelerated by the presence of nitrous acid (see this J., 1913, 976). In presence of free acid, azoimide is formed, and the greater the H-ion concentration the greater the retardation of the reaction given in the equation. The reaction between hydrazine and nitrous acid can be either (1) $N_2H_4 + HNO_2 = NH_3 + N_2O + H_2O$, or (2) $N_2H_4 + HNO_2 = N_3H + 2H_2O$, followed by the secondary change, $N_3H + HNO_2 = N_2 + N_2O + H_2O$. In the presence of weak acids (1) takes place, but with strong acids (2) occurs, the yield of azoimide being much depressed owing to the secondary reaction. In 30·3 % phosphoric acid solution the total azoimide, both actually obtained and that formed and then decomposed, was 56·9 %, 58·8 % of the hydrazine being decomposed, corresponding to a yield of 96·7 % on the hydrazine decomposed. The best actual yield of azoimide, 59·6 %, was obtained by using 400 c.c. of a 16·5 % solution of phosphoric acid, 27·6 grms. of hydrazine chloride, and 1·35 grms. of sodium nitrite dissolved in 400 c.c. of water. As only 82·3 % of the hydrazine underwent change, the yield was about 76 % of that theoretically possible.—E. H. T.

Hydrazine; Oxidation of ——. VII. The alleged rôle of nitrous acid in the formation of hydronitric acid [azoimide]. A. W. Browne and O. R. Overman. J. Amer. Chem. Soc., 1916, 38, 285—302. (See Sommer, this J., 1913, 976, and Z. anorg. Chem., 1914, 86, 71.)

Ammonium sulphate was practically unaffected by boiling with hydrogen peroxide, potassium chlorate, or potassium persulphate, in a solution strongly acid with sulphuric acid: no nitrous acid or nitric acid was obtained; and the addition of ammonium sulphate to a reacting mixture of hydrazine sulphate, sulphuric acid, and hydrogen peroxide served to decrease rather than increase the yield of azoimide. When hydrazine sulphate was oxidised, in sulphuric acid solution, with potassium nitrite, however, the yield of azoimide was larger and that of ammonia much less than when oxidation was effected by hydrogen peroxide under the same conditions. The view that ammonia and then nitrous acid are formed as intermediate products in the oxidation of hydrazine by reagents containing no nitrogen is therefore rejected. —F. Sodn.

Silicon hydrides. I. Hydrides obtained from magnesium silicide by the action of acids. A. Stock and C. Somieski. Ber., 1916, **49**, 111—157.

Magnesium silicide, prepared by the ignition of an intimate mixture of 2 parts of magnesium and 1 part of silica containing from 0·3—0·5% of alkali, which somewhat modifies the violence of the reaction, was decomposed by dropping it gradually into concentrated hydrochloric acid in an air-free atmosphere. In the gaseous product of the reaction, after removal of hydrogen, silicane, SiH_4, predominated, and decreasingly smaller quantities of disilicane, Si_2H_6, trisilicane, Si_3H_8, and tetrasilicane, Si_4H_{10}, were found and isolated by fractional evaporation of the liquefied gases. The presence of penta- and hexasilicane was also indicated. Silicane has m.pt. —185° C., b.pt.—112° C. at 750 mm.; it is slowly decomposed by water, and is often spontaneously inflammable in air. Disilicane melts at —132·5° C., and boils at —15° C. at 760 mm.; it has a more repulsive odour than silicane, and although stable at ordinary temperatures, in presence of air it explodes with great violence. Tri- and tetrasilicane were also isolated in a pure state. They are unstable liquids at ordinary temperatures, b.pt. 53° C. at 760 mm., and 0° C. at 7·5 mm. respectively, and spontaneously explosive in air. No hydride of the type Si_2H_4, nor higher members of the silicane series than Si_6H_{14} could be detected.—G. F. M.

Hydrogen and chlorine: Interaction of —— under the influence of alpha particles. H. S. Taylor. J. Amer. Chem. Soc., 1916, **38**, 280—285. (See this J., 1915, 136, and Bodenstein, 1916, 113.)

Further experiments have shown that the reactivity of the gaseous mixture, prepared by electrolysis, diminishes with the exhaustion of the hydrochloric acid used, and is increased by regenerating the solution. In a favourable case, it is computed that approximately 4000 molecules of chlorine were converted into hydrogen chloride for each pair of ions radiated into the gas. —F. Sodn.

Ammonia formation in the gasification of coke and coal by steam and air. Markgraf. *See* IIa.

Influence of steam on the yield of ammonia in the pyrogenic decomposition of solid fuels. Sachs. *See* IIa.

Composition and use of certain seaweeds. Hendrick. *See* XVI.

Production of formaldehyde and other organic substances from formic acid. Hofmann and Schumpelt. *See* XX.

Solubility of barium, strontium, calcium, and lead sulphates in ammonium acetate solutions at 25° C., and separation of these substances by means of ammonium acetate solution. Marden. *See* XXIII.

Effect of dissolved substances on the velocity of crystallisation of water. Walton and Brann. *See* XXIV.

Patents.

Roasting pyrites or the like in shaft furnaces, especially for the manufacture of sulphuric acid. H. Koppers, Essen. Ger. Pat. 288,322, Aug. 30, 1913.

The furnace is provided with a rotating conical grate and a rotating ash-pan disposed in a closed chamber, the arrangement being similar to that in gas producers with rotary grates; as the ash-pan rotates, the pyrites cinder is removed by fixed scrapers into a chamber, from which it is discharged, at intervals, through a valve. Air is introduced below the grate through a central pipe. The upper part of the shaft is enlarged and is provided inside with a hood through which the gases pass to the outlet. The pyrites is charged into the annular space surrounding the hood and falls gradually into the interior of the shaft. A quantity of steam is introduced with the air to prevent the temperature rising too high. A part of the steam is decomposed, but any hydrogen sulphide formed is again decomposed into water and sulphur dioxide, so that the steam acts merely as a temperature regulator, and the gases from the furnace contain about 10% SO_2 and 6—8% O_2. —A. S.

Aluminium salts; Process for producing soluble——. M. F. Coolbaugh and E. H. Quinney, Rapid City, S.D. U.S. Pat. 1,170,418, Feb. 1, 1916. Date of appl., June 2, 1913.

Argillaceous and silicious rocks, earths, or minerals, free from potash but containing insoluble compounds of aluminium, are powdered and mixed with 1·7 parts of limestone to each part of silica by weight. The mixture is heated to incipient fusion, cooled quickly, and the product leached with dilute sulphuric acid. Three parts of sulphuric acid by weight is required for each part of aluminium by weight in the roasted mixture. Aluminium sulphate is recovered from the resulting solution by crystallisation.—J. B. C. K.

Non-poisonous, non-alkaline, stable, oxygen-developing phosphates; Preparation of——. Chem. Werke vorm. H. Byk, Oranienburg. Ger. Pat. 287,588, Mar. 4, 1911.

By treating neutral phosphates with hydrogen peroxide in suitable proportions, products are obtained which are easily soluble, stable, and have a high content of active oxygen, and, being almost neutral in reaction and non-poisonous, can be used in therapy and in foodstuffs.—B. V. S.

Ammonia from the elements; Manufacture of——. Centralstelle für Wissenschaftl.-Techn. Untersuchungen, Neubabelsberg. Ger. Pat. 288,496, Feb. 17, 1914.

A quantity of chromic oxide equal to from ten to twenty times that of the catalyst is used as a support for the latter. The contact mass may be prepared by impregnating chromic oxide, obtained by ignition of pure chromic acid, with an aqueous solution of a salt of the metal to be used as catalyst, and then drying in a current of nitrogen and hydrogen. The chromic oxide may be mixed with other suitable substances before impregnation. —A. S.

Ammonia from its elements; Synthetic production of——. H. Wade, London. From Centralstelle für Wissenschaftl.-Techn. Untersuchungen, Neubabelsberg, Germany. Eng. Pat. 2392, Feb. 15, 1915.

See Ger. Pat. 288,496 of 1914; preceding. Ruthenium, osmium, or platinum or their compounds may be used as catalysts.

Saturator for the manufacture of ammonium sulphate. J. Schulte, Berlin-Wilmersdorf. Ger. Pat. 288,497, May 1, 1914.

The gas-inlet tube is surrounded by a wider tube; both tubes extend below the surface of the acid in the saturator. The outer tube acts in the manner of an air-lift pipe, the liquid and bubbles of gas rising therein and the liquid overflowing at the upper end. Intimate contact being the gas and liquid is thus attained.—A. S.

Zinc: Preparation of a mixture of sodium sulphite and hydroxide for precipitating —— from solutions. W. Buddeus, Charlottenburg. Ger. Pat. 288,498, July 14, 1914.

A solution of sodium sulphate is treated with lime and sulphur dioxide, the precipitated calcium sulphate is separated, and the solution of sodium bisulphite is boiled with excess of calcium hydroxide, whereby calcium sulphite is precipitated and a solution of sodium sulphite and hydroxide for use in precipitating zinc from solutions is obtained. When added to a sulphate solution of zinc this solution produces a precipitate of basic zinc sulphite, $ZnSO_3$, ZnO, and the sodium sulphate also formed is used for preparing a further quantity of the precipitant. The calcium sulphite is treated with sodium sulphate solution and sulphur dioxide to form sodium bisulphite for use in the process.—A. S.

Carbonic acid baths; Production of a mixture of sodium bicarbonate and primary sodium phosphate for the preparation of ——. W. Esch, Hamburg. Ger. Pat. 288,523, Dec. 5, 1914.

Solid secondary sodium phosphate is treated, at a moderate temperature, with carbon dioxide. A mixture of sodium bicarbonate and primary sodium phosphate is thus obtained, which may contain as much as 21% of loosely combined carbon dioxide. It is relatively stable in presence of water at low temperatures, but on warming readily evolves carbon dioxide.—A. S.

Zinc sulphide; Method of manufacturing dehydrated ——. C. Ranson, Paris. U.S. Pat. 1,171,246, Feb. 8, 1916. Date of appl., Sept. 6, 1910.

See Fr. Pat. 418,124 of 1910; this J., 1911, 38.

Zinc oxide; Manufacture of pure ——. W. Asef. Fr. Pat. 476,751, Dec. 12, 1914.

See U.S. Pat. 1,165,743 of 1915; this J., 1916, 255.

Alkali halides: Process and apparatus for the electrolysis of ——. Siemens und Halske A.-G. First Addition, dated July 25, 1914, to Fr. Pat. 468,645, Feb. 19, 1914.

See Eng. Pat. 17,089 of 1914; this J., 1915, 871.

Oxygen; Preparation of ——. Permutit Co. Fr. Pat. 477,044, Jan. 6, 1915.

See Eng. Pat. 24,558 of 1914; this J., 1915, 1208.

Process for obtaining ammonia from incandescent coke from gas retorts. Ger. Pat. 288,524. *See* IIa.

VIII.—GLASS; CERAMICS.

Patents.

Composition for lining crucibles and the like to withstand intense heat. J. B. Sidebottom, Leeds. Eng. Pat. 2578, Feb. 18, 1915.

Yellow sand (112 parts) and gas tar (8 parts) are mixed and baked for 5 hours at 200° F. (93° C.).
—B. N.

Quartz or silica products and their manufacture. P. L. Pfannenschmidt. Fr. Pat. 477,377, Jan. 6, 1915.

See Eng. Pat. 420 of 1914; this J., 1915, 906.

IX.—BUILDING MATERIALS.

Patents.

Wood, textiles, and the like; Process for rendering —— non-inflammable. D. Steinherz, Charlottenburg. Ger. Pat. 287,744, Mar. 26, 1914.

The materials are impregnated with a solution containing about 20% of magnesium sulphate and 5% of ammonium sulphate.—J. F. B.

Slag: Treatment of —— for the manufacture of bricks and for other purposes. E. R. Sutcliffe, Leigh. U.S. Pat. 1,171,676, Feb. 15, 1916. Date of appl., Aug. 17, 1914.

See Eng. Pat. 18,806 of 1913; this J., 1914, 964.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Cast-iron; Sulphur in ——. E. Leber. Stahl u. Eisen, 1915, **35**, 877—882. Z. angew. Chem., 1915, **28**, Ref., 616.

The author considers that the results published by Coe (Iron and Steel Inst., 1913, 361, this J., 1913, 536; see also this J., 1913, 87) and Jüngst disprove the view that sulphur has a directly prejudicial effect on the strength of cast-iron. In certain cases the results show that a higher sulphur content results in an unmistakable rise in strength and a partial improvement in flexibility. The tendency to segregation and the formation of cavities increases, however, with the sulphur content, and for this reason sulphur may be prejudicial. Segregation does not affect the strength so much as do cavities. The action of sulphur in promoting the formation of cavities is in causing the internal friction of the particles during the transition from the molten to the solid state, not only to become very great, but to increase so rapidly that frequently pouring must be stopped because the casting has solidified. This difficulty is overcome by pouring the iron as hot and as quickly as possible, and lack of success in casting iron with a high sulphur content is due to these precautions not having been observed.—T. St.

Malleable iron; The principles underlying the method of producing ——. K. Bricker. Montan. Rundschau, 1915, **7**, 563—568. Z. angew. Chem., 1915, **28**, Ref., 615.

The view that molten iron is immune from oxidation so long as it contains more easily oxidisable elements, and that only after the removal of silicon, phosphorus, manganese, and carbon, can the iron itself be oxidised, is erroneous. Each refining operation on the solid or molten metal affects in the first place the iron itself, with the formation of difficultly fusible scale. This combines with silica to form easily fusible iron silicates which can dissolve both silica and ferrous oxide. The ferrous oxide dissolved in the freshly formed iron silicate slag diffuses into the molten iron, and there gives up its oxygen to the impurities present in proportion to the heat evolved in the several reactions, whereby silicon is converted into iron silicate, manganese into manganous oxide, and phosphorus into iron phosphate, and considerable quantities of heat are liberated. The iron silicate thus formed passes into the slag, increasing the capacity of the latter for dissolving silica and ferrous oxide. The manganous oxide, which is insoluble in the molten iron, separates out and combines with free silica in the slag to form manganese silicate. The iron phosphate is also taken up by the slag. The reaction between ferrous oxide and carbon is accompanied by absorption of heat, and can only take place if sufficient heat is available. The resulting carbon monoxide gives rise to a more or less violent bubbling of the molten metal. The carbon tends also to reduce the metal silicates and phosphates, and failing the presence of sufficient basic material, phosphorus may return into the iron. The certain removal of phosphorus from the iron is thus only possible with a slag rich in metal or lime. The ferrous oxide finally remaining in the molten iron must be decomposed by the addition of manganese, silicon, or aluminium. The removal of sulphur is not brought about by oxidation, but by the segregation of metallic sulphides which pass into the slag. To prevent the return of sulphur into the bath these sulphides must either be destroyed by combustion, or they must be transformed in the slag into compounds insoluble in the molten iron. This is effected most readily by the presence of lime in the slag.—T. ST.

Iron or other metals : New thermo-electric method for the study of the allotropy of ——. C. Benedicks. Comptes rend., 1916, **162**, 297—299.

IF a metal possessing an allotropic change point is made to form a closed circuit, and if a portion of the metal is heated to above the change point, and if also the position of the heated portion is not stationary with respect to the metal as a whole, the two contact surfaces between the phases will be at slightly different temperatures, and an electric current may be produced in the circuit. The e.m.f. will depend on the direction of displacement of the heated portion, the difference in temperature between the allotropic change point on heating and cooling respectively, and on the thermo-electric power between the two phases. An iron wire (C 0·10, Si 0·014, Mn 0·03, P 0·026, S 0·007 %) the ends of which were attached to a galvanometer, was passed at a uniform speed through a small electric furnace, the central temperature of which was measured. The effect was very marked, becoming observable at about 600° C.: the A_3 point is plainly indicated by a discontinuity in the curve, which, above 875° C., becomes a straight line. No indication could be obtained of the A_2 point. A small sample of extremely pure iron gave similar results but the effect was considerably more feeble. The rate of movement had very little influence with the first sample, but the readings were greater for higher speeds with the purer sample. No current was obtained when the iron wire was replaced by a copper wire. The results are considered to support the theory of the allotropy of iron as advanced by the author.—T. ST.

Galvanising processes. K. Arndt. Verein deutscher Giessereifachleute, Dec. 16, 1915. Z. angew. Chem., 1916, **29**, Wirthschaftl. Tl., 77—79.

IN Germany since the outbreak of war copper has been replaced by galvanised iron for many purposes. Galvanising may be effected by the hot process, the electrolytic process, Schoop's metal-spraying process, or by sherardising. In the hot process if the bath of molten zinc is allowed to solidify it must be heated from above for re-melting, otherwise the tank may be damaged owing to expansion of the zinc. The temperature of the bath must not be allowed to rise too high (see Diegel, this J., 1915, 1147). Sheet iron galvanised by the hot process has about 400 grms. of zinc per sq. m. instead of about 1 kilo. of zinc as formerly. Cables for use in mines are now largely made from wire galvanised by the electrolytic process, because in wire galvanised by the hot process, unless the conditions are very carefully controlled, the strength may be materially reduced owing to the formation of a relatively brittle zinc-iron alloy. An advantage of electrolytic galvanising is that it reveals defects, such as fine cracks or the like, in the iron, which would be concealed by hot galvanising. It is also specially suitable for articles such as springs, which must not be heated to a high temperature. In the case of electrolytically galvanised sheet iron a coating of 200 grms. of zinc per sq. m. is sufficient to prevent rusting. Schoop's metal-spraying process is specially suitable for galvanising large objects. Sherardising is particularly suitable when it is desired to preserve the finest details of the article to be galvanised ; iron screws which have been galvanised by this process are ready for use without further treatment. Narrow tubes can be galvanised inside by sherardising, and this process is used in making the 5 Pf. galvanised iron coins recently introduced in Germany.—A. S.

Reduction of roasted zinc blende ; Injurious effect of sulphide and sulphate sulphur on the ——. V. Lindt. Metall u. Erz, 1915, **12**, 335. Chem.-Zeit., 1915, **39**, Rep., 456.

IN the reduction of roasted zinc blende of low sulphur content (2—3 %), sulphide-sulphur acts injuriously when the ratio of zinc to sulphide-sulphur is less than 10 : 1, and favourably if this ratio is 18 : 1. Sulphate-sulphur is detrimental to the reduction of roasted blende containing 1—2 % of sulphide-sulphur when the ratio of zinc to sulphate-sulphur is 4 : 1 and favourable when the ratio is 5 : 1. In the case of products with a relatively high content of sulphide- and sulphate-sulphur, the sulphur acts injuriously on the reduction if the ratio of zinc to sulphide-sulphur is less than 20 : 1 or of zinc to sulphate-sulphur less than 6 : 1. The loss of zinc on reduction is higher with products, free from lead, in which the sulphide-sulphur is present entirely as iron sulphide, and in those of very low iron content or in which the iron is present entirely as zinc ferrite, than in other cases.—A. S.

Zinc smelting ; Treatment of by-products containing mercury from ——. F. Juretzka. Metall u. Erz, 1915, **12**, 307. Chem.-Zeit., 1915, **39**, Rep., 413.

ZINC blende from the Rhine district contains at times 0·005—0·01 % of mercury, probably due to an admixture of fahl-ore. When the blende is roasted the mercury vapour escapes with the gases, and when these are utilised for the manufacture of sulphuric acid, the mercury is deposited partly before reaching the Glover tower and partly in the Glover tower and in the lead chambers. Sludge from the Glover tower contains 5—8 % and that from the chambers 3—5 % Hg. The sludge is drained, mixed to a stiff paste with " lime-sand " (waste from lime burning), and then with just sufficient lime to neutralise the acid, and the mercury recovered by distillation at a dull red heat. —A. S.

Copper extraction from pyrites cinder at Pernau (Livonia). Metall u. Erz, 1915, **12**, 379. Chem.-Zeit., 1915, **39**, Rep., 444.

AT the sulphite-cellulose works of the Zellstofffabrik Waldhof, the pyrites cinder is treated for the recovery of copper by mixing with salt and roasting by the Buddeus process with compressed air (see Ger. Pat. 285,888 of 1913 ; this J., 1915, 1150). The pyrites contains 1·5 % Cu, and the mixture of pyrites cinder and salt contains 8·5—7·9 % NaCl, 1·7—2·4 % Cu, and 4·8—5·3 % S. No fuel is used, the heat of the roasting reaction being sufficient ; the charge in the furnace has a height of 6 metres. After roasting, the material contains 78·3 % of the copper as cupric chloride, 18·5 % as copper oxide, and 3·2 % as cuprous sulphide. The liquor condensed from the furnace gases consists of a mixture of sulphuric and hydrochloric acids, the latter preponderating.—A. S.

Aluminium industry E. Collett. Polyteknisk Forenings, Christiania, Dec. 16, 1915. Chem.-Zeit., 1916, **40**, 40.

THE world's production of aluminium in 1912 was 60,000 tons; for 1915 an output of 100,000 tons was anticipated, but owing to the war barely

80,000 tons was made. The present price of aluminium in Norway is 3 to 4 kr. per kilo. (1s. 6d.—2s. per lb.). Crude bauxite is now freed from silicates and impurities for the European aluminium industry in the South of France. The conditions for the production of the metal by thermo-electrolysis are particularly favourable in Norway. For the production of 1 ton of aluminium 5 h.p.-year is required. Outside Norway the cost of 1 h.p.-year is estimated at about 50 kr. (£2 15s.), or 250 kr. (£13 15s.) for 1 ton of the metal (*i.e.*, 25% of the total cost). In Norway the h.p.-year costs only 20 kr. (£1.2s.), or 10% of the total cost of production, owing to the abundance of water power.—C. A. M.

Lead from radioactive minerals; Density of ——. T. W. Richards and C. Wadsworth. J. Amer. Chem. Soc., 1916, **38**, 221—227.

THE density of ordinary lead (atomic weight 207·2), determined in a special form of pycnometer, was 11·337, whilst that of radioactive lead (atomic weight 206·3) was 11·288. Continued fractional crystallisation of the nitrate and chloride of the radioactive lead produced no change in the density of the metal.—F. SODN.

Chrome-iron ore as lining for reverberatory furnaces. E. Hall. Eng. and Min. J., 1916, **101**, 267—268.

PARTICULARS are given of the author's experience with chromite linings in reverberatory matting furnaces used for smelting basic ores containing lead, zinc, and silver. Linings composed of coarse and fine chromite made into a "concrete" with fireclay were unsatisfactory, lumps of chromite being washed out when the charge was stirred. The greatest durability—3 to 4 times that of ordinary firebrick—was obtained with a dry masonry lining constructed of large blocks of chromite bedded on a mixture of crushed chromite and blende, with which mixture the interstices between the blocks were also filled. After a few weeks' working with this lining there accumulated, between the slag and the matte, a layer of chromite sand, rich in silver, which required periodical removal to ensure efficient working of the furnace. The impossibility of smelting this product, and the saturated chromite "bottoms," in the matting furnace, formed the chief drawback to the use of chromite linings; these refractory residues could only be treated satisfactorily in a lead blast furnace of large capacity.—W. E. F. P.

Sulphides of copper. Posnjak and others. *See* VII.

Reduction of metallic oxides with hydrogen at high pressures. Newbery and Pring. *See* VII.

Electrometric titration of vanadium. Kelley and Conant. *See* XXIII.

PATENTS.

Steel; Method of superficially hardening ——. C. P. Sandberg, London. Eng. Pat. 1878, Feb. 5, 1915.

To produce a sorbitic structure superficially in carbon steel, the metal (wheel, tyre, etc.) is cooled moderately quickly, from a temperature above to one below the critical temperature, by means of a blast of air or steam; the degree of cooling is sufficient to prevent the surface of the metal from being raised to the critical temperature again by the heat remaining in the mass.—W. E. F. P.

Steel [springs, etc.]; Treatment of ——. C. P. Sandberg, London. Eng. Pats. (A) 8257 and (B) 8258, June 3, 1915. (See also Eng. Pats. 18,972 of 1914 and 1878 of 1915; preceding abstract).

(A) STEEL may be hardened throughout its mass or to varying depths by cooling it moderately quickly from a temperature above the critical range by means of an elastic fluid or vapour impinging upon its surface, to such a temperature below the critical range, that the object or the portion treated will not again be raised to the critical temperature by any heat remaining in the mass. (B) Steel is cooled moderately quickly in the manner described above by means of an atomised liquid.—W. R. S.

Cementation furnace. K. Issem, Berlin-Buchholz. Ger. Pat. 288,162, July 26, 1914.

IN the rear end of the muffle are two tubes which serve respectively as inlet and outlet for the carburising gas. By this arrangement the gas remains in the muffle for a relatively long period, and the eddying produced prevents it from becoming cooled. The resulting carburisation is extremely uniform as regards both the surface distribution and the depth of the carburised layer.—T. ST.

[Metal] articles; Casting composite ——. W. J. Mellersh-Jackson, London. From Foreign Patents Corporation, New York. Eng. Pat. 1691, Feb. 2, 1915.

IN a process for making composite articles, such as the shells of projectiles, consisting of a cast metal (steel) united to a metal of lower melting point (a copper band), the latter is heated to a temperature just below its melting point while in position in a metal mould and the molten metal then poured in. The mould consists of two parts hinged together.—W. E. F. P.

Ferrous metals; Process of uniting copper to ——. W. M. Page, Chester, Pa. U.S. Pat. 1,171,066, Feb. 8, 1916. Date of appl., June 17, 1913.

A STEEL billet is dipped into a molten bath of a copper-iron mixture low in iron, to which a deoxidiser (*e.g.*, phosphorus) has been added; this produces an adherent coating of copper-iron alloy. Substantially pure copper is then cast against the billet.—W. R. S.

Iron-nickel alloys (ferro-nickel, nickel steel); Method for the production of —— *direct from raw materials.* W. Borchers and K. Wagenmann, Aachen. Ger. Pat. 288,644, Dec. 24, 1914.

To produce ferro-nickel the raw material, *e.g.*, roasted nickel-matte, roasted nickel-speiss, or hammer- or mill-scale from the working of nickel steel, consisting for the most part of iron oxides with smaller amounts of nickel oxides, is smelted with basic material such as lime, magnesia, or calcined dolomite, and with carbon sufficient to reduce the nickel oxide, but insufficient to reduce the iron oxide present. To produce nickel steel, raw material containing the requisite amount of nickel is added to the molten iron contained in a basic furnace prior to the iron being converted into steel.—T. ST.

Retort furnaces for the recovery of volatile metals such as zinc. E. Gellbach, Hohenlohehütte, Germany. Eng. Pat. 1930, Feb. 6, 1915.

THE regenerative heating system is employed, but the direction of the flame is maintained constant in the combustion chamber of the retort furnace in order to ensure uniform heating.—W. R. S.

[Ore reduction] furnaces. W. W. Crawford, London. Eng. Pat. 2481, Feb. 16, 1915.

A CONTINUOUSLY operating oil-fired furnace using preheated air has a series of feed hoppers, each of which consists of two parts communicating with each other by means of a valve so as to permit of hermetical closing during the operation. The hoppers communicate with a series of tubular retorts, mounted in the furnace, through which the material progresses continuously, together with a reducing gas (*e.g.*, carbon monoxide) capable of being regenerated from the waste gases.—W. R. S.

Furnace; Metal-melting ——. J. and T. Burley, Birmingham. Eng. Pat. 15,994, Nov. 12, 1915.

THE furnace, for melting aluminium, brass swarf, or other metal, has a melting pot shaped and set like an ordinary "copper" and provided with a cover through which one or more vertical gas-burners project. The charge is melted from the top, and oxidation of the metal prevented, by the gas flames, the fire beneath the pot being only sufficient to maintain the metal in a molten condition.—W. E. F. P.

Tin; Electrolytic refining of ——. W. J. Mellersh-Jackson, London. From American Smelting and Refining Co., New York. Eng. Pat. 11,818, Aug. 16, 1915.

SEE U.S. Pat. 1,157,830 of 1915; this J., 1915, 1212. In preparing the electrolyte, a porous diaphragm is interposed between the anode and cathode, and the passage of the current is continued until the solution contains about 6% by weight of tin.

Tin-plate waste; Method of detinning —— by means of oxyacids of sulphur. J. Rosenthal, Berlin. Ger. Pat. 288,533, Nov. 12, 1913.

THE material is treated with concentrated sulphur oxyacids, which dissolve the tin and at the same time render the iron passive. Oxidising gases are excluded during the operation.—T. ST.

Metals from waste oils [from plating operations]; Process for the recovery of ——. M. E. Rothberg, Crafton, Assignor to Falk Co., Pittsburgh, Pa. U.S. Pat. 1,170,342, Feb. 1, 1916. Date of appl., Nov. 16, 1915.

WASTE oil or fat "from the process of plating metals with tin, lead, zinc, etc." is agitated with a quantity of mineral acid slightly in excess of that required to combine with the metals present, but of such strength as to prevent the formation of an emulsion; the acid solution is then separated from the oil and treated for the recovery of the contained metals.—W. E. F. P.

Ores; Treating ——. *Metallurgical furnace.* U. Wedge, Ardmore, Pa. U.S. Pats. 1,170,375 and 1,170,376, Feb. 1, 1916. Dates of appl., Oct. 7, 1911, and Jan. 15, 1913; both renewed July 1, 1915.

THE treatment is effected, in two stages, in a furnace of the superposed-chamber type containing an upper and a lower series of hearths connected by channels extending through an intervening combustion chamber. Air preheated by the waste gases from the lower hearths is caused to pass through the upper series in an upward direction; and the gaseous products from the combustion chamber to traverse the lower series in a downward direction.—W. E. F. P.

Ores; Process and apparatus for the electric firing of materials and ——. W. H. Hampton, New York, Assignor to The Conley Electric Furnace Co., Inc., Wilmington, Del. U.S. Pat. 1,171,117, Feb. 8, 1916. Date of appl., May 3, 1913.

THE material is carried on an endless perforated conveyor, and electrical resistance conductors are arranged over a portion of the path of travel. A continuous downward blast of air is produced by a suction arrangement on the under side of the path of travel; the air is heated by passing over the resistance conductors and then flows through the conveyor and ore.—B. N.

Aluminium; Production of ——. H. F. D. Schwahn, Belleville, Ill. U.S. Pat. 1,171,360, Feb. 8, 1916. Date of appl., June 1, 1915.

AN intimate mixture of finely divided alumina and amorphous carbon, suitable for the production of aluminium, is obtained in the form of fume by directly heating powdered aluminium sulphate with a hydrocarbon flame in a revolving container.—W. R. S.

Metals, metallic oxides and sulphides; Process for obtaining ——. H. Speketer, Griesheim. Ger. Pat. 288,282, May 19, 1914. Addition to Ger. Pat. 266,221 (this J., 1913, 1161).

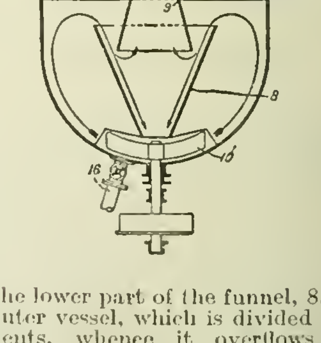
IN the production of metals, metallic oxides, or sulphides by heating a mixture of ore or the like and reducing agent in a rotary furnace (*loc. cit.*), the latter is connected to a long, narrower tube in which the ore or the like, without admixture of reducing agent, is strongly preheated by the waste gases from the rotary furnace. The preheated ore then falls into the rotary furnace where it is mixed with reducing agent and the process completed. —A. S.

Copper; Treatment of lead- or zinc-containing copper ores, smelting products, dross, industrial waste, etc., for recovery of ——. E. Schmidt, Berlin-Reinickendorf. Ger. Pat. 288,283, June 17, 1914.

THE material is melted in a blast-furnace, and the molten metal made to fall in drops through a hot oxidising gas-stream into a reverberatory furnace. The hot oxidising gases, which serve also to heat the reverberatory furnace, deprive the falling metal so completely of the lead and zinc, which at this stage are still retained in considerable quantity, that the metal collecting in the reverberatory furnace is pure enough after a short treatment to be cast into anodes or ingots. The gases from the blast and reverberatory furnaces are united for the recovery of lead and zinc.—T. ST.

Fine ores; Treatment of —— by flotation. Hernádvölgyi Magyar Vasipar Részvény-Társasag, Budapest. Ger. Pat. 288,390, Dec. 18, 1913.

A MIXTURE of ore, water, and, if necessary, oil and acid, is charged into the closed vessel (see fig.) through the tube, 5, and is forced by the agitator, 10, from the lower part of the funnel, 8, outwards into the outer vessel, which is divided into radial compartments, whence it overflows into the funnel, 8. In the upper part of the funnel, the mixture has a considerably diminished velocity, and the oil-coated particles tend to rise in the tube, 9. Compressed air is introduced through the valve, 13, and exerts sufficient pressure on the upper surface of the mixture in the funnel, 8, to cause the level of the liquid in the tube, 9, to rise so that the oil-coated particles overflow into the launder, 14. Oil is admitted as required through



the valve, 15. When the separation is complete, the supply of compressed air is stopped, and the tailings are discharged through the pipe, 16.—A. S.

Lead coatings; Methods for increasing the mechanical resistance of soft —— of vessels. F. Schüler, Frankfort. Ger. Pats. (A) 288,571, Mar. 28, 1914, and (B) 288,572, Sept. 3, 1914.

(A) The lead coating is softened by a blowpipe flame and small pieces of metals harder than lead are worked in by kneading, pressing, or rolling. To ensure good contact with the lead, the metallic fragments are first scrubbed, and then protected from oxidation by being coated with a material which is later driven off by heat. (B) Fragments of natural or artificial stones, which are harder than lead, are worked into the softened lead coating, or are mixed with the molten lead before this is applied to the vessels to be coated.—T. St.

Chrome-nickel steel for armour plates, projectiles, etc.; Manufacture of ——. Comp. des Forges et Aciéries de la Marine et d'Homécourt. Fr. Pat. 477,625, June 23, 1914.

See Eng. Pat. 16,687 of 1914; this J., 1915, 286.

Copper on iron and steel; Production of adherent coatings of ——. S. O. Cowper-Coles. Fr. Pat. 477,073, Oct. 31, 1914.

See Eng. Pat. 25,393 of 1913; this J., 1914, 793.

Smelting materials containing zinc or other volatile metal; Process of ——. J. M. Hyde, Berkeley, Cal., U.S.A. Eng. Pat. 2221, Feb. 11, 1915. Under Int. Conv., Feb. 13, 1914.

See U.S. Pat. 1,118,012 of 1914; this J., 1915, 36.

Zinc ores; Process of smelting ——. J. M. Hyde. Fr. Pat. 477,646, Feb. 10, 1915.

See U.S. Pat. 1,118,012 of 1914; this J., 1915, 36.

Zinc: Apparatus for electrolytic production of ——. M. Perreur-Lloyd, Boulogne, France. Eng. Pat. 4681, Mar. 25, 1915. Under Int. Conv., May 28, 1914.

See Fr. Pat. 472,764 of 1914; this J., 1915, 497.

Detinning; Process of ——. F. von Kügelgen, Holcombs Rock, Va., and G. O. Seward, Jersey City, N.J., Assignors to Columbia-Knickerbocker Trust Co. Reissues Nos. 14,070 and 14,071, Feb. 15, 1916 (dates of appl., Aug. 27, 1907, and Oct. 30, 1915) of U.S. Pat. 851,946, Apr. 30, 1907.

See this J., 1907, 619.

Ore concentration. A. H. Higgins, Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pat. 1,170,637, Feb. 8, 1916. Date of appl., Aug. 31, 1915.

See Eng. Pat. 19,855 of 1914; this J., 1916, 184.

Ore; Concentration of ——. E. H. Nutter, San Francisco, Cal., Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pat. 1,170,665, Feb. 8, 1916. Date of appl., Aug. 31, 1915.

See Eng. Pat. 19,856 of 1914; this J., 1916, 184.

Minerals; Concentration of —— by flotation. New Jersey Zinc Co. Fr. Pat. 476,655, Dec. 5, 1914.

See U.S. Pat. 1,156,041 of 1915; this J., 1915, 1151.

Ores; Treatment of ——. O. C. Rudolph, London, Assignor to O. Stalmann, Salt Lake City, Utah. U.S. Pat. 1,171,255, Feb. 8, 1916. Date of appl., Dec. 16, 1914.

See Eng. Pat. 29,156 of 1913; this J., 1915, 142.

Sulphide and oxide ores; Treatment of —— to extract copper, lead, and zinc. W. Borchers and W. Menzel. Fr. Pat. 476,878, July 20, 1911.

See Ger. Pat. 275,904 of 1913; this J., 1914, 870.

Roasting pyrites or the like in shaft furnaces. Ger. Pat. 288,322. *See* VII.

Preparation of a mixture of sodium sulphite and hydroxide for precipitating zinc from solutions. Ger. Pat. 288,498. *See* VII.

XI.—ELECTRO-CHEMISTRY.

Transport numbers in non-aqueous solutions. A. N. Sachanov and A. M. Grinbaum. J. Russ. Phys.-Chem. Soc., 1915, 47, 1769—1789.

The authors have measured, at the ordinary temperature, the transport numbers in aniline (dielectric constant, 6·85) and in mixtures of aniline with pyridine containing (*a*) 80 vol. % of the former (8·0) and (*b*) 50 vol. % (9·7). The results obtained, together with those of previous investigators, show that in the aniline-pyridine mixtures and also in pyridine (12·56) or acetonitrile (35·8), the transport number for silver diminishes as the concentration increases; for one and the same concentration, the transport number diminishes with diminution of the dielectric constant of the solvent. In aniline, on the other hand, the transport number increases as the concentration increases from V=5 to V=1. These results are explained on the assumption of the formation of complex anions, $Ag(NO_3)'_2$, and complex cations, $(AgNO_3)^{\cdot}$.—T. H. P.

Arcs in gases between non-vaporising electrodes. Mackay and Ferguson. *See* IIb.

Electrochemical experiments with organic arsenic compounds. Fichter and Elkind. *See* XX.

Patents.

Air; Apparatus for electrically treating ——. Method and apparatus for making ozone. W. T. Hoofnagle, Glen Ridge, N.J., Assignor to Electro-Chemical Products Co., New York. U.S. Pats. (A) 1,169,824 and (B) 1,169,825, Feb. 1, 1916. Dates of appl., Apr. 23, 1915.

(A) A reaction chamber is provided with means for opening and closing it at intervals, in order to admit and confine successive charges of the air, or other gas, to be treated, and by the aid of a relay switch an electric current is passed through the closed chamber. The current is cut off by an arrangement controlled by the change in pressure brought about by the chemical change in the substance treated, the arrangement comprising a pressure gauge connected to the chamber, a contact member moved by the gauge, and an adjacent member moving backwards and forwards with the contact member. The two members have contact surfaces adapted to engage in one direction of movement only with a switch, for interrupting the flow of the current through the chamber. (B) Air is drawn in a rarified state through a reaction chamber, provided with inlet and outlet openings, the flow being rapidly checked and then released in one of the pipes, so as to cause surging of the air. Rapid expansion and compression of the air are thus produced whilst it is passing through the chamber, and an electric current is passed through the air.—B. N.

Synthetic and chemical substances; [Electrical] apparatus for use in producing ——. J. R. Watson, Baltimore, Md. U.S. Pat. 1,169,893, Feb. 1, 1916. Date of appl., Jan. 25, 1915.

A seamless retort, disposed horizontally, is provided with extensions forming end journals, one of which is bored to form a mouth; the latter is sealed by a device which opens when a certain pressure is exceeded in the retort, so as to relieve the excess pressure. The retort is heated electrically, the heating means being controlled by a circuit governed thermostatically by an arrangement co-operating with the other end journal, so as to vary the supply of current according to the temperature of the retort. Means are provided for rotating the retort, which is supported by the end journals in bearings on a frame.—B. N.

Anti-cathode for Röntgen-ray tubes. M. Gundelach, Gehlberg, Germany. U.S. Pat. 1,170,247, Feb. 1, 1916. Date of appl., Apr. 21, 1915.

The anti-cathode consists partly or entirely of uranium.—B. N.

Electrolysis; Apparatus for —— with horizontal cathode. G. Herfeldt, Plaidt. Ger. Pat. 288,224, Apr. 13, 1913.

The cathode rests loosely on bars and supports the device by which the gas is led away into a side chamber. The bars are held in place by set screws and can be raised and lowered. The opening in the partition between the electrolysing chamber and the side chamber is at the level of the cathode-diaphragm system and is sufficiently wide to allow this to be drawn through. A similar opening, which can be closed, is provided in the outer opposite wall of the side chamber, to allow of the complete withdrawal of the cathode-diaphragm system. The device for leading off the gas consists of half-tubes, arranged side by side on the cathode, with the open sides facing upwards and downwards alternately; those facing upwards support the edges of adjacent half-tubes facing downwards, distance-pieces being interposed to allow of free circulation. Alternatively S-shaped tubes, connected with one another in the same way as roofing tiles, may be used.—A. S.

Electrical separation of bodies in suspension in insulating fluids, especially in gases. E. Möller. Fr. Pat. 476,976, July 22, 1914.

See Ger. Pat. 282,737 of 1913; this J., 1915, 703.

Electric furnaces; Process and apparatus for producing flow in the molten mass in ——. Elektrochem. Werke G.m.b.H. Fr. Pat. 476,998, July 22, 1914.

See Eng. Pat. 17,426 of 1914; this J., 1915, 712.

Process for electrolytically reducing or oxidising organic substances. Eng. Pat. 15,750. *See* XX.

XII.—FATS; OILS; WAXES.

Linseed oil and linolenic acid; Formation of acrolein by the oxidation of ——. A. H. Salway. Chem. Soc. Trans., 1916, **109**, 138—145.

When linolenic acid or the fatty acids of linseed oil absorb oxygen, acrolein is one of the volatile substances formed, but no trace of this substance is produced when oleic acid is oxidised. The formation of acrolein is difficult to explain if there are two stereoisomeric linolenic acids having the formulæ suggested by Erdmann, Bedford, and Raspe (this J., 1909, 531; see also Rollett, this J., 1909, 1210), but if linolenic acid contains the grouping R.CH : CH.CH : CH.CH : CHR′, no such difficulty is encountered. The acid first absorbs oxygen with the formation of an oxygenide, and since the central point of unsaturation should be relatively stable, there is a tendency to form the dioxygenide; this would decompose with the formation of a mixture of aldehydes, including acrolein, and carbon monoxide and dioxide. Glycerol, when treated with oxygen, does not yield acrolein. In the drying of linseed oil it is probable that the glyceride of linolenic acid is oxidised in the stages mentioned above; the mixture of aldehydes then polymerises and forms, with the unchanged part of the oil, the well-known elastic varnish. In experiments carried out with linseed oil, linseed oil fatty acids, and linolenic acid, these were separately treated at 100° C., with successive quantities of oxygen under a pressure of 2 atmospheres and the gaseous products were collected in water; the acrolein was identified and its quantity determined by converting it into silver acrylate. The following amounts of the latter were obtained:—From 100 grms. of linseed oil, 0·370 grm.; 100 grms. of linseed oil fatty acids, 0·510 grm.; 100 grms. of linolenic acid, 0·340 grm. Oleic and linolic acids did not yield acrolein under the conditions of the experiments.—W. P. S.

Linolic acid; Glycerides of —— A. Grün and H. Schönfeld. Z. angew. Chem., 1916, **29**, 37—39, 46—48.

It appears very probable that in many drying oils, linolic acid is combined with saturated acids in the form of mixed glycerides, and the authors have synthesised such mixed glycerides with a view to compare them with products from drying oils. Linolic acid was prepared from poppy-seed oil by Rollett's method (this J., 1909, 1209), and purified by fractional distillation of its methyl ester *in vacuo*. The potassium salt was obtained as a white crystalline substance, easily soluble in alcohol, less soluble in water. By the action of αα-dichlorohydrin on this salt, αα-dilinolin was prepared, but only in poor yield. It was identified by conversion into its octabromide (αα-di-tetrabromostearin), m.pt. 71° C. The diglyceride may also be obtained by the interaction of αα-dichlorohydrin and the potassium salt of linolic acid tetrabromide (9.10.12.13-tetrabromostearic acid), the bromine being eliminated from the resulting αα-di-9.10.12.13-tetrabromostearin by the action of potassium iodide in ethyl acetoacetate solution. Mixed glycerides of linolic acid with stearic and palmitic acids were prepared by treating diglycerides of the saturated acids with linolic anhydride. The latter was obtained by heating linolic acid with acetic anhydride in a sealed tube for 4 hours at 140°—150° C., distilling off the acetic acid and excess of acetic anhydride *in vacuo*, and purifying the linolic anhydride by dissolving in absolute alcohol and precipitating with 96% alcohol. α-Linolo-α′β-distearin melts at 33·5°—34° C., β-linolo-αα′-distearin at 41°—42° C. (m.pt. after solidification, 36° C.). α-linolo-α′β-dipalmitin at 11·5°—13° C., and β-linolo-αα′-dipalmitin at 28°—29° C. The mixed glycerides of linolic acid melt at a lower temperature and are more soluble in organic solvents than the corresponding compounds of oleic acid.—A. S.

Gynocardia and chaulmoogra oils and gynocardic and chaulmoogric acids. M. A. Rakuzin and G. D. Flier. J. Russ. Phys.-Chem. Soc., 1915, 47, 1848—1851.

Gynocardia oil and chaulmoogra oil have often been confused, and investigation of products sold as gynocardia oil and gynocardic acid showed that these were actually chaulmoogra oil and chaulmoogric acid; the latter have the specific rotations +51·8° and +55·5° respectively (see Chattopadhyay, this J., 1915, 1102; Power,

1915. 1214), whereas the gynocardia products are inactive. The healing properties in cases of leprosy probably belong to chaulmoogric and not to gynocardic acid. With chaulmoogra seeds the width is one-half of the length, and hydnocarpus seeds possess eight obtuse angles. The latter were formerly known as vegetable mercury, being regarded as of value in cases of secondary syphilis.—T. H. P.

Alfalfa seed oil : Constants and composition of ——. C. A. Jacobson and A. Holmes. J. Amer. Chem. Soc., 1916. **38,** 480—485.

Crushed alfalfa seeds on extraction with gasoline yielded 9·47 % of a drying oil, resembling safflower oil, of sp.gr. 0·9117 at 24°/4°C., and 0·9149 at 24°/24 C., saponif. value. 172·3, iodine value 154·2, acid value 2·85, acetyl value 19·8, Reichert-Meissl value 0·10, unsaponifiable matter 4·4 %, glycerol 1·97 %. The oil contains 92·5 % of insoluble fatty acids having the following constants : neutralisation value 191·5, mean mol. wt. 293, sap. value 189·9, iodine value 169·5; these consist of 90·4 % of liquid acids containing oleic, linolic, and linolenic acids, and 9·6 % of solid acids containing carnaubic, daturic, and possibly behenic acids. —T. C.

Coula edulis and Limonia warneckei from tropical Africa ; Oil fruits of ——. H. Wagner and J. B. Lampart. Z. Unters. Nahr. Genussm., 1915. **30,** No. 6. Bull. Agric. Intell., 1915, **6,** 1634—1635.

Coula edulis :—The kernels from the nuts, from Kamerun, yielded 30·48 % of a brownish-yellow fat with the following characters :—Sp.gr. at 25° C., 0·9116 ; refractometer reading at 40° C., 51·2 ; acid value, 18·41 ; saponif. value, 189·7 ; iodine value (Hübl), 83·36 ; Reichert-Meissl value, 0·38 ; Polenske value, 0·32 ; iodine value of liquid fatty acids, 89·5 ; and unsaponif. matter, 0·16 %. The liquid fatty acids consisted in the main of oleic acid. The seeds, after removal of moisture and fat, contained 2·47 % crude fibre and 1·92 % nitrogen. *Limonia warneckei* :—The fruit of this plant, now known as *Afraegle paniculata*, Schumach, came from Togo. The seeds contained 6·75 % crude fibre and 2·6 % nitrogen, and yielded 38·5 % of a yellow fat with a bitter taste. It had the following characters :—Refractometer reading at 40° C., 47·7 ; m.pt. 32·4° C. ; solidif. pt., 21·5° to 21·0° C. ; acid value, 7·34 ; saponif. value. 188·8 ; iodine value (Hübl), 75·2 ; Reichert-Meissl value, 0·55 ; Polenske value, 0·55 ; iodine value of fatty acids, 80·47 ; iodine value of liquid fatty acids, 94·88. The free fatty acids and solid fatty acids consisted chiefly of palmitic acid.—C. A. M.

Oils : Hydrogenation of —— *in presence of nickel borate.* H. Schönfeld. Z. angew. Chem., 1916, **29,** 39—40.

Bosshard and Fischli (compare this J., 1915. 1079), on the basis of an experiment with oleic acid, have stated that in the hydrogenation of oils in presence of nickel borate, catalytic action comes into play only after the borate is decomposed. The author points out that his conclusions in regard to the favourable action of nickel borate as catalyst referred only to neutral fats and that he was aware of the decomposition of nickel borate by free fatty acids (see Seifensieder-Zeit., 1914, **41,** 945). In Bosshard and Fischli's experiment, the activity diminished with increasing decomposition of the catalyst, and this confirms the author's contention that nickel borate is a more effective hydrogen-carrier than the mixture of nickel and nickel oxide (with boric acid) formed by its decomposition. In many cases hardened fats (especially from marine animal oils) produced with the aid of nickel or nickel oxide contain more nickel than those prepared with the aid of nickel borate. (Compare also Erdmann and Rack, and Normann ; this J., 1915, 722.)—A. S.

Wijs' iodine solution ; Preparation of ——. S. Ueno. J. Chem. Ind., Tokyo, 1916, **19,** 1—30.

Although the proportions of iodine (7·14 grms.) and iodine trichloride (39·36 grms.) per litre adopted by Holde, by Ubbelohde, and by Marcusson have been shown by Dubovitz (this J., 1915, 305) to be wrong, the author finds that the solution containing such excess of chlorine gives iodine values practically identical with those obtained with a " normal " solution. The iodine values given by an old Wijs' solution are somewhat too low. A large excess of chlorine in the solution gives too high values, which however, tend to become normal after the solution has been kept for a few days. A moderate excess of iodine in the solution has practically no effect on the results. The iodine value of Chinese and Japanese wood oil determined by Wijs' solution is lower than normal, but the usual values may be obtained by prolonging the absorption. Wijs' solution turns reddish-brown when mixed with wood oil. Determination of the halogens in the iodo-chloride of the fatty acids of wood oil showed that more chlorine is absorbed than corresponds to the formula ICl. The slowness of the absorption of old iodine solutions by wood oils is as pronounced in the dark as in the light.—C. A. M.

[Fatty] oils ; New delicate method of analysing ——. A. Mazzaron. Staz. Sperim. Agrar. Ital., 1915, **48,** 583—594. Bull. Agric. Intell., 1915, **6,** 1700—1701.

When oils are treated with strong sulphuric acid for the measurement of the rise of temperature, according to Tortelli's test (this J., 1904. 668), evolution of sulphur dioxide invariably occurs. This observation forms the basis of a new analytical constant for characterising fatty oils of various origins. The sulphur dioxide value is expressed as the number of c.c. of *N*/10 iodine solution reduced by the sulphur dioxide evolved by 20 c.c. of the oil when treated with 5 c.c. of pure sulphuric acid, sp.gr. 1·8417. The following values are given for various oils tested at 20° C.:—Olive, 2·4 ; sesamé, 49·5 ; cottonseed, 137·5 ; maize, 65 ; soya, 223 ; colza, 15 ; earthnut, 7. A number of samples of olive oil of Italian origin, with which the rise of temperature varied from 42·2° to 46·1°, gave sulphur dioxide values ranging between 2·1 and 2·6. Owing to the very considerable difference between the sulphur dioxide value of olive oil and those of other oils commonly used for adulteration, this new constant should prove of service in detecting such adulterations.—J. F. B.

Soaps ; Reducing power of ——. W. Schrauth. Seifensieder-Zeit., 1915, **42,** 369. Chem.-Zeit., 1915, **39,** Rep., 474.

In the preparation of soaps containing oxygen-yielding substances or mercury compounds for therapeutic purposes, the reducing power of the soap basis is often a disturbing factor. Only beef tallow, coconut oil, palm-kernel oil, or castor oil should be used in the manufacture of soaps designed for the purposes mentioned.—A. S.

Patents.

Organic [fatty] compounds : Reduction of ——. E. B. Higgins, Wallasey. U.S. Pat. 1,170,814, Feb. 8, 1916. Date of appl., May 15, 1913.

See Eng. Pat. 23,377 of 1912 ; this J., 1913, 989.

Extracting oil, juice, and other liquids, and for moulding plastic substances ; Machine for ——. G. R. Schueler. Fr. Pat. 477,046, Jan. 6, 1915.

See Eng. Pat. 501 of 1914 ; this J., 1915, 237.

Soap. I. Leiser. Fr. Pat. 477,001, July 22, 1914. See Eng. Pat. 17,461 of 1914: this J., 1915, 878.

Combination of two stills for the distillation of tar, mineral oils, or oils and fats. Ger. Pat. 288,702. *See* III.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Rosin in driers; Detection of ——. E. W. Boughton. U.S. Bureau of Standards, Technol. Paper No. 66. J. Franklin Inst., 1916, 181, 267.

Rosin in driers may be detected by means of the following tests:—(1) The Liebermann-Storch reaction (see Storch; this Journal, 1888, 136). (2) 0·2 grm. of the mixture of unsaponifiable matter, fatty acids, and rosin acids separated from the drier is treated with 5 c.c. of 97% alcohol. In the presence of rosin a pronounced turbidity is obtained, but the test will not detect rosin in presence of small amounts of kauri resin. (3) 1 grm. of the mixture of fatty and rosin acids is treated with absolute alcohol and concentrated sulphuric acid (Wolff's method; see this J., 1914, 363), and the acid value due to unesterified acids is then determined: if it exceeds 10, the presence of rosin is indicated. The test will detect rosin in proportions amounting to 6% of the ash-free non-volatile constituents of the drier.—C. A. M.

Formation of acrolein by the oxidation of linseed oil and linolenic acid. Salway. *See* XII.

Patents.

Pigments containing copper; Production of ——. "Siegwerk" Chem. Laboratorium, Siegburg. Ger. Pat. 287,149, Jan. 9, 1912.

Suitable pigment dyestuffs or organic lakes are treated with alkaline copper solution until no further alteration in colour occurs.—F. W. A.

Resilient composition for printer's rollers. Usher-Walker, Ltd., and C. E. Sohn, London. Eng. Pat. 2167, Feb. 10, 1915.

Glue soaked in water and glycerin is heated with aldehydes, or compounds formed by the condensation of an aldehyde with an amine, and the mixture run into moulds of the desired shape. Formaldehyde and aniline or *o*-toluidine, or a cyclic aldehyde, such as furfural, or furfuramide, or caramel, or caramel mixed with furfural or furfuramide, may be employed, and where the compound is insoluble, it is previously mixed into a cream with glycerin, or water, or a mixture of these.
—B. N.

Plastic materials; Production of solid ——. K. Hagendorf, Baufelde, and A. Breslauer, Berlin-Halensee. Ger. Pat. 288,347, May 20, 1914. Addition to Ger. Pat. 274,179 (this J., 1914, 838).

Albumin solution or blood serum is evaporated with 25% formic acid and heated with phenol, trioxymethylene, or formaldehyde solution, sodium sulphite, and alkali until a solid product is formed. In presence of an excess of alkali, the condensation is complete, and very hard, brittle, transparent products are obtained suitable for moulding.
—F. W. A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber of Hevea brasiliensis; Oxidisability of ——. M. Kerbosch. Mededeel. over Rubber, 1914, No. III., 16—40. Bull. Agric. Intell., 1915, 6, 1703—1704.

Experiments in Java on the oxidisability of *Hevea* rubber under the influence of sunlight and of diffused daylight gave the following results:—Rubber prepared by evaporation of the latex resists oxidation better than that prepared by coagulation. The difference is due to the presence in the former of certain unidentified soluble constituents of the latex. The oxidisability of the rubber is not affected by the presence of quebrachite. The superiority of the Brazilian method of coagulation is probably due chiefly to the retention of the soluble constituents mentioned above, and not to the smoking operation.—A. S.

Caoutchouc and its homologues; New syntheses of ——. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, 47, 1910—1915.

Much of the work published since 1911 on the polymerisation of the diolefines is inaccurate and many of the patents useless. In the succeeding papers the author describes: (1) peculiar processes of isomerisation of two different forms of isoprene-caoutchouc, and (2) methods for the catalytic polymerisation of diolefines, both to normal caoutchoucs, *i.e.*, of equal value to the natural caoutchoucs, and also to abnormal caoutchoucs; these methods give nearly or quite quantitative yields.—T. H. P.

Erythrene-caoutchouc; Synthesis of the symmetrical bromide of ——, of the caoutchouc itself, and of caouprene. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, 47, 1915—1927.

Caouprene bromide is identical with the symmetrical bromide of erythrene-caoutchouc. Removal of hydrogen bromide from either caouprene bromide or the unsymmetrical bromide of erythrene-caoutchouc yields dehydrocaouprene, $C_{32}H_{48}Br_{16}—16HBr = C_{32}H_{32}$, and a homologous compound, $C_{32}H_{24}(CH_3)_8$, is similarly obtained from the bromide of natural Para caoutchouc, $C_{32}H_{40}(CH_3)_8Br_{16}$. Cryoscopic determination of the molecular weight of the readily soluble modification of caouprene bromide (α) in ethylene bromide gives the value 1809, in agreement with the above formula. When forced through a capillary dipping into alcohol or glacial acetic acid, the unsymmetrical bromide of erythrene-caoutchouc or caouprene bromide in concentrated solution is precipitated as a continuous white thread, but this exhibits little strength and no silky lustre. Caouprene bromide is regarded as having the structure,

$$\begin{array}{l} \mathrm{CHBr.[CH_2.CHBr]_7CH_2} \\ \dot{\mathrm{C}}\mathrm{H_2.[CHBr.CH_2]_7\,\dot{C}HBr.} \end{array}$$

Reduction of caouprene bromide by means of zinc dust yields erythrene-caoutchouc and, in greater or less proportion, the isomeric caouprene, $C_{32}H_{48}$. Caouprene is transparent and forms either a viscous liquid or an amorphous, elastic mass; on dry distillation it yields carbon and hydrogen almost quantitatively, and when heated at 60°—70° C. with benzoyl peroxide is converted into normal erythrene-caoutchouc. It was ozonised in chloroform solution but decomposition of the ozonide with water gave no definite product; its tetrabromide and dihydrochloride were prepared. The action of zinc dust on the unsymmetrical bromide of natural or synthetic caoutchouc in presence of alcohol gives the free caoutchouc, $C_{32}H_{48}Br_{16} + 8Zn = 8ZnBr_2 + C_{32}H_{48}$. This reaction has been used for the recovery of rubber from the bromide of Para caoutchouc.—T. H. P.

Natural caoutchouc; Synthesis of —— by way of β-myrcene. I. I. Ostromyslenski and F. F. Koschelev. J. Russ. Phys.-Chem. Soc., 1915, 47, 1928—1931.

Cautious heating of isoprene at 80°—90° C. yields an open-chain, myrcene-like hydrocarbon, $C_{10}H_{16}$, which contains three ethylenic linkings, two of them in conjugated positions, and is termed β-myrcene. This hydrocarbon is a colourless, mobile liquid, soluble in all the ordinary organic solvents ; it boils at 63°—63·5° C. under 20 mm. and at 58° C. under 13 mm. pressure, and has the sp.gr. 0·8472 at 20°/4° C. and $n^{20}_{D} = 1{\cdot}53681$. When heated at 60°—70° C. with sodium and barium peroxide, β-myrcene is converted quantitatively into normal isoprene-caoutchouc, whereas under similar conditions isoprene gives an abnormal caoutchouc. The most probable constitution for β-myrcene is

$CH_2 : CH.C(CH_3) : CH.CH_2.CH_2.C(CH_3) : CH_2$.

Unsuccessful attempts were made to avoid the use of isoprene and to prepare the hydrocarbon by dehydration of the corresponding alcohols of the terpene series.—T. H. P.

Caoutchoucs ; Structure of ——. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1932—1936.

THE bromide of natural caoutchouc, being homologous with caouprene bromide, has a unicyclic structure, $[\cdot CH_2.CH_2.CBr(CH_3).CHBr\cdot]_x$, and since, under the action of zinc dust, it is converted readily and quantitatively into the free caoutchouc, the latter will also possess a unicyclic structure, namely, $[\cdot CH_2.CH_2 \cdot C(CH_3) : CH\cdot]_x$; the positions of the methyl groups and unsaturated linkings in this formula are established by the products of decomposition—lævulinic aldehyde and acid. In the case of normal isoprene-caoutchouc, prepared by direct heating of isoprene, the grouping of the methyl radicles and ethylenic linkings must be different from that given above, since decomposition of the corresponding ozonide by means of water gives not only lævulinic derivatives but also succinic acid and acetonylacetone. Willstätter has shown that multiple-membered, unicyclic groupings of unsaturated hydrocarbons are readily transformed into polycyclic groupings, and Harries has proposed for natural caoutchouc a structure in which such isomerisation is assumed. That both free caoutchouc and also its halogenides and hydrohalogenides possess unicyclic structures and are not polymerides of the corresponding cyclo-octadiene is, however, shown by the following facts : (1) Caoutchouc bromide and hydrobromide have the respective compositions, $C_{32}H_{40}(CH_3)_8Br_{16}$ and $C_{32}H_{40}(CH_3)_8(HBr)_8$, and not $C_{32}H_{40}(CH_3)_8Br_4$ and $C_{32}H_{40}(CH_3)_8(HBr)_2$. The action of halogens on caoutchouc is not accompanied by depolymerisation of the molecule, since erythrene-caoutchouc bromide has the molecular weight 1809, corresponding with the formula, $C_{32}H_{48}Br_{16}$, and readily regenerates the free caoutchouc when treated with zinc dust. (2) Dimethylcyclo-octadiene tetrabromide, described by Willstätter, is a crystalline compound with a sharp melting point and has no properties comparable with those of caoutchouc bromide. (3) Polymerisation of cyclo-octadiene occurs with almost explosive readiness and yields crystalline and horny compounds, but no trace of caoutchouc. On the other hand, in no case does the depolymerisation of caoutchoucs or any of their other reactions give rise to cyclo-octadiene derivatives.
—T. H. P.

Polymerisation of ethylenic compounds and mechanism of the conversion of vinyl bromide into the bromide of erythrene-caoutchouc. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1937—1941.

THE conversion of unsaturated compounds into ring compounds is completely analogous to the process of polymerisation, the molecule first undergoing decomposition into a hydrogen atom and a free radicle, the affinities of which are immediately satisfied by the double linking of the same molecule. Thus, the conversion of unsaturated compounds into cyclic compounds may be regarded as a process of intramolecular polymerisation. At the moment when the trimeride appears, the polymerisation of vinyl bromide proceeds in two directions : (1) a small part of the trimeride undergoes intramolecular polymerisation with formation of the stable, six-membered ring compound, 1.3.5-tribromocyclohexane, which is an oily liquid, b.pt. 154°—158° C. under 13 mm. pressure, and is converted into benzene when heated with quinoline, (2) the remainder of the trimeride unites with unchanged monomeride until a 32-membered chain of carbon atoms is formed, this then undergoing ring formation to form the symmetrical bromide of erythrene-caoutchouc.
—T. H. P.

Mechanism of the conversion of isoprene into caoutchouc and conversion of β-myrcene into caoutchouc. I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1941—1947.

THE discovery of the formation of β-myrcene by the author and Koschelev (*vide supra*) in the process of conversion of isoprene into caoutchouc throws light on the mechanism of this process. In the first phase, the hydrogen atom and the residual radicle from a molecule of isoprene combine at the ethylenic linking of a second molecule, giving the dimeride, β-myrcene. The latter is then converted into the trimeride, and so on, until the octameride is formed, this then undergoing "intramolecular polymerisation" to isoprene-caoutchouc. As was shown by Steimmig (this J., 1914, 267), all the polymerides of isoprene yet obtained differ from natural Para caoutchouc, since decomposition of their ozonides by water yields acetonylacetone and succinic acid in addition to lævulinic aldehyde and acid. Theoretically, β-myrcene may, like isoprene, dissociate into a hydrogen atom and a radicle in different ways, and experiment shows that, under the action of metallic sodium and barium peroxide, pure β-myrcene is converted quantitatively into normal isoprene-caoutchouc, which has an elasticity point considerably below 0° C. and coincident with that of natural caoutchouc ; on the other hand, a mixture of 90% of isoprene with 10% of β-myrcene gives, under the same conditions, a quantitative yield of an isomeric, abnormal caoutchouc, the elasticity point of which is +110° C. This polymerisation of chemically pure β-myrcene may possibly represent the only synthesis of natural caoutchouc, that is, of a substance perfectly identical with natural Para caoutchouc, both in the general structure of its nucleus and also in the positions of the methyl groups and double linkings of the molecule.

There is reason to believe that tropical plants synthesise natural caoutchouc by way of β-myrcene or myrcene-like hydrocarbons or their dimerides and not by the polymerisation of isoprene. Thus, the sap of plants frequently contains compounds with an atom-grouping like that of myrcene, such as geraniol, linalool, nerol, etc., and simple dehydration of these unsaturated alcohols would lead immediately to the corresponding myrcenes. A very close analogy exists between the polymerisation of isoprene and that of vinyl bromide. Each gives cyclic compounds of two types, one 6-membered and the other 32-membered ; the former are dipentene and tribromocyclohexane respectively, and the latter, caoutchouc and the bromide of erythrene-caoutchouc.—T. H. P.

Caoutchouc ; New method for the cold vulcanisation of ——, *by means of sulphur, or trinitrobenzene, or benzoyl peroxide.* I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1885—1892.

IT has been previously shown (this J., 1916, 58) that a mixture of a primary or secondary aliphatic amine with a metallic oxide either accelerates the vulcanisation of natural and synthetic caoutchoucs or considerably lowers the temperature of vulcanisation. Further investigation shows that, in presence of such mixtures, vulcanisation takes place at the ordinary temperature. The process is especially rapid with chemically pure caoutchoucs, such as normal erythrene- or normal isoprene-caoutchouc, obtained synthetically. After cold rolling, the mixture is left in the air or in the ordinary moulds, the vulcanisation occupying from a few weeks up to three months, according to the purity of the original caoutchouc. With natural caoutchoucs the vulcanisation requires 2—6 months at the ordinary temperature. When a homogeneous mixture of natural or synthetic caoutchouc (50 grms.), sulphur (2·5 grms.), amine (0·5 grm. of piperidine piperidyldithiocarbamate) and oxide (5 grms. of oxide of zinc, magnesium, or lead) is heated at 40°—60° C. for 10—40 minutes, it suffers no apparent change in properties, but when subsequently left in the air or in moulds it undergoes complete vulcanisation in 10—48 hours. By means of this method, vulcanising presses and autoclaves may be almost entirely dispensed with, the consumption of fuel is considerably diminished, and the percentage of waste possibly lowered. Further, since the volume changes either not at all or by a negligible amount at the ordinary temperature, the use of special metallic moulds is rendered unnecessary. The degree of vulcanisation effected in the above way is suitably measured by measuring the time required for complete vulcanisation of the original caoutchouc at 130°—145° C. Thus, it was found that, immediately after cold rolling, the above mixture was vulcanised in 15—20 minutes at 145° C.; when kept at the ordinary temperature for 23 hours (or 10 days), the time necessary at 145° C. was 8—10 (or 1—2) minutes. Vulcanisation by means of 1.3.5-trinitrobenzene or benzoyl peroxide also takes place at the ordinary temperature, no special catalyst being necessary. Oxides of zinc, magnesium, and, particularly, lead accelerate the action when the nitro-compound is used, but these oxides retard cold vulcanisation by benzoyl peroxide and also diminish the value of the vulcanised material. When trinitrobenzene is used, time is saved by preliminary heating of the mixture at 50°—60° C. or by preparing it with hot rolls, but the rolling with benzoyl peroxide must be carried out at the ordinary temperature, since otherwise a sticky mass results. Cautious heating of the mixed mass at 30°—80° C. for 10—40 seconds is also necessary in this case, but access of air must be avoided.—T. H. P.

Vulcanisation of caoutchouc; Mechanism of the action of amines and metallic oxides on the ——. [*Formation of sulphur dyestuffs.*] I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1892—1898.

WITH a mixture of caoutchouc, sulphur, amine, and metallic oxide, the sulphur and the amine first react with formation of the corresponding thiozonide, $2R.NH_2 + 4S = R.NH.S.S.S.NHR + H_2S$, this reaction proceeding only in presence of a catalyst such as an oxide. The unstable thiozonide then transmits its sulphur to the caoutchouc, the amine being regenerated, or the aminic residue, under the influence of the oxide, uniting with a fresh portion of sulphur to give thiozonide. Thus, the process is one of double catalysis: the metallic oxide catalyses the formation of the thiozonide of the amine, which, in its turn, accelerates the formation of the caoutchouc thiozonide and so catalyses the vulcanisation. Only primary and secondary amines give thiozonides and these are also the only amines which catalyse the vulcanisation of caoutchouc. Thiozonides of aromatic amines, which are formed according to the equations,

(1) $2C_6H_5.NH_2 + 4S = C_6H_5.NH.S.S.S.NH.C_6H_5 + H_2S$, and

(2) $C_6H_5.NH.S.S.S.NH.C_6H_6 = NH_2.C_6H_4.S.S.S.C_6H_4.NH_2$,

are relatively stable compounds and should, therefore, be incapable of functioning as sulphur-carriers; an explanation is thus afforded of the observation that aromatic amines have practically no catalysing action on the vulcanisation of caoutchouc. From Bernstein's observation (this J., 1913, 919) that the ordinary vulcanisation of caoutchouc proceeds at the ordinary temperature under the action of ultraviolet light, it is concluded that, in absence of air, this light activates sulphur by converting it into thiozone; the vulcanisation is then effected partly by the latter and partly by the ozone formed simultaneously. It is shown experimentally that thiozone is also formed when ordinary yellow sulphur is dissolved in a primary or secondary aliphatic amine, such as piperidine with a side chain, and the solution either heated for 20—50 minutes with lead oxide in a reflux apparatus on a water-bath or left at the room temperature. If, as Erdmann supposes (this J., 1908, 934), sulphur dyes are either stable thiozonides or products of their decomposition, condensation, etc., the presence of a mixture of amine and oxide should lower the temperature of formation of these dyes almost to the ordinary temperature or should accelerate their formation at higher temperatures. Such a mixture should cheapen and simplify the production of some of these dyes and should lead to the isolation of a new series of ozonides unobtainable at the higher temperatures and with prolonged heating.—T. H. P.

Vulcanisation of caoutchouc; New method for the —— *by means of halogen compounds. Mechanism of vulcanisation.* I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1898—1904.

IN the formation of vulcanite-like substances by the action of bromine, iodine, or iodine bromide on caoutchouc, the first phase of the change undoubtedly consists in the formation of the caoutchouc halogenide, the unchanged caoutchouc then absorbing this new compound or forming a swollen mass with it. It is, indeed, found that this process may also be carried out by treatment of the caoutchouc with its halogenide; the latter acts when either freshly-prepared or old. All three halogenides of either natural or synthetic caoutchouc may be employed. Caouprene chloride or bromide exerts a similar action on caoutchouc, the products obtained from the chloride being especially valuable in view of their great stability and relatively low elastic point, and of the fact that they are easily obtained in a chemically pure condition. The amount of caoutchouc used need not exceed 7—10 parts per 100 parts of caouprene chloride, the cost of the ebonite obtained being considerably reduced. Similar vulcanisation is effected by the action of the hydrochloride of natural caoutchouc, but not by that of aluminium chloride. The products obtained by the above methods have the black colour of ordinary ebonite, are electrical non-conductors, may be scratched with the nail, keep well even in moist air, and take a high polish.—T. H. P.

Vulcanisation of caoutchouc; New method of —— *by molecular oxygen, ozone, or ozonides of organic compounds.* I. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1904—1909.

THE action of ozone in vulcanising caoutchouc depends on the preliminary formation of the caoutchouc ozonide. The ready-formed ozonide has, indeed, an effect similar to that of ozone, both soft and horny resins being formed; the course of the process is determined most of all by the concentration of the vulcanising compound. When caoutchouc is exposed in an atmosphere of dry air to the ultraviolet rays of a quartz mercury lamp, it undergoes gradual vulcanisation, increasing in weight at the expense of the oxygen: at 40°—80° C. this process takes place fairly rapidly but at 120° C. no vulcanisation occurs. Vulcanisation of caoutchouc by means of its ozonide takes place under the same conditions as vulcanisation by benzoyl peroxide (this J., 1916, 59). In presence of moisture, chemically pure caoutchouc activates molecular oxygen and thus behaves like most of the terpenes. Thus, moist isoprene- (or erythrene-) caoutchouc of the normal series, when left in the air at the ordinary temperature, gradually becomes covered with a layer of new, less elastic substance, this process being analogous to the drying of vegetable oils. If normal erythrene-caoutchouc, coated in this way, is passed between cold rolls to render it as homogeneous as possible, and then heated in the ordinary way in absence of air, the unchanged caoutchouc undergoes vulcanisation; if, however, this surface is first removed, vulcanisation does not take place. It is evident that this layer, consisting of a product of the action of atmospheric oxygen on the caoutchouc, constitutes the vulcanising substance. The vulcanisation of caoutchouc by its halogenides or ozonides is a purely physical process and is comparable with the formation of celluloid; the latter process may, indeed, be regarded as vulcanisation of cellulose esters by camphor, etc. The large number of known vulcanising agents indicates that the chemical nature of these plays no determining part. All these agents form colloids with the caoutchouc and it is by these colloids that vulcanisation is effected.—T. H. P.

Vulcanised caoutchouc, coloured with organic pigments; Preparation of ——. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, 47, 1993—1995.

Since organic pigments readily decompose at a high temperature, especially in presence of sulphur, the author's method of vulcanisation at the ordinary temperature in presence of sulphur, an amine, and an oxide is of especial value in the manufacture of caoutchouc articles coloured with such pigments. Some of the latter are not decomposed when heated either at a comparatively low temperature or even at the temperature of ordinary vulcanisation provided that this is maintained for only a short time; in such cases the author's process permits of the acceleration of the vulcanisation or of the lowering of the temperature employed. Experiments were made with Eosin, Erythrosin, Alkali Blue, and cinnamylidenefluorene. Preliminary tests show that, when mixed with caoutchouc, magnesium oxide, and sulphur, Eosin readily decomposes on heating, cinnamylidenefluorene polymerises, and Erythrosin withstands a short heating at 135° C. (10 minutes) or heating at 55° C. for some days, but is rapidly decomposed under the conditions of ordinary vulcanisation. Caoutchouc coloured with Eosin or Erythrosin leaves a coloured streak on paper. The colour obtained, which may be distributed uniformly by thorough rolling, is violet-red with Erythrosin, purer red with Eosin, blue with Alkali Blue, and yellow with cinnamylidenefluorene. In the case of Erythrosin, a mixture of 3 grms. of the dyestuff, 10 of caoutchouc, 2 of magnesium oxide, 0·8 of sulphur, and 0·2 of piperidine piperidyldithiocarbamate, after cold rolling, was completely vulcanised in iron moulds after 10 minutes at 140° C. Analogous results were obtained with the other dyestuffs mentioned.
—T. H. P.

Plantation rubber; Vulcanisation experiments on ——. B. J. Eaton and J. Grantham. Agric. Bull. Fed. Malay States, 1915, 4, 58—62.

The experiments relate to what may be termed the "ripening" process of coagulated "slab," as a result of which the rubber develops a more rapid rate of cure (see this J., 1916, 263, 264). By examining samples, cut from pressed and unpressed slab, at intervals after coagulation, the authors find, in the cases both of estate samples and samples prepared by themselves, that the rate of cure increases until the sixth or seventh day, after which little or no change takes place. The change is most rapid during the first three days.
—E. W. L.

Rubber tiles; Quality of ——. F. C. Van Heurn. India Rubber J., 1916, 51, 189—191.

The author has examined some 35 samples of tiling rubber, including a number of samples prepared *ad hoc*. On each sample the following determinations were made:—mineral matter (by incinerating and also by solution in paraffin); saponifiable constituents; acetone-soluble constituents; loss in weight by abrasion against a revolving, roughened disc. In some cases "hardness" was determined by Breuil's "Elastodurometer." Bearing in mind that the advantages of rubber as a floor covering, over other materials, are slight wear and softness combined with elasticity, the conclusion is drawn that a mixing for the purpose should contain from 20 to 30% of new rubber. Serviceable products can be obtained with much less rubber than this, but such products are of inferior value in so far as the characteristic properties of rubber floor covering are concerned. In a really high-grade article the use of factice, rubber waste, or reclaimed rubber should be excluded. The analytical results are tabulated in detail.—E. W. L.

New methods of obtaining divinyl, isoprene, piperylene, and dimethylerythrene. Ostromyslenski. *See* XX.

Conversion of cyclobutane derivatives into erythrene. Ostromyslenski. *See* XX.

Analysis, purification, and qualitative reactions of isoprene. Ostromyslenski. *See* XX.

Patents.

Plastic and like materials [*rubber*]; *Roller apparatus for masticating* ——. J. H. Nuttall, and D. Bridge and Co., Ltd., Castleton, Lancs. Eng. Pat. 22,105, Nov. 6, 1914.

Hollow masticating rollers are provided with internal longitudinal ribs projecting inwards in a radial direction. A central solid core—preferably of wood—is driven in, and longitudinal channels are thus formed on its periphery. Through these channels the cooling medium is circulated, either through all in the same direction, or by means of a special distributing head in one direction through some and in the opposite direction through others.
—E. W. L.

Rubber substitute: Process for preparing a ——. A. A. Glidden, Watertown, Mass., Assignor to Hood Rubber Co. U.S. Pat. 1,171,187, Feb. 8, 1916. Date of appl., Oct. 11, 1913; renewed July 8, 1915.

Vulcanised rubber waste is heated with an unsaturated hydrocarbon of the 1.3-butadiene series, and a quantity of a higher fatty acid—such as stearic acid—equal to 1% of the weight of hydrocarbon, in sealed vessels at 100° to 120° C. for a period of 1 to 3 weeks.—E. W. L.

Fabrics ; Process for coating —— with rubber. F. M. Seiberling. Fr. Pat. 477,719, Feb. 18, 1915.

See Eng. Pat. 1289 of 1915 ; this J., 1915, 1261.

Preparation of unsaturated alcohols. Ger. Pat. 288,271. *See* XX.

XV.—LEATHER ; BONE ; HORN ; GLUE.

Patents.

Skins and hides ; Process for softening ——. O. Röhm, Darmstadt. Ger. Pat. 288,095, Nov. 12, 1914.

The hides are steeped in an aqueous solution of the lipolytic and proteolytic enzymes of the pancreatic gland. If it be desired to preserve the hair and wool, the bath should have an alkaline reaction, but for the manufacture of leather a neutral bath is employed. The hides become soft after one day's steeping ; the fat is attacked and the flesh softened, so that it is easily removed by scraping.—J. F. B.

Glue manufacture ; Preparation of chrome-tanned leather for ——. W. Prager, Darmstadt. Ger. Pat. 287,288, Aug. 2, 1914. Addition to Ger. Pat. 257,286 (this J., 1913, 501).

The leather waste is de-tanned by heating with solutions of acid salts in presence of acids or salts having a reducing action. The reducing agent decomposes the sulphur compounds which are the cause of the dark colour of the product prepared according to the original specification.—J. F. B.

Tanning extract from waste sulphite-lye ; Production of ——. H. B. Landmark, Drammen, Norway. Eng. Pat. 7090, May 11, 1915.

See Fr. Pat. 474,336 of 1914 ; this J., 1915, 1105. Sulphuric acid may be used instead of oxalic acid for precipitating the lime.

Plastic materials from glue, glycerin, and powdered filling materials ; Process for hardening ——. J. Traube, Charlottenburg. Ger. Pat. 288,321, June 23, 1914.

The material after being moulded is immersed in water for 20—30 mins. to dissolve the glycerin in the surface layer.—F. W. A.

Resilient composition for printers' rollers. Eng. Pat. 2167. *See* XIII.

XVI.—SOILS ; FERTILISERS.

Soil ; Oxidising power of —— *in relation to de-acidification.* F. C. Gerretsen. Arch. Suikerind. in Nederlandsch-Indie. Bull. Agric. Intell., 1915, 6, 1583—1584.

The oxidising property of soil may be ascertained by treating 2 grms. of the soil for 5 mins. with an acidified 1% solution of potassium iodide, then centrifuging the mixture, and titrating the liberated iodine with $N/100$ sodium thiosulphate solution. The oxidising property of soil (expressed in mgrms. of iodine liberated per 100 grms. of soil) depends upon the iron compounds and upon the presence or absence of oxydases. The latter have been found in certain good soils, and in some cases have been found responsible for 25 to 30% of the total oxidising power. Examination of soils from different parts of Java showed that there was a relationship between the oxidising power and the growth of plants in the soil. For example, weak oxidising power was always accompanied by unsatisfactory development of sugar-cane. The iodine value has shown that de-acidification of certain soils causes a pronounced increase in the oxidising power, and in this way it is possible to estimate the degree of de-acidification. Aeration of soils in suspension by shaking frequently increases the oxidising power, and mere exposure to light and air has a similar effect on certain soils. The reaction is not given by soils free from iron. —C. A. M.

Seaweeds ; Composition and use of certain ——. J. Hendrick. J. Board Agric., 1916, 22, 1095-1107.

Seaweeds which are found growing round the coasts of the United Kingdom in sufficient abundance to be of importance from the point of view of potash supply belong to two different orders. Those growing between tide-marks and known as black wrack, bladder wrack, and cut-weed belong to the order *Fucaceæ*, whilst the seaweeds growing in shallow water below low-water mark, and known as drift weed and tangles, belong to the *Laminariaceæ*. Of the latter, *L. digitata* is by far the most important. Both kinds of seaweed contain from 70 to 85% of moisture and the average composition of the dry substance is shown in the following table :—

	L. digitata.		*L. stenophylla.*		*F. vesiculosus.*	*F. nodosus.*	*F. serratus.*
	Stems.	Fronds.	Stems.	Fronds.			
	%	%	%	%	%	%	%
Organic matter	64·03	77·28	64·73	77·76	79·71	78·39	77·56
Soluble ash	27·98	17·30	29·00	18·84	16·08	16·90	17·30
Insoluble ash	7·37	4·59	5·73	4·13	3·30	4·14	4·53
Silica	0·66	0·82	0·53	0·26	0·92	0·57	0·62
Nitrogen	1·31	1·30	1·02	1·08	1·18	1·13	1·50
In soluble ash :—							
Potash	10·49	5·25	12·35	4·49	3·07	2·52	4·18
Soda	5·35	4·24	4·91	4·91	4·51	5·78	4·85
Sulphuric acid (SO_3)	2·94	2·97	1·77	2·42	5·71	5·46	3·95
Total halogen, as chlorine	9·92	6·11	11·28	6·56	3·44	3·50	4·70
Iodine	0·54	0·38	0·32	0·29	0·04	0·09	0·05

If drift weed (*Laminaria*) was merely dried and ground it would form a manure containing about 10% of potash, 1% of nitrogen, and a considerable quantity of organic matter ; at the present price of potash, such a manure would be very valuable. *L. digitata* is also rich in iodine, the ash of the stems yielding over 33 lb. of iodine per ton, whilst the ash of the fronds yields over 40 lb. per ton. In the dry state the *Fuci* do not form nearly so rich a manure as the *Laminaria*, but at the present time it would pay to dry and burn the weed in order to obtain a potash manure ; the *Fuci* grow in abundance on many parts of the coast where no great quantity of *Laminaria* can be obtained.

The seaweed known as dulse (*Rhodymenia palmata*) is used to a small extent as human food or as a relish to food in the crofting districts of Scotland and Ireland. Cattle and sheep will eat *Alaria esculanta* and the fronds of *L. stenophylla*, but have not been observed to eat *L. digitata*. —W. P. S.

Molasses residue ; Conversion of —— into an easily-spread fertiliser. J. E. Brauer. Centralbl. Kunstdüngerind., 1915, **20**, 242—244. Bull. Agric. Intell., 1915, **6**, 1593.

In a process devised by Wilkening the molasses is mixed with peat dust and inoculated with *azotobacter*, which decomposes the betaine and causes the fertiliser to lose its stickiness. The fermented product contains about 25% water, 3·75% nitrogen, 9·75% potash, and 45% humus, and the proportion of phosphate may advantageously be increased by the addition of superphosphate. The mixed fertiliser will contain about 25% water, 3% nitrogen, 7·5% potash, 3% phosphoric acid, and 9% gypsum. Practical tests with this fertiliser have given good results. It is estimated that it will be possible to produce about 350,000 tons of the fertiliser per annum in Germany.—C. A. M.

Determination of potassium in potassium salts by the perchlorate method. Hager and Kern. *See* VII.

Formation and translocation of carbohydrates in plants. I. Carbohydrates of the mangold leaf. Davis, Daish, and Sawyer. *II. Dextrose-lævulose ratio in the mangold.* Davis. *III. Carbohydrates of the leaf and leaf stalks of the potato. Mechanism of the degradation of starch in the leaf.* Davis and Sawyer. *See* XVII.

Fungicide for use against American gooseberry mildew. Eyre and Salmon. *See* XIXb.

XVII.—SUGARS ; STARCHES ; GUMS.

Beets ; The variation of sugar-content in ——. O. Munerati, G. Mezzadroli, and T. V. Zapparoli. Staz. Sperim. Agr. Ital., 1915, **48**, 605—637. Bull. Agric. Intell., 1915, **6**, 1642—1643.

The sugar content of individual beets was determined at different stages of growth and the distribution of the sugar in the root ascertained by a series of samples taken either parallel to the axis or at right angles to it. The results showed that it is not possible to devise any rule concerning the distribution of the sugar in a single root, since in each beet the distribution is of a definite type varying more or less from that of the average. In all cases the smallest differences (rarely exceeding 0·5%) occur in the cylinders of pulp normal to the axis in the upper third of the root, below the neck. For determinations of the sugar content, the growing roots were carefully exposed on the side corresponding to one of the smooth zones between the sugar-bearing strands, and cylinders of pulp taken at right angles to the axis for immediate analysis ; the soil was replaced around the beets on the following day. Later, the roots were pulled up and again sampled by taking a cylinder of pulp below the first one. The results led to the conclusion that the changes in the sugar content of beets during growth do not follow any definite rule, since different beets reach the maximum sugar content at different times and begin to degenerate at different times. The analysis of a beet at any given time affords no criterion of its sugar content at some other period. Two beets showing an identical sugar content at the same moment may have very different values in regard to the transmission of their sugar-producing power and *vice versa.*—J. F. B.

Sugars ; Presence of reducing substances other than invert-sugar in industrial ——. L. Maquenne. Comptes rend., 1916, **162**, 277—282. (See also this J., 1915, 1263 ; 1916, 268, 320.)

The author standardised the method previously described for the determination of invert sugar in presence of sucrose, and compiled tables corresponding to different conditions of operating, *e.g.*, heating for 10 mins. at 65° C. or for 3 mins. at ebullition. The degree of accuracy possible is indicated by the results for the test mixtures of pure sucrose and invert-sugar shown in the accompanying table. In the case of commercial sugars discrepancies were always observed between the results obtained at high and at low temperatures (see table) ; the author attributes these discrepancies to the presence of substances which exert little or no reducing action at 65° C., but have an appreciable effect at higher temperatures. They may perhaps be identical with the non-fermentable reducing substances which remain in fermented molasses.—J. H. L.

	Percentage of invert sugar found by operating :	
	at 65° C.	at ebullition.
Test mixtures :—		
Sucrose +0·01% invert sugar..	0·010	0·012
„ +0·11% „ „ ..	0·109	0·111
„ +0·21% „ „ ..	0·209	0·210
Raw cane sugar	1·66	1·79
Raw beet sugar	0·084	0·096
Refined sugar	0·003	0·012
„ „ recrystallised	0·000	0·010

Indole and skatole ; Occurrence of —— [during the desaccharification of beet molasses]. E. O. von Lippmann. Ber., 1916, **49**, 106—107.

The ammoniacal vapours which are evolved during the desaccharification of beetroot molasses by the strontia process contain appreciable quantities of indole and skatole, to which they owe their fæcal odour. These substances are probably produced by the decomposition of protein matter by the alkali, and by taking advantage of their different solubilities in water and the greater volatility of skatole, their isolation in a pure condition is in most cases possible.—G. F. M.

Carbohydrates in plants ; Studies on the formation and translocation of ——. I. Carbohydrates of the mangold leaf. W. A. Davis, A. J. Daish, and G. C. Sawyer. J. Agric. Sci., 1916, **7**, 255—326. (See also this J., 1916, 201.)

The formation and translocation of the sugars in the mangold were investigated under actual conditions of growth. Starch is entirely absent from the leaf after the very earliest stages of growth ; as soon as the root begins to develop so that the sugars formed in the leaf can be translocated to it, the starch disappears from the latter. Maltose is never present in the leaf, mid-ribs, or stalks at any stage of the growth. During the early stages of growth, when leaf formation is the principal function, sucrose is present in the leaf tissue in excess of the hexoses, but later, when sugar is being stored in the root, the reverse is the case, hexoses predominating largely in the leaf.

The following table shows the range of variation of the carbohydrates in the leaf during growth :—

Date.	Temp. ° F.	Sucrose.	Hexoses as invert sugar.	Pentose.	Pentosan.
		%	%	%	%
Aug. 26—27	45—75	1·50—3·11	0·20— 2·16	0·36—0·52	5·19—5·96
Sep. 10—11	43—50	4·24—8·27	5·38— 8·90	0·34—0·76	4·42—5·90
Oct. 10—11	31—61	4·98—9·52	9·39—12·41	0·61—0·92	6·21—7·15

In the mid-ribs and stalks the hexoses (18—25%) always predominate over the sucrose; the quantity of hexoses varies widely during the day and night, and throughout the season, whilst the sucrose remains practically constant in amount (5·5—7·4%). In passing from leaves to mid-ribs, from ribs to the tops of stalks, and from top to bottom of the stalk, the ratio of hexoses to sucrose increases steadily and rapidly. As the season advances the predominance of the hexoses becomes more and more marked. The proportion of sucrose in the leaf follows the temperature curve very closely in the daytime, whilst the proportion of hexoses increases faster than the temperature. These facts can apparently be best explained by the hypothesis brought forward by Brown and Morris that sucrose is the primary sugar formed in the mesophyll of the leaf under the influence of the chlorophyll; it passes into the veins, mid-ribs, and stalks, undergoing more and more complete inversion during its passage, until it enters the root as hexose. It is reconverted into sucrose in the root, and in this form the sugar is not able to leave the root until required for the second season's growth. These views agree with those of other observers (see Colin, this J., 1914, 1217). The entire absence of invertase from the root renders it improbable that the sucrose is synthesised from the hexoses by a process of reversible zymohydrolysis. Pentoses form only a small proportion of the total sugars in the tissues; they are probably formed from the hexoses and appear to be the precursors of the pentosans.—W. P. S.

Carbohydrates in plants; Studies on the formation and translocation of ——. *II. Dextrose-lævulose ratio in the mangold.* W. A. Davis. J. Agric. Sci., 1916, 7, 327—351.

IN mangold leaves dextrose and lævulose appear to be present in approximately equal amount, but optically active substances are also present which are not precipitated by basic lead acetate and affect the results obtained in the estimation of the two sugars. The effect of these substances is particularly marked in the mid-ribs and stalks, particularly at the bottom of the latter, where the dextro-rotatory substance (possibly glutamine) seems to predominate. Until dextrose and lævulose can be determined by methods which are independent of polarimetric data, it seems justifiable to assume that the dextrose and lævulose exist in the leaves and stalks as invert sugar and travel in nearly, if not exactly, equal proportions to the roots where transformation into sucrose occurs.—W. P. S.

Carbohydrates in plants; Studies of the formation and translocation of ——. *III. Carbohydrates of the leaf and the leaf-stalks of the potato. Mechanism of the degradation of starch in the leaf.* W. A. Davis and G. C. Sawyer. J. Agric. Sci., 1916, 7, 352—384.

SUCROSE is the principal sugar present in potato leaves when the tubers are beginning to develop; its amount increases from sunrise (1·76%) up to 2 p.m. (3·66%), and then falls during the rest of the day and night. The leaf contains less than 1% of hexoses (calculated on the dry substance) and this quantity fluctuates during the early part of the day, due apparently to conversion into or formation from starch. During the morning the proportion of starch changes but little; directly the amount of sucrose reaches its maximum at 2 p.m. the hexoses begin to increase in the leaf and at the same time "soluble starch" (dextrin) is first detected, its quantity increasing up to 6 p.m. At this hour, 2 hours before sunset (early July), the true starch reaches a maximum value (5·95%); the quantity of starch and "soluble starch" then falls rapidly until between midnight and 2 a.m. the amount left is 0·2%. The starch is apparently converted directly into dextrose. In the stalks, the reducing sugars predominate over the sucrose. As in the mangold (see preceding abstract), optically active impurities interfere with the determination of the true proportions of dextrose and lævulose, but in the stalks, where the amount of this impurity is less than in the leaves, it is possible that the dextrose is in excess, as it appears to be from the analytical results obtained, and that the starch in the tuber is built up from this sugar. Maltose is always absent from the potato leaf and from the leaves of other plants which form much starch in the leaf. The degradation of starch in the leaf is probably effected by a mixture of enzymes similar to the enzymes of *Aspergillus oryzæ* (taka-diastase); maltase is in relative excess, so that the starch is converted completely into dextrose.—W. P. S.

Sugars; Action of cyanides of the alkali and alkaline-earth metals on ——. *II.* E. Rupp and A. Hölzle. Arch. Pharm., 1915, **253**, 404—415. J. Chem. Soc., 1916, **110**, i., 119—120. (Compare this J., 1914, 96.)

THE preparation of α-glucoheptoic anhydride from dextrose is effected more conveniently by barium cyanide than by potassium cyanide. The latter causes the formation of dark-coloured by-products, but when its hydrolytic dissociation is diminished, by the use, for example, of potassium zincocyanide, the reaction product is obtained, and remains, nearly colourless. α-Glucoheptoic anhydride has recently come into use as a diabetic sugar under the name hediosite. The sparingly soluble basic barium glucoheptoate,

$$HO\cdot CH_2\cdot[CH\cdot OH]_5\cdot CO\cdot O\cdot Ba\cdot OH,$$

may be utilised to isolate the product of the reaction between dextrose and an alkali cyanide, the yield of hediosite by this method being 30—33%. The velocity of reaction of a 10% dextrose solution and potassium cyanide (1 mol.) has been followed polarimetrically, the results being controlled by estimations of the ammonia evolved. About one-half of the sugar has reacted within two hours, and the reaction ceases after three days. The consumption of the cyanide increases rapidly with the concentration of the dextrose solution, and is enormously accelerated catalytically by alkalis.

Mannose and potassium or barium cyanide react in aqueous solution with the evolution of ammonia and the formation of barium mannosecarboxylate, from which the corresponding lactone is obtained by acidification. Lævulose and potassium or barium cyanide react, hydrogen cyanide, followed after several hours by ammonia, being evolved; the product obtained by evaporating the solution over sulphuric acid in a vacuum is probably potassium lævulosecarboxylate. The behaviour of galactose is quite similar to that of lævulose. In the case of lactose, hydrogen cyanide is evolved, followed after several days by ammonia. The biose reacts smoothly with 1 mol. of the cyanide, the more rapidly the greater is the concentration of the solution, but subsequently a second molecule of the cyanide is very slowly decomposed. These results are interpreted as indicating the formation of potassium lactosecarboxylate, which is then hydrolysed to potassium glucoheptoate and galactose, the latter being subsequently converted slowly into potassium galactosecarboxylate. The behaviour of maltose is very similar to that of lactose, except that a second molecule of the cyanide scarcely enters into reaction.

Starch; Phosphoric acid in ——. J. N. Northrop and J. M. Nelson. J. Amer. Chem. Soc., 1916, **38**, 472—479.

POTATO starch was found to contain 0·06% of chemically combined phosphorus which could not be removed by extraction with dilute acid either as free or combined phosphoric acid. 60 kilos. of starch was suspended in 240 litres of water, 12 litres of concentrated hydrochloric acid added, and steam blown in until the mass liquefied, when it was further heated at 65° C. until a sample gave no precipitate on the addition of alcohol. Barium hydroxide was then added until the solution was neutral, the resulting precipitate filtered off and alcohol added to the filtrate, when 300 grms. of a barium compound was obtained, which after conversion into the lead salt and subsequent decomposition of this by hydrogen sulphide yielded 110 grms. of a substance containing 4·9% of phosphorus. This, on repeating the purification by means of the lead salt, gave a definite substance $C_{17}H_{31}O_{16}(H_2PO_3)$, $[\alpha]_{22}=108° 30'$, in the form of a white, amorphous, hygroscopic powder which reduced Fehling's solution and on hydrolysis yielded 64·8% of dextrose, but gave no definite derivatives on acetylating or benzoylating.—T. C.

Glycogen ; Crystalline polysaccharides from ——. H. Pringsheim and S. Lichtenstein. Ber., 1916, **49,** 364—369. (See this J., 1912, 1001 ; 1913, 985.)

Attempts have been made to ferment other polysaccharides besides starch by means of Schardinger's *Bacillus macerans*, in order to ascertain whether they also are built up of polysaccharides with a ring structure. Inulin and salep gum were not fermented, but this is not surprising as they are built up from lævulose and mannose respectively, and not from dextrose. Glycogen, however, which has many other points of resemblance to starch, was found to be fermentable by *Bac. macerans*. Commercial glycogen mostly contains a high percentage of mineral matter. A specimen nearly free from ash contained albumin, which, however, nearly all coagulated during sterilisation. It was fermented for four weeks in 5% aqueous solution with a potato culture of the bacillus. The same products were formed as from starch, but the ratio of dextrin β (β-hexa-amylose) to dextrin α (tetra-amylose) was 3 : 1, instead of 1 : 6 as in the case of starch. It is, however, unsafe to draw conclusions as to the structure of starch and glycogen from these ratios, as it is not known whether *Bacillus macerans* can produce tetrasaccharides from hexasaccharides. —F. Sp.

Potatoes ; Manufacture of dextrin and glycerin-substitute from rotten ——. W. Esch. Z. Spiritusind., 1915, **28,** 259. Z. angew. Chem., 1915, **28,** Ref., 646.

The potato mash is boiled with the waste Stassfurt salt, kieserite, from which sufficient acid is liberated at the boiling temperature to effect the conversion of the starch to dextrin. The liquid is neutralised by lime water, whereby a precipitate is produced which carries down with it the coloured impurities ; the filtered dextrin solution is then concentrated to the desired consistence. Adhesives and softeners for textile finishes may thus be prepared.—J. F. B.

Gum arabic ; Qualitative tests for and determination of ——. C. E. Waters and J. B. Tuttle. U.S. Bureau of Standards, Technol. Paper No. 67. J. Franklin Inst., 1916, **181,** 266—267.

The most distinctive reaction of gum arabic is that obtained with basic lead acetate. Mixtures of neutral ferric chloride and alcohol and of copper sulphate and sodium hydroxide are valuable as reagents for confirmatory tests. The reactions given by these reagents with gum arabic, dextrin, and gum ghatti are quite distinct. Satisfactory quantitative results may be obtained by the use of a reagent made by dissolving 50 grms. of copper acetate in water, adding ammonia in excess, and diluting the liquid to a litre with water and alcohol so that the final solution contains 50% of alcohol. Fifty c.c. of the solution of gum (containing about 0·25 grm.) is mixed with an equal vol. of alcohol, and then with 25 c.c. of the copper reagent, with constant stirring. The precipitate is collected on a previously weighed paper, washed with 50% alcohol containing ammonia, then with 75% and finally with 95% alcohol, dried at 105° C. until constant in weight, and ignited in a porcelain crucible. The residue of ash deducted from the weight of the original precipitate gives the amount of "net gum arabic." An allowance must be made for the moisture in the sample, which is determined by drying the gum in a current of hydrogen at 105°C. In 18 test determinations the amount of gum ranged from 96·6 to 103·3%, the average being 99·5%.—C. A. M.

Conversion of molasses residue into an easily-spread fertiliser. Brauer. *See* XVI.

Patents.

Liquids [sugar solutions] ; Process of purifying ——. F. B. Bachler, Assignor to Kieselguhr Co. of America, Los Angeles, Cal. U.S. Pat. 1,170,868, Feb. 8, 1916. Date of appl., Mar. 1, 1915.

A mineral colloid, such as hydrous aluminium silicate (clay), is added to the sugar solution, or other liquid to be purified, followed by a coagulant together with kieselguhr, which is used to produce a porous precipitate. The mixture may be heated if desired. The liquid is filtered or otherwise separated from the precipitate.—J. H. J.

Sugar ; Recovery of —— *from molasses.* F. Tiemann, Berlin. Ger. Pat. 288,411, Aug. 30, 1913. Addition to Ger. Pat. 279,719 (this J., 1915, 371).

Instead of completely inverting a portion of the molasses and mixing it with the rest, a portion of the sucrose in the entire molasses is inverted, until the desired ratio of invert sugar to sucrose and salts is attained. The process is applicable to molasses and by-products from cane or beet sugar manufacture and especially in the latter for the manufacture of a sugar for cattle fodder free from the deleterious salts of beet molasses. —J. F. B.

[Sugar cane] bagasse and product thereof. Packing or obturating material. U.S. Pats. 1,170,487 and 1,170,488. *See* V.

XVIII.—FERMENTATION INDUSTRIES.

Barley grain ; Morphology of the —— *with reference to its enzyme-secreting areas.* A. Mann and H. V. Harlan. U.S. Dept. Agric., Bull. No. 183. 1915. J. Inst. Brew., 1916, **22,** 73—108.

Examination of thousands of barley grains of various types, at all stages of germination, confirmed the conclusions of Brown and Morris (this J., 1890, 530) that the secretion of diastase during germination is the work of the epithelial layer of the scutellum. The cytase and proteolytic enzymes also are probably secreted by the same cell-layer. The cells of the endosperm may retain to some extent the power of producing diastase (translocation diastase) after the infiltration of starch has been completed (cp. Ling, this J., 1912, 740) but the quantities so produced must be very small compared with those formed by the scutellum. The chief function of the aleurone layer is probably to protect the endosperm against bacteria and moulds ; it persists until the endosperm has been depleted of starch, and then under natural conditions it forms a convenient source of nitrogen for the plantlet. As the conversion of the endosperm during germination advances from the region of the scutellum to the distal end of the grain it makes most rapid progress through the layers near the aleurone cells, probably because the cells in these layers are younger and less tightly packed with starch than those at the centre of the grain. The aim of malting is to effect complete modification of the endosperm with the minimum loss of starch. In long grains with pointed ends and a narrow scutellum, a considerable amount of starch is dissolved at the proximal end and consumed by the embryo before modification has extended throughout the endosperm. The ideal grain of malting barley is broadly oval in shape, with a scutellum which presents the maximum surface to the endosperm and extends well over the edges of the latter. The greater diastatic power of small-berried as compared with large-berried malts is explicable from geometrical considerations, since the smaller the grain the greater is the secreting area of the scutellum in proportion to the volume of the endosperm. Similar considerations apply to the nitrogen-content of barley in relation to size, for the aleurone layer (which is almost invariably 3-cells deep whatever the size of the grain) provides the major part of the total nitrogen. The secretion of diastase depends not only on the size but also on the vigour and condition of the epithelial layer. The vigour appears to be greater, according as the individual palisade cells are longer and narrower, and their condition depends in some way not understood on the proper maturing and curing of the grain.—J. H. L.

Grape juice ; Clarification of ——. F. T. Bioletti. Rep. Coll. Agric., Univ. California, 1914, 190—191. Bull. Agric. Intell., 1915, **6,** 1697.

From the results of tests it appears that complete and permanent brightness of grape juice is readily obtained by the following operations : (1) Defecation for 24—48 hours with 8—12 oz. of potassium metabisulphite per ton. (2) Racking of clear juice ; mixing with finings (6 oz. of casein or egg albumin per 100 U.S. gallons) and heating to 80° C. (3) Addition of 0·1—0·2 % of citric acid to the hot juice and allowing to stand at room temperature for 36 hours. Racking from finings and filtering. Bottling and final pasteurisation at 70°—75° C. It is remarked that the temperatures mentioned, while effective for the purpose, are probably unnecessarily high and likely to injure the flavour of the more delicate juices.—J. F. B.

Yeast ; Changes in the physiological condition of brewery ——. O. Furnrohr. Z. ges. Brauw., 1915, **38,** 297—299, 305—307, 313—316, 345—347, 353—355, 361—364.

There is in general a pronounced difference in fermentative activity between those bottom-fermentation yeasts which flocculate readily and those which remain longer in suspension in a powdery form (cp. Schönfeld, this J., 1912, 651). The former do not produce such complete attenuation as the latter, and the author found, by fermentation tests in pure sucrose solutions by Kusserow's method, that the powdery yeasts possess a much greater working power (*Triebkraft*) than the flocculating ones. The working power of both types may vary considerably from time to time in the brewery, as the character of the brewing materials varies. In order to investigate means for remedying yeast weakness, the author studied the effect of washing various types of bottom-fermentation yeasts with water containing different compounds. Calcium salts were found to be most effective in raising the fermentative activity, and gypsum is recommended as most convenient. One kilo of gypsum per hectolitre of yeast has a pronounced effect, and tends to produce a change from flocculating to powdery character, and to give more brilliant beers without any perceptible influence on their flavour. If the washing water contains an excess of solid gypsum the yeast is stimulated to a much greater extent than when a saturated solution alone is used ; the solid particles may perhaps free the cells from adhering viscous matters which impede direct contact between the cells and the surrounding liquid. The stimulating effect of washing with calcium salts persists after the yeast has carried out a fermentation of wort. Washing with water containing sulphuric or phosphoric acid appears to have a weakening effect on yeast.—J. H. L.

Brewing waters ; Biological investigation of ——. *Behaviour of the organisms of the same water towards worts from different breweries.* H. Will. Z. ges. Brauw., 1915, **38,** 329—331, 337—340.

In testing brewing water to ascertain whether the organisms present are capable of developing to an undesirable extent in sterile wort, it is advisable to employ wort from the brewery for which the water is intended. Worts from different breweries, or even those from the same brewery at different times, differ considerably in their powers of resistance to the organisms of water. A wort of rather low resistance, which can be obtained without difficulty as required, should be uniformly employed in all cases where the rule suggested above is impracticable.—J. H L.

[*Brewers'*] *pitch ; Regeneration of* ——. F. Koritschoner. Brau- und Malzind., 1915, 187. Woch. Brau., 1915, **32,** 307.

Pitch that has been used once can be regenerated (provided it has not been burnt or unduly spoiled), by heating it at 200° C. until frothing and crackling have ceased, then removing the scum and thoroughly admixing 10% of paraffin wax. After the molten mass has stood for a short time it is passed through a fine sieve and cooled. Mixtures of new pitch with 50% or less of this regenerated product may be used for coating storage or transport casks.—J. H. L.

Elderberry wine ; Manufacture and properties of ——. G. Maue. Z. Unters. Nahr. Genussm., 1915, **30,** 231—234. Bull. Agric. Intell., 1915, **6,** 1697—1698.

For the manufacture of elderberry wine in Schleswig-Holstein, the berries, gathered at the beginning of October, are crushed with a wooden pestle. The juice, being very acid and rich in extract, is diluted in the proportion of 1 gall. of juice to 2 of water with the addition of 10 lb. of sugar and allowed to ferment spontaneously at 15°—20° C. After 8 weeks, the main fermentation being finished, the vessel is filled up with sugar solution, and closed with a fermentation stopper to prevent the entrance of air. The wine was bottled at the end of March. When examined in December it resembled ordinary red wine and evolved a considerable amount of carbon dioxide when poured out. The analytical results were as follow : Sp.gr. of the wine at 15° C., 0·9911 ; sp.gr. of the distillate, 0·9825 ; alcohol, 10·89 grms. per 100 c.c. ; extract, 2·16 ; mineral matter, 0·205 ; sulphuric anhydride, 0·011 ; free acid (calc. as malic acid), 0·466 ; volatile acid (as acetic acid), 0·107 ; non-volatile acid (as malic acid), 0·346 ; total tartaric acid (Halencke and Möslinger), 0·015 ; glycerol, 0·630 ; invert sugar, 0·140 ; sucrose, 0·005 ; tannin (Nessler and Barth), 0·040 grm. per 100 c.c. The alkalinity factor (Fresenius and Grünhut) was 1·06, the alcohol : glycerol ratio 100 : 5·79. Large quantities of citric acid were found in the wine

and this fact might serve as an indication in its detection as an adulterant of ordinary wine.
—J. F. B.

Fucus evanescence (hibalsunomata) ; Acetic fermentation of ——. E. Takahashi. J. Chem. Ind., Tokyo, 1916, **19**, 30—41.

The seaweed, *Fucus evanescence*, which grows on the east coast of Hokkaido, ferments when mixed with a little water and lime, and yields acetic acid containing a small proportion of propionic acid. The lime (3 to 5% of the dry material) should be added in three to four successive quantities, and the temperature should be kept at 30° C. for 2 weeks, or 20° C. for 3 to 4 weeks. The yield of acetic acid is increased by the addition of fucose.
—C. A. M.

Starch in spent grains ; Polarimetric method for determining ——. F. M. Wieninger. Z. ges. Brauw., 1915, **38**, 257—260, 265—267, 273—274, 281—283, 289—291.

In Lintner's method for determining starch in barley (this J., 1912, 653) the small quantities of other optically active substances which are extracted do not affect the results seriously ; but in the case of spent grains, sulphuric acid extracts dextrorotatory constituents of the husks, which may increase the apparent starch-content of the grains by 4% or more, and also lævorotatory substances which have a much smaller influence, *e.g.*, 0·5%. The lævorotatory substances may be precipitated alone by zinc sulphate, and the rotation of the filtrate from this precipitate will represent the starch and other dextrorotatory substances. The rotation of the non-amylaceous dextrorotatory matters alone, can be found by precipitating another portion of extract with phosphotungstic acid to remove the lævorotatory substances and the whole of the starch. This forms the basis of the author's method which is carried out as follows :—The sample is washed, dried, and ground as finely as possible. Two portions, each 2·5 grms., are introduced into 100 c.c. flasks, one is moistened with 2·5 c.c. of 1% zinc sulphate solution, and both are digested with 25 c.c. of sulphuric acid of sp.gr. 1·1 for 20 mins. at 22° C. (see *loc. cit.*). Another 25 c.c. of sulphuric acid is then added to each, and the first is treated with 10 c.c. of 25% zinc sulphate solution and the second with 20 c.c. of 8% phosphotungstic acid. Both are made up to 100 c.c. with sulphuric acid of sp.gr. 1·3, thoroughly shaken and filtered through dry filter papers. The one treated with phosphotungstic acid gives a clear filtrate, which in a 200 mm. tube usually gives a reading of about 0·4 angular degree. The other is allowed to filter for 30 mins. ; the cloudy filtrate is left to stand for 4—5 hours, then shaken with 6—7 grms. of pure dry barium sulphate, filtered until clear, and the rotation observed in a 200 mm. tube. The difference between the rotations of the two solutions, in angular degrees, multiplied by 10·16, gives the percentage of starch in the sample.—J. H. L.

Enzyme action : Nature of ——. *IV. Action of insoluble enzymes.* W. M. Bayliss. J. Physiol., 1915, **50**, 85—94. J. Chem. Soc., 1916, **110**, i., 174.

Urease, lipase, emulsin, invertase, lactase, papain, peroxydase, and catalase are active in media from which they can be filtered off by ordinary paper, whilst the filtrates are inactive. Pepsin and trypsin are much more active in suspensions than are the filtrates ; these enzymes are capable of a small degree of colloidal solution in such solutions. Enzymic activity is thus manifested at the interface of contact between the solid enzyme phase and the liquid substrate phase. The catalysts concerned are not in true solution.

Conversion of molasses residue into an easily-spread fertiliser. Brauer. *See* XVI.

Oxidation of ethyl alcohol by means of potassium permanganate. Evans and Day. *See* XX.

Patents.

Beer : Method of de-alcoholising ——. W. Becker and D. H. Montgomery, Assignors to C. L. Montgomery and M. M. Becker, Virginia, Minn. U.S. Pat. 1,171,306, Feb. 8, 1916. Date of appl., Sept. 16, 1915.

The beverage is heated to a temperature not exceeding 167° F. (75° C.) and then sprayed so that the spray is collected into the form of a flowing sheet which is itself heated to 167° F. and enabled to give off its alcohol as vapour. The collected liquid is re-heated to 167° F. and the process repeated, the de-alcoholised product being finally cooled and stored.—J. F. B.

Alcohol ; Continuous process for the preparation of absolute —— *from alcohol-water mixtures.* K. Kubierschky. Ger. Pat. 287,897, Oct. 24, 1914.

By the introduction of steam or by direct heating, alcohol vapour containing water is produced from the alcohol-water mixture in a distilling column, and is passed into a second column at a point near its centre, where it meets a liquid immiscible with water and of lower boiling-point, *e.g.*, benzene, petroleum spirit, carbon tetrachloride, etc. Practically all the water, all of the added liquid, and a small amount of alcohol escape as vapour at the head of the second column, and practically anhydrous alcohol (96%) is obtained in the gaseous or liquid state at the bottom of the column. The mixture from the head of the second column, when condensed, separates into an aqueous layer and an upper layer containing a small amount of water ; the former is passed into the first, and the latter into the second column. In a modified process the alcohol-water mixture is introduced directly into the second column, and the first column is used for the distillation of the aqueous layer just mentioned.—F. W. A.

Centrifugal separator [cider mill]. U.S. Pat. 1,170,551. *See* I.

XIXa.—FOODS.

Cereal flours ; Exact method for determining the amount of offal in ——. A. Heiduschka and K. Heinich. Z. Unters. Nahr. Genussm., 1915, **30**, 226—228. Bull.Agric.Intell., 1915, **6**, 1699—1700.

A mixture of 2·5 grms. of flour, 10 c.c. of water, and 20 c.c. of hydrochloric acid of sp.gr. 1·19, is kept for 30 mins. at the ordinary temperature, then centrifuged for 10 mins. (2000—3000 revs. per min.), and the clear liquid decanted. The insoluble matter is retained on a tared filter (11 cm. diam.), washed once with 5 c.c. of 25% hydrochloric acid and twice with 10 c.c. of water, and the filter with the residue (milling offals) dried at 100° C.—J. F. B.

Milk ; Constituents of sour —— *precipitated in the alcohol test.* F. Reiss and G. Diesselhorst. Molk.-Zeit., 1915, 712. J. Chem. Soc., 1916, **110**, ii., 120.

The precipitate obtained with 70% alcohol contains the whole of the nitrogen originally present in the milk. Calcium phosphate was found both in the precipitate and filtrate, whilst magnesium phosphate to a great extent remains in solution although some was found in the precipitate. Two samples of milk were employed, having acidities of 11·2 and 29·4 respectively.

"*Nutrose*"; *Composition and properties of* ——. M. A. Rakuzin and E. M. Braudo. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1852—1853.

"Nutrose" is sold as a tasteless powder, neutral to phenolphthalein, and, like casein, shows all the colour reactions of the proteins with the exception of Liebermann's reaction. Its specific rotation is —145·15°, and the ash-content (Na_2CO_3) is 1·63 per cent. All these properties are in agreement with those of sodium caseinate. The authors have prepared a number of coloured caseinates with salts of the heavy metals.—T. H. P.

Composition and use of certain seaweeds. Hendrick. *See* XVI.

Formation and translocation of carbohydrates in plants. I. Carbohydrates of mangold leaf. Davis, Daish, and Sawyer. *II. Dextrose-lævulose ratio in the mangold.* Davis. *III. Carbohydrates of the leaf and leaf stalks of the potato. Mechanism of the degradation of starch in the leaf.* Davis and Sawyer. *See* XVII.

Patents.

Chocolates; Process for the manufacture of ——, *also applicable for the making of soluble powdered cocoa.* J. Gloor, Rutherglen, Scotland. Eng. Pat. 7041, May 11, 1915.

The heat necessary to cook and roast cacao-beans, or other nuts, is generated by friction alone, the temperature being thus raised to 270° F. (132° C.) or over. When sugar is added to the beans, as in the preparation of chocolate, it is caramelised in 35—60 mins. The process is also applicable to the caramelising of the mixture of milk and sugar used in preparing milk chocolate. —J. H. J.

Vegetable milk and its derivatives; Process for making ——. W. J. Melhuish. Fr. Pat. 477,371, Oct. 28, 1914.

See Eng. Pat. 24,572 of 1913; this J., 1915, 196.

Margarine; Manufacture of ——. Naaml. Vennoots. Ant. Jurgens Vereen. Fabrieken. Fr. Pat. 477,579, Feb. 9, 1915.

See Eng. Pat. 2013 of 1915; this J., 1916, 324.

Flour; Manufacture of an improved ——. T. T. Vernon. Fr. Pat. 477,523, Feb. 4, 1915.

See Eng. Pat. 558 of 1914; this J., 1915, 374.

Preparation of non-poisonous, non-alkaline, stable oxygen-developing phosphates. Ger. Pat. 287,588. *See* VII.

Recovery of sugar from molasses. Ger. Pat. 288,411. *See* XVII.

XIXb.—WATER PURIFICATION; SANITATION.

Hypochlorites; Stability of dilute solutions of ——. *Consequences from the standpoint of their use in water sterilisation.* L. Vallery. Comptes rend., 1916, **162**, 326—327.

Hypochlorites in very dilute solution, containing a few parts per million of active chlorine, are subject to a slow decomposition, limited or not according to the concentration; in the former case the limit is markedly affected by very small variations in the medium. The velocity of decomposition in the absence of any sensible chemical reaction, appears to be represented by a portion of an equilateral hyperbola. The influence of the medium is either purely catalytic or purely chemical. Since the action of hypochlorites in sterilising water extends over a considerable time, it is important that the traces left in the water should be less than can be detected by taste, 0·1—0·15 mgrm. per litre.—J. H. J.

Chlorine in town water supplies; Detection of free ——. G. A. Le Roy. Comptes rend., 1916, **162**, 327—329.

Starch-iodide reagent fails to indicate less than 0·05 mgrm. of chlorine per litre of water. This difficulty may be got over by a method of concentration. About 10 litres of the water is frozen by placing in a metal vessel and circulating cooled brine around it. When only about 1/50 of the water is left unfrozen, this portion, which contains the free chlorine, is taken out and tested with the starch-iodide reagent. In this way it is possible to detect 0·0005 mgrm. per litre. The method may be varied by freezing the whole of the water, then dividing the block of ice in two, and applying the reagent to the freshly exposed surface. The test can be made quantitative by measuring exactly the volume of the water taken and the amount left unfrozen, and examining this portion by colorimetric methods.—J. H. J.

Formaldehyde; Effect of methyl alcohol on the disinfecting power of ——. F. Croner. Z. Hyg., 1914, **78**, 541. Chem.-Zeit., 1915, **39**, Rep., 439.

On adding increasing quantities of methyl alcohol to formaldehyde, the disinfecting power first decreases continuously but then increases again, the disinfecting power of the mixtures with a high content of methyl alcohol being greater than that of formaldehyde alone. Methyl alcohol alone has a strong disinfecting action; like ethyl alcohol it is most active at a concentration of 70%, whilst the anhydrous alcohol shows relatively little activity. —A. S.

Fungicide for use against American gooseberry-mildew. J. V. Eyre and E. S. Salmon. J. Board Agric., 1916, **22**, 1118—1125.

Solutions of liver-of-sulphur of the strength generally recommended for use as a fungicide are quite inefficient against gooseberry-mildew; at a concentration at which the solution becomes effective, the gooseberry bush is so severely "scorched" as to preclude the use of the solution. An ammonium sulphide solution containing 0·18% of sulphur can, however, be recommended for commercial use, on an experimental scale, for the purpose of protecting gooseberries from mildew. The solution is prepared by saturating 1 gall. of 10% ammonia solution with hydrogen sulphide and then adding 2 galls. of 10% ammonia and 5 galls. of water; 1·25 lb. of flowers of sulphur is then dissolved in the solution by agitation in a closed vessel. For use, 1 gall. of the solution and 1 lb. of soft soap are mixed with 19 galls. of water. In view of its proved efficacy, lime-sulphur wash should be used for the early sprayings until its use interferes with the marketing of the berries, when the ammonium sulphide solution should be employed.—W. P. S.

Patents.

Filters [; *Adding reagent to water in* ——]. J. Taylor and L. Whyte, Manchester. Eng. Pat. 1170, Jan. 25, 1915.

The inlet pipe for conveying water to be filtered is provided with a Venturi tube or like device for setting up a pressure difference due to the rate of flow. A small tube connects the pipe at a point of full diameter to the top of a small closed vessel filled with a chemical solution, while another small tube extends from near the bottom of the vessel to the constricted part of the Venturi tube. The reagent is thus forced into the pipe at a rate which is regulated by a needle valve and which is determined by the rate of flow of the water.—W. F. F.

Water; Purification of ——. J. C. Heckman, Avalon, Pa. U.S. Pat. 1,171,046, Feb. 8, 1916. Date of appl., Mar. 9, 1915.

Water containing acids is passed through "granulated" blast-furnace slag which contains most of its original calcium oxide.—J. H. J.

Sterilising of liquids by the action of the ultra-violet rays; Apparatus for facilitating the ——. J. de Kowalski, Frieburg, Switzerland. Eng. Pat. 1662, Feb. 2, 1915. Under Int. Conv., Feb. 2, 1914.

A guide wheel placed across the passage through which the liquid flows, directs the liquid at an angle against the blades of another wheel, the axle of which is supported in the long axis of the passage way. The rotation of this turbine wheel gives an eddying motion to the liquid, which is then exposed to ultra-violet light.—J. H. J.

Sewage and other waste liquids; Apparatus for treating ——. T. K. Irwin. Fr. Pat. 476,856, Sept. 5, 1914.

See Eng. Pat. 20,816 of 1913; this J., 1914. 565.

Sewage sludge; Method and apparatus for concentrating ——. J. Grossmann. Fr. Pat. 476,956, Sept. 28, 1914.

See Eng. Pat. 22,778 of 1913; this J., 1914, 981.

Sterilising flowing liquids by ultra-violet rays; Apparatus for ——. J. de Kowalski. Fr. Pat. 477,450, Jan. 30, 1915.

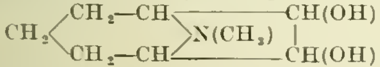
See Eng. Pat. 1662 of 1915; preceding.

Process of purifying liquids. U.S. Pat. 1,170,868. *See* XVII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Scopoline; Degradation of ——. E. Schmidt. Ber., 1916, 49, 164—168.

Scopoline, a degradation product of scopolamine, is converted into hydroscopoline bromide, $C_8H_{12}BrN(OH)_2$ on treatment with hydrobromic acid, and this on reduction with zinc and sulphuric acid loses bromine with the formation of hydroscopoline $C_8H_{13}N(OH)_2$, a substance which on careful oxidation yields N-methyl-*a*-*a*′-piperidinedicarboxylic acid, the constitution of which has been confirmed by synthesis from dibromopimelic ester. This fact points to the following structural formula for hydroscopoline:—



—G. F. M.

Alkaloids; Purification of the residues left on evaporating ethereal and chloroform extracts of ——. A. C. Pereira. Chem.-Zeit., 1916. 40, 39.

Alkaloidal residues may be completely freed from ptomaines by treatment with hydrogen peroxide. The aqueous tartaric acid solution is shaken with ether, as in Otto's method, or with chloroform, then separated from the ether, made alkaline with sodium hydroxide, heated to boiling point with a few c.c. of hydrogen peroxide, cooled, and the analysis continued in the usual way. In like manner it is possible to purify the acid ethereal residue. Certain alkaloids such as strychnine, nicotine, and coniine are not affected by this treatment, but others (*e.g.*, morphine) may form oxidation products.—C. A. M.

Pyridine and isoquinoline bases from casein; Formation of ——. A. Pictet and T. Q. Chou. Ber., 1916, 49, 376—381.

In order to test the theory that the pyridine, quinoline, and isoquinoline rings in the alkaloids might be produced by the condensation of decomposition products of proteins with other substances present in the plant, particularly formaldehyde, 50 grms. of casein was hydrolysed with 150 grms. of hydrochloric acid (sp.gr. 1·19) under a reflux condenser for 6 hours, during which 25 grms. of methylal was added, drop by drop, in order to maintain a constant supply of formaldehyde. The product of several experiments was evaporated to dryness, mixed with three times its weight of quicklime, and distilled. The oily yellow distillate, which weighed 9% of the original casein, was almost completely soluble in dilute hydrochloric acid. The tertiary bases were freed from primary and secondary bases by treatment with sodium nitrite, and were separated and fractionally distilled. The products were identified (where possible) by the examination of their picrates, auro- and platino-chlorides, and in some cases by the boiling point of the free base. The following were the fractions and substances obtained:—105°—120° C. (C_5H_5N, pyridine), 140°—180° C. (C_7H_9N, 2.6-dimethylpyridine, and C_7N_9N, vinyldihydropyridine (?) or quinuclidine (?)), 220°—250° C. (C_9H_7N, isoquinoline), 250°—260° C. (C_9H_7N, isoquinoline, and $C_{10}H_9N$, 4-methylisoquinoline), 260°—270° C. ($C_{11}H_{11}N$, ethyl- or dimethylisoquinoline (?)), 270°—280° C. ($C_{12}H_{13}N$). No trace of quinoline was found. Casein treated in the same way, but without the addition of methylal, gave almost exclusively primary and secondary amines and none of the above-mentioned tertiary bases.—F. Sp.

Sumbul root; Constituents of ——. F. W. Heyl and M. C. Hart. J. Amer. Chem. Soc., 1916, 38, 432—446.

A sample of unsliced sumbul root, *Ferula sumbul*, of unknown origin, imported from Moscow, was investigated and the following substances isolated and identified: sucrose, lævulose, betaine, a white acid resin yielding vanillic acid and an oil on hydrolysis, a phytosterol, $C_{27}H_{46}O$, m.pt. 134°—135° C., acetic, butyric, valeric, tiglic, angelic, oleic, linolic, cerotic, palmitic, and stearic acids, a phytosterolin, $C_{33}H_{57}O_6$, m.pt. 290° C., giving an acetate, m.pt. 159°—160° C., neutral resinous substances yielding umbelliferone on hydrolysis, and glucosidic resinous substances yielding umbelliferone and dextrose on hydrolysis. The ground material on distillation in steam yielded 0·68% to 1·1% of an essential oil, sp.gr. 0·932 at 15° C., which deposited on standing a few yellow crystals, m.pt. 113°—114° C.—T. C.

Bay oil experiments in Montserrat. Robson. W. Indian Agric. News, Jan. 15, 1916. Perf. and Essent. Oil Rec., 1916, 7, 34—35. (See also this J., 1915, 101.)

The yield of leaves from the experimental plot of one acre of bay trees in Montserrat in 1914 shows a further increase over the crop obtained in the previous year, 3256 lb. of leaves being obtained yielding about 39 lb. of oil, *i.e.*, 19·5 oz. of oil per 100 lb. of leaves, as against 18·3 oz. obtained in 1913, the increased yield being probably due to greater care having been taken to remove only mature leaves. Monthly distillations indicate that no definite period of the year is specially suitable for harvesting the leaves. 150 lb. of leaves was distilled for nine hours, each hour's distillate being separately collected and examined, when it was found that the small amount of heavy oil distilling from the sixth to the ninth hour, containing 96°—99 % of phenols, materially improved the quality of the distillate of the first six hours when added to it. Comparative distillations were made to decide (1) if leaves lightly packed in the still gave more oil than if tightly pressed, (2) if sea-water in the boiler gave better results, (3) if fresh leaves were better than those dried for three days; no consistent results were however obtained. Experiments indicated that cultivated trees do not give a better oil than uncultivated trees.—T. C.

Eucalyptus MacArthuri; Oil of ——. Perf. and Essent. Oil Rec., 1916, **7**, 46.

THE leaves of *Eucalyptus MacArthuri* (Paddy's river box) found in New South Wales yield on distillation a reddish oil with a pleasant, aromatic odour, having the following characteristics: sp.gr. 0·926, optical rotation +2°, esters as geranyl acetate 66·7%, total geraniol 76·3%, soluble in 3 vols. of 70% alcohol. The oil contains a small quantity of pinene but no eucalyptol or phellandrene.—T. C.

Ylang-ylang in the Philippines; Production and properties of the essential oil of ——. H. D. Gibbs. Philipp. J. Sci., A, 1915, **10**, 99—103. Bull. Agric. Intell., 1915, **6**, 1647—1648.

THE commercial extraction of the oil is most successful in the Philippines and Réunion, where the product is of superior quality. Most of it is consumed in France. The exports from the Philippines during five years were as follows:—1909, 6186 lb.; 1910, 4132; 1911, 3705; 1912, 6127; 1913, 4778lb. The average value per lb. has declined from $14·2 in 1909 to $12·2 in 1913. The recent reduction of the prices of the flowers and the improvement in the quality of the product have reduced the amount of inferior oil on the market. In view of this, it appears necessary to revise the classification as follows:—

Quality.	Ester value.	$n_{D.}$	$\alpha_{D.}$	Soluble in alcohol of
				%
Extra	>145	<1·4900	<—35°	80
1*a*	>120	<1·4950	<—48°	90
1*b*	>100	<1·4990	<—60°	90—96
2	>100	<1·4990	<—60°	96

Although not accepted by Schimmel and Co., the author maintains that the solubility in alcohol may be used as a typical test, by determining the lowest concentration of aqueous alcohol with which the oil may be mixed in the proportion of 2 to 1 of alcohol without producing turbidity.

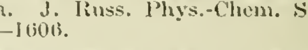
—J. F. B.

Zingiberol: a new sesquiterpene alcohol occurring in essential oil of ginger. B. T. Brooks. J. Amer. Chem. Soc., 1916, **38**, 430—432.

150 GRMS. of essential oil of ginger, after removing terpenes and sesquiterpenes, yielded on fractionation 24 grms. of a sesquiterpene alcohol, zingiberol, b.pt. 154°—157° C. at 14·5 mm., possessing the characteristic fragrance of ginger. When treated with sodium in dry ether zingiberol readily forms a sodium compound, which on heating with potassium bisulphate yields a hydrocarbon, $C_{15}H_{24}$, b.pt. 255°—257° C., identical with zingiberene or *iso*-zingiberene. On treating zingiberol with hydrogen chloride or hydrogen bromide in acetic acid solution, it is slowly converted into *iso*-zingiberene dihydrochloride, m.pt. 169° C., or dihydrobromide, m.pt. 176° C. Essential oil of ginger, freed from terpenes and sesquiterpenes, contains in addition to zingiberol, the following constituents: citral, methylheptenone, nonylaldehyde, linalool, *d*-borneol, esters of acetic and caprylic acids, a trace of a phenol which is probably chavicol, and cineol. The previously-recorded constituent, gingerol, could not be identified.—T. C.

Fenchone derivatives. S. S. Nametkin, L. N. Abakumovskaja, T. I. Maceévskaja, and V. S. Manuilova. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1590—1606.

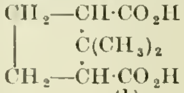
THE fenchanes obtained by Kishner and Proskurjakov (J. Russ. Phys.-Chem. Soc., 1911, **43**, 582) and by Wolff and Nolte (Annalen, 1912, **394**, 86) appear to be identical and have been prepared from fenchone under conditions which have not been observed to cause rearrangement in bicyclic systems. The authors have, indeed, succeeded in establishing the identity of the three bicyclic systems: Kishner and Proskurjakov's fenchane, natural fenchone and isofenchone. Assuming that fenchone has the structure assigned to it by Semmler, that of fenchane will be



$$CH\begin{cases}C(CH_3)_2\cdot CH_2\\ CH_2\\ CH_3—CH_2\end{cases}C(CH_3)$$

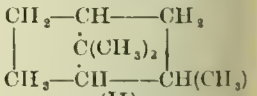
.

In the case of Zelinski's fenchane (J. Russ. Phys.-Chem. Soc., 1904, **36**, 770), nitration of this yields principally a tertiary nitro-compound and apocamphoric acid (formula I); structure (II) is therefore attributed to this "fenchane," for which the name "isobornylane" is suggested:



$$\begin{array}{l}CH_2—CH\cdot CO_2H\\ |\qquad \dot{C}(CH_3)_2\\ CH_2—\dot{C}H\cdot CO_2H\end{array}$$

(I)



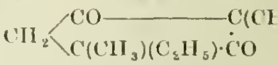
$$\begin{array}{l}CH_2—CH——CH_2\\ |\qquad \dot{C}(CH_3)_2 \quad |\\ CH_3—\dot{C}H——CH(CH_3)\end{array}$$

(II)

—T. H. P.

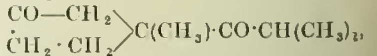
"Hydroxyfenchone"; Konovalov's ——. S. S. Nametkin and V. A. Chochrjakova. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1611—1615.

THE compound which was described by Konovalov (*ibid.* 1903, **35**, 953) as hydroxyfenchone and was obtained by reduction of the tertiary nitro-compound formed when fenchone is nitrated, is shown by the authors to be a diketone, $C_{10}H_{16}O_2$. Its probable constitution is



$$CH_2\begin{cases}CO——C(CH_3)_2\\ C(CH_3)(C_2H_5)\cdot\dot{C}O\end{cases}$$

or



$$\begin{rcases}CO—CH_2\\ \dot{C}H_2\cdot CH_2\end{rcases}C(CH_3)\cdot CO\cdot CH(CH_3)_2,$$

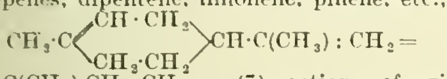
both of these containing asymmetric carbon atoms in accord with the optical activity of the compound.—T. H. P.

Cyclopentylcarbinol; Isomerisation of —— *on conversion into halogenated derivatives.* S. S. Nametkin and O. N. Morozova. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1607—1610.

IN aqueous solution, hydrochloric, hydrobromic or hydriodic acid causes partial isomerisation of the 5-membered ring-system of cyclopentylcarbinol into a 6-membered one at 100°—105° C. The extent of the isomerisation is, in all cases, of the order of 50% and appears to depend but little on the nature of the acid. Less marked but undoubted isomerisation takes place when the cyclopentylcarbinol is treated with iodine and red phosphorus.—T. H. P.

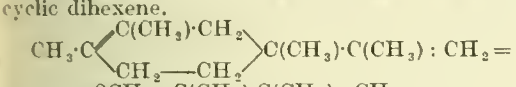
Divinyl, isoprene, piperylene, and dimethylerythrene, New methods of obtaining ——. I. Ostromyslenski J. Russ. Phys.-Chem. Soc., 1915, **47**, 1917—1978

ISOPRENE may be obtained by the following methods: (1) Depolymerisation of natura myrcene, $CH_2:C(CH_3){\cdot}CH_2{\cdot}CH_2{\cdot}CH:CH{\cdot}C(CH_3):CH_2 = 2CH_2:C(CH_3){\cdot}CH:CH_2$; (2) dehydration of isoamylene-glycol, $OH{\cdot}C(CH_3)_2{\cdot}CH_2{\cdot}CH_2{\cdot}OH = 2H_2O + CH_2:C(CH_3){\cdot}CH:CH_2$; (3) removal of 2HCl from 1·3-dichloroisopentane by means of quinoline or other amines, $Cl{\cdot}C(CH_3)_2{\cdot}CH_2{\cdot}CH_2Cl = 2HCl + CH_2:C(CH_3){\cdot}CH:CH_2$; (4) removal of HCl from monochloroisoamylenes by means of sodium stearate, $C(CH_3)_2:CH{\cdot}CH_2Cl = HCl + CH_2:C(CH_3){\cdot}CH:CH_2$; (5) removal of acetic acid from the acetic ester of hydroxy-γ-amylene, $CH_2:C(CH_3){\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}COCH_3 = CH_3{\cdot}CO_2H + CH_2:C(CH_3){\cdot}CH:CH_2$; (6) depolymerisation of the terpenes, dipentene, limonene, pinene, etc.,



$$CH_3{\cdot}C\left\langle\begin{matrix}CH{\cdot}CH_2\\CH_3{\cdot}CH_2\end{matrix}\right\rangle CH{\cdot}C(CH_3):CH_2 =$$

$2CH_2:C(CH_3){\cdot}CH:CH_2$; (7) action of zinc dust on 1.2.3.4 - tetrabromoisopentane, $CH_2Br.C(CH_3)Br.\ CHBr.CH_2Br + 2Zn = 2ZnBr_2 + CH_2:C(CH_3){\cdot}CH:CH_2$. Dimethylerythrene may be obtained by: (1) depolymerisation of the cyclic dihexene,



$$CH_3{\cdot}C\left\langle\begin{matrix}C(CH_3){\cdot}CH_2\\CH_2\text{—}CH_2\end{matrix}\right\rangle C(CH_3){\cdot}C(CH_3):CH_2 =$$

$$2CH_2:C(CH_3){\cdot}C(CH_3):CH_2;$$

(2) dehydration of pinacone by means of sulphanilic acid or salts of phosphoric acid,

$$HO{\cdot}C(CH_3)_2{\cdot}C(CH_3)_2{\cdot}OH = 2H_2O + CH_2:C(CH_2){\cdot}C(CH_3):CH_2.$$

(For the preparation of piperylene, see this J., 1916, 70.) Tilden observed that dipentene is depolymerised at 400°—600° C. into isoprene, and the author finds that pyrogenetic decomposition of homologues of dipentene yields homologues of isoprene, cyclic dibutene being converted into erythrene, $C_8H_{12} = 2CH_2:CH{\cdot}CH:CH_2$, and yclic dihexene into βγ-dimethylerythrene, $C_{12}H_{20} = 2CH_2:C(CH_3){\cdot}C(CH_3):CH_2$ (see Lebedev, this J., 1914, 1223). When heated at 150°—250° C., limonene is converted into polyterpenes of high boiling point, whereas at 500°—600° C. it yields soprene, and the increased yield of the latter, btained by Staudinger and Klever (this J., 1911 023) is due, not to dilution of the limonene vapour, ut to the high temperature at which this vapour s formed; good results are obtained when the imonene is mixed with benzene, toluene, xylene, ight petroleum, etc. The pyrogenetic decomosition of turpentine yields isoprene and also ases and hydrocarbons distilling between 60° nd 150° C.; these hydrocarbons may be used n place of the benzene, etc., as a diluent. Pyroenetic decomposition of saturated hydrocarbons nd of hydrocarbons containing one double linking, ields only erythrene, no homologues of the latter eing obtained: $C_4H_8RR' = CH_2:CH{\cdot}CH:CH_2 +$ 'H + RH, and $C_4H_7R = CH_2:CH{\cdot}CH:CH_2 + RH$; atural myrcene gives isoprene in 60—70% yield. he conversion of 1.3-dichloroisopentane into ythrene by the action of an amine only takes lace when the basicity of the amine is relatively w; in the case of primary amines, this weakening the basicity may be effected by introduction of dicles. In this reaction, quinoline, parachlorod parabromo-aniline, and tetramethyldiaminoenzophenone are converted into colouring matters basic character; these behave as indicators, ing coloured red or violet by acid, whilst on utralisation the liquid is mostly decolorised d the free base precipitated in a brown amorous condition. When heated with quinoline, th chloroisoamylene, $CH_2:C(CH_3){\cdot}CH_2.CH_2Cl$, d its isomeride, $C(CH_3)_2:CH{\cdot}CH_2Cl$, yield oprene, the dimethylallene formed in the tter case undergoing isomeric change; when the inoline is replaced by sodium stearate, such ange does not take place, dimethylallene being us obtained. When heated with lime, sulphanilic acid, or alkali alkyloxide, the acetic ester of isoamylenic alcohol gives no trace of isoprene, but under the influence of alumina at 380°—450°C., a yield of 20 per cent. of isoprene is obtainable. The dehydration of isoamyleneglycol to isoprene takes place under the same conditions as the dehydration of 1.3-butyleneglycol; alumina and also phosphoric acid were used as dehydrating agents (see Lebedev, this J., 1914, 1223). The results obtained on heating hydrocarbons of different types lead to the following general rule: Open-chain hydrocarbons containing one ethylenic linking in the molecule, or saturated cyclic hydrocarbons, lose at a high temperature mostly saturated hydrocarbons, all the carbon atoms being expelled with the exception of four which remain in the form of erythrene. The latter may, indeed, be obtained from almost any hydrocarbon containing not less than four carbon atoms in the molecule, thus:

$$C_nH_{2n+3} + Cl_2 = HCl + C_nH_{2n+1}Cl;\ C_nH_{2n+2}Cl = C_4H_8RCl = HCl + RH + CH_2:CH{\cdot}CH:CH_2.$$

—T. H. P.

Erythrene; Conversion of cyclobutane derivatives into ——. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1978—1982.

ERYTHRENE may be obtained: (1) by the removal of a molecule of hydrogen bromide from bromocyclobutane by the action of alcoholic potassium hydroxide, quinoline, or barium chloride in absence of air, and (2) in almost theoretical yield by the removal of a molecule of water from cyclobutanol by passing the vapour of the latter over alumina (*Argilla pura*) heated to 300°—350° C.

—T. H. P.

Isoprene; Analysis, purification and qualitative reactions of ——. I. Ostromyslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1983—1988.

THE formation in a reaction of a diolefine with conjugated double linkings may be detected by shaking 5—10 drops of the products of the reaction for a short time with 50 c.c. of concentrated aqueous sulphur dioxide solution, the mixture being then left at the ordinary temperature in a hermetically sealed vessel. In the course of 2—30 hours an abundant, colourless, amorphous precipitate is formed, this consisting of a compound of the diolefine with the sulphur dioxide, possessing characteristic properties (compare Ger. Pat. 236,386; this J., 1911, 1088). Isoprene may be determined quantitatively by converting it into 1.3-dichloroisopentane:—

$$CH_2:C(CH_3).CH:CH_2 + 2HCl = C(CH_3)_2Cl.CH_2.CH_2Cl;$$

if *a* grms. of the dichloro-compound be obtained from *S* grms. of the crude isoprene, the latter contains $3403a/70{\cdot}49S$ per cent. of isoprene. The procedure is as follows: 200 grms. of the crude isoprene, containing butylenes, amylenes, benzene, etc., with b.pt. 30°—40° C., is energetically shaken with 1500 c.c. of fuming hydrochloric acid for 6 hours in a mechanical shaker. The black, opaque, upper layer of chloro-compounds is separated, washed with aqueous sodium chloride solution saturated in the cold, again separated after the emulsion formed has divided into two layers, dried over calcium chloride, and distilled. At 40°—50° C. only two or three drops of hydrocarbons generally distil over and the fraction 50°—90° C. contains butylene and amylene chlorides; the fraction 90°—130° C. is collected separately. From 130° C. the temperature usually jumps immediately to 142° C., the b.pt. of the 1.3-dichloroisopentane. When the crude isoprene has been obtained, for instance, from turpentine, the 1.3-dichloroisopentane cannot be distilled, but it is found that the residue in the distilling flask with b.pt. beyond 143° C. consists, in spite of its black colour, of almost chemically pure 1.3-dichloroisopentane; in a vacuum, indeed, this residue distils completely within 0·5° at the proper temperature. This residue may be filtered through glass wool and the filtrate weighed. The fraction, b.pt. 90°—130° C., is subjected to careful fractional distillation, as it contains 1.3-dichloroisopentane, sometimes in considerable quantity. The fractionation is carried out three times, in each case up to 112° C. A method is described for the purification of crude isoprene containing turpentine, benzene, amylenes, etc. When heated with sodium, chemically pure isoprene yields an abnormal caoutchouc differing considerably in its properties from the sodium-isoprene-caoutchouc described first by Matthews and Strange and later by Harries. The structure of the benzene molecule is discussed in relation to the action of magnesium or sodium on compounds such as vinyl bromide (see Austerweil, this J., 1912, 503).—T. H. P.

Esters of unsaturated alcohols; Preparation of —— from aldols. I. I. Ostromysslenski. J. Russ. Phys.-Chem. Soc., 1915, **47**, 1991—1993.

The action of magnesium amalgam on aldol yields the acetyl derivative of crotonyl alcohol, thus:

$CH_3.CH(OH).CH_2.CHO = 2CH_3.CHO.$

$CH_3.CH(OH).CH_2.CHO + CH_3.CHO =$
$CH_3.CH(OH).CH_2.CH_2.O.CO.CH_3 =$
$H_2O + CH_3.CH : CH.CH_2.O.CO.CH_3.$

When treated with alumina, this ester is readily converted into erythrene and acetic acid (see this J., 1916, 69). If analogues and homologues of aldol exhibit similar behaviour towards magnesium amalgam, this reaction would represent a new method for obtaining esters of unsaturated alcohols.—T. H. P.

Coumarin; Some derivatives of ——. F. D. Dodge. J. Amer. Chem. Soc., 1916, **38**, 446—457.

On warming coumarin with a concentrated solution of sodium bisulphite it is converted into well-crystallised sodium hydrocoumarinsulphonate, $C_9H_6O_2.NaHSO_3.H_2O$. This is reconverted into coumarin and sodium sulphite and sulphurous acid when heated for 2 hours at 150°—160° C., whilst on heating with excess of caustic alkali and acidifying, it yields coumaric acid. On adding caustic soda solution to a solution of sodium hydrocoumarinsulphonate, coumarin and sodium sulphite are first produced, and then react to form the open-chain, difficultly crystallisable compound, sodium hydrocoumaricsulphonate, which can be reconverted into the lactone form by treatment with acetic anhydride and into coumaric acid by treating with excess of alkali and acidifying. Limettin, a dimethoxycoumarin from expressed oil of limes, gives similar reactions but the limettic acid could not be obtained crystalline. When coumarin is treated with excess of alkali it is completely hydrolysed and the excess of alkali can be titrated with approximate accuracy. On standing, the neutral solution becomes alkaline, coumarin being slowly regenerated until an equilibrium is reached, the equilibrium being disturbed and more coumarin being formed if the latter is removed as formed.—T. C.

Hydrogenation; Catalytic —— of organic compounds by means of base metals at ordinary temperatures. C. Kelber. Ber., 1916, **49**, 55—63.

Nickel which has been reduced at 450° C. is almost inactive as a hydrogenising catalyst at ordinary temperatures and atmospheric pressure as a substitute for platinum or palladium, but if the nickel salt is precipitated in presence of a suitable carrier, such as infusorial earth, silicates of aluminium or magnesium, or certain charcoals, as, for example, blood charcoal, and then reduced at 450° C., a catalyst is produced of which the activity is much greater than that of nickel reduced at a much lower temperature. For example, using 0·5 grm. of nickel, reduced at 450° C., on 4·5 grms. of carrier, the hydrogenation of cinnamic acid in aqueous-alcoholic solution was accomplished in one-fifth of the time required with an equal weight of pure nickel reduced at 310° C. The catalyst was prepared by precipitating the basic carbonate of nickel from nickel sulphate solutions in presence of the infusorial earth, washing and drying the precipitate, and reducing in hydrogen at 450° C. for two hours. After cooling in hydrogen, carbon dioxide was passed over the reduced metal for half an hour, and the catalyst was then ready for use. Hydrogenation is best conducted in aqueous, aqueous-alcoholic, or acetic acid solution. In benzene, acetone, ether, or ethyl acetate catalysis is slower, whilst chloroform is distinctly inhibitive. Cobalt may be used instead of nickel in these reactions, but it is somewhat less active.—G. F. M.

Diethylamine; Preparation of ——. W. E. Garner and D. Tyrer. Chem. Soc. Trans., 1916, **109**, 174—175. (See also Price and others; this J., 1916, 147.)

A mixture of 3000 c.c. of alcohol and 3000 grms. of ethyl bromide is saturated with ammonia several times during the course of a day, and, after 24 hours, the alcoholic liquid is separated from the crystals of ammonium bromide, and the alcohol and unchanged ethyl bromide are removed by distillation. The residue is diluted with water, the solution boiled to remove the last traces of alcohol, and the hydrobromides of the mixed bases are then decomposed by the addition of concentrated sodium hydroxide solution. The bases are next separated by fractional distillation, the yield being: monoethylamine, 10·9, diethylamine, 17·9, and triethylamine, 19·1%. About 80% of the diethylamine (boiling within 1° C.) can be obtained by two fractional distillations. The separated alcoholic ammonia containing the ethyl bromide may be used again for the preparation of a further quantity of the mixed hydrobromides, and about 50% of the monoethylamine can also be converted into diethylamine. Five hundred grms. of the crude monoethylamine is dissolved in 2500 c.c. of alcohol and treated with 1000 grms. of ethyl bromide, the mixture being cooled in ice. After 24 hours, 200 grms. of ammonium bromide is added, and the solution treated as described.—W. P. S.

Ethyl alcohol; Oxidation of —— by means of potassium permanganate. W. L. Evans and J. E. Day. J. Amer. Chem. Soc., 1916, **38**, 375—381.

With increasing quantities of alkali up to about 175 grms. per litre, decreasing amounts of alcohol were requisite for the complete reduction of a constant quantity of permanganate. Concentrations higher than this had practically no further effect on the amount of alcohol required. This result was due to the increasing proportions of carbon dioxide and oxalic acid in the oxidation products as the concentration of alkali increased. In the absence of alkali, acetic acid (6 grms.) and carbon dioxide (0·071 grm.) were the sole products from 5 grms. of alcohol, but with a concentration of potassium hydroxide as low as 0·53%, oxalic acid (0·951 grm.) was also found, and this substance rapidly increased in amount at the expense of the acetic acid until at an alkali concentration of 17% 2·992 grms. of oxalic acid, 3·519 grms. of acetic acid, and 1·772 grms. of carbon dioxide appeared as oxidation products of 5 grms. of alcohol. The experiments were conducted at 50° C.—G. F. M.

Magnesium halides; Etherates of ——. N. Domanicki. J. Russ. Phys.-Chem. Soc., 1915. **47**, 1790—1972.

Magnesium chloride yields a mono-etherate. $MgCl_2.(C_2H_5)_2O$. which is obtained by the action of magnesium on either an ethereal solution of *αβ*-dichloroethane or a mixture of dry ether with sulphur chloride. The analogous compound. $MgClBr.(C_2H_5)_2O$. is formed by the action of magnesium on an ethereal solution of *α*-chloro-*γ*-bromopropane.—T. H. P.

Organic arsenic compounds; Electrochemical experiments with ——. F. Fichter and E. Elkind. Ber., 1916. **49**. 239—251.

Quinquevalent arsenic in aliphatic and aromatic arsinic acids can be reduced by electrolytic hydrogen only in acid solution: in alkaline solution no action takes place. The electrolytic apparatus employed consisted of a porous cell of 35—40 mm. diameter. provided with a very well-fitting rubber bung. which was bored to carry the stem of a globular cathode and a gas-delivery tube. The solution to be reduced is placed in this cell which is inserted in a thick-walled beaker. a leaden spiral tube forming the anode and also acting as cooler. By the electrolysis of a solution of *p*-aminophenylarsinic acid in 2*N* hydrochloric acid, *p*-aminophenylarsine was obtained: $NH_2.C_6H_4.AsO_3H_2 \rightarrow NH_2.C_6H_4.AsO \rightarrow NH_2.C_6H_4.AsH_2$: but if the vessel was not absolutely air tight. *p*-arsenoaniline was formed by oxidation. For this reduction. amalgamated zinc formed the best cathode. mercury being slightly inferior. Using a lead cathode. the yield was improved by increasing the current density. by mixing alcohol with the aqueous hydrochloric acid. and by avoiding a rise in temperature. In a heated solution. aniline and arsenious acid were produced. By reducing *p*-aminophenylarsine oxide in presence of a lead cathode, or of an amalgamated lead or zinc cathode. the hydrochloride of *p*-arsenoaniline was formed:

(1) $NH_2.C_6H_4.AsO + 2H_2 = NH_2.C_6H_4.AsH_2 + H_2O$.

(2) $NH_2.C_6H_4.AsO + H_2As.C_6H_4.NH_2 = NH_2.C_6H_4.As:As.C_6H_4.NH_2 + H_2O$.

Phenylarsinic acid. dissolved in alcoholic aqueous hydrochloric acid. is reduced to phenylarsine. A solution of *o*-nitrophenylarsinic acid in 2*N* sodium acetate solution yields hydrazobenzene-*o*-*o*′-diarsinic acid.

$$H_2O_3As.C_6H_4.NH.NH.C_6H_4.AsO_3H_2$$

together with a little *o*-aminophenylarsinic acid. a platinum U-shaped cooling tube being used as cathode. In hydrochloric acid solution the reduction goes further. o-arsenoaniline hydrochloride being produced. The reduction of cacodylic acid to cacodyl was accomplished by electrolysing it in 2*N* sulphuric acid with a cathode of amalgamated zinc: a little cacodyl (and also dimethylarsine) escaped with the hydrogen. but most of it remained in the cell in a pure state. The oxidation of cacodylic acid by anodic oxygen was performed in 1*N* caustic soda solution; monomethylarsinic acid is first formed and this is slowly oxidised to arsenic acid:

$$CH_3.AsO_3H_2 + 4O = H_3AsO_4 + CO_2 + H_2O.$$

The electrolytic conductivity of several phenylated arsinic acids in various degrees of dilution was determined by the Kohlrausch method.—E. H. T.

Formaldehyde and other organic substances: Production of —— from formic acid. K. A. Hofmann and K. Schumpelt. Ber., 1916. **49**, 303—317.

The auto-reduction of formates by the action of heat was investigated by mixing them with an excess of ignited white sand and heating quickly to 150°—500° C. in a rapid current of moist carbon dioxide. The production of aldehyde was detected by means of the morphine-sulphuric acid reaction, and the quantitative yield. together with that of other products which react with iodine. was determined iodometrically. The gaseous products. carbon monoxide. hydrogen. methane. but not carbon dioxide. were also determined. as were also in many cases. the methyl alcohol. acetone. and carbon produced. The experiments showed that the metals could be arranged in a series indicating gradually increasing production of volatile organic carbon compounds from their formates. viz.: Ni, Fe. Mn. rare earth metals. Cu. Th. Na. K. U. Zn. Mg. Ca. Ba. Li. The detection of formaldehyde was rendered difficult in the case of the alkaline-earth formates owing to the presence of empyreumatic substances. furfural. and acetone: with barium and the alkali formates the aldehyde reaction was very indecisive. Nickel formate is decomposed at 210° C. into metallic nickel and gases. but no aldehyde is formed. 10 grms. produced 310 c.c. carbon monoxide. 801 c.c. hydrogen. and about 50 c.c. residual gases (methane). Ferrous formate at above 150° C. gave ferrous oxide. the same gases. and a trace of formaldehyde. Cupric formate. $Cu(HCO_2)_2+3\frac{1}{2}H_2O$. left metallic copper and evolved hydrogen. carbon monoxide and very little methane: formaldehyde was also produced. Manganese formate. $Mn(HCO_2)_2+2H_2O$. yielded manganous oxide. a little charcoal. aldehyde. and gases. Zinc formate at above 250° C. gave the oxide. gases. aldehyde. and appreciable quantities of other volatile organic compounds. Magnesium formate. $MgC_2O_4H_2+2H_2O$. decomposed at above 300° C. into oxide. charcoal. etc. Calcium formate. at above 380° C.. left the carbonate and charcoal. and more acetone and methyl alcohol than formaldehyde escaped: barium formate decomposed in a similar manner. Lithium formate. $LiCO_2H+H_2O$. gave thick white fumes at above 300° C.. substances resembling furfural and pyruvic acid. much charcoal. the inorganic gases. and much acetone and methyl alcohol. but little aldehyde. Sodium and potassium formates gave much carbon monoxide and hydrogen. but practically no formaldehyde. The addition of lithium or sodium formate to calcium formate resulted in a greatly increased production of organic substances which absorbed iodine. but no increased yield was observed when the lithium salt was mixed with barium or magnesium formates. Admixed lithium and nickel formates gave no organic distillation products and the quantities of gases evolved were very different from those expected. This was due to the nickel salt being decomposed first. and the resulting nickel acting catalytically on the other formate. Copper. reduced similarly from the formate. has also a catalytic effect on the decomposition of lithium formate.—E. H. T.

8-Hydroxyquinolinecarboxylic acids and their derivatives. Dihydroxyanthraquinone-3.7-diquinoline. Von Niementowski and Sucharda. *See* IV.

Gynocardia and chaulmoogra oils and gynocardic and chaulmoogric acids. Rakuzin and Flier. *See* XII.

Reducing power of soaps. Schrauth. *See* XII.

Determination of iodine in organic preparations. Rupp and Lehmann. *See* XXIII.

Patents.

Limes, oranges or other citrus fruits: Expelling machine for extracting the essential oils from ——. J. F. Driver. Loughborough. Eng. Pat. 1721. Feb. 3. 1915.

The machine consists of an eccentrically rotating flexible disc having a puncturing surface of small spikes on its working side and spring rollers for applying pressure to the other side: the fruits are pressed between the puncturing surface and a rigid or semi-rigid surface containing passages, which embrace the fruits and cause them to follow a compound curved path in regard to the actuating centre of rotation. The rigid surface of the conveyor disc may be constructed as an upwardly perforated or as an interlaced grid supported in a collecting receptacle for the expressed oil, both being of partial ring form, with or without sides for keeping the fruits in place. The conveyor disc is rotated at a different speed from the puncturing disc and actuates a feed-hopper from which the fruits fall into the respective recesses, while the flexible disc is raised as it passes over the lip of the hopper.—J. F. B.

Aromatic aldehydes; Manufacture of ——. J. Longman, London. Eng. Pat. 3152, Feb. 26, 1915.

The reaction between a liquid aromatic hydrocarbon and carbon monoxide, with formation of the corresponding aldehyde, is effected under increased pressure, in presence of aluminium chloride. The use of cuprous chloride is unnecessary but the presence of a little hydrochloric acid is sometimes an advantage. The method is also applicable to the halogenised hydrocarbons. Details are given of the preparation of benzaldehyde, *p*-tolyl-aldehyde and *p*-chlorobenzaldehyde, the pressure used varying from 50 to 90 atmospheres.—B. V. S.

Reducing or oxidising organic substances; Process for electrolytically ——. O. Imray, London. From Soc. of Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,750, Nov. 8, 1915.

The substance to be reduced or oxidised, is emulsified, either as such or dissolved in an immiscible solvent, with the electrolyte; the difference of density between the organic substance or its solution and the electrolyte is so great that emulsification can be effected by suitable mechanical means at one electrode, without the emulsion produced extending to the other electrode, which is in contact only with the electrolyte: no diaphragm is needed in the electrolytic chamber. For instance, in reducing nitrobenzene the anode is an iron cylinder with a conical bottom covered with cement and the cathode is a cylindrical bundle of iron gauze; the electrolyte is dilute caustic soda solution and the emulsion, produced by a high speed rotary pump, is fed on to the cathode from which the heavy nitrobenzene and azobenzene, as they separate, fall on to the cement bottom and are again put into circulation by the pump. In reducing azobenzene to hydrazobenzene the vessel has cement sides and iron bottom (anode); the electrolyte is caustic soda solution containing lead oxide and the solution of azobenzene in benzene floats on this; emulsification is effected by oscillation of the cathode at the surface of contact of the two liquids. Methods are also given for the reduction of nitrobenzene to hydrazobenzene, the reduction of nitrotoluene to hydrazotoluene, and the oxidation of isoborneol to camphor, the details varying with the densities and solubilities of the substances used.—B. V. S.

Formaldehyde solutions; Composition of matter for the production of ——. G. P. Fuller, Niagara Falls, N.Y., Assignor to The National Electric Co. U.S. Pat. 1,170,624, Feb. 8, 1916. Date of appl., Dec. 7, 1914.

A solid polymer of formaldehyde is mixed with a substance capable of dissolving it, such as an alkali or a substance giving an alkaline solution with water.—B. V. S.

Leucocytic extract and method of making the same. R. A. Archibald, Oakland, Cal. U.S. Pat. 1,171,299, Feb. 8, 1916. Date of appl., July 13, 1911.

Dilute acetic acid is added to blood to destroy the red corpuscles, after which the leucocytes are separated by centrifuging and are emulsified, neutralised, diluted, and heated to destroy any anti-ferments. The emulsion is then incubated until autodigestion takes place and the supernatant fluid is separated. This fluid forms a permanent solution, and possesses the property of increasing the number and the activity of the leucocytes when injected parenterally.—J. H. J.

Esters of 2-phenylquinoline-4-carboxylic acid and their derivatives; Preparation of liquid ——. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 287,959, Apr. 25, 1913.

The iso-amyl esters of 2-phenylquinoline-4-carboxylic acid or its derivatives are prepared in the usual way; they are specially valuable in certain diseases because of their oily nature and the ease with which they are absorbed by the skin.—B.V.S.

2-Phenylquinoline-4-carboxylic acid; Salt-like compounds of ——, *and its derivatives, homologues, and analogues.* Kalle und Co. Ger. Pat. 287,993, Oct. 7, 1913.

If the 2-phenylquinoline-4-carboxylic acid derivative contains a free carboxyl or hydroxyl group it is treated in dilute alkaline solution with tannin solution and then with dilute acetic acid; if it does not contain such a group it is treated in dilute acid solution with tannin followed by dilute sodium acetate solution. The tannin compounds have a similar action to the parent bodies, in their influence on the secretion of uric acid and their soothing effect in cases of inflammation, and in addition are tasteless and do not irritate the stomach.—B. V. S.

Quinoline derivatives containing iodine; Preparation of ——. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 288,303, May 15, 1914.

If in the usual methods for the preparation of derivatives of 2-phenylquinoline-4-carboxylic acid, an iodine compound of an aromatic amine, of an aromatic aldehyde, or of acetophene is used, an iodised end product is obtained. These new substances, whether the iodine is in the quinoline nucleus or in the phenyl side chain, have a therapeutic value, especially in the treatment of gout, since the action of the acid is strongly increased by the combination with iodine. The compounds are quite tasteless, unlike both the uniodised acids and iodides. As examples are mentioned the 4-carboxylic acids of 6-iodo-2-phenylquinoline, 2.4′-iodophenylquinoline, and 6-methoxy-2.4′-iodophenylquinoline.—B. V. S.

Amino derivatives of 2-phenylquinoline-4-carboxylic acid; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 288,865, July 20, 1914. Addition to Ger. Pat. 287,804 (this J., 1916, 198).

Isatin is condensed with amino-acetophenone, instead of with its acidyl derivative as in the first patent.—B. V. S.

2-Aryl-4-cyanoquinolines; Preparation of — Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,243, Nov. 25, 1914.

By heating an amide of a 2-arylquinoline-4-carboxylic acid above its melting point, water is split off and the corresponding nitrile is formed: from the nitriles other therapeutically valuable derivatives can be produced. Details are given of the preparation of 2-phenyl-4-cyanoquinoline. —B. V. S.

Cholic acid compounds; Preparation of tasteless ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,087, Apr. 16, 1914. Addition to Ger. Pat. 285,828 (this J., 1915, 1166).

Instead of using, as in the chief patent, acetic formic anhydride, formic acid is used, with or without condensing agents. Varying quantities of formic acid combine with the cholic acid, according to the conditions of the reaction. The new compounds are white powders, soluble in alcohol, acetic acid, and benzene, and form difficultly soluble barium salts.—B. V. S.

Alcohols: Preparation of unsaturated ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,271, Dec. 11, 1913.

3-Methylbutinol and its homologues are reduced by means of sodium, zinc dust and acetic acid, copper-zinc dust, colloidal palladium, or nickel, to 3-methylbutenol and its homologues, which by elimination of water give isoprene and its homologues. The reduction of 3-methylpentinol to 3-methylpentenol and of cyclohexanolacetylene to cyclohexananolethylene is described.—F. W. A.

Boro-disalicylic acid: Preparation of ——. A. Foelsing, Berlin-Wilmersdorf. Ger. Pat. 288,338, Feb. 8, 1914.

Hydrogen sulphide is led into an aqueous solution of the boro-disalicylate of a metal giving an insoluble sulphide. The acid obtained in this way, $OH.B:(O.C_6H_4.CO_2H)_2$, is easily soluble in water, alcohol, methyl alcohol, acetone, and glycerin, has a bitter taste and is non-poisonous. It is more strongly bactericidal than mixtures of boric and salicylic acids or their salts, and is useful as an internal antiseptic.—B. V. S.

Coli bacillus and lactic acid producing bacteria: Preparation of dry cultures of ——. M. Hohenadel, Aussig, Bohemia. Ger. Pat. 288,375, Dec. 10, 1913.

Flour which has been partially saccharified, is mixed to a thin paste with water, dilute salt solutions, milk-serum, etc., and used as a culture medium for the bacteria. The cultures are subsequently separated and dried in the usual way. These cultures are more easily soluble than casein cultures and consequently have a better action in the stomach.—B. V. S.

Organic phosphorus compounds: Preparation of ——. R. Willstätter and E. Sonnenfeld, Berlin-Dahlem. Ger. Pat. 288,393, June 30, 1914.

By simultaneous treatment of unsaturated compounds with phosphorus and oxygen, phosphorus oxide addition compounds are obtained, similar to nitrosites and nitrosates; P_2O_3 is added if the phosphorus is in excess and P_2O_4 if the oxygen is in excess. The reaction occurs with homologues of ethylene, unsaturated fatty alcohols and aldehydes, unsaturated acids and their derivatives, substituted aryl-olefines such as cinnamic acid, and cyclo-olefines such as pinene. The compounds are interesting because of their decomposition products, and their peculiar therapeutic properties. (See also this J., 1915, 683.)—B. V. S.

Aluminium ethoxide: Process for the distillation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 289,157, Feb. 22, 1914.

In distilling aluminium ethoxide at atmospheric pressure, if the vapours are quickly led away from the still, for instance by making it low, and condensation on the upper part of the still is prevented, there is no decomposition, and a product of equal purity and yield is obtained as by vacuum distillation.—B. V. S.

Acetaldehyde from acetylene; Process of preparing ——. P. Duden and G. Peters, Assignors to Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. Reissues Nos. 14,063 and 14,064, Feb. 15, 1916 (date of appl., Jan. 4, 1916), of U.S. Pats. 1,151,928 and 1,151,929, Aug. 31, 1915.

See this J., 1915, 1031.

Preparation of non-poisonous, non-alkaline, stable, oxygen-developing phosphates. Ger. Pat. 287,588. *See* VII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Opacity of diffusing media. O. Bloch and F. F. Renwick. Phot. J., 1916, **56**, 49—67.

The authors wished to determine the connection between the optical opacity of a dry plate and its photographic qualities. Abney, using a photographic method, found that the density (opacity logarithm) of a dry plate is not proportional to its thickness, and explained this departure as due to selective colour absorption by the film. Other observers have assumed density and thickness to be proportional, and in a report on diffusing media in Trans. Amer. Illum. Eng. Soc., Vol. X., No. 5 (P. G. Nutting, Chairman of the committee) it is stated definitely that this law holds for piles of opal glass, paper, etc. The authors coated emulsion on glass in different thicknesses, measured the density in contact with opal glass (D_o), and determined the silver salt per unit area by finding the percentage composition of the dry film and weighing the film on the piece of plate measured. By plotting densities against weight of AgBr, curves are obtained showing the density to increase more slowly than the weight; but if logarithms are plotted in each case, a straight line is obtained, the equation for which is $\log. D = b \log. W + \log. a$ or $D = aW^b$, a varying for the first three emulsions tested from 0·166 to 0·260, and b from 0·57 to 0·65 ($b = 1$ gives D proportional to W). That the explanation is not due to selective colour absorption was suggested by the fact that density measurements were made in blue light and also by making similar measurements with an emulsion of BiOCl, which is white and not light-sensitive; for this $D = 0{\cdot}20\ W^{0{\cdot}51}$. This rule was found to hold over very wide limits and two alternative explanations are offered—either that the medium has no specific density, the density of any part of the film being dependent on its position with respect to the illuminated face, or that the method of measurement was wrong. As no reason for the former could be seen the latter was assumed and a long series of tests made to find the effects of possible variations in methods of measurement. Opal glass was selected for this purpose owing to its high diffusing power, uniformity, and lack of colour. A piece of opal 1·1 mm. thick was selected and pieces of it reduced by hydrofluoric acid to various thicknesses down to 0·155 mm.; by using these and by addition for thicknesses above 1·1 mm. a total range from 0·155 mm. to 5·5 mm. was obtained. Density measurements were made under a large number of different conditions as to illumination, relative sizes of the various parts of the system, etc., testing all variations that seemed at all permissible. In each set the figures conformed very closely to the log. law, the value of b varying from 0·6 to 0·98 and 1·02; full details of the experiments are not given, only illustrations of the effect of some of the variations. The following conclusions are drawn:—The specific density of solid opal glass is independent of thickness, but it is difficult to be sure of measuring it accurately; all external scattered light must be carefully excluded; the area of the piece to be measured must be large in comparison with the thickness, to avoid the influence of light lost at the edges (at least 2½ cm. diameter for 5 mm. thickness); all surfaces must be matt, or optical contact must be made to avoid inter-reflection between surfaces; the specimen should be measured between two opals, the front (illuminating) one being a little larger and the back one a little smaller than the specimen. The values $b = 0{\cdot}98$ and $b = 1{\cdot}02$ were obtained by measuring between two opals with the limitations as to size, etc., as indicated above. The instruments used were the Ferguson-Renwick bench photometer and the Martens polarisation photometer, but the latter had too small an illuminating opal and diaphragm to give a value of b higher than 0·93 under the best conditions. Having apparently got a method for determining the specific density of opal glass fresh experiments were made with emulsion film. Keeping the film on glass, the value of b was 0·5 between two opals dry, from 0·6 to 0·65 with the film side only in dry contact with opal, and 0·85 glass side in oil contact with opal. Stripped film gave $D = 0{\cdot}74W^{0{\cdot}66}$ in oil contact with one opal and $D = 0{\cdot}76W^{0{\cdot}68}$ in oil contact between two opals, using the Martens instrument. With emulsion film of bismuth oxychloride and the bench photometer the values of b under the same conditions were 0·65 and 0·91, this latter being the highest value obtained for a gelatin emulsion film. To determine the effective density of such a film it was prepared in wedge form and a plate exposed behind it and a neutral wedge of known value to blue light (ammoniacal copper solution). Both images on the plate were carefully measured and plotted and by comparison with the known densities of the neutral wedge the effective densities of the emulsion wedge were obtained. The equation obtained in this way for the density of the emulsion film was $D = 1{\cdot}123W^{0{\cdot}82}$. The logarithmic relationship has a still wider application: for instance the relation between $D_{\|}$ and $D_{\#}$ given by Callier (Phot. J., 1909) as $D_{\#} = \frac{D_{\|}}{1.52}$ was found from Callier's own figures to be expressed much more closely in agreement with the experimental results by the formula $D_{\#} = 0{\cdot}637 D_{\|}^{1{\cdot}01}$ —B. V. S.

Resolving power of photographic plates. H. J. Channon. Phot. J. 1916. **56**, 71.

Tugman's paper (this J. 1916. 143) contains two mistakes with respect to Goldberg's work. When these are corrected it is seen that both forms of the turbidity factor, δ, given by Goldberg are identical, and not different as argued by Tugman. —B. V. S.

Patents.

Photographic plates. H. Arnold and M. Levy-Dorn, Berlin. Eng. Pat. 2243, Feb. 11, 1915.

The speed of photographic plates to X-rays is increased by the use of colloidal solutions of substances opaque to the rays, such as tungstic acid, thorium hydroxide, and the like. The colloidal solution may be introduced into the silver bromide emulsion at any convenient point in the process, or the plate may be double-coated, the first coating being a slow emulsion containing the colloid and the second coating an ordinary fast emulsion. The gelatin of the emulsion prevents precipitation of the colloid.—B. V. S.

Photographic papers, photographic film support and similar manufactures: Apparatus for coating and drying ——. F. M. Cossitt and L. D. Castor, Assignors to Ansco Co., Binghampton, N.Y. U.S. Pat. 1,171,321, Feb. 8, 1916. Date of appl., May 11, 1914.

The drying is effected in a vacuum chamber, fitted with a condenser, and containing the coating machine; special devices are adopted to maintain the emulsion at a constant level in the coating tank, to pass the material into and out of the vacuum chamber without interference with the vacuum, and to protect the coated surface from contact with other parts of the apparatus while in the chamber.—B. V. S.

Colour photograph or film and method of producing same. F. E. Ives, Woodcliffe-on-Hudson, N.J. U.S. Pat. 1,170,540, Feb. 8, 1916. Date of appl., July 1, 1914.

A two-colour process in which after producing an insoluble, blue-green image, the plate or film is re-sensitised, exposed, and the second image produced by a different process, generally by the introduction of a suitable red dye.—B. V. S.

Ripened, fine-grain photographic emulsions with animal or plant albumin as an important constituent: Preparation of ——. E. Lehmann, Charlottenburg, and P. Knoche, Berlin. Ger. Pat. 288,076, Apr. 16, 1914.

The emulsions are digested for some time at a temperature below their coagulation point, or after drying they are treated with steam: before treatment salts, such as potassium or ammonium nitrate, which promote coagulation are removed, for example, by dialysis, and salts hindering coagulation, such as iodides, bromides, and thiocyanates, may be added.—B. V. S.

Photographic materials (plates, films, paper, and the like) with addition of a dye by which the light-sensitiveness is reduced. G. W. A. Sosna and J. E. Biedebach, Berlin. Ger. Pat. 288,328, Feb. 5, 1915.

By treatment with a suitable blue or violet dye, such as Methyl Violet, the sensitiveness to artificial light is reduced without appreciable alteration of daylight sensitiveness.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Patents.

Explosives and process of making them. Dinamite Nobel Soc. Anon. Fr. Pat. 476,690, Dec. 8, 1914.

See Eng. Pat. 21,352 of 1914; this J., 1916, 111.

Explosives: Manufacture and stabilisation of ——. Melasse-Schlempe G.m.b.H. Fr. Pats. 476,930 and 476,931, Feb. 28, 1914.

See Eng. Pats. 5736 and 5737 of 1914; this J., 1915, 818.

XXIII.—ANALYSIS.

Paper pulp filter: Application of —— *to the quantitative estimation of calcium and magnesium.* S. L. Jodidi and E. H. Kellogg. J. Franklin Inst., 1916, **181**, 217—232.

A considerable saving of time is effected in the determination of calcium and magnesium by collecting the precipitates in a Gooch crucible containing paper pulp made from filter paper and tables of results show that the results are as accurate as when ordinary filtration is adopted. The estimation of calcium volumetrically by the titration of the combined oxalic acid with permanganate was performed in twelve minutes and the paper pulp did not interfere with the accuracy of the titration, as is stated to be the case when standard filter papers are used. When precipitating and filtering calcium oxalate it is necessary to have the solution dilute, ranging from 0·01—0·10 grm. CaO per 200 c.c.; with stronger solutions the filtrate is cloudy.—W. G. C.

Barium, strontium, calcium, and lead sulphates: Solubility of —— in ammonium acetate solutions at 25° C., and a criticism of the present methods for the separation of these substances by means of ammonium acetate solutions. J. W. Marden. J. Amer. Chem. Soc., 1916, **38**, 310—316.

The solubility of the four sulphates mentioned in ammonium acetate solutions of different strengths at 25° C. was determined and from the results it is evident that the solubilities even of barium and strontium sulphates are considerable as compared with their solubilities in water. The solubility of lead sulphate, however, increases much more rapidly than the others with increasing concentration of ammonium acetate. Addition of 1% of ammonium sulphate to the ammonium acetate solution diminishes the solubilities of barium and strontium sulphates sufficiently for a qualitative separation, calcium and lead sulphates being still soluble. A boiling 3N-ammonium acetate solution containing 1% of ammonium sulphate is therefore used to wash the precipitated mixed sulphates and the filtrate is evaporated with sulphuric acid, the residue ignited, treated with sodium hydroxide solution and filtered and the lead detected as chromate in the filtrate. The residual barium and strontium sulphates are converted into carbonates and examined in the usual manner.—G. F. M.

Iodine in organic preparations; Determination of ——. E. Rupp and F. Lehmann. Arch. Pharm., 1915, **252**, 443—451. J. Chem. Soc., 1916, **110**, ii., 110—111.

The method depends on the fact that chlorine and bromine in organic preparations are removed in the elementary state by heating with sulphuric acid and potassium permanganate in the presence of a silver salt, whilst iodine is retained in the form of silver iodate, provided an excess of permanganate is always present. Twenty c.c. of concentrated sulphuric acid and 25 c.c. of N/10-silver nitrate are heated in a 500 c.c. Kjeldahl flask until the flask is filled with white fumes. The mixture is then cooled, 2·5 grms. of finely powdered potassium permanganate is added, and a small glass tube containing the substance (0·25 grm.) is allowed to slide into the mixture. When a vigorous evolution of gas does not ensue by shaking, 5 c.c. of water is added immediately; otherwise the addition of the water is postponed until the vigorous reaction has almost ceased. After the addition of the water the mixture is vigorously shaken for one or two minutes, and is then kept for fifteen minutes with frequent shaking. The flask is then closed with a filter-funnel and heated in a sloping position, at first gently until the liquid boils, then strongly. The heating is maintained until the manganese dioxide has been almost entirely decomposed and a deep blue solution has been obtained. This is thoroughly cooled, treated with a freshly-prepared solution of 5 grms. of crystallised ferrous sulphate in 100 c.c. of water, and is vigorously shaken for a few minutes until the silver odide has curdled and the supernatant liquid is quite clear. The contents of the flask are then washed into a large beaker and the excess of silver s titrated with N/10-thiocyanate. In some cases ess energetic treatment suffices to decompose the organic preparation. For example, 0·5 grm. of airol (bismuth gallate iodide) is boiled for two or three minutes with 20 c.c. of 25% nitric acid and 20 c.c. of N/10-silver nitrate, the mixture is diluted with 50 c.c. of water and allowed to cool. little potassium permanganate is added to oxidise any nitrous acid and then ferrous sulphate until the red colour has disappeared, and the xcess of silver is titrated with N/10-thiocyanate; not more than 12·1 c.c. of the last (=20% of odine) should be consumed.

Determination of benzol in coal gas. *See* IIa.

Method of ascertaining the accuracy of producer gas analyses. Hoffmann. *See* IIa.

Colorimetric determination of acetylene. Weaver. *See* IIa.

Determination of potassium in potassium salts by the perchlorate method. Hager and Kern. *See* VII.

Determination of periodates, iodates, bromates, and chlorates in presence of each other. Differential iodometry. Barnebey. *See* VII.

Preparation of Wijs' iodine solution. Ueno. *See* XII.

New delicate method of analysing oils. Mazzaron. *See* XII.

Detection of rosin in driers. Boughton. *See* XIII.

[*Determination of*] *oxidising power of soils.* Gerretsen. *See* XVI.

Qualitative tests for and determination of gum arabic. Waters and Tuttle. *See* XVII.

Biological investigation of brewing waters. Will. *See* XVIII.

Polarimetric determination of starch in spent grains. Wieninger. *See* XVIII.

Determination of the amount of offal in cereal flours. Heiduschka and Heinich. *See* XIXa.

Constituents of sour milk precipitated in the alcohol test. Reiss and Diesselhorst. *See* XIXa.

Detection of free chlorine in town water supplies. Le Roy. *See* XIXb.

Purification of the residues left on evaporation of ethereal and chloroform extracts of alkaloids. Pereira. *See* XX.

Analysis, purification, and qualitative reactions of isoprene. Ostromyslenski. *See* XX.

Patent.

[*Carbon dioxide recorders, etc.*] *Instrument for recording percentage volumes of constituent gases.* W. W. Crosweller. Manchester. Eng. Pat. 5041, Apr. 1, 1915.

The gas samples are alternately sucked into and expelled from a gas burette, which is so arranged in conjunction with the inlet end of the siphon used for draining off water from the power vessel, that the gas burette will always contain a quantity of water which will become stagnant and saturated with the soluble constituents of the gas being tested. The absorbing vessel is filled with caustic potash solution of sp.gr. 1·27 and is in communication with the top of the gas measuring burette.
—J. B. C. K.

XXIV.—MISCELLANEOUS ABSTRACTS.

Water; Effect of dissolved substances on the velocity of crystallisation of ——. J. H. Walton and A. Brann. J. Amer. Chem. Soc., 1916, **38**, 317—330.

The crystallisation of ice from aqueous solutions at —9·1° C. was retarded by the dissolved substance in all cases investigated. Solutions of equimolecular concentrations show different retarding effects. For compounds with less than eight atoms per molecule the property is apparently quite specific, but with more than eight atoms in the molecule a rough relationship exists between the number of atoms and the inhibition—the greater the number the lower the rate. Colloids such as gelatin, ferric hydroxide, and certain dyestuffs also retarded the velocity of crystallisation.—G. F. M.

Trade Report.

Mineral production of Canada in 1915. J. McLeish. Canada Dept. of Mines, Mines Branch.

The Canadian metal-mining industry in 1915 showed the highest production ever recorded, and notwithstanding the greatly decreased production of materials of construction, such as cement, clay and stone quarry products, a very large increase is shown in the total mineral output, over that of 1914. The demand for copper, lead, nickel, and zinc led to great activity in the operation of the developed deposits of these metals and also, later in the year, to the opening up of old and the exploitation of new deposits. The capacities of steel furnaces were taxed to the utmost to meet the demand for shell steel. Among non-metallic minerals the recovery of benzol and toluol in by-product coke-ovens was a direct result of the war, as was also the activity in the mining and shipment of magnesite and of chrome ores.

The larger gains in metal production, as compared with 1914, were 49·6% in nickel, 35·5% in copper and 24·9% in lead. The only loss was 0·2% in silver.

The following table (which is subject to revision) gives details of the mineral production in 1915 :—

Product.	Quantity.	Value.
Metallic:—		
Antimony, lb.	961,040	$192,208
Cobalt, metallic, lb.	211,610	502,388
Cobalt, oxide, lb.	379,219	
Nickel, metallic, lb.	55,325	42,193
Nickel, oxide, lb.	200,032	
Copper, lb.	102,612,486	17,726,307
Gold, oz.	916,076	18,936,971
Iron, pig, from Canadian ore, tons	158,598	1,740,808
Iron ore, sold for export, tons	93,444	187,682
Lead, lb.	45,377,065	2,541,116
Molybdenite, lb.	28,600	28,460
Nickel, lb	68,077,823	20,423,348
Silver, oz.	28,401,735	14,088,397
Zinc ore, tons	15,553	636,204
Total	..	$77,016,082
Non-metallic :—		
Actinolite, tons	220	82,420
Arsenic, white, tons	2,291	141,830
Asbestos, tons	113,115	3,491,450
Asbestic, tons	25,700	21,819
Chromite, tons	11,486	162,618
Coal, tons	13,209,371	31,957,757
Corundum, tons	262	33,138
Felspar, tons	15,455	59,124
Graphite, tons	2,610	121,023
Grindstones, tons	2,580	35,768
Gypsum, tons	470,335	849,928
Magnesite, tons	14,779	126,535
Manganese, tons	17	5,460
Mica, tons	..	81,021
Mineral pigments :—		
Barytes, tons	550	6,875
Ochres, tons	6,248	48,353
Mineral water	..	118,796
Natural gas, M. cu.ft.	18,319,710	3,300,825
Peat, tons	300	1,050
Petroleum, bbl.	215,464	300,572
Phosphate tons	217	2,502
Pyrites, tons	296,910	1,028,678
Quartz, tons	127,108	205,153
Salt, tons	119,900	600,226
Talc, tons	11,885	40,554
Tripolite, tons	317	12,119
Total	..	$42,755,594
Structural materials and clay products :—		
Cement, portland, bbl.	5,681,032	6,977,024
Clay products	..	3,918,200
Kaolin, tons	1,300	13,000
Lime, bu.	4,932 767	1,015,878
Sand and gravel	..	2,098,683
Sand-lime brick, number	23,211,802	182,651
Slate, square	397	2,039
Stone	..	4,504,599
Total structural materials and clay products	..	$18,712,074
Grand total, 1915	..	$138,513,750

Books Received.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. I. Tungsten and Manganese Ores. By H. Dewey and C. E. N. Bromehead, with contributions by T. Eastwood, G. V. Wilson, and R. W. Pocock. Price 1s. Vol. II. Barytes and Witherite. By R. G. Carruthers, T. Eastwood, G. V. Wilson, R. W. Pocock, and D. A. Wray, with contrbutions by H. Dewey and C. E. N. Bromehead. Price 1s. 6d. Vol. III. Gypsum and Anhydrite. By R. L. Sherlock and B. Smith. Celestine and Strontianite. By R. L. Sherlock. Price 1s. E. Stanford, Ltd., 12, 13, and 14, Long Acre, London, W.C.

Prohibitions of export in force in the United Kingdom and in certain Allied and neutral Countries. Supplement to the Board of Trade Journal, Feb. 17, 1916. Price 3d.

This supplement contains complete lists of articles, which, according to information received by the Board of Trade up to the 14th February, are prohibited to be exported from the United Kingdom, and certain foreign countries, viz.: Denmark, France, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Roumania, Russia, Spain, Sweden, and Switzerland.

Production of explosives in the United States during 1914. By A. H. Fay. U.S. Bureau of Mines, Technical Paper 107.* Price 5 cents.

Permissible explosives tested prior to March 1, 1915. By S. P. Howell. U.S. Bureau of Mines, Technical Paper 100.* Price 5 cents.

Methods of preventing and limiting explosions in coal mines. By G. S. Rice and L. M. Jones. U.S. Bureau of Mines, Technical Paper 84.* Price 15 cents.

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* A limited supply of these is available for free distribution by the Director, U.S. Bureau of Mines, Washington, D.C. When this supply is exhausted, copies can be obtained at the prices mentioned from the Superintendent of Documents, Government Printing Office, Washington.

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Official Notice.

BRITISH INDUSTRIES AFTER THE WAR.

Appointment of Committees.

The President of the Board of Trade has decided to appoint Committees to consider the position of certain important British industries after the war, especially in relation to International competition, and to report what measures, if any, are necessary or desirable in order to safeguard that position.

The following Committees have been constituted:—

For the iron, steel and engineering industries.

Sir Clarendon Hyde (Chairman); Mr. A. Balfour; Sir Hugh Bell, Bart.; Mr. A. J. Hobson; Sir Hallewell Rogers; and Mr. Douglas Vickers.

For the shipping and shipbuilding industries.

Sir A. A. Booth, Bart. (Chairman); Professor W. S. Abell; Sir Archibald Denny, Bart.; Sir Edward Hain; Captain H. B. Hooper; Mr. James Readhead; and Mr. Oswald Sanderson.

All communications relating to the above Committees should be addressed to Mr. Percy Ashley, at the Board of Trade, S.W.

The constitution of a Committee for the *Textile industries* will be announced shortly.

London Section.

Meeting held at Burlington House, on Monday, March 6th, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

FUEL ECONOMY.

Y PROFESSOR WILLIAM A. BONE, D.SC., PH.D., F.R.S.

f the Imperial College of Science and Technology, London, S.W.

In opening this discussion it is not my intention do more than to present the salient facts of the tuation, and to enlist active interest and support r the work of the British Association Fuel conomy Committee which has been appointed consider it from a national standpoint.* It is ost important in regard to the task that the Committee has undertaken that there should be full opportunity for suggestions and criticism, which at this stage will be particularly helpful, because unless there is behind us the driving power of an enlightened public opinion, our labours will be largely in vain.

Fuel economy from a national standpoint.

The national aspects of fuel economy may be considered from two somewhat different standpoints—namely: (1) In view of the economic situation created by the war, and the necessity of enforcing a policy of national economy in the utilisation of essential commodities as the best means of paying a colossal war debt; and (2) in view of the interests of that remoter, but nevertheless not far distant future, when our coal supply will be restricted by approaching exhaustion.

It can hardly be questioned that the chief material basis of the great industrial and commercial expansion of this country during the past century has been our abundant supplies of easily obtainable coal, which, until quite recent years, have given us a position of great advantage over all other countries. It is also equally true that we can no longer claim any advantage in this respect over our two nearest competitors, and that our whole economic future is dependent on our ability to maintain abundant supplies of relatively cheap fuel, which in turn, is limited by the probable duration not of our *total* available supplies (which is after all only an academic question), but of our easily workable coal seams in relation to present and future demands. In other words, what we have to consider is how long we can continue to get coal at a cost which will not place us as a nation at a disadvantage relative to our nearest competitors.

In order that we may the more clearly apprehend the grave national importance of the coal question at this crisis in our history, I will invite attention to a brief statistical survey of the world's coal resources, and the relation of the principal coal-producing countries thereto. And in doing so, I am fully aware that all estimates of probable and possible supplies of coal must be regarded as to some extent conjectural, and subject from time to time to revision as new regions are geologically surveyed and opened out. Nevertheless, there are good grounds for believing that the extent and distribution of the world's coal reserves are now sufficiently well known to warrant a tolerably accurate forecast of the future to be made.

The world's coal resources.

According to an exhaustive and very illuminating report upon the World's Coal Resources issued by the International Geological Congress in 1913, the total probable and possible reserves of coal of all kinds (including anthracites, bituminous coals, and lignites) available within 6000 feet of the earth's surface, are estimated to be 7,397,553 million metric tons; or, approximately 6000 times the present total annual consumption.†

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* For a fuller statement of my views the reader is referred to y recent lectures before the Royal Institution, which are now blished in pamphlet form.—W. A. B.

† See also W. F. Reid, this J., 1915, 775.—Ed.

Therefore, the world as a whole need have no fear of any speedy exhaustion of its coal supplies.

Of the estimated total reserves, 6·75 % are anthracites (mainly located in China), 52·75 % are bituminous coals, 40·5 % belong to the less valuable sub-bituminous class, which includes all the lignites and tertiary brown coals.

A survey of the geographical distribution of the estimated reserves should cause the belligerent powers of Europe to recognise the folly of the present wholesale destruction of human life and accumulated wealth, for no less than 69 % of the total are located in America (almost wholly in North America), 17·3 % in Asia, 10·6 % in Europe, 2·4 % in Oceania, and only 0·8 % in Africa. It is a significant fact that the two tropical Continents of South America and Africa are practically destitute of coalfields of any economic importance. The future wealthy republics of South America must continue, as heretofore, to import coal, machinery, and heavy manufactured goods, in exchange for agricultural produce and raw materials.

Pursuing the matter a little further, we find that of the total estimated reserves, 51·8 % are located in the United States, 16·4 % in Canada, 13·5 % in China, 5·7 % in Germany, 2·6 % in Great Britain, 2·4 % in Siberia, 2·2 % in Australia, and only 0·8 % in Russia. I think that China's resources have probably been considerably under-estimated; and I should be inclined to place China second to the United States. Otherwise the relative positions of the remaining countries are probably substantially as stated. It is, therefore, not difficult to foresee where, in the not far distant future, when Europe's coal supplies approach exhaustion, the world's chief centres of manufacturing industry will be located.

The relative insignificance of Great Britain's coal reserves is a fact of which our commercial and ruling classes seem to be profoundly ignorant, otherwise effective measures would have been taken long ago to check the criminal wastefulness of all classes of the community using coal.

It must be our business not only to make these facts universally known, but to insist upon the Government taking immediate effective action in the direction of establishing some systematic supervision and control of fuel consumptions in all large industrial areas, and of furthering scientific investigations on a large scale upon the better utilisation of coal. Chemists have succeeded in rousing the Government to action in regard to the revival of our languishing coal-tar colour industry, but no organised body of scientific men, so far as I know, has hitherto thought it important, or worth while, to take similar action in regard to the vastly greater subject of fuel economy and the proper utilisation of coal. The time for action has now come, and if we fail to discharge this obvious duty, we shall have forfeited, as a class, all claim to leadership and public esteem.

The world's demands for coal are increasing rapidly year by year. Thus in 1903, they were 800 million tons; five years later—that is in 1908—they had increased to about 1,000 million tons; and by the year 1913, they amounted to no less than 1,250 million tons. This represents a continuous increase over a ten-years period, at a "compound interest" rate, of nearly 5 % per annum, which rate is hardly likely to diminish after the conclusion of the present war.

Inasmuch as the world's demands have, during the period in question, been principally supplied by three countries—namely, the United States, Great Britain, and Germany—which between them have annually raised practically 83 % of the coal consumed in the world—we may now concentrate our attention upon the statistics for these countries.

If we examine the annual outputs of anthracite and bituminous coals (lignite and brown coals have been excluded because of their relative unimportance, although Germany annually raises large quantities of brown coal for consumption) of the three countries for each of the fifteen years 1900 to 1914 inclusive, excluding the outputs for the last of these years, all of which showed a sharp decline owing to industrial dislocation subsequent upon the outbreak of the war, and the year 1912 for the British output, which was affected by the great coal strike, we find that the outputs of all three countries, and particularly those of the United States and Germany, showed a progressive increase over the whole period.

If now, the average outputs for each of the three successive quinquennial periods included in the fifteen years' survey be taken, the following figures are obtained, which indicate that the output of the United States is increasing annually at a "compound interest" rate of 6 %, that of Germany at a compound rate of 4 %, while the British output is increasing at a compound rate of only 2 %. Assuming that these relative rates of increase are maintained after the war, it may be predicted that Germany's output of coal will overtake that of Great Britain about twenty years hence, when each country will be producing some 120 million tons per annum.

Coal productions of the United States, Great Britain, and Germany—Quinquennial averages, 1900 *to* 1914*—millions of tons per annum.*

	United States.	Great Britain.	Germany
1900–4	288·2	226·8	112·5
1905–9	400·5	256·0	139·8
1910–14	519·2	269·9	168·7
Approximate percentage rate of increase (compound interest)	6·0	2·0	4·0

The following quinquennial averages of Britis output of coal for a period of 45 years from 187 to 1914 inclusive, shews how closely the continuou increase in production has followed a 2 % com pound interest law.

Coal productions in Great Britain—Quinquenni averages, 1870 *to* 1914*—millions of tons p annum.*

Perivel.	Average Output.	Calculated at 2 %. Compound Interest
1870–4	121·5	121·5
1875–9	134·0	131·1
1880–4	156·0	148·1
1885–9	165·0	163·5
1890–4	180·0	180·5
1895–9	202·0	199·8
1900–4	227·0	220·1
1905–9	256·0	243·0
1910–14	270·0	268·2

There are three points to which I desire to c attention in connection with these figures. T first is that the total outputs by no means repres the real rate of depletion of our available suppli a vast amount of coal is left behind in the mi because under present individualistic conditio it does not pay to bring it to the surface. A bigger profit on the capital of a colliery company can often be earned by working the better classes of coal and leaving the softer or inferior grades underground. According to figures issued in the Report of the 1905 Royal Commission on Coal Supplies this wastage amounted to about 25 per cent. of the total coal won in the larger coalfields, and personally, I consider this to be a conservative estimate. The question of checking this wastage is one of supreme national importance. Much of the coal now left in the mine ought to be brought up and converted at the pithead into useful forms of energy and products for public purposes. Some people put it forward as an argument in favour of the nationalisation of mines, and most of us will I suppose agree that the nation should possess and exercise some power of control or supervision in such a matter.

But from the *gross* amount of coal actually brought to the surface a certain deduction must be made on account of power expended in the actual mining operations (winding, hauling, pumping, ventilating, etc.) before we arrive at the *net* coal available for public consumpton. There are great differences in the efficiencies of colliery machinery for such purposes. Here again some supervision by an Advisory Fuel Board would certainly effect economies in the case of inefficient plants.

We are all painfully conscious of the substantial advances of the price of coal for manufacturing purposes during recent years ; selecting the two triennial periods, 1897-9 and 1907-9, respectively, as a base of comparison, the average pithead price of coal increased from 6·62 to 8·66 shillings per ton, or by more than 30%, and the result of the great coal strike of 1912, and the legislation which it provoked, has been to accelerate this rise. The increase in the cost of getting coal in this country, due partly to deeper workings, partly also to greater precautions for ensuring the safety of the miner, as well as to higher wages, is a matter of serious public concern. Much of this increase is inevitable and, therefore, unavoidable ; but it can be effectively counteracted by corresponding economies in the uses of coal.

I come next to our export trade in coal, about which there is much difference of opinion. During the past sixty years it has increased something like twenty-fold and since 1870 the proportion of exported coal to the total output has increased from about 13% to over 30%, whilst its percentage value relative to our total export values has increased from 4·3 to 10·4%. In the year 1913 we exported 97·7 million tons, or 34% of our gross output, valued at £53,000,000. We now transact 70% of the world's sea-borne coal trade, and as the trade is so vital to the maintenance of our mercantile supremacy, it is hardly likely hat our Government would want to hamper it, much less to see it diminished. As it will probably go on increasing for some time to come, he question of the re-imposition of our export duty is almost certain to come up in the near uture. Every shilling of duty imposed per on would bring in to the Treasury £5.000.000 per annum, and I venture to suggest that the Government might well impose a duty the proceeds of which should be earmarked for nvestigations upon coal and fuel economy, and n loans in aid of installing improved means of sing fuel.

With regard to our home consumption of coal, which since 1871 has increased from 4·0 to 4·5 ons per annum per head of population, there will e general agreement about the prodigious waste and inefficiency which is going on everywhere around us every hour of the year. The 1905 Royal Commission estimated that the possible saving in our annual coal bill at that time amounted to between 40 and 60 million tons, or say about 30% of the total fuel burnt ; but even this was, in my opinion, an under-estimate of the real waste at that time, and probably there is to-day quite as great a margin for economy. Now it is pertinent to ask what public action have the Government or our scientific and industrial leaders taken since 1905 to check this criminal waste. The answer is absolutely nothing : for anything that has been done in a public way, the 1905 Commission might never have reported. Nor was the subject mentioned when ministers of the Crown addressed lately the pioneers of economy who rolled up in their motor cars from Park Lane to the Guildhall, upon the virtue and necessity of national saving at this crisis. Yet of all directions in which national economy can be most healthfully and advantageously exercised, this is perhaps the most obvious and prolific. Why should not deputations from our scientific and technical societies be sent to Whitehall to insist on something being done ? The nation has a right to expect that its scientific leaders shall not allow the Government to overlook such an important matter.

As the basis of an estimate prepared by Mr. George Beilby for the 1905 Royal Commission, we can form the following approximate estimate of the relative magnitude of the various uses of coal in this country, which are roughly grouped under 5 heads.

	%	
(1) Mines and factories	40	Power purposes 30·0%
(2) Iron, steel, metallurgical, pottery, and ceramic industries	20	
(3) Gas works	10	Carbonisation 20·0%
(4) Railways and coasting steamers	10	
(5) Domestic purposes	20	
	100	

The Committee which has been appointed by the British Association includes prominent representatives of the principal industrial users of fuel, as well as eminent "power" engineers and chemists who have made a special study of gaseous fuels and combustion ; and while every important branch of fuel technology is represented, there is no preponderating interest, so that the problem of fuel economy and the proper utilisation of coal will be reviewed from a national and not from any sectional standpoint.

The scope of the inquiry being so wide, the Committee has wisely decided to resolve itself into five different Sub-Committees, each with its own Chairman, for the detailed consideration of the following five important aspects of the problem.

I. *Chemical and Statistical* (including the chemical nature of coal and the character of the principal British coal seams). Chairman : Dr. J. T. Dunn, of Newcastle-on-Tyne.

II. *Carbonisation* (including gas works, coking ovens, low temperature distillation, and the utilisation of products derived therefrom). Chairman : Mr. T. Y. Greener, of Beamish, Co. Durham.

III. *Power and Steam Raising*, including experiments of public power schemes. Chairman : Mr. Chas. Merz, of London.

IV. *Metallurgical (Iron and Steel) and Ceramic Industries.* Chairman: Dr. J. E. Stead, F.R.S., of Middlesbrough.

V. *Domestic Smoke Prevention*, including problems relative to domestic heating. Chairman: Mr. E. D. Simon, of Manchester (who is also Chairman of the Manchester Corporation Committee on Air Pollution).

It will be the first duty of each Sub-Committee to collect the data and information, whether published or otherwise, as will enable it to report to the General Committee as to the present state of science or practice in relation to the particular aspect of the fuel question falling within its purview and in the cases of Sub-Committees II., III., and IV., they will endeavour to arrive at a judgment as to (1) the probable *average* efficiencies actually realised in practice, (2) the best average efficiencies which might be expected if the best appliances and methods were universally employed, and (3) the probable margins of economy.

The General Committee will sit at intervals to receive and discuss memoranda submitted by the various Sub-Committees, and such as are approved will probably be referred to a special Committee appointed to edit the various memoranda for publication and to draft the main covering Report.

Having thus reviewed the present state of science and practice relative to coal and its uses in the various principal industries, the Committee will then proceed to consider the question of the ways and means by which economies already within reach can be realised, and what steps (if any) should be taken in the direction of public control and supervision of fuel consumption; this part of the inquiry will necessarily include the consideration of the question of how far, and on what lines, the Government may help either by the establishment of a Fuel Advisory and Control Board, or by the carrying out of large scale investigations in a Central Fuel Experimental Station, or both.

Now it is highly important that the Committee should not only be assured of the active interest and support of the fuel using industries, but also that suggestions and information bearing upon its work should be freely communicated to it, either openly or confidentially, as the case may be. Such communications may be made in the first instance either to myself, as Chairman of the General Committee, or to Mr. E. D. Simon, of 20, Mount Street, Manchester, the Secretary; they will then be passed on to the Chairman of the particular Sub-Committee concerned. Any, and all communications marked "*confidential*," and intended for the guidance of the Committee in arriving at its conclusions, will be so treated; on the other hand, due acknowledgment will be made of the source of any information which may be communicated for publication and of which use is made in the Report.

As Chairman of the Committee I naturally feel some hesitation in putting forward any decided views of my own whilst matters are *sub-judice*, lest I should lay myself open to the accusation of seeking to prejudice the inquiry. In order, however, to give point to this discussion I may perhaps indicate a few of the more important aspects of the problem which seem to me to require special consideration; no doubt others equally important will be suggested during the discussion, and I have purposely not attempted to make a complete or exhaustive list.

(1) In the first place, there is a great need of much further experimental research upon the chemical character of coal, about which we are still very ignorant. At present our knowledge concerning the combustion and distillation of coal is entirely empirical, and will necessarily remain so until we have gained a much clearer insight into the real nature of the complex compounds contained in the coal substance, and of the mechanism of their decomposition by heat.

(2) Concurrently with such an inquiry there should be undertaken a systematic chemical survey of the principal seams in British coalfields, for not only do coals from different seams vary greatly in their physical texture and chemical character but also considerable variations may be traced along one and the same seam, and it is important that such differences and variations should be systematically worked out and made public. The determination and compilation of such data would be invaluable to manufacturers, and when completed would provide a basis for a scientific classification of British coals generally, which at present we do not possess.

(3) The problem of low temperature distillation is of great national importance, both from the point of view of the domestic smoke question and as a source of hydrocarbon oils suitable for motor spirit. The use of raw coal for domestic fires, steam raising, and furnace work generally is a barbarous custom which from a chemical point of view cannot be defended. The investigation of the manufacture and uses of smokeless "semi-coke" is not a matter which ought to be left entirely to private enterprise; it should be supplemented by a systematic investigation on behalf of the public by disinterested experts aided by substantial Government grants.

(4) In connection with the subject of carbonisation, I desire to repeat the views which I have already expressed on several former occasions as to the unsatisfactory situation in the coking industry. It is to be deplored that out of the 20 million tons of coal carbonised for hard metallurgical coke in the year 1913, no less than 6·5 million tons were treated in bee-hive ovens, involving a dead loss in values of by-products of something like £2,500,000 sterling. In face of the fact that all bee-hive ovens have long ago been abolished in Germany, their continuance in this country is a grave reflection upon our industrial economics, and I suggest that the Government be pressed to give a reasonable time-limit beyond which no bee-hive oven installation shall be allowed to remain in operation.

But the present situation in the by-product coking industry itself calls for immediate action. We depend largely upon this branch of industry for our supplies of benzol and toluol which are essential for the manufacture of high explosives, and one would have thought that long ago the Minister of Munitions would have established a systematic chemical inspection and supervision of all by-product coking-plants, but this has not been done. I have repeatedly drawn the attention of the Ministry to this serious omission and have offered to help in organising such control, but to no purpose.

The position in regard to the supplies of benzo and toluol may be sufficiently gauged by a statement recently made in the United States Geologica Survey Bulletin No. 254, that benzol normall selling for 20 cents or less a gallon, has been sold i America at $1·25 for immediate shipment and fo 65 cents on contract; whilst toluol, with a norma price of 25 cents, has been sold for as much as $ a gallon for immediate delivery and for $1.2 on contract.

Anyone who has perused the recent numbers the excellent Coking and By-Product Sectio issued monthly by the "Gas World" will be aware of the serious dissatisfaction with the Ministry of Munitions which is prevalent throughout the by-product coking industry. A paper recently read before the Coke Oven Managers' Association by Mr. G. Stanley Cooper on "Some Difficulties due to War" was a scathing indictment of the policy of the Government in connection with by-product coking as a munitions industry. I am constrained to quote one paragraph from the paper because it is an endorsement of all that I have publicly said during the past six months with reference to the scandalous neglect of the Government in this particular:—

"In view of the importance of benzol in the present crisis it is rather surprising that we have not had some official guidance with regard to the best method of working our plants to produce the largest yield of benzol, etc. . . . I think that the first step which the Ministry of Munitions ought to have taken was to appoint a committee of practical men to investigate the question and give us all the benefit of those investigations. They should tell us not only what to do, but how to do it."

In commenting upon this paper, a "Gas World" leader remarks:—

"From the tone of the discussion it may be gathered that it is the intention of the Association to make strong representations to the Ministry of Munitions that the industry should be consulted on all propositions affecting its members—a very necessary step if the best results are to be attained."

(5) The question of power production and steam raising will receive special attention by the Committee, for the margin of realisable economy in this direction is admittedly very large. Here it is a question not merely of the efficiencies of the various types of prime movers, but also of the organisation of public power schemes and the utilisation of the various forms of surplus energy which are now wasted in every large industrial area. I have dealt with this question fully in my recent Royal Institution Lectures, and time does not permit of my developing it further to-night.

(6) Considerable progress has been made within the past few years in the direction of utilising surplus coke oven gas and blast furnace gas for power and heating purposes in the iron and steel industries, but much remains to be done in the way of accelerating the change over from the old uneconomical arrangements and setting out of plant before the possible economies are fully realised. When by-product coke ovens, blast furnaces, steel furnaces, and rolling mills are universally located on one site and put under one management, it will be possible to turn out a ton of finished steel section from the rolling mills with the expenditure of no more coal than must be charged into the coking oven in order to provide the necessary coke for the blast furnace. The need of gas producers and coal fired boilers in the steel works and rolling mills will disappear, except perhaps in the manufacture of special steels, and in armament works. Our present output of iron and steel might be achieved with about two-thirds of our present fuel consumption.

DISCUSSION.

Dr. **CHARLES CARPENTER** said that no thinking man could be present at that meeting without being conscious of the fact that they were face to face with a very grave situation, affecting not only the present, but the future of this country. One fact he thought must come home to every one of them, namely, that it was high time they realised that their birthright in the land was not only liberty, but an interest in the disposal of its mineral resources. Professor Bone had pointed out their great importance to the welfare of this country; and he thought they could not but agree that they certainly ought to have something to say with regard to their utilisation. The only difficulty was how they were to put that principle into practice. Professor Bone had given an example of the attitude of the most up-to-date Government Department they had had in this country, namely, the Ministry of Munitions, to the coking industry. Yet it was to the Government they must look if anything were to be done in putting the fuel problem on a proper basis. It was perfectly certain that individualism had entirely broken down. From whatever aspect the coal question was looked at, present methods were absolutely wrong: for instance the export of coal was untrammeled and uncontrolled in any way, the producers of the coal sending it out of the country for a few extra pence a ton to those who were competing in nearly every industry. And if they looked at the matter from the point of view of the utilisation of the energy that existed in the coal, the present state of affairs was equally unsatisfactory.

He supported Professor Bone's suggestion with regard to the great importance of arriving at some opinion as to what was possible in the way of converting the energy of the coal into fuel. Speaking for one industry which appeared in the figures Professor Bone had placed before them, he did not think there was any industry in the country which knew so little of what was possible to be achieved, than the industry engaged in carbonising coal for the production of illuminating gas. The present working was quite empirical; and he did not know that any real steps had been taken, except in a crude and elementary manner, to fix a goal for their efforts. There was no standard result to guide them as to how coal should be carbonised, and in what degree they were obtaining the best possible returns. He did not think they could rely upon those responsible for working gas undertakings, who were no different to other manufacturers, and unlikely to take upon themselves the responsibility of making this investigation. But he thought there was much to be said for the admirable suggestion made by Professor Armstrong at Newcastle, that a small tax should be levied upon the coal raised to be applied for the specific purpose of protecting the user.

As had been pointed out, and he agreed, it was their duty to take the matter up seriously, and bring it home to the Government, though he realised that was a most difficult problem. With regard to the work Professor Bone had done on the utilisation of the energy of heating gas, he was afraid, like many other pioneers and investigators, Professor Bone was not likely to reap the full benefit which was bound to accrue from that work, but he had set many people thinking. It had been proved to be economic in many cases, and on a considerable scale, to substitute gas heat for solid fuel, simply by reason of the fact that the amount of heat required to be put into the article which needed the heat was so absolutely under control.

Professor **H. E. ARMSTRONG** expressed great surprise that Professor Bone should come forward to speak of the work of the British Association before their Society, of work which their Society ought to have done years and years ago. What was a Committee of the British Association? It was a Committee of one, he said, with power to add to its number. The Committee was Professor Bone; he had had the wit to gather certain men around him and had led them to take on this work. The British Association was a mere figment of the imagination. It did not exist except for a few hours, once a year. It was a pure farce that a subject of such vast importance should be undertaken in such a way. The question was whether they were or were not going to take this matter in hand themselves? The Society ought not, for one moment, to allow Professor Bone to continue this so-called British Association Committee: the task he had set himself ought to be the work not merely of a Committee but of the whole Society of Chemical Industry. What was the Society going to do? They had heard their President speak. Within the next few weeks, were they going to tell the Government what to do in this matter of fuel economy and insist on their following the advice that was given them? Everyone knew the problem was of the greatest importance to industry generally: that our existence as a commercial and manufacturing nation was at stake. It was not a question of thinking of Germany alone. They had to take into account the fact that 61% of the coal was in the United States. That was the factor which was going to tell against Great Britain in the future. They would not need to bother about the German factor, in the long run. They might be affected by it for a few years after the war—because the Germans would still be organised and we would not be. What they had to consider was the enormous resources of raw materials in the United States, not only of fuel but of other materials which could be worked up with that fuel. He had travelled through the Missabie iron region. west of Lake Superior: he had seen nothing but iron ore along a belt a couple of hundred miles long, 20 miles wide; the deposits were anything up to 600 feet deep below a thin crust of drift. These were the facts they had to bear in mind.

As to Professor Bone's point of Germany being on a level with this country 20 years hence, he had spoken only of their output of coal; but it was necessary to look at the matter from the point of view of the use Germany was going to make of the coal she raised in comparison with the misuse that would be made of it in the United Kingdom if we did not reform our ways.

Reference had been made by the President to flameless combustion. Professor Bone, had brought out his invention several years ago but, in the way customary in this country, it had got into the hands of the company promoter; Professor Bone was out of it and the enterprise was asleep.

Professor Bone had talked of ear-marking the duty on coal exports? What he would propose to them was to ear-mark Professor Bone to take him away from this absurd collecting of mere information for a British Association Committee and set him to work which he was specially fit to do, far, far more fit than any other man in the country, namely, to develop the subject of surface combustion. The Germans were working at it as hard as they could. That was the direction in which the Society should show itself to be practical. Far better use would be made of Professor Bone, if they could in some way lay hold of him for the work he had instigated. He (the speaker) wanted the £600,000 a year that could be got by placing a tax of ½d. per ton on all coal raised at the mine used to help men like Professor Bone to find out how we could best utilise coal. If that were done they would be within a measurable distance of accomplishing something. As he had said at Newcastle, this Society would lose all public esteem if it did not come forward in protection of the public against the company promoter who was going to start in on the soft smokeless coke business; there were signs of him everywhere. People would only lose their money if they supported any process of that kind so long as attempts were made to solve it by small scale experiments. It seemed to him, if this Society were going to do anything at all—and it had never had such an opportunity as that now before it of doing great national work—it must at once appoint a small Committee to draft a Memorial to the Government outlining a scheme for legislation, and then ask to see Mr. McKenna and Mr. Lloyd George. His view was that unless their Society were now to show itself alert and take the opportunity before it to do something real, it could not last, as it would not remain of any worth.

Mr. **Jacques Abady** said that it was somebody's function to see that the public only used coal in an economical way. It might be said that was a matter for which the chemists had the whole responsibility: but it would almost appear as though the chemists were waiting for the Government to tell them what to do, instead of the Government waiting for the chemists to tell them what to do.

With a view to the recovery of by-products, he suggested that they might with advantage direct their attention to urging the use of coal by closed distillation rather than open combustion; and if necessary to try to foster legislation and every movement on the part of the Government or the Municipalities to encourage that. It must not be thought that in utilising electricity for power (as for instance in Mr. Merz's North of England electricity scheme, which had been referred to), they were doing away with the waste of coal. Unless electricity were produced by some method of combustion in which by-products were recovered, and that combustion was applied to the utilisation of prime movers which were economical, then they would be deceiving themselves if they thought they were being economical.

Mr. **W. J. A. Butterfield** called attention to methods by which economy might be effected in the consumption of raw coal for power purposes. It appeared useless at the present time to ask the central power station engineer to adopt large gas engines in place of boiler plant and steam turbines, because he was not satisfied of the efficiency and reliability of large gas engine units for the continuous work of a central power station. The Committee referred to by Prof. Bone might usefully endeavour to secure the improvement of large gas engines in order to make them acceptable for central power station work, whereby the complexity of the production of power from coal by means of the boiler and steam turbine or other engine would be avoided in favour of the simpler and more efficient conversion by means of the internal combustion engine. So long, however, as the central power station engineer was dependent on the boiler and steam turbine it would be difficult to show that economy of fuel could be effected by gasifying the coal before use as a boiler fuel. The coal might be gasified directly as in the Mond process, or it might be carbonised and the coal gas and the resultant coke, or producer gas made from the coke, used in place of raw coal in the boilers, but in either case about 25% of the calorific value of the coal was lost in the gasification process, and, on the large scale, gas firing of boilers, *e.g.*, at Dudley Port, showed an evaporative efficiency of about 80%. Prof. Bone had obtained a higher evaporation from gaseous fuel, but it would be impossible to assume at present that in the gasification of coal and the consumption of the gas under boilers more than 65% of the calorific value of the coal would be utilised in the generation of steam. Raw coal in modern power station plant gave as high an evaporative efficiency, and the cost of the gas making plant was saved. The by-products of gasification would have to attain an altogether improbably high market value if they were to repay the cost of the gas making plant and the expenses of operating it. Except when applied to inferior grades of fuel, gasification therefore appeared to offer no prospect of economy over the consumption of raw coal if power stations worked through boilers had alone to be considered. Considerable economy in the consumption of coal for the production of power could be readily effected in many works and power stations through the replacement of inefficient boilers and steam engines by more modern plant, and this replacement should be furthered by private effort in all directions, supplemented perhaps by State intervention.

There were other cases of industrial heating in which it would be difficult to prove that the use of gaseous fuel would conduce to economy as compared with raw coal. For instance, the earliest rotary cement kilns were heated by producer gas, but this had now been displaced by coal dust, which had been found to be more economical. It was possible that with the greater efficiency of modern producers and methods of burning gas, producer-gas firing of these kilns might be reinstated, but it would be difficult to obtain in them compensation for the inevitable loss in the producer of an appreciable proportion of the calorific value of the coal.

In domestic heating there was much room for economy of fuel, but it seemed doubtful if the small householder would take kindly to the use of soft coke of the "Coalite" type. This fuel had the disadvantage of extreme bulkiness as compared with coal, so that the small cellars of town houses would hold only half as much fuel of this type as of coal, and more labour and expense would be involved in the transport of so bulky a material. Gas coke laboured under this disadvantage as compared with raw coal, though to a less degree. Economy in the domestic consumption of coal might best be effected by promoting the use of coal gas for both heating and cooking purposes whereby a large quantity of coke would be produced and made available for use in industrial operations in place of raw coal.

Mr. **Walter F. Reid** said he thought Professor Armstrong was right as to the importance he attached to the Committee of the British Association. He did not think the British Association would have very much weight with the Government. That very matter had been discussed fully at their Annual Meeting at Manchester when he himself had read a Paper on the subject (see this Journal, 1915, 775); in addition to the figures given by Professor Bone, he had also given some statistics, which summed up the coal production of the Central Powers, and compared it with the coal production of themselves and their Allies. Germany now had Belgium, and the coal-producing district of France, which gave a production of about 366,000,000 tons of coal, whereas the amount available for the Allies was about 111,000,000 tons.

Very great advances had been made with regard to the production of power from coal, and figures had been given in his Paper showing how the cost of electricity produced from coal had been diminished, especially in London; at one generating station, for example, in 1899 23·1 lb. of steam had been used to generate one kilowatt, 16·15 lb. in 1909, 2·75 lb. in 1914, and only 11·8 lb. per kilowatt in 1915. They were certainly advancing, and private enterprise was not altogether idle. In many of the statements that were made about by-products and their value, one thing which was very often omitted was the question of the carriage, which had been pointed out by Mr. Butterfield. It was necessary to have all the materials on the spot. The production of power direct from pulverised coal was also being experimented with at the present moment. If the difficulty with regard to the process for the generation of power by direct combustion of pulverised coal were surmounted, the production of gas would be done away with altogether. Those were all directions in which he thought they should work. Anything that could stop the domestic consumption of coal in the open grate, would undoubtedly be of great national advantage. Very good work was being done in that direction in Manchester and other places. The Coal Smoke Abatement Society of London had done a very great deal to prevent the production of those dense fogs which had been so frequent in London at one time, but were now so rarely seen. He agreed with the suggestion made by Professor Armstrong and many others, that if people were to make a personal profit out of the waste of our coal reserve, through exportation to foreign countries, they should certainly be made to contribute in some way to the economy of fuel.

Dr. **H. A. D. Jowett** thought that the Council of the Society of Chemical Industry should take cognisance of the fact that there was much to be done from the point of view of educating not only the Government but the public generally, to view the problem from the scientific standpoint, which would be a matter of no little difficulty. It had always been a matter of astonishment to him that so little progress had been made in this country with a system of either low-pressure steam or hot-water heating, which could be done either by means of gas or by coke furnaces for domestic use. However, our houses were not made for that kind of heating, and furthermore the climate was not so well adapted as in other countries. The old English fire would want some explaining away. One point which appealed to him as a manufacturer was with regard to the supply of electrical power. Some years ago they were going to have one central power station instead of the many Authorities, and manufacturers each making their own power, and they were to be supplied at something like ½d. per unit. The question of cheap power was really a very serious thing for manufacturers in and around London. He did not think in the light of recent events anyone would ever care to suggest now that they should rely on one power station, but a great deal could be done in power production. It was astonishing what they were doing in America with regard to co-ordination. A very large tract of land had been taken in New York by the side of the river and arrangements made for establishing factories with a uniform rate for haulage, power, steam, and almost everything. He thought as manufacturers they should realise that they would have severe competition, not only from America but from Germany, where these efficient methods of co-ordination were in use, and he hoped they would be able to do something in the way of educating the Government and the public in these matters.

Mr. **Robt. H. Clayton** said one point overlooked was the amount of the damage which coal did, when used in the domestic grate, which was greater than the value of the coal wasted. In Manchester they had taken the matter in hand and formed "An Air Pollution Advisory Board" as a sub-department of the Sanitary Committee, and had co-opted as members the heads of all the Societies in Manchester which they thought could be of benefit, and created a first-rate Committee. The Corporation had given them a substantial grant, and had a special department which was obtaining very valuable figures. He did not believe in all the talk against the Government. He thought a little more could be done if they did more themselves.

Mr. C. A. Klein said he thought that some progress would be made if the Council ascertained and considered the agreed opinions of each Section on this important subject, and if this were done it might be possible for the Society as a whole to discuss the subject at the next General Meeting and then determine whether or not it was prepared to take definite action with a view to the vigorous prosecution of some positive policy. It appeared to him that the Society could with advantage undertake propaganda work with the object of interesting other societies whose interests were so seriously affected by the present methods of fuel consumption quite apart from the point of view of loss of energy or the loss of by-products.

He was personally interested in the manufacture and use of paint, and anyone connected with that industry knew only too well how seriously their products suffered through the destructive action of soot and the acids of town air. The sympathies of engineers, architects, and others should be enlisted with a view to co-operative action on positive lines.

Mr. S. O. Nevile said that the brewing industry was not of great importance compared to the large fuel consumers quoted, but it was representative of a large number of industries which used fuel for power and heating. When one came to make economies in a factory of that sort, the difficulty was where to go for information. In the brewing industry and many industries of that kind, the fuel bill, although collectively important from a national standpoint, was not a very large proportion of the expenses of conducting any one individual business. The matter was evidently one of great national importance, and if a system could be arranged, possibly under the Home Office, whereby the ordinary Inspectors of Factories could be reinforced by a staff of engineers, whose business it was to give information to owners of small factories, and also test their consumption of fuel, enormous economies could be made in most, if not all, factories.

At the present time one was not allowed to lay a brick without official sanction for fear it might traverse the theories adopted by local authorities, but there was nothing whatever to prevent one installing the most inefficient plant and thus wasting national wealth in the form of fuel.

Professor Bone, in reply, expressed his surprise that Professor Armstrong had thought fit to disparage in such a mischievous way the efforts of the British Association Committee to deal with the question of fuel economy. In his opinion the British Association was probably better fitted than any other existing organisation to initiate such an investigation because, through its various sections, it could secure the effective co-operation of chemists, engineers, economists, and geologists, for an absolutely disinterested and unfettered inquiry into the various aspects of the subject and, in fact, it had, in this instance, already succeeded in doing so in a manner which had surpassed all expectations. He felt that Professor Armstrong had spoken in ignorance, both of the *personnel* of the Committee and of the arrangements which had been made for the prosecution of its work. The Committee was, in fact, probably the strongest combination of chemists, metallurgists, engineers, and geologists that could have been got together for the purpose, and the way in which many eminent men of wide scientific knowledge and practical experience had consented to co-operate actively in the work of the Committee, and to devote a considerable amount of their time to it, was a sufficient answer to Professor Armstrong's gibes. It was difficult enough in this country to secure the whole-hearted co-operation of scientific and practical men for an investigation of such national importance, and it was regrettable that the only voice which had been raised in disparagement of the work should have been that of Professor Armstrong. Surely it was immaterial what label was attached to a body of men who undertook to find out the facts of the situation, so long as they were competent to deal with it, and were working on well-considered lines, and he appealed to the Council of the Society, and to the chemical industry as a whole, to support the movement which the British Association had initiated.

He agreed with the suggestion which had been put forward about the tax on coal for the support of investigations in fuel economy, but he thought that the tax should fall upon the coal which was exported, and not upon the coal which was consumed at home.

He disagreed with the suggestion that the present organisation of London's electrical supply could be regarded as a progressive enterprise. Personally, he considered it to be a conspicuous example of how the public interest in such matters was in this country so often thwarted by local and vested interests, and of the failure of Parliament to legislate on broad and comprehensive lines. The population of the London area in question was about 7¼ millions. Its electrical supply, instead of being organised under a single controlling authority on one uniform scheme, was in the hands of no less than 65 separate authorities, which generated current on 49 different systems, from no less than 70 generating stations containing some 585 prime movers. The average size of the generating stations was only 5285 kilowatts; many of the oldest stations still contained reciprocating engines, and some were so placed that they had to resort to carting their coal. Current was distributed from the stations at 54 different voltages, and the consumer was charged at one or other of some 70 different rates for the current which he used. Compared with the position of affairs in Paris, Berlin, New York, or other large centres of population, London's arrangements were hopelessly uneconomical and out of date.

The Chairman, in putting a vote of thanks to the meeting, said he hoped that the President would adopt the suggestion of Professor Armstrong and induce the Council to form a small Committee to deal with the question. He also emphasised Professor Bone's suggestion that the discussion should not be terminated in the room but be continued by correspondence.

THE ANALYSIS OF COMMERCIAL BENZOLS.

BY P. E. SPIELMANN, PH.D., B.SC., F.I.C., AND E. G. WHEELER, A.I.C.

The examination of the benzol fraction of light naphtha has become of special interest owing to the Government control which is being exercised over this branch, amongst others, of the coal tar industry. The following method of analysis aims at providing a simple way of determining the percentages of benzene, toluene, paraffin, and carbon bisulphide in a properly washed commercial benzol. There is no new principle involved and no special apparatus is required. These are negative qualities which may recommend it to industrial laboratories possessing the simplest equipment. The method has been devised in view of the requirements of the Department of Explosives Supplies of the Ministry of Munitions, but it is, in reality, of independent application. It is the outcome of a considerable number of laboratory experiments based on an acquaintance with many hundreds of samples of commercial benzols.

Determination of toluene.—It has been found that if 100 c.c. of a mixture of benzene and toluene be distilled from an Engler flask at the rate of 7 c.c. a minute, with proper precautions with regard to draughts and efficient condensation of the distillate, the volume in c.c. passing over up to 90° C. indicates the quantity of toluene present in the mixture when reference is made to a previously constructed curve. It has been found, further, that the presence of paraffin and carbon bisulphide in the quantities normally occurring in commercial benzols does not upset this relationship to any material degree.

The method is not to be trusted above 20% of toluene, because the errors which ordinarily balance one another in any chemical manipulation may, if acting all in one direction, cause an error of 2% or more. Thus, the increasing inaccuracy with increasing quantities of toluene carries the method into the region of others for the estimation of toluene, such as that of Colman (pamphlet published by H.M. Stationery Office) and of Northall-Laurie (pamphlet, H.M. Stationery Office; Analyst, 1915, 384; this J., 1915, 950), which, from this point onwards, show a greater accuracy the higher the percentages of toluene present.

Experience has shown that the estimation of the toluene by the distillation method just described may vary in the hands of different workers with slightly differing apparatus, to the extent of 2%. Although such a discrepancy is in itself undesirable and can be rectified, it does not have any appreciable effect in the subsequent estimation of paraffin.

Determination of carbon bisulphide.—Carbon bisulphide is easily and completely removed by alcoholic potash in the known manner; but instead of the potassium xanthate being estimated, the benzol is washed several times with water, in order to remove the xanthate and alcohol, and dried: its specific gravity is then determined. The difference between the original specific gravity of the sample and the specific gravity just obtained is proportional to the quantity of carbon bisulphide present, and this can be found by reference to a previously constructed curve.

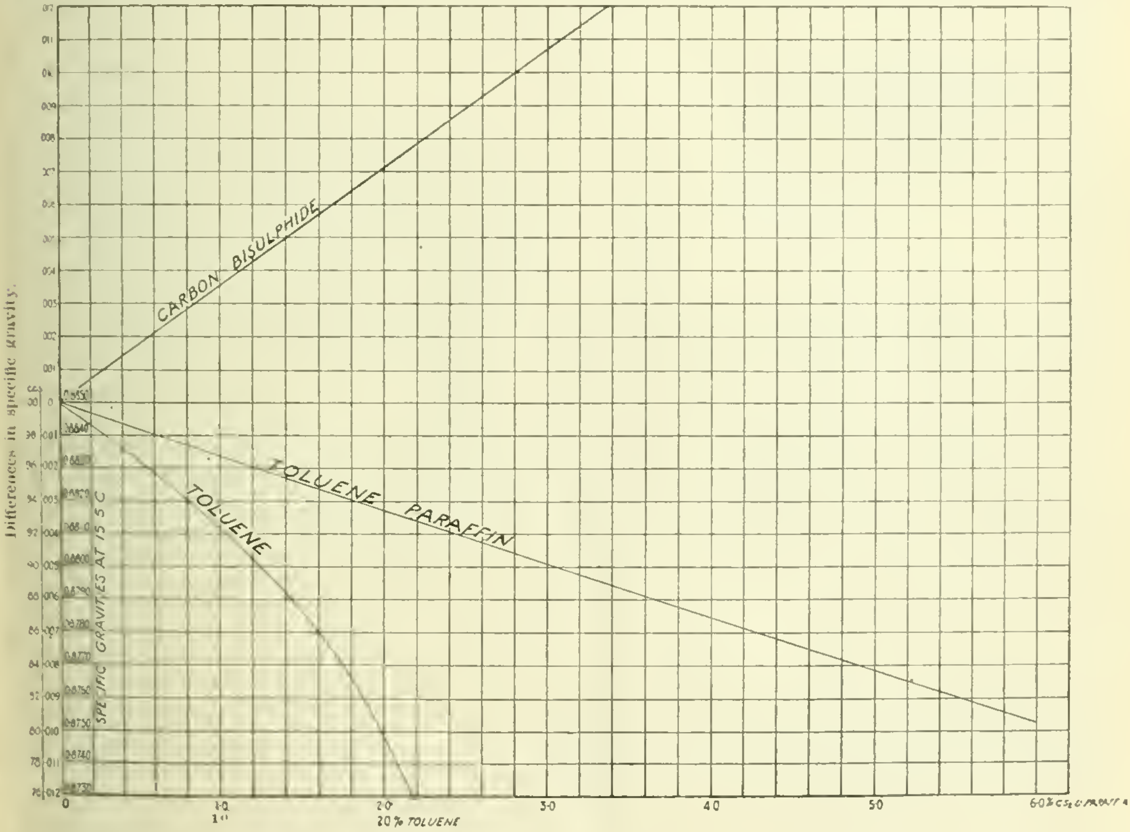

FIG. 1.

This method has been suggested by Nickels (Allen's "Commercial Organic Analysis," 1900, Vol. II., pt. 2, p. 183) and by Ellerton (this Journal, 1912, p. 11). The slope of the curve in Figure 1 is given by the constant 0·002816, a slightly different figure from the 0·00316 found by Ellerton.

Determination of paraffin.—After the removal of carbon bisulphide, the liquid consists substantially of a mixture of benzene, toluene, and paraffin. The quantity of toluene has already been determined, and the specific gravity of a mixture of benzene and the ascertained quantity of toluene can be found from a previously constructed curve, so that the difference between the specific gravity of the benzene-toluene mixture and that of the sample after removal of carbon bisulphide is proportional to the quantity of paraffin present, the actual value of which can be found from an experimental curve.

Originally, there was some doubt as to the proper specific gravity to ascribe to the paraffin occurring in benzols. This must certainly vary with the varying quality of coal distilled, as well as with the character of the retorts and the temperature of the destructive distillation. From actual analysis and from theoretical considerations, this has been taken to be 0·730. As a matter of fact, it has been found by experiment that the gravity may vary 0·025 without seriously upsetting the results obtained.

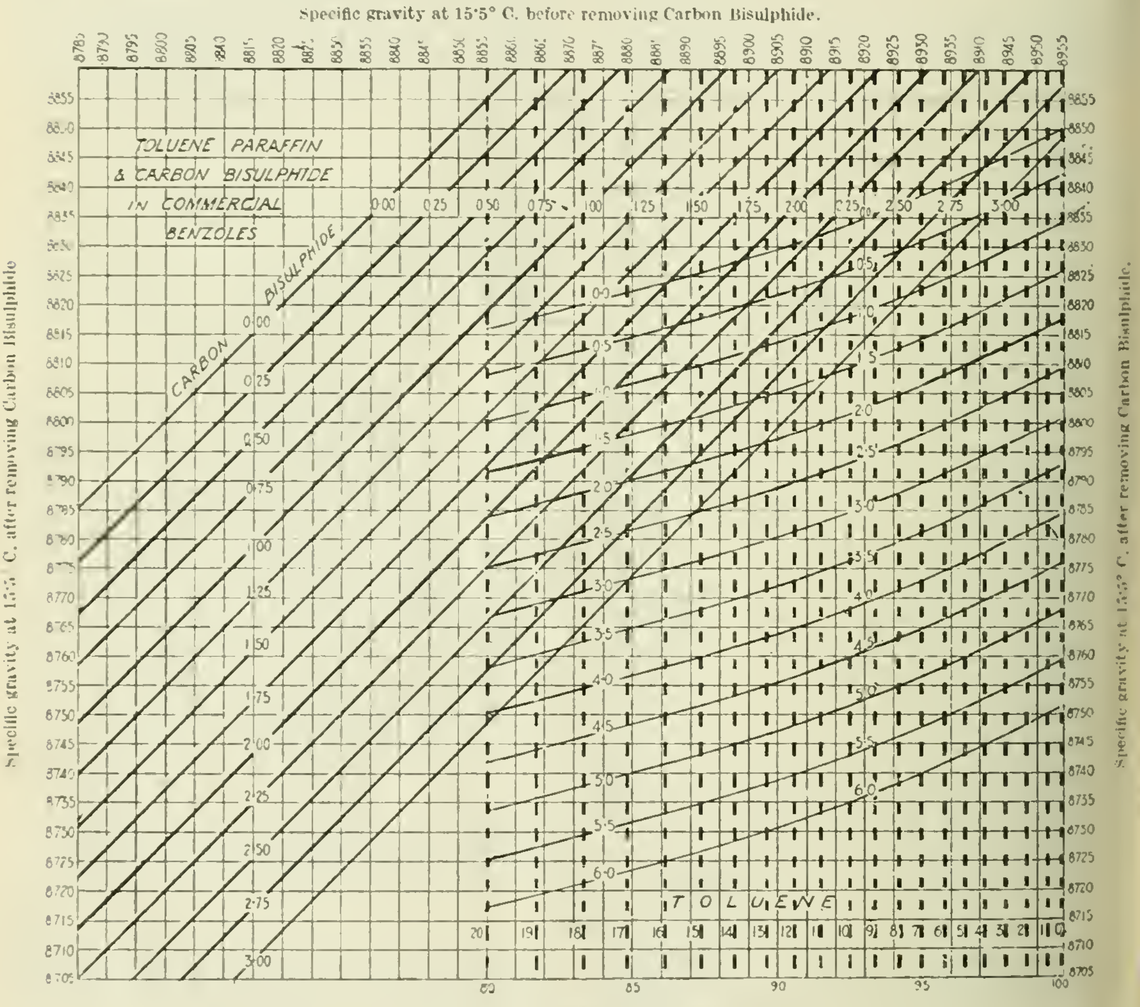

FIG. 2

Determination of benzene.—This constituent is estimated by difference. The work has been based on the specific gravity of benzene being 0·8848 at 15·5° C., a figure which has been obtained from synthetical benzene, boiling constantly at 80·2° C.

The graphs, however, have been drawn for a specific gravity of 0·8850 at 15·5° C., To a certain extent the unimportant impurities present in benzols will tend to balance one another with respect to their specific gravities, but with an upward tendency.

The most important of these impurities is thiophen, but this is seldom present to an amount of more than 0·5% (Lange) and averages about 0·26% (Schwalbe, Z. Farben- u. Textil-Ind., 1905, **11**, 113). The latter quantity would cause an error of 0·3% in the quantity of paraffin found, but as this is within the limits of accuracy of the method, it can be neglected.

From the analysis of a number of known mixtures and of commercial benzols the following can be quoted, the results being given in per cent. vol./vol. :—

Known Mixtures.

	Benzene %.		Toluene %.		Paraffin %.		Carbon bisulphide %.	
	Taken.	Found.	Taken.	Found.	Taken.	Found.	Taken.	Found.
A.	87·0	87·5	10·0	9·2	2·0	2·3	1·0	1·0
B.	84·0	84·4	10·0	6·8	4·0	4·8	2·0	2·0

Commercial Benzols.

	Distillation test.		Specific gravity.		Paraffin %	Carbon bisulphide %.	
	c.c.	Toluene. %	Original	After removing CS_2.		By curve.	By titration.
1.	98·9	1·5	0·8875	0·8838	0·25	1·05	0·78
2.	91·2	11·4	0·8892	0·8840	—	1·45	1·34
3.	97·9	3·0	0·8866	0·8839	—	0·75	0·71
4.	98·6	2·0	0·8894	0·8857	—	1·00	0·93
5.	94·1	7·7	0·8872	0·8810	1·3	1·75	1·70

It will be seen that an average accuracy can be expected to the extent of toluene 1·0%, paraffin, 0·5%, and carbon bisulphide 0·1%, and that the extreme error is not serious.

A few preliminary experiments with "first runnings" show that this method of analysis can be applied with a slight modification.

In Fig. 1 are collected in one diagram the curves showing the effects on the specific gravity of benzene, of toluene, carbon bisulphide, and paraffin, together with the toluene distillation curve. The method of employment is to find the percentage of *toluene* from the result of distillation, and then to pass up that ordinate until the benzene-toluene specific gravity line is met, at a point opposite which is found the specific gravity of such a benzene-toluene mixture. The differences of specific gravity, which have already been described as being proportional to the percentages of *carbon bisulphide* and *paraffin*, are read off from their respective curves.

Actually a slight error is introduced by thus obtaining the percentage of paraffin in a benzene-toluene-paraffin mixture and making no allowance for the carbon bisulphide removed from the original sample: the numerical difference is, however, too small to be of account.

Taking, for example, No. 3 from the above table:—

Distillation: 97·9 c.c. = 3% toluene
Sp.gr. of original sample = 0·8866
Sp.gr. after removal of CS_2 = 0·8839

Difference 0·0027 = 0·75% CS_2.

Sp.gr. of benzene + 3% toluene = 0·8840
Sp.gr. after removal of CS_2 = 0·8839

Difference 0·0001 = negligible% paraffin.

It is interesting to note in passing that the effect of toluene on the specific gravity of benzene is exactly one-tenth the effect of paraffin of the specific gravity of 0·730.

For the sake of convenience of working, one of us has developed from the above results, by means of a series of calculations, the curves shown in Fig. 2. Here it is not even necessary to determine he various differences in specific gravity: only he observed figures need to be dealt with. The nalytical results are interpreted as follows:—

The number of c.c. distilling below 90° C. represents the percentage of *toluene* shown below. The umber of c.c. distilling below 90° C. has been lotted against the specific gravity found after removal of CS_2, in such a manner that the percentage of *paraffin* is read off directly. The specific gravity of the sample has been plotted against the specific gravity after removing *carbon bisulphide*, whereby the percentage of the latter can be directly read off.

Taking as an example No. 5 from the above table:

Distillation: 94·4 c.c. = 7·7% toluene.
Sp.gr. after removal of CS_2 = 0·8810
Junction of 94·4 c.c. ordinate and 0·8810 line is at 1·3% paraffin.
Sp.gr. of original sample = 0·8872
Sp.gr. after removal of CS_2 = 0·8810.
Junction of these two co-ordinates is at 1·75% CS_2.

It may be of interest to follow the mathematical evolution of the one set of curves from the other.

The curves in Fig. 1 have been found to have the following numerical characteristics.

Distillation curve. It has been found that up to 8% of toluene (equivalent to 94·3% distilling below 90°) this is a straight line of the formula $D = 100 — 0·7T$, where D = the percentage of c.cs. below 90° and T = percentage of toluene.

Above 12% of toluene (equivalent to 90·6% distilling below 90° C.), the curve closely approximates to an exponential curve $D = e^{2·034-0·0063T}$. The "No-man's land" between these two curves is occupied by a line following the obvious general curvature.

Toluene curve. The variation in specific gravity of benzene by varying admixtures of toluene is found to follow the law, $T = 6060·61(0·8850 — g_1)$, where g_1 = the specific gravity of the benzene-toluene mixture.

Paraffin curve. This is expressed by $P = 606·061\ (g_1 — g_2)$, where g_1 = the specific gravity of the benzene-toluene mixture, and g_2 = the specific gravity after removal of CS_2.

Carbon bisulphide curve. This is represented by $S = 281·6\ (g — g_2)$ where g = original specific gravity of the sample, and g_2 = specific gravity after removal of CS_2.

The graph in Fig. 2 was obtained by plotting

$$g_2 = g — \frac{S}{281·6}$$

By uniting the formulae representing the distillation curve with the paraffin and toluene specific gravity curves, the following expressions were obtained, which represent in Fig. 2 the percentage of paraffin as described earlier:—

$D = 100 — 1242·42\ (0·8850 — g_2) + 7P$, up to 8% of toluene:

$\log. D = 2·031 — 38·183(0·8850 — g_2) + 0·063P$, above 12% toluene.

We take pleasure in recording our thanks to Mr. G. Campbell Petrie and to Mr. F. Butler Jones for their assistance in working out the details of this method.

Discussion.

Dr. H. G. Colman said that he had tested the method described with mixtures of known composition, and had found it to be accurate within the limits given by the author.

Meeting held at Burlington House on Monday, April 3rd, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

THE FEDERATION OF THE INTERESTS OF APPLIED AND PURE CHEMISTRY IN AN IMPERIAL UNION OF BODIES REPRESENTING THE VARIOUS BRANCHES.

BY HENRY E. ARMSTRONG.

At no time more than at the present has it been so clear that the progress, in this country, of chemical science and of chemical industry, giving to both terms their broadest meaning, is entirely dependent upon an effective coalition of the two interests and the recognition of their essential interdependence. Not only, heretofore, has there been no proper union of industry with science but, of late years, even the interests of scientific workers have been frequently sub-divided, specialisation more and more encouraged: the tendencies, in fact, have been the very opposite of those which, it is admitted, are desirable, especially as a language is being developed which has the effect not only of separating us from the public but even of estranging us within our own ranks. And it cannot be denied that much of our scientific jargon is largely "side." To take a simple example—nothing is gained by introducing "adsorption," a word not in the dictionary, "which no fellow can understand," when words such as "absorption" and "adhesion" are available, with which everyone is familiar. An article in the Pall Mall Gazette of March 27, on "The Parable of the Bubble" is full worthy of attention from this point of view—as a straw showing the way the wind bloweth. To quote one sentence—"The face which Science shows to the public is almost uniformly forbidding: its literature is composed chiefly of 'books that are no books,' produced in a diction from which all the true life of language has disappeared." There can be little doubt that if science come fully into communion with industry, it will only be when science talks the language of industry and of ordinary life—common sense and the vulgar tongue.

The question of paramount importance for us to consider at the present time is: What can we do to bring about a more effective co-operation of all the interests which may properly be collected under our chemical banner? I venture to suggest for discussion that it is desirable to establish, in the immediate future, an Imperial Union or Institute of Chemical Science and Industry—an Imperial Society of Scientific and Industrial Chemistry. Difficulties, grave difficulties, may lie, undoubtedly do lie, in the way of such an organisation and must be overcome before it can be finally established: but let us face them and overcome them; let us thrust aside negative considerations and dwell, as far as possible, upon the positive advantages the scheme will have in operation; we must, if we are in earnest in our desire to make our science effective. Personal feelings, even legitimate aspirations to figure independently, must be put aside, if possible, in favour of a policy which will safeguard our Imperial interests. The enemy is not only at our gates but will long remain there and will only be overcome by superior organisation.

A good example has been set us. The medical profession was led, several years ago, to recognise the advantages that would accrue from the union of the various interests. In 1907, seventeen societies, representing the various sections of scientific activity of medical men, were dissolved and their members admitted as Fellows of the Royal Medical and Chirurgical Society, which had been granted an enlarged Charter for the purpose. Each of the Societies retains its individuality and forms a definite unit of the general body, each unit having its President, Vice-Presidents, Officers and Council and being represented on the Council of the general body by its President. A Journal is issued monthly; the proceedings of the various sections are all printed in this but are kept apart and paged separately. The subscription is three guineas but it is possible to belong to a single section at a lower fee. The Society has commanding premises at 1, Wimpole Street, erected at a cost of about £50,000.

It is unquestionably desirable to effect a similar union of all chemical interests, scientific and industrial, throughout our Empire; no opportunity like the present will ever recur; if we cannot come together now, we shall never join forces.

The Association should comprise at least the following sections:—

Chemical Science in general.
Chemical Industry ,,
Agricultural Chemistry.
Chemistry of Fuel (gaseous, liquid and solid).
Chemistry and Metallurgy of Ferrous Metals.
Chemistry and Metallurgy of Non-Ferrous Metals.
Chemistry in relation to Brewing and Distilling.
Chemistry of Dyestuffs and Dyeing.
Chemistry of the Textile Industries.
Analytical Chemistry.
Physical Chemistry, including Morphology (Crystallography).
Biological Chemistry.
Pharmacological Chemistry.
Photographic Chemistry.

The bodies to be considered from which such sections could be constituted are as follows:—

Chemical Society.
Society of Chemical Industry.
Iron and Steel Institute.
Institute of Metals.
Society of Dyers and Colourists.
Institute of Brewing.
Institution of Gas Engineers.
Society of Public Analysts.
Faraday Society.
Biochemical Society.
Mineralogical Society.
Royal Photographic Society.
Australian Societies.
Canadian Societies.
East and West Indian Societies.

Sections of the Association should be maintained in outlying regions of the Empire; if desirable, also in provincial towns.

Of course, a House will be required, in London, in which all the various sections can find accommodation, with ample space for a common library.

The addition of a Club, either as part of the enterprise or in direct association with it, may also be foreshadowed as desirable.

It may be urged that some of the bodies in the list given have a large proportion of members who are not scientific. Far from being a disadvantage, however, the presence of such men in a scientific organisation would be one of the chief elements of its strength—the object to be achieved being the combination of scientific and industrial interests to the fullest possible extent.

An Association such as that now foreshadowed, fully representative of chemical interests generally throughout our Empire, could wield great influence on behalf of its members and be capable of advising on all necessary occasions, as well as of maintaining and extending the status and influence of both Chemical Science and Chemical Industry.

It would necessarily publish Transactions but would also issue a weekly Journal of information and abstracts.

The feeling is fairly general, I believe, that some action must be taken to modify existing conditions of publication—that the waste of effort involved in the issue of so many overlapping journals, all open to improvement, is in no way defensible; it is clearly desirable to collect our British chemical literature at least within one set of covers—though arranged in sections separately paged. One result of such action would be to diminish the evils of specialisation, by bringing under the notice of the specialist the accounts of work done in fields other than his own.

Not only is the chemist of to-day overwhelmed by a chaos of conflicting communications but these are often so crude and curt in statement, so disjointed, that he is not properly informed as to the real character of the progress of his art and science and has little chance of developing true literary feeling. A much more complete and efficient organisation of literary effort is required, not only to bring our science into repute as an art but to make it of avail to ourselves; there are not a few directions, in fact, in which it is imperative to stimulate and develop the literary side of chemical science.

There are, indeed, vast possibilities before us, if we can but secure harmonious inter-relationships throughout the field of chemical activity; the need of unison is very great, in view of the urgency of the claims upon us, for unless we co-operate and organise our scattered forces, we shall accomplish little—as others will inevitably be organised against us. Let us then for once decide forthwith to pull together: recognising and proclaiming the infinite value to society of our subject, by ourselves showing that we are believers in the greatness of our mission; that it is one that only a true brotherhood can accomplish.

Newcastle Section.

Meeting held at Newcastle-on-Tyne on Wednesday, March 15th, 1916.

PROF. H. LOUIS IN THE CHAIR.

BY-PRODUCTS OF ESPARTO GRASS.

BY DR. C. BUDDE.

Esparto grass is a raw material very largely used in the paper making industry of this country. The main product obtained from it is, of course, the cellulose fibre, but this represents roughly speaking only one half of the weight of the grass. The substances representing the other half are at present more or less wasted. I have for the past 6 or 7 years been doing some work in connection with the recovery and utilisation of some of these substances, and a coherent report of the possibilities in this direction may not be without interest in these times when the prevention of waste is the watchword. Most of the work reported here is several years old, and I have recently heard of reports in American or Canadian journals to the effect that products similar to some of those described below have been obtained from the waste liquors of the soda-wood-pulp industry. My work has been done with the main purpose of obtaining commercially valuable results, so that I have been able to pay little or no attention to the purely scientific side of the question.

The by-products of esparto grass are contained in two media, viz., the esparto dust and the "black liquor."

Esparto dust.

The esparto grass reaches the paper mill in the form of bales pressed tightly together by hydraulic pressure. In this form it is too compact for successful chemical treatment, and it is therefore first of all passed through a machine containing a revolving body studded with short iron rods which tear up the compact grass and make it loose. The same machine performs simultaneously the other important function of removing the dust. A powerful fan causes a strong current air to pass through the grass as it is being tossed about in the machine, and the air carries all the dust along with it. Only a few years ago this dust was sent to waste in different ways, but nowadays most paper mills have installed special dust collectors where the air current is made to deposit the dust in a confined space, whence it is ultimately discharged into bags.

The esparto dust thus obtained is a very valuable material, as it contains anything from 25 to 50 % of a high-class vegetable wax, hard and of a high melting point. I have worked out a special method for the recovery of this wax, but other methods are in operation elsewhere for the same purpose. The wax as recovered by my method is hard, rather brittle, and of a light brown colour, and possesses the following chief characteristics, viz., m.pt. about 165° F. (74° C.). Loss of weight at 100° C. overnight, about 1·5 %. Ash, 0·02 %. Acid value, 34·42. Saponification value, 71·41. Iodine value, 6·48. Unsaponifiable (soluble in hot CCl_4), 50·34 %. Fatty acids, 45·89 %.

At first there was some difficulty experienced in placing this esparto wax on the market, but it is now eagerly demanded at a good price by some manufacturers. Unfortunately, however, the quantity of dust obtainable at any one paper mill is not very large, so the output of wax is insufficient to meet the demand.

What remains of the dust after the wax has been eliminated may be calcined, and when all the organic substances have thus been removed a yellow-brown powder is obtained; it consists mainly of silica, and is very fine and very sharp, so it makes an excellent knife powder and might be made useful in many ways for cleaning, polishing, and grinding metals and other materials.

"Black liquor."

In the course of manufacture the esparto grass (after having been put through the machine described above) is boiled in autoclaves under a pressure of 3 or 4 atmospheres for about 4 hours with a solution of caustic soda containing about 4 % of NaOH. When the boiling is finished the spent lye is run off to a storing tank, and the grass is washed several times with water. The first wash water is mixed with the spent lye, and the following ones are run to waste (unless local conditions make it necessary for sanitary reasons to work them up too). The mixture of the spent lye with the first wash water is technically known as "thin black liquor," and contains practically all the non-cellulose constituents of the esparto grass except those which have been previously removed in the form of dust. The thin black liquor contains also the soda used in boiling the grass, and until now the soda is the only product recovered from it. With this end in view the thin black liquor is first concentrated to about one-sixth of its bulk (usually on the multiple effect evaporation principle). It is now known as "thick black liquor," which when hot is a viscous black liquid of syrupy consistency; when cold, it solidifies into a sort of granular jelly. In the ordinary way of manufacture it is led in a continuous stream into one end of a rotating soda furnace in which the remaining water is evaporated and all the organic constituents are burned, so that it emerges from the other end of the furnace in the form of so-called "black ash," consisting chiefly of sodium carbonate. The heat necessary for this process is under normal conditions exclusively derived from the combustion of the organic constituents of the thick black liquor. This is all the advantage taken at present of these organic constituents.

It will be readily understood that as far as the black liquor is concerned there is no occasion to complain about the quantity available, so from this point of view the black liquor is by far the more important of the two items dealt with.

In considering the products obtainable from the black liquor, it should be kept in mind that the liquor contains the soda used for boiling the grass. Thick black liquor contains as a rule from 12 to 15 % of Na_2O.

The most important constituent quantitatively, however, is an "extract substance," which according to Cross and Bevan constitutes a definite chemical individual of the formula $C_{21}H_{24}O_8$. This substance can be made use of in a good many ways, but it is a new thing on the market, and a demand for it (and the products derived from it) has to be created before anything can be done with it in practice.

Among the easily marketable by-products obtainable from the black liquor, the most important from a quantitative point of view is *acetic acid.* The black liquor also contains some wax, but it is scarcely worth recovering. There is not very much of it, and it is not of such a good quality as the dust wax.

Attempts have been made to causticise the black liquor directly, the idea being to precipitate the extract substance as a calcium salt by treatment with lime, and thus recover soda in the form of hydroxide, directly available for a fresh boiling of grass. This idea is theoretically excellent but practically impossible, owing to the thick, slimy, and extremely voluminous nature of the precipitate obtained, which places insuperable obstacles in the way of separating the liquid from the precipitate either by filtration or other means.

It has also been proposed to precipitate the extract substance by means of carbon dioxide under pressure, so that the soda is recovered as bicarbonate.

Another proposal is to distil the black liquor after addition of lime, whereby several alcohols and ketones are obtained. Besides, if the distillation temperature is not too high, sodium acetate may be recovered from the residue in the retort by lixiviation with wood spirit or similar solvent.

I do not think any of these proposals have ever been adopted on a large scale.

If the black liquor is slightly acidified by addition of an acid, the extract matter is thrown out of solution, but the precipitate thus formed is of a similar voluminous and slimy character to that obtained with lime. Immediately after precipitation it fills up the whole volume of the liquid making it thick and viscous; it settles down very slowly and is very difficult to separate by filtration. If washed by daily decantation for 5 weeks, filtered, and dried, it forms a dark brown powder, of which about 28 grms. is obtained from 1 litre of thin black liquor. If this substance is extracted successively with ether, chloroform, and alcohol, the ether dissolves 1·64 % (a light-coloured wax), the chloroform 8·11 % (a dark-coloured waxy substance), and the alcohol 6·51 % (a substance resembling very dark-coloured shellac). The extract matter can be precipitated in the form of a light-coloured powder, easily separable from the liquid, by means of free chlorine or strongly oxidising acids, but the products obtained are very different from that just described as shown by their behaviour towards solvents. I shall not go further into these details, however, as I consider them to be of no practical interest. One point to notice is that none of these products is entirely soluble in alcohol.

If the slimy mixture of precipitate and liquid is boiled, the extract matter seems to be chemically changed, a thin yellow opaque fluid being obtained. Whether this is a solution or merely a suspension or emulsion I do not know, but in any case it is capable of remaining practically unaltered for weeks; the solid matter settles down exceedingly slowly, it passes through filter paper, and it does not seem possible to separate the solid part from the liquid at this stage; it may be evaporated almost to dryness without changing its character. If boiled in open vessels a thin black film keeps forming on the surface; this is probably a product of oxidation, since it does not appear unless the air has free access. If a small surplus of acid is added to thick black liquor while hot, opaque plastic masses are formed which, if dissolved in water, give opaque solutions similar to those just described. The masses and solutions are slightly different according to the acid used in producing them.

These opaque solutions will dye wool and silk directly, imparting a drab-yellow colour. By after-treatment with oxidising substances, such as ferric chloride or potassium bichromate, the drab colour may be turned into different shades of brown. By means of copper sulphate greenish khaki shades may be obtained, and it is also possible by suitable treatment of these opaque solutions to evolve a dyestuff which will give very pretty orange shades to wool and silk directly. This latter dyestuff I have not yet succeeded in isolating.

If hot black liquor is treated with a large excess of acid, instead of a small excess, the extract matter is changed into a resinous substance. This process is accompanied by a splitting off of carbon dioxide; the reaction is most easily seen if the operation is carried out in an autoclave, when there will be a sudden rise in pressure without any corresponding increase in temperature. The resinous matter ultimately gathers together in lumps and may be very easily removed from the liquid, which is then almost clear, but it still contains a small quantity of an oily substance which may be extracted with ether.

The form in which the resin is recovered varies considerably, according both to the nature and the quantity of the acid used—also according to the temperature and pressure under which the operation is carried out. This may be partly due to the fact that the resin enters into loose combination with the acid present. So loose, however, is this combination that the acid may be removed by boiling with water.

When sulphuric acid is used for this process, black liquor is brought to boil in a retort and the acid is then gradually added. A development of carbon dioxide takes place at once, because a large proportion of the soda is present as carbonate, and a further development occurs when the resin is formed. The total amounts to 3 or 4 % of the weight of the thick black liquor; it is fairly pure and may be collected if so desired. The liquid distilling over contains chiefly acetic acid and furfural. After the distillation the resin has gathered together in a lump in the retort and can be removed.

The resin thus obtained is black, owing to the presence of acid. When hot it is soft and plastic, when cold it is brittle and easily reduced to powder. It retains water with great tenacity, and is very difficult to dry unless powdered. For the purpose of purifying it is reduced to a coarse powder, boiled in water, drawn into "ribbons," and dropped into cold water. This process is repeted untihl a sufficient degree of purity has been reached. The resin now appears as brown "ribbons" with a silky surface. It is most easily dried if crushed to powder.

This resin may be used for many purposes, such as for sizing brown paper, waterproofing, staining and varnishing paper, cardboard, fabrics of all kinds, leather, wood, metals, perhaps for making insulating varnishes, etc. It is soluble in acetic acid, acetic anhydride, acetone, phenol, aniline, and hot alcohol or methylated spirit. All such solutions may be used as spirit varnishes. It is insoluble in ether, petroleum spirit, oils, and turpentine. It is soluble in alkaline solutions, even in borax, and a borax solution forms a fairly good water varnish. In fact, the resin may be used as a substitute for shellac for a large number of purposes, even to some extent in French polish. With ammonia it forms a loose combination. Therefore, if a fabric is impregnated with a solution of the resin in ammonia and left to dry, the ammonia will gradually evaporate and leave insoluble resin in the pores of the fabric. The resin combines with formaldehyde, which makes it harder, but less soluble, and it is also capable of being "vulcanised" with sulphur.

If this resin is treated with strong nitric acid, oxalic acid is formed and also a yellow dyestuff, which is different from the orange dyestuff previously mentioned. It either contains picric acid or is closely related thereto; it has a bitter taste, gives a deep red colour with warm potassium cyanide, and dyes wool and silk directly in much the same shades as those obtainable with picric acid, *i.e.*, from canary yellow to a fairly dark brown.

The resin is also capable of yielding sulphide dyes, but these are on the whole more satisfactorily produced directly from the black liquor. Quite a number of brown dyes are obtainable in this way, among them also direct cotton dyes; but there is particularly one such dye which should prove useful, because the process of making it is very simple and cheap. The process is carried out at a lower temperature than I believe is usually employed in making such dyes. It will impart many shades of brown to wool, silk, and mordanted cotton, especially some deep and rich brown shades.

If thick black liquor is mixed with sulphur and gently heated, a plastic mass is obtained which is of very fine grain, and will take and retain very fine imprints.

The distillate obtained in recovering the resin contains chiefly acetic acid and furfural. It is neutralised with sodium, barium, or calcium carbonate, and re-distilled, when the furfural passes over with the first part of the distillate. The yield of raw furfural is very considerable—in fact, it has amounted to over 1·5% of the weight of thick black liquor. The raw furfural is found to contain about 70% of pure furfural. By distilling it a "light oil" of a light yellow colour is first obtained; it is soluble in sulphuric acid, with which it gives a blue colour. Judging from the boiling point it may be thiophen. The next thing that comes over is furfural proper. This is, to the best of my knowledge, only obtained as a by-product in one other industry, and that probably by this time a rather obsolete one, viz., the production of natural madder. The furfural was saleable before the war to German dye-works at a good price. It gives almost the same chemical reactions as benzaldehyde and has a similar appearance, smell, and flavour. Whether it could replace benzaldehyde in the making of sweets and perfumes I cannot say, but I believe a Malachite Green can be made from it by a process analogous to that by which ordinary Malachite Green is made from benzaldehyde. I have not been able to find any buyers for it in this country, but the development of the dye industry may perhaps create a demand for it. It can certainly be used according to recent patents—as a solvent for nitrocellulose, whether in the form of guncotton or otherwise, and as an ingredient of varnishes.

After the furfural proper has distilled over some liquids of higher boiling points are obtained. These consist probably mostly of higher homologues of furfural, such as methyl-furfural, ethyl-furfural, etc.

The residue in the retort after the furfural has been driven off is a solution of sodium, barium, or calcium acetate, according to the method of neutralisation. It is evaporated to dryness, and may be sold as such or worked up to acetone or acetic acid. The acetic acid obtained has a slight aromatic odour, but is otherwise very pure and of a perfectly satisfactory colour, so that it should fetch a good price. The quantity of anhydrous acid amounts to about 5% on the weight of thick black liquor.

It will have been noticed that in the process just described the soda in the black liquor is practically lost. It is scarcely possible to recover both the resin, the furfural, the acetic acid, and the soda (unless such acids as oxalic acid be substituted for the sulphuric acid), but I have worked out a process by which the furfural, the acetic acid, and the soda may be recovered in one operation, and in addition all the nitrogen from the grass is recovered in the form of ammonia. This process may have the best chance of immediate success, because nearly all the products obtained are easily disposed of and the process involves a utilisation of nitre cake, a question which is at present attracting considerable interest and attention. The process is in its main features as follows: Thick black liquor is mixed with an excess of nitre cake. The mixture, which is strongly acid, is distilled in a retort. There is the usual development of carbon dioxide (which may be recovered), and then the acetic acid and the furfural distil over. When the distillation temperature has reached about 200° C. the reaction of the distillate changes from acid to alkaline. The receiver is changed, and the distillate now obtained is very rich in ammonia. During the latter part of the distillation a substance of the consistency and appearance of vaseline also comes over, the exact nature of which I have not had time to ascertain; it changes colour and becomes brown when exposed to the air, and I suppose it contains some phenolic and cresolic compounds, so it may prove useful for the impregnation of wood. But the quantity is not very large. The quantity of ammonia obtained is about ¾% by weight of the thick black liquor. Towards the end a little gas is formed which may be burned under the retort. The soda—both that from the black liquor and that from the nitre cake—remains in the retort in the form of sodium sulphide which may be directly used for boiling grass, or else it may be sold or causticised in the usual way in the mill; in which latter case the sulphur would be recoverable from the calcium sulphide sludge by the well known process.

It goes without saying that sulphuric acid may be used instead of nitre cake in the process described, but I think the use of nitre cake ought to increase its chances.

I have only been able to give a vague outline of the possibilities involved in the problem discussed, but it appears fairly obvious that when a paper works producing, say, 10,000 tons of thick black liquor per annum is at present throwing away 300 or 400 tons of carbon dioxide, 500 tons of acetic acid, 150 tons of furfural, 75 tons of ammonia, yielding 300 tons of sulphate, or alternatively to the ammonia about 2000 tons of esparto resin, there should be some room for improvement.

Discussion.

Prof. **Bedson** said that in his investigation on soluble products from coal, he had prepared many bodies resembling very closely the resinous and colouring matters exhibited by the author, showing considerable similarity between the soluble products of early and present forms of vegetation when undergoing chemical change.

Mr. COLLINS asked how the acetic acid was obtained from the "black liquor."

Mr. H. D. SMITH commented on the high melting point of the wax and inquired whether it could be bleached.

Mr. E. F. HOOPER asked as to the permanency and efficiency of the dyes and dyed products, and whether any or what mordants were used.

Mr. BRIGGS spoke about his experience in producing many similar products as wax, resins, and colouring matters, referring to the action of nitric acid on the products, and the sulphide dyes.

Dr. BUDDE, in reply, said that the acetic acid was distilled off the black liquor in an excess of sulphuric acid. He had not tried to bleach the wax, but thought it would probably not be easy. The colours were dyed direct on to cotton and wool without mordants. In one case, however, the cotton was mordanted with tannin. The colours had so far proved very permanent.

Messrs. W. GEMMELL and S. W. CRAGGS showed an apparatus successfully used for the electrolytic determination of lead in a 60—40 copper-zinc alloy.

Mr. E. F. HOOPER exhibited a specimen of salicylic acid now being made commercially in the district, by a synthetic process.

Nottingham Section.

Meeting held at Nottingham, on Wednesday, March 22nd, 1916.

MR. JOHN WHITE IN THE CHAIR.

THE SWELLING OF GELATINOUS TISSUES.

BY PROF. H. R. PROCTER, D.SC., AND DONALD BURTON, M.SC.

(Contribution from the Procter International Research Laboratory.)

Recent investigations have shown that the swelling of gelatine and gelatinous fibres under the influence of acids and alkalis is dependent on the of each of the constituents in the jelly of 1 grm. of Coignet's gelatine in different concentrations of hydrochloric acid at about 18° C. The mathematical conditions of this equilibrium have been formation of highly ionised salts or bases, the osmotic pressure of which causes the swelling, and, given the necessary constants, the volume of swelling and the concentrations of all the constituents of the swollen jelly or fibre can be calculated from the known concentration of the surrounding solution with which it is in equilibrium. Figure 1. represents approximately the quantities fully explained elsewhere,[*] and we only propose here to give such a sketch as may render them available for technical application and comprehensible to the general reader. As regards their practical importance it may be remarked that there is hardly any process in leather manufacture in which problems of swelling do not arise, and it is probable that the materials of many other colloidal industries such as rubber, cellulose derivatives, and textile fibres, are governed by the same or similar laws.

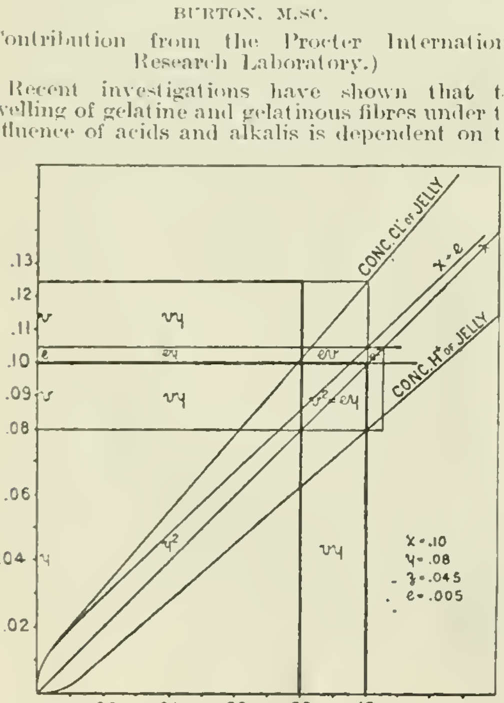

FIG 1

Curves of Concentration.

If gelatine or hide fibre be immersed in a dilute acid solution, it will swell to a much larger extent than in pure water, but will finally reach a definite limit. In this case the gelatine acts as a weak base, one or more of its amino-groups combining with the acid to form a highly ionising salt, of which the acid ions (Cl' if HCl has been used) exert osmotic pressure in the ordinary way, while the gelatine ions retain their colloid character and neither diffuse nor exert appreciable osmotic pressure, probably because they polymerise to form a complex molecular network within which the negative ions are retained by the electrochemical attraction of the positive colloid ions. The tendency of the anions to diffuse can therefore only exert itself in expanding the network, and drawing into it the outside acid solution which can pass freely through its surface. Since, however, it can only do this as acid—that is, with equal quantities of positive and negative ions, while the ionised anion is wholly negative—it follows that at equilibrium the jelly must always contain an excess of anion and a deficiency of hydrion as compared with the external acid solution, in which they are equal.

It is, however, a condition of such a two-phased equilibrium[†] that the *products* of any similar pairs of anion and cation in the two phases must be equal to each other (*e.g.* $H^{\cdot}_1 \times Cl'_1 = H^{\cdot}_2 \times Cl'_2$); and a mathematical necessity that the *sum* of an unequal pair is greater than that of an equal pair giving the same product, as the sum of two adjacent sides of a rectangle is greater than that of those of a square of equal area, and as the sums of the ionic concentrations represent the osmotic pressures it is obvious that the products and the osmotic equations cannot be simultaneously fulfilled. If, therefore (again taking HCl as an instance), $H^{\cdot}_1 \times Cl'_1 = H^{\cdot}_2 \times Cl'_2$ we must, if in the first phase the negative and positive ions are unequal, write the osmotic equation $H^{\cdot}_1 + Cl'_1 = H^{\cdot}_2 + Cl'_2 + e$, where e is the necessary difference between the two sums. e is therefore an osmotic pressure which tends to make the jelly swell to infinity, and as the jelly does not do so, but assumes a definite equilibrium-volume dependent on the concentration of the external acid, it is clear that some opposing force, equal to e at equilibrium, must exist to balance it. This force is the tension of the elastic colloid net of which we have spoken, and if we think of an elastic jelly-mass it is easy to conceive of it as a mere mechanical tenacity which resists and increases the osmotic pressure within the jelly. As, however, we gradually raise the temperature of the jelly, and so diminish its tenacity which opposes swelling and thereby increases its swollen volume, e does not diminish without limit but apparently retains a definite value when the jelly is actually liquefied, so that a part at least of e is due to the molecular attractions not dependent on the jelly state. Very possibly the whole apparent solidity of the jelly is caused by molecular or electro-chemical attractions and the opposing osmotic pressures. Whatever the ultimate cause of these attractions, it is shown that they obey the general physical law first enunciated by Hooke, viz., that "the strain is proportionate to the stress," and that the force e causing (and resisting) swelling is proportionate to the volume of the jelly, e being in the case of Coignet's gelatine at 18° C. about 1/5000 of the volume in c.c.

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[*] H. R. Procter, Trans. Chem. Soc., 1914, **105**, 313.

[†] Donnan and Harris, Trans. Chem. Soc., 1911, **99**, 1575.

In earlier papers on the gelatine equilibrium (*loc. cit.*), it was assumed as a simplification that the gelatine salt was wholly ionised, or at least as much so as the hydrochloric acid‡ employed in the experiments, and for practical purposes and in the case of solutions of the dilutions used, the assumption is fully justified. For complete mathematical treatment, however, it is necessary strictly to define all concentrations as those of the ions only, on which those of the unionised substances are dependent, but as the latter take no direct part in the equilibrium they may for the most part be neglected. The following notation has been adopted and will be used here for any mathematical discussions which may be requisite.

At equilibrium, the external solution contains an acid only, and its concentration is x, which represents either the hydrion H˙, or the anion (say Cl′). All concentrations are expressed in gramme equivalents per litre. The jelly phase contains free acid less in concentration than x, and the ionised gelatine-salt with the same anion as the acid; and

y = the hydrion or anion of the free acid.

z = concentration of either ion of the gelatine-salt; $y+z$ = therefore the total anion.

a = the concentration of the unionised gelatine-salt.

g = the sum of concentrations of gelatine, unionised gelatine-salt, and gelatine-ion.

e = excess of concentration of diffusible ions in the jelly over that of the external solution.

V = the volume of the jelly in cubic centimetres.

We may therefore write the equilibrium of products:—

1. $x^2 = y\ (y+z)$.

and that of osmotic pressures:—

2. $2x+e=2y+z$.

and by solving these equations simultaneously many interesting relations are derived, such as

$$x=y+\sqrt{ey}=\sqrt{y^2+yz}=\frac{z^2-e^2}{4e}$$

$$y=\frac{-z+\sqrt{z^2+4x^2}}{2}=\frac{2x+e-\sqrt{4ex+e^2}}{2}=\frac{(e-z)^2}{4e}$$

$$z=\frac{x^2-y^2}{y}=\sqrt{4ex+e^2}=e+2\sqrt{ey}$$

$$e=\frac{(x-y)^2}{y}=z+2y-2\sqrt{y(y+z)}=-2x+\sqrt{z^2+4x^2}$$

These relations can be represented graphically for any value of x as shown in Fig. 2.

It will be noted that these formulæ are quite general and do not involve any constants, and when any two of the variables are known all others can be calculated regardless of the nature of the protein or acid, but fixing one variable only does not fix the others, as is readily seen by a consideration of any of the formulæ given. For example, if we let e equal 1, then the formula

$$z^2=4ex+e^2 \text{ becomes } z^2=4x+1$$

which is the curve of the parabola and z may be given any value at all by substituting suitable values for x. So, for any protein and any acid which form an equilibrium of the type discussed, fixing e only requires that the point $(z,\ x)$ lie somewhere on the path of the parabola; but for a particular protein and particular acid, under fixed conditions of temperature, etc., not only the parabola is defined by fixing e, but also the exact position of the point $(z,\ x)$ on that parabola. It must therefore be possible to reduce the general formulæ to equations containing only two variables, for particular proteins and acids, by the introduction of the necessary constants.

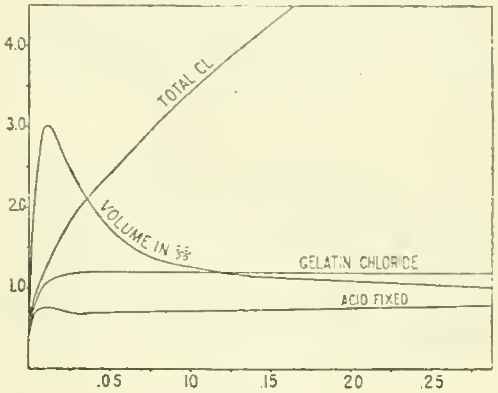

FIG. 2.

Curves of Quantity.
Normality of initial acid.

By means of the ionisation relations of the protein salt a formula for the swelling volume has been derived. In the case of hydrochloric acid the protein chloride produced would follow the equations (an analagous case would be that of ammonium chloride):—

(a) $[\text{Prot}^+]\times[\text{Cl}']=\text{K}[\text{Prot Cl}]$ or $z(y+z)=\text{K}a$

(b) $[\text{Prot}]\times[\text{H}^+]=\text{K}'[\text{Prot}^+]$ or $y(g-a-z)=\text{K}'z$

$$\text{and since } g=\frac{1000}{\text{V (m. wt. of protein)}}$$

$$\text{V}=\frac{1000\ \text{K}y^2}{(\text{m. wt. of protein})\ (x^2-y^2)\ (x^2+\text{K}y+\text{KK}')}$$

The application of Hooke's law leads to the equation

$$e=\text{C}\left(\text{V}-\frac{1}{\text{sp. gr. of protein}}\right)$$

The constants involved are three in number: K, the ionisation-K of the protein salt, is generally not a real constant but varies according to concentration as do the ionisation-K's of most strong electrolytes; the union of protein molecule and hydrogen ion involves another ionisation-K which has been called K′ and is probably constant, at least in the case of hide and gelatine; and finally the resistance of the proteins to swelling involves a third constant C, which depends for its value only upon what is known as the bulk modulus.

Thus, if the constants for the particular protein and acid are known, only one variable is required for the calculation of all the others; where the constants are not known two variables will be necessary.

A completely worked out theory is not necessarily capable of direct application without further

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‡ The following short table, based on the figures of Bray and Hunt (J. Amer. Chem. Soc., 1911, **33**, 781) and those of Noyes and Falk (*ibid.*, 1912, 454), gives the fractional proportion of hydrochloric acid ionised at different normalities:—

0·200	0·100	0·050	0·020	0·010	0·005	0·002	0·001
0·900	0·925	0·944	0·962	0·972	0·981	0·988	0·990

experiment: in fact such a condition is the exception rather than the rule. It is proposed in the present paper to discuss the theory principally from the tanner's point of view, although the principles are applicable to some other industries as well, and to suggest the possibilities of its practical application. Progress in the leather industry has been slow largely because of our ignorance from a physical and chemical standpoint of the very complex reactions involved in the wet work. This theory clears up some of the difficulties, although there is still much to be done along the lines of pure organic chemistry upon which the theory does not touch. The most immediate result which has been achieved is a complete explanation of the causes of "plumping and falling," and it is hoped that this will provide the means of controlling the degree of plumping very exactly in actual practice.

It has been shown, in the equilibrium of gelatine and hydrochloric acid, and this is equally true of hide substance and any acids or alkalis, that the variable e is a direct measure of the swelling and for either hide substance or gelatine we may write

$$e = C\,(V - 0{\cdot}7) = -2x + \sqrt{4x^2 + z^2}$$

It will be obvious to any mathematician, since z has a limiting maximum value, that e represents a curve which increases to a maximum and then decreases approaching zero. The important thing from the tanner's standpoint is the volume, which obviously depends for its value upon that of C. In the case of pure gelatine the value of C is largely dependent on the temperature, and some values for Coignet's pure gelatine at different temperatures are given in the following tables.

7° C.

V.	x.	y.	z.	e.	C.
11·3	0·179	0·137	0·097	0·0129	0·0012
14·6	0·0645	0·038	0·072	0·0185	0·0013
18·5	0·0296	0·0126	0·057	0·0229	0·0013
22·2	0·0064	0·0011	0·036	0·0255	0·0012

15° C.

V.	x.	y.	z.	e.	C.
17·6	0·197	0·160	0·082	0·0085	0·00050
19·8	0·105	0·075	0·072	0·0120	0·00063
23·2	0·0476	0·0295	0·047	0·0111	0·00049
27·3	0·0224	0·0100	0·040	0·0154	0·00058
34·2	0·0085	0·0021	0·032	0·0195	0·00058

Averages for C.

7°	0·00125
15°	0·00055
*18°	0·00021

* These figures were from a large number of determinations at a temperature of about 18° C.

It is probable that the two ionisation-Ks, which have been determined for gelatine and hydrochloric acid, are the same for hide as for gelatine. For any acid, K′ has been found to be of the order of 0·00015, and for gelatine chloride, K has been shown to be of the same order as the ionisation-K of hydrochloric acid, for corresponding concentrations. If we know the value of C, all variables including the swelling can be calculated from x, which is easily determined by a simple titration of the external solution. This is of practical importance as it enables one to differentiate between the acid combined with the hide, that held within the substance of the hide, and that held mechanically in the interstices between the fibres.

When a hide is immersed in hydrochloric acid, combination takes place between the hide molecules and the acid, forming a chloride of hide or collagen, which ionises to Cl′ and a colloid cation; when immersed in alkalis the combination of the colloid is with the positive ions and OH′ is ionised. We can use the same notation for alkalis as for acids by letting x represent the ionised alkali in the external solution and y that within the jelly or hide-substance itself. Thus if we put a hide in a solution of alkali of increasing concentration it will swell to a maximum and then fall again up to a strength of alkali which will decompose it and the same is true for acids. For hides of a given average weight at constant temperature the degree of plumping is determined by the value of x, and this applies to liming as well as to acid swelling. When systems of control have been sufficiently developed, it should be possible to produce any degree of plumping or falling desired, simply by regulating the strength of acid or alkali of the solution in which the skins are immersed. This will be important throughout the wet work, but especially in the bate. The point of greatest "falling" of the hide will be that where e is a minimum and this does not necessarily occur at the neutral point as might be supposed at first sight. The minimum of acid swelling occurs only when the concentration of hydrion is nil, but, as every chemist knows, this occurs only at an infinite concentration of alkali since

$$[H^+] \times [OH'] = 10^{-13{\cdot}8}$$

But swelling due to alkali (say NaOH) begins when $[Na+]$ is nil, which is at the neutral point. It follows, then, that the point of minimum swelling will be, not at the true neutral point where $[H^+] = 10^{-6{\cdot}9}$, but slightly on the alkaline side; and this accounts for the great degree of falling produced by bates containing or producing ammonia and its salts.

In the case of strong acids, in the absence of salt, it will be found possible to derive formulæ which, although not so accurate as those given, are to be commended for their much greater simplicity. If, in the experiments with gelatine and hydrochloric acid at 20° C. we can assume total ionisation of the acid and gelatine-salt, then between $x = 0{\cdot}01$ and $x = 0{\cdot}3$ the formulæ can be reduced to $z = \frac{x^{\frac{1}{2}}}{10}$ (approximately); $e = \frac{0.0025}{x^{\frac{1}{2}}}$ (approximately), and from these all other variables can be calculated as shown before; and these simplified formulæ become applicable to hide merely by substituting other suitable constants.

We have shown the applicability of the theory to the processes of liming, deliming, and pickling, but it obviously extends over the whole of the chemical changes taking place during tanning—whether vegetable or mineral.

Before the principles discussed can be incorporated into any system of control work it will obviously be necessary to perform a number of practical experiments which can probably best be done by the tannery chemist, for whom the problem is simplified by specific requirements and conditions, as well as by having a continuous process upon which to make observations. It is intended to continue the more practical side of the problem in these laboratories later, but it has seemed advisable in the meantime to attempt to arouse the interest of the tanner's chemist in a problem which we hope will be of great importance to him.

At this point the "practical" man will be apt to think that he has been given a lot of abstruse theories and much mathematics complicated with unknown "constants" some of which are not even really constant, and that at least till these are known it is impossible to put the work to any real use. Of course all this is too true, and is inevitable in any investigation of a theory which is at all complicated, for one must know the way in which actions are related before one can begin to determine working constants. It is, however, much to know on what the relation of one fact to another depends, and even that there is a regular relation at all, and in this sense we believe something useful has been accomplished. We have shown that, other things being equal, the swelling and the amount of acid or alkali absorbed is dependent on the hydrogen-ion concentration of the outer solution, and for a given compound such as gelatine or the collagen of hide-fibre at a given temperature there will be no difficulty in making tables or curves to show these for any known concentrations. The real trouble arises from the solid elasticity of the material which introduces another "constant" which we have called the "bulk modulus," of the nature of which we yet know very little, but which obviously varies very much with temperature and mechanical texture of the material. For a given kind of hide at a given temperature it is no doubt possible to construct a table giving from the known concentrations of the outer solution the volume of swelling and all the other variables, and this, for his own material, is well within the powers of the tannery chemist. To determine the laws of variation of the bulk-modulus and so make the table calculable for *any* temperature and *any* material may also be possible, but much more difficult and probably too complex for general use, but as most tanners work only a limited range of materials at temperatures which can be kept approximately constant, the simpler table will generally meet real requirements.

As to the best method of practical procedure, it may be suggested that graphic curves are in every way better than numerical tables, as in nature almost all changes are continuous, while a table can only give a series of definite steps, and a curve conveys a visual impression of the law of change which a table does not do. To the mathematician the form of the curve often denotes at once the nature of the law, and he can say at sight to what sort of algebraical equation it corresponds, but this knowledge is not at all essential to its practical use. No kink in the curve has been observed at the melting point of jellies, and the general form of the curves is completely given in Figures 1. and 2.

As regards actual methods of determination, the dry weight of hide is best obtained by drying an average sample of the material used, since any attempt actually to dry the pieces used for experiment would materially alter their character.

If the molecular concentration of the acid be determined by titration, as must generally be the case, it must not be forgotten that the equilibrium depends on the ionised part only, and that while this is 90% or more of the total molecular concentration of strong acids such as hydrochloric or sulphuric, it is a very small fraction of it in weak acids like acetic, so that in comparing experimental curves it must be remembered that the greatest ionic concentrations of weak acids correspond to very small normalities of strong ones.

So long as only pure acids or alkalis exist in the outer solution it is not difficult from tables and published matter to ascertain the actual ionic concentration, but in the jelly the matter is complicated by the repressive action of the highly ionised gelatine-salt on the ionisation of the acid or alkali, so that it is usually best to be content with mere normalities, but in this case it must not be forgotten that much larger apparent quantities of free acid in the jelly in proportion to the gelatine salt will be required for the equilibrium with weak acids and will correspond to no greater hydrion concentration.

In considering outer solutions containing salt it is necessary to remember that the action of the anion is to repress the swelling of the gelatine-salt, while the function of the hydrion is to maintain the quantity of the latter by preventing hydrolysis. As this is almost completely stopped by solutions above 0·05N of hydrion concentration there is little difference in the effect in reducing swelling of further additions of acid or of its neutral salt, except that the latter cannot cause hydrolytic decomposition of the gelatine. Below 0·05N it is necessary to consider the functions of the hydrion and anion separately.

The determination of the total acid in the jelly or hide includes not merely the free acid but the combined anion of the gelatine salt which is decomposed by titration with a strong alkali. If the titration is made direct in the hide with sodium hydroxide and phenolphthalein, many hours are required to reach the final neutral equilibrium, while methyl-orange fails to estimate the last portions of combined acid. Adopting a suggestion of Mr. J. A. Wilson, the process may be shortened by digesting for some hours with excess of a $N/10$ solution of sodium bicarbonate and titrating back an aliquot part of the solution. In this case methyl-orange must be used, but for greater accuracy the final titration may be made at a boil with alizarin or litmus as indicator.

It is not possible by direct titration to determine the actual *free* acid in the hide. With jellies and strong acids approximate results may be obtained by salting out as described in a previous paper,* but the method is not accurate when applied to weak acids. Under certain conditions the ionic concentration can be directly determined electrometrically by the hydrogen concentration cell, but this has its limitations and requires special apparatus. With strong acids and certain assumptions the free acid concentration can be calculated very approximately from the total acid absorbed by the jelly by the formula:

$$\text{Free acid} = \frac{x^2}{\text{total acid}},$$

where x is the concentration of the outer solution; but with weak acids the necessary corrections for ionisation are very complicated.

The following method will give approximate results even with weak acids if the concentration of the outside solution is not too small. A known quantity of the hide-material calculated to dry weight is placed in a known volume of acid of definite strength and allowed to remain with occasional shaking till equilibrium is reached (at least 48 hours). The acid is then poured off into a graduated cylinder and the skin allowed to drain into it for an hour or two in a covered funnel. The volume of swelling is then calculated from the loss of volume of the solution plus the water originally contained in the skin, and an aliquot part of the liquid is carefully titrated with sodium hydroxide and phenolphthalein to determine the equilibrium concentration. The skin is now treated with excess of common salt and allowed to drain thoroughly and pressed between filter paper to remove as much liquid as possible, and the remaining combined acid titrated in it by one of the methods described above. This will be the combined acid (ionised or not), and deducted from the total acid of the jelly will give the total free acid (ionised or not). The principal source of error is the change in the hydrolysis of the jelly-salt by the minute quantity of free HCl formed by the action of the organic acid of the salt. The organic acid combined with the gelatine is almost wholly and quantitatively replaced by hydrochloric acid. The ionisation may be approximately calculated from known ionisation-constants if that of the salt be presumed equal to other salts

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*Trans. Chem. Soc., 1914, **106**, 314.

of the same acid. The results may be to a certain extent checked by division of the (ionised) x^2 by the (ionised) total acid, which should equal the (ionised) free acid found.

Proceeding from methods of investigation to the application of the theory to explain actual problems of leather manufacture, its most direct application will be to the process of pickling, to elucidate which the research was originally started. This process consists in outline in treating the skins in an acid bath to form the gelatine-salt, and then in a concentrated common salt solution to repress the swelling and to substitute salt for all or part of the free acid in the skin without removing that actually combined. The acid generally used is sulphuric to which some salt is usually added to moderate the swelling, but any other acid can be substituted which will give the solution of about $N/20$ of actual hydrion concentration which is required for a practically complete saturation of the gelatine base. In any case if common salt is used to repress the swelling, the acid left combined with the gelatine is almost entirely hydrochloric which is substituted by the salt for the original acid used; skin pickled with formic acid was found by analysis to contain almost 3% of chlorine reckoned as HCl combined with the gelatine base, and even where sulphuric acid is used the substitution is nearly complete. It may seem strange at first sight that a weak acid should be capable of decomposing salt, but it must be remembered that the gelatine salt is highly ionised and the sodium chloride is present in enormous excess, so that according to the mass-law the quantity of gelatine formate remaining must be vanishingly small. The salt acts on the equilibrium by enormously increasing the outside Cl' pressure without adding to that of the ionising gelatine chloride so that the free acid is almost completely expelled and the actual fibre nearly dehydrated. Gelatine can be so compresesd as to retain less than its own weight of water and an appreciable portion of salt is expelled from this retained solution by the osmotic pressure of the gelatine-chloride.

The pickling process is used both as a means of preserving the skins even for months in a wet condition, and as a preparation for tanning, especially with chrome; and the requirements for the two purposes differ considerably. For mere preservation it is probably desirable to use as little excess of acid as possible beyond that needed to saturate the gelatine base, and to substitute the free absorbed acid entirely with salt solution. In practice, however, mainly to save time, it is found convenient to use stronger acid solutions, which in reasonable limits do not do much harm. Neither the quantity nor the concentration of acid required to produce the best results can be exactly given, as they are dependent not only on the character of the skins but on the volume of the liquor, but about 7·5 grms. of concentrated sulphuric acid, and 80 grms. of common salt per litre has given good results on sheepskins in such quantity as can be conveniently paddled in it. 100 c.c. of such a solution will require about 15 c.c. of $N/1$ alkali for neutralisation, which will be reduced to 8—10 c.c. by use, partly through dilution by water brought in by the skins. The sulphuric acid may be replaced for several packs, but the salt will gradually be converted into sodium sulphate which will also control the swelling. The usual method in practice is to put a "jugful" into the vat for each lot of skins, or more if the foreman is so minded, and usually too much is used. The salt solution should always be kept saturated and the skins paddled for at least twenty minutes in it. It is not usually changed and consequently gets more and more charged with acid, and it would no doubt be better from time to time *nearly* to restore its neutrality by addition of soda. Pickled skins swell inordinately if placed in water and hence must either be neutralised or tanned in salted liquors, and of course the more acid is left in the skins the more salt is needed in the tanning liquor. We see no practical object in substituting more expensive acids for sulphuric except to minimise the effects of careless pickling.

When pickling is used as a preliminary to chrome tanning the objects are different and the method must be modified accordingly. In the two-bath process the skins are first brought into a bath of bichromate acidified with hydrochloric or sulphuric acid to liberate chromic acid. Pickled skins carry in with them a certain quantity of acid, so that the acid added directly to the bath must be reduced, and as only free chromic acid is fixed by the skins, they are penetrated rapidly and evenly by the bichromate from which the chromic acid is liberated on the fibre and the acid in the skin is neutralised by its soda or potash base. Probably other purposes are also served by the preliminary swelling. It is thus desired to carry acid in with the skins and the final salt bath is omitted, sufficient salt being added to the acid bath to control the swelling as desired. In considering the acid required it must not be forgotten that the skins mechanically carry an appreciable quantity of the acid solution with them into the chrome bath.

Skins are also frequently pickled as a preliminary to the single-bath process of chrome tanning, but with somewhat different objects. The tanning liquor is a solution of a basic chrome salt, and the more basic it is the greater the quantity of chrome ultimately fixed by the skin. As, however, basic chrome solutions are colloidal, too basic solutions tan the surface too heavily and penetrate very slowly to the centre, and bringing the skin in an acid condition into the bath enables a more basic solution to be used without producing this effect.

Pickling is also sometimes used as a preliminary to ordinary vegetable tannage in salted liquors, and it is found that soft tannages can be produced in this way in less time and with less tanning material than where the pickling is omitted. The effects of pickling on tannage are no doubt in part at least dependent on the fact that the colloid compound gives rise to a surface electric potential on the molecules or their complexes which must have a profound effect on adsorption and colloidal combination, but the study of these electrical phenomena, though begun, is yet far from complete. When these problems are solved, it is probable that the vexed question of the necessary acidity of tan liquors can be definitely dealt with. Apart from pickling, and metallic tannages which themselves are in part pickling processes, the theory explains a good deal even with regard to alkaline swelling and the bating and puering processes. It probably offers a complete explanation of the different degrees of swelling produced by different alkalis and alkaline salts, but its application to the theory of bates and puers is still more interesting, if as yet more speculative. If hide is swollen by an alkali such as lime, the swelling is gradually reduced by neutralisation, and, with increase of acid, again increases as the skin becomes acid; but it is recognised by the practical manufacturer that the depletion produced by the most careful delining is less thorough than that obtained by the use of ferments, dung bates, or puers. While the acid swelling is due to the acid anion combined with the skin the alkaline is caused by hydroxyl ionised from complex gelatine base formed with the alkali, and the hydroxyl concentration is inversely proportional to the hydrion concentration. At the neutral point of water a certain pressure from the acid anion still exists and the curve of acid swelling is prolonged to the alkaline side of this neutra point while the hydroxyl swelling only takes its origin there. It follows that in a swelling curve compounded of these two curves the minimum point must be, not at the neutrality of water, but somewhere very slightly on the alkaline side. All the dung bates in action are alkaline. It is true that, in a transition from the alkaline to the acid condition, goods must necessarily pass through this point of minimum swelling, but to produce the required effect they must not merely pass through it but be maintained at it sufficiently long for the effect to be produced; and this can only occur in presence of some base just weak enough to regulate the hydroxyl concentration at the required point. This may be made clear by an illustration. With a strong acid and base a solution may well pass from the acid condition indicated by methyl orange to the alkaline one of phenolphthalein with a single drop of $N/10$ solution, while in presence of a weak acid many c.c. may be required. Dung bates naturally contain a variety of excessively weak amino-acids and amine salts, and it is not improbable that the mixture may nearly hit the required minimum. Wood has shown* that a mixture of an amine salt, and an enzyme to digest the keratin residues and other matters requiring removal will produce the essential effects of a puer; and "Oropon" containing ammonium chloride and pancreatic enzymes is for many purposes a successful substitute, but it is unlikely that in either case the *optimum* alkalinity is exactly attained. The problem of a perfect chemical puer is thus reduced to the search for suitable enzymes and suitable salts of weak bases and does not seem impossible of solution. The hydroxyl concentration of working pure liquors is easily determined by the hydrogen electrode.

In this connection it may be pointed out that though the total alkalinity of old and mellow limes is greater than that of fresh ones, it is quite probable that their hydroxyl concentration is lower, because of the dissolved amino-compounds which they contain together with bacterial enzymes. As Stiasny has shown, the alkaline effect of ammonia present, to which a good deal of the alkalinity is due, is much reduced by its tendency to form complex ions with lime comparable to those which it forms with copper.

Apart from the questions of leather chemistry the theory has important applications. The kindred industries of dyeing and textiles are also based on the behaviour of fibres which are in their nature colloid jellies, and though their chemical constitution differs from that of skin, it is almost certain that their behaviour is governed by analogous laws.

With animal physiology and medicine the relation is still more direct. It has been shown by Pauli and others that in all probability muscular contraction and relaxation depend on the same causes as govern the behaviour of the pickled skin; and Dr. Martin Fischer attributes the dropsical swelling of kidney and ovarian disease and the failure of blood pressure in "surgical shock" to acid swelling of the tissues which he treats with salt and alkalis. Probably Loeb's fertilisation of star-fish eggs by salt solutions is in the same connection.

Communication.

ACTION OF METALLIC SALTS ON WOOL AND SILK IN PRESENCE OF NITRITES AND AN ACID.

BY EDWARD LODGE AND G. E. F. LODGE.

When wool or silk is treated with a metallic salt, a nitrite, and an acid, and the temperature gradually raised to the boiling point, or if the wool be first mordanted with a metallic salt, with or without the aid of an assistant, and afterwards treated in the same or in a separate bath with a nitrite and an acid, a coloration is obtained entirely different from that obtained by the action of a metallic salt and an acid without the nitrite. The effect is also totally different from that produced when wool is first treated with a nitrite and an acid, and afterwards with a metallic salt.

The shades of colours produced range from yellows, tans, fawns, browns, and olives to drabs. The shades vary much according to the percentage of acid used; for example, if a bath be made up of 4% copper sulphate, 5% sodium nitrite, and 2% oxalic acid, the wool entered cold and gradually raised to the boiling point, the fibre is coloured a claret-brown or maroon; if the quantities are doubled a similar but deeper tone is obtained, whilst if the amount of oxalic acid be increased the shade gradually becomes more yellow; with 7% oxalic acid the shade is brown-fawn, and with 10% acid the shade is not so deep as with 8—9% acid. The shades obtained by the use of copper salts are fast to soaping, but fugitive to light, until the percentage of acid reaches 7%, when the colours are fast to light.

On treatment of wool under the conditions given in the example, and after boiling for half an hour with 3% potassium bichromate and 1% sulphuric acid, the claret-brown becomes a yellow-brown; the shade is not fast to light, but offers some resistance to soap and alkalis.

Other acids can be substituted for the oxalic acid. Sulphuric acid is the most active; with formic or sulphuric acid (same percentages) the shade is some tones deeper than that obtained with oxalic acid, and the fading is not so marked: with sulphuric acid the resistance to light is really good.

Wool treated with 4% ferrous sulphate, 5% sodium nitrite, and 2% oxalic acid, becomes coloured a dull olive; on using 8% oxalic acid a much browner shade is obtained. These shades turn much deeper and duller on exposure to light and air.

Wool under treatment with 4% iron alum, 5% sodium nitrite, and 2% oxalic acid yields an olive shade; an increased percentage of iron alum gives deeper shades. These shades exhibit excellent resistance to atmospheric exposure as well as to soaping. With 8% iron alum, 5% sodium nitrite, and 8% oxalic acid, a nut brown colour is obtained, which on exposure changes into a deep yellow brown.

A treatment with 4% nickel sulphate, 5% sodium nitrite, and 2% oxalic acid, results in the production of a salmon pink, of all-round fastness; on increasing the amount of acid to 8% the colour obtained is a shade of tan.

Cobalt yields olive shades, very similar to ferric iron, but not so green in tone; the more acid is used the greener is the tone produced. These shades become greener on exposure. Manganese salts give fawns; the more acid the yellower is the shade obtained. Chromium, whether in the form of a chromium salt or a chromate, results in the wool being coloured brown. These shades may be considered fast. Zinc, antimony, lead, and calcium salts produce various shades of fawns and browns. Vanadium gives pleasing yellow-brown shades which resist atmospheric exposure very well indeed. Potassium titanium oxalate gives a beautiful yellow-orange or gold shade, fast to light. Aluminium salts furnish yellow shades sensitive to alkalis.

Most metallic salts give some colour or other, chiefly, however, fawns and browns, and if a sufficiency of an acid be used they are relatively fast colours.

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* This Journal, 1898, 17, pages 1010 to 1013.

The metals so fixed are available for colours requiring a mordant, the results being deeper than those obtained when working under ordinary mordanting conditions. The shades appear brighter and clearer if produced by the two-bath method, *i.e.*, mordanting first with a metallic salt, and treating in a fresh bath with the nitrite and an acid.

Similar results are obtained on silk.

When considering the course of the reaction it is interesting to note that with iron salts green tones are obtained, and with chromium browns—shades similar to those obtained by a combination of *o*-nitrosophenols (*o*-quinone-oximes) with these metals.

The various results obtained under the nitrous acid-metallic salt treatment, would suggest that some nitroso-metallic complex results between the fibre substance and the metal. Amongst the degradation-products of wool, tyrosine is a compound which might be expected to react with nitrous acid. If wool contains substances with contiguous hydroxyl groups, these would account for the pleasing results obtained with titanium salts. The oxides of this element give yellow and orange colorations with catechol, chromotrope acid, and similarly constituted compounds.

The subject requires further investigation and an extended study is in progress.

Our thanks are due to Prof. G. T. Morgan, F.R.S., for valuable suggestions in regard to this investigation, and to Mr. F. Vickerman for carrying out much of the experimental work.

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Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

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I.—GENERAL; PLANT; MACHINERY.

Smoke precipitation; Recent progress in electrical ——. F. G. Cottrell. Eng. and Min. J., 1916, 101, 385—392.

When gases are subjected to the action of alternating currents, the suspended particles are agglomerated into larger aggregates, and then settled under the influence of gravity, but with large volumes of rapidly moving gases in smelter flues, high-tension continuous currents are necessary. In the author's process, an alternating current is transformed to a high voltage, 20,000 to 75,000 volts, and then converted into an intermittent direct current by a special rotating contact maker driven by a synchronous motor. The discharging electrode is formed from a bare metal wire placed axially in the flue, or the thin edge of a metallic sheet, and a system of pipes carrying the gases is used as the collecting electrode, or the latter may be formed of plates hung in the flue with discharging electrodes between. Experiments were first made on the collection of sulphuric acid mist from a contact acid plant, and these led to the first commercial installation, in which from 5000 to 10,000 cub. ft. of gas per minute was treated, thus recovering some 2 galls. of acid per minute. Later, the method was applied to the treatment of gases in various copper works, and in one case 200,000 cub. ft. of gas per minute was treated in 2500 vertical steel pipes, 5″ × 10′, which acted as collecting electrodes, the discharge electrodes consisting of No. 10 iron wires suspended in the axis of each tube from insulated bars. The difference in potential was 25,000 volts, with a consumption of 60 to 80 kw., and several tons of fume per day, averaging 50 % lead, in addition to other values, was collected. The pipes were arranged to be shut off in sections, and the fume tapped out into hoppers by a system of swinging hammers. Wider pipes, up to 4ft. diam., have been employed, but longer pipes and higher voltage are then required. The process has also been applied successfully to the collection of lead fumes from lead blast furnaces, zinc fumes from brass foundries, the purification of sulphur burner gases in paper mills, and the recovery of alkali salts, up to 20 tons of sodium salts per day, from the waste liquor evaporator gases in the paper pulp industry. In manufacturing Portland cement, about 100 tons per day of dust is now collected in one works, having a daily capacity of over 5000 barrels; this dust contains from 3 to 5 % of potash salts in a water-soluble form, whereas the raw material has only about 1 % in an insoluble form. By treating the dust in another kiln with more raw material, 3 to 4 tons of dust per day containing 30 % potassium sulphate is collected. The process has also been applied successfully in collecting soot from coal smoke, in detarring and cleaning illuminating and coke oven gases, in purifying air from sand blasts, etc., in works, and in the absorption of gases, such as chlorine in a bleach works, by means of slaked lime dust, which is afterwards precipitated electrically. It is also suggested that a further important development in the future may be the cleaning of iron blast furnace gas.—B. N.

Patents.

Anti-incrustation briquettes, or blocks, especially for use in steam boilers. R. Barton, Hull. Eng. Pat. 7398, May 17, 1915.

An intimate mixture of finely powdered zinc 33—50 parts, vegetable matter containing tannin 40—57 parts, and an alkali or alkaline compound 10 parts, with or without graphite.—W. F. F.

Absorbing, condensing and purifying apparatus. J. F. Rhoades, Millinocket, Me. U.S. Pat. 1,171,648, Feb. 15, 1916. Date of appl., Dec. 17, 1914.

The gas is passed through a series of pairs of upper and lower tanks, connected by vertical pipes; it enters the upper tank, meets a washing or absorbing liquid, and flows with it to the lower tank, which is provided with a gas-collecting bell spaced away from the tank wall. The gas passes from the bell to the upper tank of the next pair and the liquid is returned to the upper tank of the first pair.—W. H. C.

Still and still-setting. H. Henderson, Port Arthur, Tex., Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,171,720, Feb. 15, 1916. Date of appl., July 9, 1915.

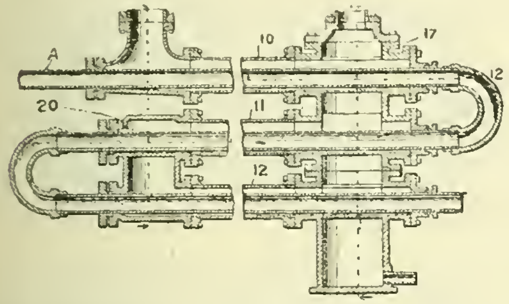
A horizontal cylindrical still is suspended by hanger rods from a series of arches with steel frames. A brick-lined furnace is suspended beneath the still by metal arch bars from lugs formed on the sides of the still.—W. H. C.

Filter mediums; Process of cleaning ——. O. J. Salisbury Salt Lake City, Utah. U.S. Pat. 1,171,892, Feb. 15, 1916. Date of appl., Nov. 21, 1914.

The filter-medium is heated with water in the vessel in which filtration takes place, and is then withdrawn while still hot and brushed, and washed with a suitable liquid.—W. H. C.

Evaporating liquids: Apparatus for ——. F. Elder, Assignor to J. L. Ebner and C. B. Wissing, Vincennes, Ind. U.S. Pat. 1,172,120, Feb. 15, 1916. Date of appl., Apr. 9, 1913.

The liquid is passed through the space between the inner tubes, A, and the outer tubes, 10, 11, 12, and the heating agent is passed through the inner tubes. The inner tubes are connected at the ends by bends, 12, and the outer tubes are connected by hollow heads, 17, 20. The latter have overflow gutters formed in the upper portion to maintain the level of the liquid in the annular space above the upper surface of the inner tube. —W. H. C.



Centrifugal gas washing apparatus. Berlin-Anhaltische Maschinenbau-A.-G., Dessau. Ger. Pat. 288,530, June 9, 1914.

Separate chambers are arranged one over the other in tower formation, each provided with a centrifugal machine keyed on to one central shaft, and outlets for passing the gas upwards into the chamber next above it. The gas outlets into each chamber are arranged in a ring round the central shaft of the apparatus, and are provided with caps. These caps collect the liquid scattered by the centrifugal machine and produce a screen of liquid drops, through which the gases pass as they enter the chamber. This action added to the whirling effect produced by the rotation of the machine causes the gases to be thoroughly purified and mixed before they reach the outlet from the last chamber at the top of the apparatus. —J. B. C. K.

Extraction process. U.S. Pat. 1,171,408. *See* XII.

Soluble catalytic agents and process of making the same. U.S. Pat. 1,171,902. *See* XII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Methane; Influence of different surfaces on the decomposition of ——. W. E. Slater. Chem. Soc. Trans., 1916, **109** 160—164.

The rate of thermal dissociation of methane was found to depend not merely on the amount of heated surface exposed to the gas, but also on the nature of the surface. Experiments at 910° C., with silica, alumina, magnesia, lime, baryta, wood charcoal, graphite, carborundum, iron, and copper, all in a similar state of fine division, showed that each substance exerts a specific influence. In every case the residual gas contained only hydrogen and methane, with a trace of nitrogen. The highest rates of decomposition were observed with iron, charcoal, and graphite.—F. Sodn.

Olefines from petroleum; Effect of temperature on the formation of —— *at atmospheric pressure.* G. Egloff and T. J. Twomey. Met. and Chem. Eng., 1916, **14**, 247—250.

Separate portions of a saturated gas oil, boiling between 250° and 350° C. and obtained by distilling Pennsylvania crude petroleum at atmospheric pressure, were cracked in the gaseous state at temperatures increasing by 50° from 450° to 800° C.; the oil recovered from each was separated into fractions boiling up to 95°, 95°—120°, 120°—150°, 170°—230°, 230°—270°, and 270° C. to tar, and the proportion of unsaturated hydrocarbons in each fraction determined by means of 95% sulphuric acid. The highest percentages of unsaturated hydrocarbons (up to 5·7%) were found in the lower boiling fractions (up to 150° C.), in which the degree of unsaturation increased with the cracking temperature up to 600°—700° C. and then declined. In the higher boiling fractions, and in the cracked oils as a whole, a similar but less marked increase was observed up to 700° C., with indications of a decline at higher cracking temperatures. It is concluded that the change in the composition of the lower boiling fractions of the cracked oils occurs in the order low-boiling paraffins to low-boiling olefines to low-boiling aromatic hydrocarbons; and in that of the higher boiling fractions in the order, high-boiling paraffins to high-boiling olefines to high-boiling aromatic hydrocarbons.—W. E. F. P.

Conductivity and electrical excitability of liquid insulators [benzene, petroleum spirit, etc.]. D. Holde. Z. Elektrochem., 1916, 22, 1—5. (See also this J., 1915, 649.)

The electric charge acquired by fluid insulators such as benzene or petrol, when they are pumped through pipes, is instantly and completely dissipated if they are allowed to flow into an earthed container. The discharge appears to be absolutely independent of the conductivity of the liquids themselves, as using, for example, a sample of ordinary chemically pure benzene with a conductivity of the order of but 10^{-15}, the charge could not be detected with an electroscope so long as the receiver was earthed, yet a charge imparted to the electroscope did not leak away through the benzene to the receiver and to earth. Inflammable liquid insulators, however low their conductivity, can therefore apparently be pumped through pipes with perfect safety so long as the receiver is earthed. It is suggested in explanation that the insulator, charged by friction, gives up its charge at the surface of the metal container when the friction ceases, and if the latter is earthed the induced potential on the inner wall neutralises this, whilst the negative potential on the outer wall escapes to earth. An alternative explanation which also obviates the difficulty of the low conductivity of the insulators was previously given (*loc. cit.*).—G. F. M.

Asphalt; Differentiation of natural and artificial ——. E. Graefe. Z. angew. Chem., 1916, 29, 21—25.

The method of Marcusson and Eickmann (Chem.-Zeit., 1908, 965; compare this J., 1911, 480) is rendered untrustworthy by the fact that certain petroleum oils rich in asphaltic substances, for example Trinidad and Venezuela oils, are nearly free from paraffin wax, while on the other hand, a mixture of a hard natural asphaltum with a fluid petroleum oil residue rich in paraffin wax would be regarded as an oil asphalt from the results of the test. Marcusson's later method (this J., 1914, 739) is the most reliable means yet discovered of distinguishing between these products. As a rapid test 1 grm. of the asphalt may be heated for 5 minutes in a test tube in a bath of cylinder oil maintained at 200°—205° C., and the vapours tested for hydrogen sulphide with lead acetate paper. All natural asphalts gave pronounced reactions, while asphaltites gave no reaction. Oil asphalts did not react at the temperature of the test, except in the case of Californian oil asphalts and the residue from Trinidad crude oil: these gave very faint reactions which, however, would not be confused with those given by natural asphalts. The extracts from asphaltic rocks gave pronounced reactions, except in one case, in which only a faint discoloration was produced. Pitches varied in their behaviour. Wood pitch reacted slightly, but distinctly, while the residue from the distillation of fatty acids discoloured the lead paper even in the cold. These pitches, however, may be distinguished by other tests (this J., 1906, 422). The reaction does not appear to depend upon the proportion of sulphur, but upon its mode of combination. For example, St. Valentine bitumen gave a stronger reaction than Trinidad asphalt with a slightly lower proportion of sulphur, while Venezuela bitumen (2·75% S) gave a fainter reaction than Cuba asphalt (1·87%). In the case of the oil asphalts, "Mexican Eagle" asphalt with about 3·5% S, gave as faint a reaction as Galician oil asphalt with 0·68% S (see also this J., 1913, 233; 1914, 66, 739).—C. A. M.

Asphalts; Distinguishing natural and artificial ——. R. Bratter. Mitt. K. K. Versuchsamt Wien, 1915, 4, 60—65. Z. angew. Chem., 1916, 29, Ref., 17.

A relatively quick method consists in melting 1 grm. of the bitumen on a water-bath, cooling and grinding the material and shaking it with 15 c.c. of cold acetone, allowing to stand 5 mins. and observing the fluorescence. The acetone solution is then evaporated, the residue treated with 5 c.c. N/2 caustic soda solution, filtered, and a few drops of freshly made diazobenzene chloride solution added. Natural asphalts yield brown, non-fluorescent solutions and give no diazo-reaction. Petroleum pitches yield brown or yellow solutions with marked yellowish green fluorescence and a negative diazo-reaction. Lignite and coal tar pitches yield yellow solutions with a dark green fluorescence and give a positive diazo-reaction. —A. B. S.

Recent progress in electrical smoke precipitation. Cottrell. *See* I.

Solubility of naphthalene in ammonia as a cause of stoppage of pipes. Hilpert. *See* III.

Determination of Prussian blue in spent oxide. Randall. *See* VII.

Patents.

Briquetting with dust from fusible organic substances, such as pitch or asphalt; Production of dust and ——. K. Fohr, Munich, and E. Kleinschmidt, Frankfort. Ger. Pat. 289,069, Apr. 15, 1914.

An inclined rotating cylindrical vessel is provided with means for feeding continuously at one end the materials that are to be briquetted. The binding agent, pitch or bitumen, is blown into the vessel in the form of fine powder by air or steam pressure, and is maintained in suspension at a temperature above its melting point, for a period of time determined by the length of the cylindrical vessel, and the pressure used for the pulverising apparatus.—J. B. C. K.

Lignite or peat dust: Process for briquetting ——. E. Schimansky, Berlin. Ger. Pat. 289,070, Nov. 22, 1914. Addition to Ger. Pat. 287,157 (this J., 1916, 101).

The strength of the briquette is increased by adding coke powder to the mixture. J. B. C. K.

Coke-oven. Gebr. Hinselmann, Essen. Ger. Pat. 289,618, Apr. 24, 1915.

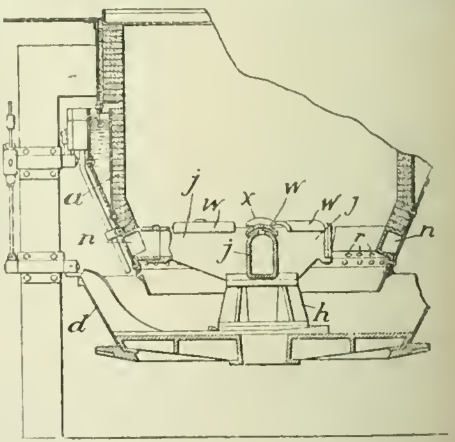
Steam is passed through flues below the floor of the oven in order that it may be superheated and then used in the various chambers as required; all risk of damage by the introduction of wet steam is thereby avoided.—A. B. S.

Coking and gas-generating oven. W. Feicks, Bloomfield, N.J. U.S. Pat. 1,171,418, Feb. 15, 1916. Date of appl., Jan. 22, 1912.

Gas and air in suitable proportions for partial combustion are introduced at the bottom into vertical heating flues in the walls of the oven. The flues are connected at the top in pairs, the connecting passage opening downwards into a secondary flue, the opening to which is regulated by a plug adjustable vertically. Additional air is supplied through openings in the centre of the plugs.—W. F. F.

Gas producer. P. B. Morgan, Worcester, Mass., U.S.A. Eng. Pat. 15,717, May 10, 1915.

The shell, *a*, of the producer is supported from the centre of the ash-pan, *d*, by means of the blast pipe, *h*, and radial pipes, *j*, so that a space is left between the base of the producer and the ash-pan for the removal of ashes. The air or mixture of air and steam which is supplied by the pipe, *h*, is blown into the fuel through annular and radial slits protected by the covers, *x* and *w*, respectively, and also downwards through perforations, *r*, in the annular conduit, *n*.—W. F. F.



Gas; Manufacture of ——. J. M. Rusby, Assignor to United Gas Improvement Co., Philadelphia, Pa. U.S. Pat. 1,172,226, Feb. 15, 1916. Date of appl., Dec. 10, 1909.

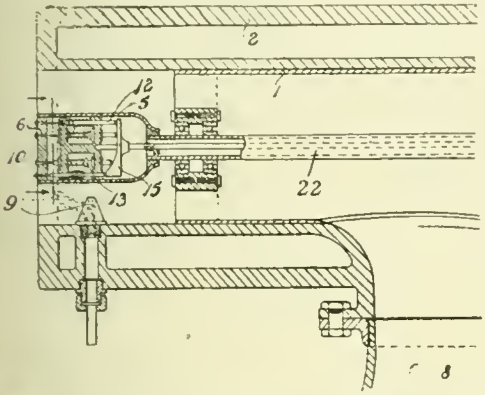
The flow through the feed pipe to a gas generator is regulated by a valve operated automatically by the movement of a floating bell in a casing. The position of the bell is determined by connecting the spaces within and without, by pipes to two points in the feed pipe, at such a distance apart that a pressure difference is set up due to the friction in the pipe.—W. F. F.

[Gas washers ;] Method of and apparatus for recovering sludge [from ——]. H. A. Brassert and W. Mathesius, Chicago, Ill. U.S. Pat. 1,171,696, Feb. 15, 1916. Date of appl., Dec. 8, 1915.

The washing water passes to a settling tank, from which the sludge is removed and conveyed to the top of a blast furnace into which it is discharged. —W. F. F.

Liquid fuel burners for high temperatures. W. W. Crawford, London. Eng. Pat. 2860, Feb. 22, 1915.

Liquid fuel is fed under pressure through the pipe, 22, into the rotating burner head, 5, provided with apertures, 6, in a diaphragm, 10. A number of cleaning drills, 12, carried by the burner head are periodically forced into the apertures, 6, against the action of springs, 13, by their revolution in contact with the fixed cam disc, 15. A water cooling space is provided between double walls, 2, and a nozzle, 9, directs cold air against the burner head. Air for combustion is supplied through a passage, 8, at such a rate that combustion takes place at a point in front of the burner and within the furnace.—W. F. F.



Mineral oils ; Apparatus for distilling ——. A. Lackman, New York. U.S. Pat. 1,171,524, Feb. 15, 1916. Date of appl., Apr. 1, 1912.

The oil passes through a number of stills in series, entering each still at the top and leaving at the bottom. The inlet to each still is heated by the outgoing vapour, and each still has a partition rising from the base, dividing it into unequal compartments; the oil is withdrawn from the lower part of the larger compartment and introduced into the smaller compartment at the top. —W. F. F.

[Gas] retorts ; Means for discharging ——. Gibbons Bros., Ltd., Lower Gornal, and E. Masters, London. Eng. Pat. 10,058, July 10, 1915.

Combustible gaseous mixtures ; [Apparatus for] the utilisation [burning] of ——. A. C. Ionides, jun., London. Eng. Pat. 5984, Apr. 21, 1915.

Benzol gas producing plant. A. Perrier, Paris. Eng. Pat. 7891, May 27, 1915.

Hydrogen or illuminating and heating gas ; Process of producing ——. K. E. Barth, Charlottenburg, Assignor to Berlin-Anhaltische Maschinenbau-A.-G., Berlin. U.S. Pat. 1,172,925, Feb. 22, 1916. Date of appl., Feb. 14, 1913.

See Ger. Pat. 267,944 of 1913 ; this J., 1914, 190.

Oil-fuel furnaces. Eng. Pat. 2804. *See* I.

Production of oil from bituminous minerals. Ger. Pat. 289,249. *See* IIb.

Recovery of by-products from gases from distillation of coal, wood, peat, etc. Ger. Pat. 289,519. *See* IIb.

Substitutes for lubricating oils. Ger. Pat. 288,148. *See* III.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Patents.

Oil ; Production of —— from bituminous minerals. M. Ziegler, Berlin-Friedenau. Ger. Pat. 289,249, Oct. 27, 1914.

Clay, shale, or other suitable bituminous mineral is passed through a kind of gas-producer in which it is treated in stages with high-pressure steam admitted through three or more ports. Oil vapour, ammonia, and the gas produced from the solid combustible matter are withdrawn through separate outlets. The residue passing out at the base of the structure is suitable for cement manufacture.—A. B. S.

By-products from gases from distillation of coal, wood, peat, etc. ; Recovery of ——. F. Brunck, Dortmund. Ger. Pat. 289,519, Dec. 13, 1913.

The hot crude gas from coke ovens, etc., is passed through the jacket of a recuperator vessel in which condensed ammoniacal liquor is treated with lime, and then passes through a vertical tray-washer in which the tar and other condensable matters are separated, the gas-water being kept sufficiently hot for any free ammonia to be volatilised. The mixture of gas and ammonia is then passed into a saturator to recover the ammonia. The gas-water and tar are collected, and the tar is allowed to settle and run off at the bottom of the receiver ; the gas-water is treated with lime and heated by the crude gas in the vessel mentioned above. In this way all ammonium salts are decomposed and the ammonia evolved is passed into the current of gas and is eventually absorbed in the saturator.—A. B. S.

Boron, titanium, and zirconium ; Preparation of masses, especially powder, of pure —— [for incandescence lighting]. Ehrich und Graetz, and E. Podszus. Ger. Pat. 289,063, Jan. 12, 1913.

Compact masses of boron, titanium, or zirconium, as free as possible from oxides, or preferably of the hydride or nitride of the element, are reduced to an extremely fine powder by mechanical means or by aid of the electric arc, the powder is compressed in moulds, and the mass, after a preliminary burning, is sintered by heating it electrically for a long time, at a temperature near the melting point, in an inert atmosphere, *e.g.*, of ammonia or hydrogen, in order to remove those impurities, especially oxygen, which are detrimental to the use of the products in incandescence lighting. When sintering is effected in an atmosphere of hydrogen, especially if this be not entirely free from oxygen or water vapour, a halogen compound of the element under treatment is preferably added. When the sintering operation is completed, the product is cooled as rapidly as possible. The inert atmosphere may be composed of mercury vapour, in which case the material under treatment is surrounded by a tube of refractory material, with a relatively narrow intervening space. The operations of disintegrating and sintering may be repeated as often as is necessary to obtain the desired degree of purity. The original material is ground in mills constructed of the same or a similar material, and preferably in a dry, non-oxidising atmosphere, or in a liquid, such as benzene, carbon bisulphide, or the like ; and the mill may be cooled, or small quantities of suitable substances incorporated with the material being ground to increase the brittleness.—A. S.

Electrodes for arc lamps; Metallic cases for ——. Siemens-Schuckert Werke, G.m.b.H., Siemensstadt. Ger. Pat. 289,589, Nov. 16, 1913.

The carbon is coated with a thin metallic film applied by any known dry process and on this film a thicker coating is produced by electrodeposition. This avoids the introduction of an electrolytic solution into the pores of the carbon with the resulting discoloration and unsteady lighting.—A. B. S.

Apparatus for the destructive distillation of sewage and the like. Eng. Pat. 8666. *See* XIXb.

III.—TAR AND TAR PRODUCTS.

Naphthalene: Solubility of —— *in ammonia, as a cause of the stoppage of pipes.* [*Determination of naphthalene.*] S. Hilpert. Z. angew. Chem., 1916. **29**, 57—59.

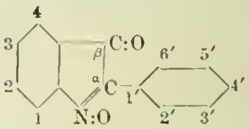
Determinations of the solubility of naphthalene in solutions of ammonia and in liquefied ammonia gave the following results in grms. per 1000 grms.:

° C.	Ammonia %.				
	0	5	10	25	100
	grms.	grms.	grms.	grms.	grms.
0	0·019	0·030	0·042	0·064	33
25	0·030	0·044	0·074	0·162	120

An addition of pyridine increased the solubility of the naphthalene. For example, the presence of 2 % of pyridine in 25 % ammonia solution raised the amounts of dissolved naphthalene to 0·082 grm. at 0° C. and 0·245 grm. at 25° C. Phenol had no influence on the solubility. By passing a current of carbon dioxide into a solution of naphthalene in 25 % ammonia, the bulk of the naphthalene was deposited. A 4 % ammonia solution saturated with carbon dioxide and containing 0·5 % of pyridine dissolved about the same amount of naphthalene as did water. With regard to the condensation of naphthalene in gas pipes, it is calculated that one kilo. of 25 % ammonia solution will yield 330 litres of ammonia gas at 0° C., and that this is able to take up 0·015 grm. of naphthalene. Since the same quantity of ammonia solution dissolves 0·16 grm. of naphthalene at 25° C., the bulk of the hydrocarbon must separate on evaporating and cooling the gas. A technical sample of liquid ammonia contained 0·05 grm. of naphthalene per kilo., so that a temperature of at least 10° C. would have to be maintained if the naphthalene were to be prevented from condensing in the pipes from the still. This tendency to separation becomes more pronounced with the rise in temperature owing to the strong increase in the partial pressure of the naphthalene. The vapours from an ammoniacal solution of naphthalene are richer in naphthalene, the higher the temperature of distillation, but the proportion of naphthalene in the mixed distillate is lower than corresponds to the partial pressure of the naphthalene at that temperature. In general it is advisable to prevent the temperature of the pipes from falling below 30° C., or to interpose a cooling chamber for the separation of the naphthalene. In the presence of pyridine the temperature of separation is lowered, since the aqueous distillate is able to dissolve more naphthalene. *Determination of naphthalene*:—Accurate results are rapidly obtained by the following modification of the picrate method:—The naphthalene (not exceeding 0·2 grm.) is dissolved in about 30 c.c. of ether, and the solution added to 50 c.c. of a standard (about $N/20$) solution of picric acid. The flask is closed with a cork through which passes a glass tube ending in a bent capillary tube. After vigorous shaking for 2 mins., the ether is drawn off by suction *in vacuo* with constant shaking until the liquid is cold. The flask is then heated on the water bath to about 30° C., the ether again drawn off *in vacuo*, and so on, until the odour of ether is barely perceptible. It is then allowed to stand for 2 hours at the ordinary temperature or for 10 mins. in ice, the picrate separated with the aid of suction, washed with 5 c.c. of ice-water, and titrated with $N/10$ sodium hydroxide solution, with litmus as indicator. For determining naphthalene in ammonia solutions, the sample is chilled in a freezing mixture and neutralised first with $5N$ and then with $15N$ sulphuric acid. The naphthalene separates in flakes which must then be separated by distillation with steam, extracted with ether, and converted into picrate as described. Naphthalene picrate shaken with water at 15° C. invariably yielded a 0·067 % solution, and the compound was stable in such a solution. Hence the currently accepted statement that naphthalene picrate is insoluble only in a saturated solution of picric acid requires modification.—C. A. M.

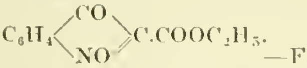
Indole derivatives [*isatogen, etc.*]; *Photochemical syntheses of* ——. P. Pfeiffer. Annalen, 1916, **411**, 72—158.

New derivatives of indole have been synthesised which are derived from a parent substance, isomeric with isatin, called "isatogen," the α-phenyl derivative of which has the following constitution:



On heating with pyridine, o-nitrostilbene dichloride gives *o*-nitrochlorostilbene, which yields *o*-nitrotolane on treatment with caustic potash. On exposure to light, a pyridine or quinoline solution of any of these three substances gives rise to phenylisatogen of the above formula. In absence of light the monochlorostilbenes are quite stable in boiling pyridine solution. Reduction of the isatogens by zinc dust in glacial acetic acid solution gives rise to the corresponding almost colourless indoxyls, which yield crystalline acetyl compounds; thus 2-cyano-α-phenylisatogen (m.pt. 227° C.) from 2-nitro-4-cyano-*μ*-chlorostilbene gives on reduction the pale yellow cyanophenylindoxyl (acetyl compound, m.pt. 190°—191° C.). On treatment with hydroxylamine hydrochloride in boiling alcohol solution, isatogens give two isomeric mono-oximes, *e.g.*, cyanophenylisatogen gives a bright yellow N-oxime (m.pt. 218° C.), and an orange coloured C-oxime (m.pt. about 246° C.). "Nitrones" of the type $R'':NR':O$ are considered to form oximes in a similar manner to ketones; hence isatogens give two structurally isomeric oximes. Introduction of a methyl group into the phenyl residue yields purple compounds, and the colour is notably deepened, as in many quinonoid substances, by the introduction of *p*-methoxyl or *p*-hydroxyl groups. The orange cyanophenylisatogen and its colourless indoxyl derivative give black crystals of a quinhydrone. Isatogens are therefore the first substances known with certainty to be *meta*-quinonoid.

Baeyer's isatogenic acid ethyl ester has been synthesised by warming a pyridine solution of *o*-nitrophenylpropiolic acid ethyl ester (m.pt. 62° C.) and allowing the solution to evaporate; recrystallisation from alcohol gave crystals (m.pt. 112° C.) identical with Baeyer's product (Ber., 1882, **15**, 780). This substance is hence considered a derivative of isatogen, having in place of Baeyer's formula the constitution:



$$C_6H_4 \begin{matrix} \diagup CO \diagdown \\ \diagdown NO \diagup \end{matrix} C.COOC_2H_5.$$

—F. W. A.

Benzoic acid; Action of —— on dimethylaniline. K. Neundlinger. Annalen, 1915, **409**, 182—187.

Fractional distillation of the oil obtained by the action of phosphorus pentoxide on a mixture of benzoic acid and dimethylaniline (O. Fischer, Annalen, 1881, **206**, 88) led to the separation of white crystals of benzoylmonomethylaniline (m.pt. 51° C.), pale yellow needles and plates of dimethylaminobenzophenone (m.pt. 92° C.), and white plates of tetramethyldiaminodiphenylmethane (m.pt. 90·5° C.).—F. W. A.

Differentiation of natural and artificial asphalts. Graefe. *See* IIa.

Distinguishing natural and artificial asphalts. Bratter. *See* IIa.

Patents.

Lubricating oils; Substitutes for ——. Chem. Fabr. von Heyden. Ger. Pat. 288,418, Mar. 18, 1915.

Phosphoric esters of phenols may be used as lubricating oils. The melting point of solid esters, *e.g.*, triphenyl phosphate, may be lowered by various additions, *e.g.*, cresyl phosphates.—F. Sp.

*Chloro-derivatives of N-dihydro-*1.2.2′.1′*-anthraquinoneazine and its substitution products; Preparation of ——.* Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 289,279, Jan. 3, 1914.

Only products containing sulphur have previously been obtained by the action of the chlorides of sulphur on anthraquinone derivatives, including anthraquinone derivatives containing nitrogen (see Ger. Pats. 224,500, 240,792, 245,768, 246,867, and 271,947), whereas it is now found that the chlorides of sulphur at sufficiently high temperatures act on N-dihydro-1.2.2′.1′-anthraquinoneazine and its substitution products, with or without the aid of a catalyst, solely as chlorinating agents.—T. C.

Aminonitro compounds and their substitution products; Preparation of aromatic ——. H. Pomeranz, Coesfeld. Ger. Pat. 289,454, Nov. 15, 1912.

Aminonitro compounds are prepared from the corresponding di- and polynitro compounds by mixing with water and iron filings, heating, and passing in sulphur dioxide until the iron is completely or almost completely dissolved. The aminonitro compound so obtained may remain partially or completely dissolved or undissolved and may be obtained directly, or after removal of the sulphur dioxide by blowing in air, by filtering, evaporating to dryness, or by extraction with a suitable solvent.—T. C.

Recovery of the waste sulphuric acid in benzol manufacture. Ger. Pats. 289,162 and 289,524. *See* VII.

IV.—COLOURING MATTERS AND DYES.

Indigo; Reduction of —— by means of triethylphosphine. N. Kishner. J. Russ. Phys.-Chem. Soc., 1915, **47**, 2129—2132.

Indigo, which is stable towards oxygen, is oxidised by the latter in presence of triethylphosphine, this being converted into the unstable triethylphosphine peroxide, $P(C_2H_5)_3O_2$, which gives up part of its oxygen to the indigo and is converted into the corresponding oxide. Triethylphosphine also exerts, however, a reducing action on indigotin-sulphonic acid, which it transforms into the white leuco-compound. This reduction proceeds even in the presence of air and precedes the oxidation referred to above; it may be carried out so as to serve as a striking lecture experiment.—T. H. P.

Cotton flowers; Colouring matter of ——. III. A. G. Perkin. Chem. Soc. Trans., 1916, **109**, 145—154. (See also this J., 1910, 15).

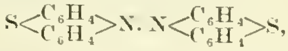
A glucoside was isolated from the alcoholic extract of the petals of red cotton flowers, *Gossypium arboreum*, identical with the isoquercitrin which had previously been obtained from yellow Egyptian cotton flowers, but neither quercimeritrin nor gossypitrin could be detected. The yellow flowers of *G. neglectum* yielded however gossypitrin as main product, together with isoquercitrin, but again no quercimeritrin was found. Other Indian flowers examined also showed this chemical distinction from the Egyptian flowers. The glucosides of the pink and white flowers, *G. sanguineum*, and *G. rossrum*, were almost devoid of dyeing properties. By the oxidation of gossypitrin with benzoquinone, a quinone, gossypitrone, $C_{21}H_{18}O_{13}$, was formed as maroon-coloured needles, m.pt. 255°—259° C. (with decomp.). It dyes aluminium-mordanted cotton green shades similar to those given by an extract of the red petals, but this is not due to any similarity between the two colouring matters, the latter being an amorphous substance probably related to anthocyanin.—G. F. M.

Dianisidine Blue. J. Pokorny. Chem.-Zeit., 1916, **40**, 10.

Dianisidine-disazo-β-naphthol-copper is sometimes referred to as a blue dyestuff, but in reality it is a violet, the blue being produced only when fatty acids are present in the naphthol preparation simultaneously with the presence of copper salts in the tetrazo-solution. As different fatty acids give rise to different shades of blue, the Dianisidine Blue is held to consist of the violet dianisidine-disazo-β-naphthol superimposed upon the green copper salt of the fatty acid, and this view accounts for the fact that it is not fast to perspiration. Dianisidine Blue is excelled by a dyestuff made by combining tetrazo-dianisidine with 2.3-hydroxynaphthoic acid (m.pt. 216° C.), or with its anilide (Naphthol AS).—E. H. T.

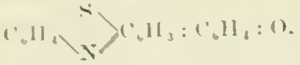
Thiodiphenylamine; Oxidation of ——. L. Pesci. Gazz. Chim. Ital., 1916, **46**, I., 103—118.

Dithiotetraphenylhydrazine,



$$S{<}\begin{matrix} C_6H_4 \\ C_6H_4 \end{matrix}{>}N.N{<}\begin{matrix} C_6H_4 \\ C_6H_4 \end{matrix}{>}S,$$

was obtained by the oxidation of thiodiphenylamine in alcoholic solution with mercuri-acetamide or yellow mercuric oxide, in the form of an amorphous white powder, insoluble in the usual solvents with the exception of benzene and chloroform. When a mixture of thiodiphenylamine and aniline was oxidised with yellow mercuric oxide, in addition to dithiotetraphenylhydrazine and other products, a colouring matter was formed which was readily separated by reason of the solubility of its hydrochloride in water, and purified by means of its zinc chloride double salt. The free base forms reddish-yellow laminæ, m.pt. 150° C., insoluble in water, readily soluble in benzene, chloroform, and pyridine. The hydrochloride forms dark green needles, and its solution dyes wool and silk dark green shades, fast to washing with water, and changing to reddish-violet on treatment with bases. Ammonium suphide converts the colouring matter into the leuco-compound. The colouring matter is regarded as *o.o*-thiodiphenoquinoneanil,



$$C_6H_4\langle{}^{S}_{N}\rangle C_6H_3:C_6H_4:O.$$

—A. S.

Thioethers and thioxanthones of the anthraquinone series: Preparation of ——. A. Schaarschmidt. Annalen, 1915, **409**, 59—78.

Thioethers of the anthraquinone series are prepared by condensing cyanobromoanthraquinones with aromatic mercaptans, or by condensing aromatic thiocyanates with o-halogenanthraquinonenitriles. Thioxanthones are obtained from the *o*-cyanothioethers by the action of hot concentrated sulphuric acid. *Examples:* (1) 1-Cyano-2-bromoanthraquinone treated with *p*-thiocresol in boiling amyl alcohol in the presence of potassium carbonate, yields 1-cyano-anthraquinonyl-2-*p*-tolyl thioether, pale yellow crystals, dissolving to a greenish-blue solution in alkaline sodium hydrosulphite. Heated on the water bath with concentrated sulphuric acid, it forms the thioxanthone, $C_{14}H_6O_2\langle{}^{S}_{CO}\rangle C_6H_3CH_3$. (2) 1-Cyano-2-bromoanthraquinone condensed with anthraquinone-1′-or 2- thioether yields respectively 1-cyano-2.1′- and 1-cyano-2.2′-dianthraquinonyl thioether, the former a brownish-yellow compound giving a red solution in sodium hydrosulphite, and the latter a bright yellow compound giving a yellowish-red solution in sodium hydrosulphite. The sodium hydrosulphite probably reduces the cyanogen-free anthraquinone radicle, and the cyanogen radicle probably only affects the colour of the leuco-compound when reduction takes place in its immediate neighbourhood. The same compounds may also be prepared by condensing 1-cyano-2-bromoanthraquinone with anthraquinonyl thiocyanates. Heated with concentrated sulphuric acid to 170—190 C. they form the corresponding isomeric thioxanthones. (3) The condensation of two molecules of 1-cyano-2-bromoanthraquinone with one molecule of 1.5-dithioanthraquinone produces di- (1-cyano-2-anthraquinonyl)-1′.5′-anthraquinone dithioether, $C_{14}H_6O_2(CN).S.C_{14}H_6O_2.S.C_{14}H_6O_2(CN)$, which when heated with sulphuric acid to 200° C. forms the corresponding dithioxanthone, a reddish-orange substance. The leuco-compounds of these dyes dissolve in alkalis forming blue or bluish-green solutions which dye cotton the same colour, changing to the colour of the parent dye when oxidised with sodium hypochlorite.—F. Sp.

Patents.

Azo dyestuffs: Manufacture of yellow ——. Akt.-Ges. f. Anilinfabr., Berlin. Eng. Pat. 100,078, Jan. 3, 1916. Under Int. Conv., May 22, 1915. (Appl. No. 93 of 1916.)

Tetrazotised 4.4′-diaminodiphenylsulphide-2.2′-disulphonic acid (thioanilinedisulphonic acid) is combined with 2 mols. of an acetoacetarylamide, in place of 2 mols. of a phenol with subsequent alkylating suggested in Eng. Pat. 7146 of 1907 (this J., 1908, 71). Brighter shades of greenish-yellow are obtained of good fastness to washing and to milling.—F. W. A.

Suspensions of insoluble dyestuffs in water: Production of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 288,899, Nov. 16, 1913. Addition to Ger. Pats. 222,191, 265,536, and 274,970 (this J., 1910, 1003; 1913, 1101; 1914, 827).

In place of sulphite-cellulose waste liquors, glycerin pitch or, better, polyglycerins may be employed to bring insoluble dyestuffs into a fine state of division.—F. W. A.

Disazo dye. F. Ackermann, Assignor to Aktien-Ges. für Anilinfabr., Berlin. U.S. Pat. 1,173,077, Feb. 22, 1916. Date of appl., Mar. 22, 1915.

See Eng. Pat. 4072 of 1915; this J., 1915, 1136.

Production of condensation products of oxazine dyestuffs. Ger. Pat. 288,728. *See* VI.

Production of azo dyestuffs on the fibre. Ger. Pat. 288,750. *See* VI.

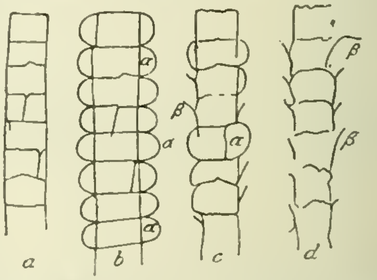
Process for preparing mixed ureas and thioureas of the aromatic series. Ger. Pat. 289,163. *See* XX.

Manufacture of ureas and thioureas of the naphthalene series. Ger. Pats. 289,270—289,272. *See* XX.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wool; The properties of —— and a new chemical method for the detection of damaged wool. K. von Allwörden. Z. angew. Chem., 1916, 29, 77—78.

According to the author there exists, between the epidermal scales and the fibre cells of the wool-hair, a substance to which he gives the name of "elasticum" and on the presence of which the valuable properties of the wool depend. Elasticum is a carbohydrate which may be isolated in the following manner:—500 grms. of scoured wool is wetted with hot water and steeped at the ordinary temperature in 8 litres of 0·2 % sodium hydroxide for 24 hours. The elasticum goes into solution together with some protein matter, from which it is separated preferably by dialysis. The solution is then acidified with acetic acid and evaporated to 200 c.c. on the water-bath. Sodium acetate and phenylhydrazine are added and the mixture is heated in the boiling water-bath. After one hour or less, the osazone of elasticum separates as microscopic needles, melting at about 188° C. and apparently identical with galactosazone. After separation from the protein matters, elasticum reduces Fehling's solution. Not only the physical properties of the wool, as shown by its behaviour in fulling and finishing, but also its chemical resistance to acids depend on the presence of the elasticum. The presence or absence of elasticum may be detected by microchemical observation of the action of chlorine water on the fibre. The wool is moistened on the object glass with one drop of water and then one drop of half-saturated chlorine water is added; the preparation is examined at a magnification of 200. In the figure, diagram *a* shows the normal wool fibre; *b* shows the same fibre after treatment with chlorine water. The action of the chlorine on the fibre-substance or the elasticum causes a swelling of the layer beneath the scales and the characteristic globular excrescences indicated by *α*. Diagram *c* shows



a fibre which has suffered from severe alkaline treatment in scouring, with the loss of a considerable portion of the elasticum; the swellings, α, are relatively few and in their place the loosened scales, β, are observed. Diagram *d* shows a worthless shoddy fibre totally deprived of its elasticum. In the case of dyed wool the reaction is slow but the colourless elasticum shows very distinctly against the coloured fibre. Alkaline treatments are the principal cause of damage to wool through the loss of elasticum; fine wools are more easily damaged than coarse. Apart from the chlorine reaction it is very difficult to detect this kind of damage; the wool fibre may preserve its normal appearance and the tensile strength of the fabric may be particularly good, but its fulling qualities and wearing qualities are greatly impaired. The damage may be caused in the scouring, in dyeing from an alkaline vat, or in the washing after dyeing, and the effects of all these processes may be combined; further, the removal of the elasticum leaves the fibre-substance open to attack by acids in dyeing from an acid dye-bath.—J. F. B.

Wool scouring: The recovery of grease from ——. E. V. Chambers. J. Soc. Dyers and Col., 1916, **32**, 61—65.

The proportion of wool grease and potash in the scouring liquors varies considerably, according to the nature of the wool treated and the method of washing adopted. An average figure might show per 1000 gallons, 40 lb. of potassium carbonate and 80 lb. of grease; a works of moderate size will discharge about 100,000 gallons of waste liquor per week. The author briefly describes and criticises eight different methods for treatment and more or less complete recovery. The most general method is precipitation of the grease by sulphuric acid and its separation by filtering and pressing; the potash is lost by this process but the plant and attention required are relatively simple. A modification, not widely adopted, consists in a preliminary steeping of the wool in cold water for extracting the potash, before scouring, and recovering the grease by the acid process. Recovery of the grease from the wool by volatile solvents and subsequent washing with water to dissolve the potash salts is practised successfully with certain precautions. Only a portion of the total grease must be removed and the treatment with solvents takes place in a centrifugal apparatus maintained under a slightly reduced pressure. The Smith-Leach process (Eng. Pat. 15,131 of 1898; this J., 1899, 592), depending on the concentration of the waste liquor in multiple effect evaporators, separation of the grease by centrifuging the concentrated liquid, and incineration of the potash solution, had a certain measure of success. The author's process (Eng. Pat. 13,005 of 1914; this J., 1915, 276) is a simplified modification of this, enrichment of the liquors being effected by repeated use instead of by evaporation. The scouring liquid is used until it becomes too dirty for further scouring; the suspended wool fibres are removed by a rotary disc screen and the liquor is passed at the rate of 250 galls. per hour through a high-speed centrifugal machine. The sand and heavy particles fly out to the periphery, the soapy water occupies an intermediate position, and the grease is skimmed off from the layer nearest the centre. The purified soap solution is returned for re-use and the cycle of operations repeated until it contains 6—8% of potash; in this way the liquid can be used again four or five times, with considerable economy of scouring chemicals. The liquor, enriched in potash, is concentrated in a steam boiler, the steam from which is used for heating the liquors before centrifuging. It is intended to carry out the final recovery of the potash by incineration in a rotary furnace. It is calculated that a plant for treating 45,000 galls. of waste liquor per week, costing £3000, will show a net profit of £26 6s. per week.—J. F. B.

Spider silk. A. Herzog. Kunststoffe, 1915, **5**, 25.

A very fine, lustrous fibre of a white or orange-yellow colour is formed by the secretion of the spider *Nephila madagascariensis*. Examination by the microscope shows that the fibre is solid, almost completely transparent, of approximately circular cross-section, and not possessed of any internal structure. The average diameter of the fibres is only $6\cdot9\mu$, and they are therefore the finest animal silk product, being less in diameter than even the finest artificial silks. The spider silk is not covered with a substance corresponding to the sericin of ordinary silk. It has approximately the same density as ordinary silk and very similar chemical properties. It swells considerably in water, the change being accompanied by a large contraction in length.—F. W. A.

Silk; [Prevention of tendering, etc., of tin-] weighted ——. K. Homolka. Färber-Zeit., 1915, **26**, 47—48.

The tendering of silk weighted with tin phosphate-silicate may be due to mineral acid developed from the weighting or to the development of chlorine by electro- and photo-chemical action. If the weighted silk be passed through a solution of 8—10% of ammonium formate, wrung out, and dried, this salt tends to neutralise the effect of any mineral acid developed, and also acts as a reducing agent, preventing the damage of the fibre by oxidation. Silk treated in this manner has greater durability and elasticity. The strength may be increased by treating the silk with substances which oxidise very easily, *e.g.*, thiourea, quinol, thiocyanates, etc.; the increase in strength is only temporary, and the feel and lustre of the silk are damaged. Treatment of weighted, dyed silk with a 1—1·5% solution of hydroxylamine hydrochloride or other derivative causes a permanent improvement in the strength and resistance to photochemical action, and the elasticity, lustre, and handle are retained even after long storage. Treatment of heavily weighted silk with ammonium thiocyanate, boric acid, tannic acid, and glycerin prevents for many months its damage by chemical or physical influences. The ammonium thiocyanate may be added to the caustic soda bath used in the weighting process.—F. W. A.

Tendering of fabrics heavily weighted with magnesium sulphate crystals. E. Ruf. Z. ges. Textil-Ind., 1915, **18**, 202.

The apparent tendering of woven materials finished with a large amount of magnesium sulphate crystals is considerable, the fabric no longer resisting the slightest strain, but the original strength is restored by washing.
—F. W. A.

Zacaton as a paper-making material. C. J. Brand and J. L. Merrill. U.S. Dept. Agric., Bull. No. 309, Nov. 4, 1915, 1—27.

Zacaton (*Epicampes macroura* Benth.), also called Mexican whisk, broom-root grass, wire grass, and rice-root grass, is found principally in Mexico, Guatemala, and other Central American States. It is a perennial grass, growing in hilly districts, and unless kept in check by fire or harvesting, it becomes an agricultural pest. The immature tops are eaten by cattle but soon become too tough for fodder. It flowers from August to October and usually attains a height of 5—7 ft. An acre of grass yields about 1 ton of roots and at least 3 tons of tops. The production of roots for brush

manufacture ranges from 3 to 5 million lb., and the tops are an entirely waste product ; a good zacaton range may be worked for root-brush material every third year. The analysis of the grass showed about 9 % of ash, very rich in silica ; determinations of cellulose by Cross and Bevan's chlorination process showed 41 % on the dry material ; omitting the alkali treatments, according to Renker's method, 51 % of cellulose was obtained. The true value probably lies between these two. The cellulose of the bleached pulp shows in a pronounced manner the properties of an oxycellulose, yielding 10·9 % of furfural on distilling with hydrochloric acid and having a "copper value" (Schwalbe) of 4·58 ; these results agree closely with those obtained from bleached poplar pulp. The bast fibres range in length from 0·5 to 3·0 mm., with an average of 1·7 mm. ; the average width is 0·0085 mm. The fibres are accompanied by the usual non-fibrous elements of grass pulps, with an appreciable proportion of pithy parenchyma ; a rough determination of the latter by washing through a sieve accounted for 7·5 % of cellulose on the dry grass. Digestions were conducted in a rotary boiler on a semi-commercial scale ; the grass required somewhat severe conditions of treatment. Satisfactory digestions were obtained with 19—20 % of caustic soda in the form of a 9 % solution digested at 160° C. for 4—6 hours. The digested material was drained and washed with remarkable ease and yielded 46—50 % of pulp on the dry grass or 43 % on the air-dry basis. The pulp bleached to a satisfactory colour with 12·7 % of its weight of bleaching powder and gave excellent fine papers on an experimental paper machine.
—J. F. B.

Recent progress in electrical smoke precipitation. Cottrell. *See* I.

PATENTS.

Degumming silk ; Process of ——. Röhm und Haas, Darmstadt, Germany. Eng. Pat. 2826, Feb. 22, 1915. Under Int. Conv., Feb. 20, 1914. Addition to Eng. Pat. 2010 of 1915 (See Fr. Pat. 475,343, this J., 1916, 39).

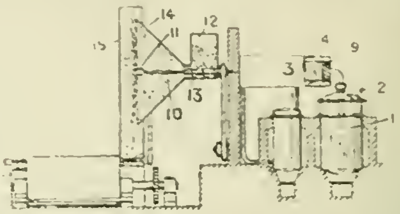
SILK, as cocoons, silk waste or the like, is degummed by first heating in water to between 90° and 100° C., and then treating in a solution of pancreatin.—B. N.

Paper pulp or the like ; Means for straining ——. The Watford Engineering Works, Ltd., Watford, J. Paramor, Rickmansworth, and J. M. Henry, Newbury. Eng. Pat. 4186, Mar. 17, 1915.

THE straining surface is constituted by a series of horizontal parallel rolls, arranged at suitable intervals apart, which revolve in the same direction but at speeds which increase progressively as the flow of the pulp advances across the straining surface in a transverse direction. The whole series of rolls forms a transversely inclined bed with suitable interstices ; the knots fail to pass through the latter, and are finally ejected by the last roll into a receptacle.—J. F. B.

Plastic materials from fibrous substances and binding agents obtained by the action of sulphur, sulphur chloride, or nitric acid on oils, tars, etc. ; Production of ——. N. Reif, Hanover. Ger. Pat. 288,532, Nov. 29, 1914.

THE substances composing the binding material are mixed at a temperature at which no reaction occurs, and the mixture is afterwards rapidly brought to the reacting temperature and then pulverised. Acid-free binding materials may thus be produced by a continuous process, without the use of neutralising agents, and are subsequently pulverised and distributed evenly on the fibres to give a homogeneous and not a matted product. The mixture composing the binding material, *e.g.*, oil, tar, rubber, and sulphur, is heated to 120°—130° C. in the boiler, 1, and then forced by compressed air from 2 into the reaction vessel, 3, containing the fixed turbine, 9, by means of which the mixture is thrown against the walls of the vessel in a finely divided state. This vessel is provided with a heating jacket, 4, and is so controlled that the mixture is heated therein to 210° C. The reaction product whilst still liquid is forced through 10 into the rotary pulveriser, 11, whence it is distributed evenly, in the form of a rapidly moving mist, over the fibrous material which is fed from 12, by the screw, 13, into the rapidly rotating funnel, 14. In a modified form of apparatus two rotary pulverisers, disposed opposite one another, are used, and the fibrous material is fed into the intermediate space.
—F. W. A.



Paper pulp ; Machine for straining ——. W. W. Beaumont, London. Eng. Pat. 3118, Feb. 26, 1915.

[*Vibrating mechanism for*] *strainers for paper pulp and the like.* E. G. Pringle, Wells, Somerset. Eng. Pat. 9222, June 23, 1915. Addition to Eng. Pat. 14,518, June 17, 1914.

Fulling [*animal fibres*] ; *Process of* ——. Textiltechn. Bureau in Rheydt A. Lehmann, Rheydt, Germany. Eng. Pat. 15,474, Nov. 2, 1915. Date of appl., Nov. 3, 1914.

SEE Ger. Pat. 284,694 of 1914 ; this J., 1915, 1138.

Plastic composition [*shellac substitute*] *and method of making it* [*from viscose*]. U.S. Pat. 1,172,073. *See* XIII.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Textile bleaching trades : Use of nitre cake as a substitute for vitriol in the ——. J. R. Hannay. J. Soc. Dyers and Col., 1916, 32, 65—66. (See also this J., 1916, 109.)

NITRE cake is stated to contain 17—33 % of available sulphuric acid but the samples examined by the author have contained 35—40 %, the theoretical value for sodium bisulphate being 40·83 %. It rapidly absorbs moisture from the air and there is some difficulty in transport ; it may be packed in dry casks or boxes provided they are protected from the rain, or may be conveyed in bulk in covered lead-lined wagons. The cake may be dissolved in stone tanks or in wooden tanks lined with lead or asphalt, at a concentration of 4 lb. per gall. If warm water is available, solution is complete in about two hours, but with cold water the cake should be allowed to dissolve over-night. The solution contains 10—11·5 % of available sulphuric acid and there are few uses to which vitriol is put in calico bleaching and printing where such liquors may not be applied. Bleachers' goods soured with nitre cake solution are equal in all respects to those soured with vitriol. Compared with vitriol at normal prices, it is doubtful whether nitre cake could be profitably applied even if the material were obtained for nothing, as the costs of freight and handling amount to a considerable sum, but at the present time it may be substituted with advantage and a small price paid for the cake at makers' works.—J. F. B.

White and red prints on indigo dyed goods. G. Tagliani and G. Arosio. Färber-Zeit., 1915, **26**, 1—3.

White and red impressions on goods dyed with indigo may be obtained by the following methods: (*a*) *White reduction steam discharge and red acid discharge.* The goods are padded with naphthol and printed with Reduction White CL and chromates and Azophor Red or the nitrosamine of *p*-nitraniline or *p*-nitro-*o*-anisidine. (*b*) *White reduction discharge and coloured oxidation discharge* with simultaneous alkaline development. The white reduction discharge is that of Haller, Pommeranz, or Sunder, or Reduction Discharge CL; the coloured discharge that of von Gallois, consisting of printing diazotised Para Red, α-naphthylamine, etc., in presence of potassium ferricyanide. The resist methods and discharge methods previously employed in practice are outlined.—F. W. A.

Afterchrome process. E. Grossmann. Färber-Zeit., 1915, **26**, 17.

As afterchroming with bichromate and sulphuric acid may cause partial destruction of the dyestuff by oxidation, resulting in the shade being dulled, acetic acid is used in place of sulphuric acid. To remove sulphuric acid remaining in the wool from the carbonising process, the wool is first treated with 0·5 % of its weight of sodium acetate.—F. W. A.

Substitutes for starch products [*for sizing and finishing textiles*]. E. Ruf. Z. ges. Textil-Ind., 1915, **18**, 140.

Glue may be used in place of starch in sizing and finishing materials, and 2 parts of a mixture of potato starch and diastafor instead of 3 parts of dextrin. The harsh handle of glue finishes may be improved by the addition of Iceland moss. —F. W. A.

Diastase; Preparations of —— [*for removing dressings from textiles, etc.*], *and their uses.* I. Pollak. Ver. österr. Chem., Dec. 4, 1915. Chem.-Zeit., 1916, **40**, 13—14.

The preparations of diastase used in the textile industry and in bread-baking are syrupy, soluble extracts containing amylolytic and other enzymes: their composition is varied according to the use to which they are destined. In the textile industry, they are used for removing starchy dressings from fabrics, the enzymes converting the starch into soluble dextrins and maltose. The preparation "diastafor," used in preparing cotton for mercerisation, is far superior to alkali; it contains starch-dissolving and sugar-forming enzymes in a concentrated form, and a two-hour treatment at 50° C. with a 0·5 to 1% solution completely removes the starch. The so-called pure diastase preparations are not free from maltose, nor is it necessary that they should be. Soluble starch and dextrins, far more uniform in composition than the so-called "acid dextrins" used in finishing, are easily produced with the aid of diastase preparations. A preparation containing oxydases has quite recently been used in bleaching; these enzymes liberate chlorine from the bleaching liquor and cause the formation of much ozone. The addition of diastatic malt extracts to the dough in bread-baking increases the amount of sugar available for the yeast organisms, and hence stimulates them and hastens fermentation.—E. H. T.

Rapid determination of chloric acid and chlorates. Taylor. *See* VII.

Patents.

Textiles; Process for treating [*neutralising acid in*] —— *by use of an electric current.* H. Krantz, Aachen. Ger. Pat. 289,280, June 9, 1914. Addition to Ger. Pat. 283,822.

The acid present in carbonised textiles is neutralised by passing them through a salt or soda solution which is electrolysed by means of an alternating current, a process claimed in the main patent for use in bleaching, etc.—F. W. A.

Bowking multicoloured goods dyed with vat colours; Process for ——. J. Graf, Bombay. Ger. Pat. 288,751, July 9, 1914.

The goods, from the loom, are padded with cold caustic soda solution to which non-oxidising salts have been added to prevent the solution of the colour, allowed to stand in the cold for a long time, and finally bleached in the usual manner. The same effect is produced on cotton as by bowking, without the colour bleeding. To avoid the formation of oxycellulose, it is advisable to add also bisulphite or other reducing agent to the caustic soda solution.—F. W. A.

Bleaching textiles by means of perborate, etc.; Process for ——. R. Starek, Königinhof, Bohemia. Ger. Pat. 289,742, June 7, 1913.

Yarn or woven material, suitably prepared, is padded repeatedly with the per-salt (perborate) solution at the usual temperature, steamed for a short time and then washed, until the bleaching is sufficient. The bowking and bleaching processes may be united by addition of lime to the per-salt solution; when the bowking is complete, the goods are soured and washed, and bleaching with the per-salt solution is completed as above. As the amount of perborate actually used is only that which is taken up by the goods, a considerable saving of perborate is effected; the process possesses the further advantage of being more rapid than ordinary bleaching.—F. W. A.

Fast dyeings; Method of producing ——. O. Imray, London. From Soc. Chem. Ind. in Basle. Eng. Pat. 13,204, Sept. 15, 1915.

The copper compounds of *o*-hydroxyazo dyestuffs, produced according to Eng. Pats. 1611 and 12,249 of 1915 (this J., 1916, 301) from a diazo component containing a carboxyl group or a coupling component containing a hydroxyl and a carboxyl group, are dyed or printed on animal or vegetable fibres as chrome lakes; the shades of the dyeings are at the most only slightly altered, and are of excellent fastness to milling and to potting. Examples are given of dyeing the copper compounds on mordants, the addition of chromate to the bath, and subsequent chroming on wool, and for dyeing and printing cotton.—F. W. A.

Dyeing with vat colours; Process for ——. R. Wedekind und Co., Uerdingen. Ger. Pats. (A) 287,042, Aug. 16, 1913, and (B) 289,314, Dec. 24, 1912. Additions to Ger. Pat. 283,356 (see Fr. Pat. 453,427 of 1913; this J., 1913, 746).

(A) Dyeing is carried out in presence of hydroxides of magnesium, aluminium, or a heavy metal, hydrosulphite, and small amounts of alkali. Deeper shades are obtained than if the metallic hydroxide and hydrosulphite alone are used. On account of the neutral reaction of the vat, the process is particularly suitable for the dyeing of wool and of silk, *e.g.*, the latter may be dyed from a vat containing benzoylamino-1-anthraquinone paste, caustic soda, magnesium hydroxide, and hydrosulphite. (B) Vat dyestuffs are reduced as usual in alkaline solution, metallic salts added to the alkaline leuco-solution in such amount that only a faintly acid vat is obtained, and the dyeing carried out with the suspension of the metallic salt of the leuco-compound obtained.—F. W. A.

Oxazine dyestuffs: Production of condensation products of —— [*on the fibre*]. J. Heilmann and Co., and M. Battegay, Mulhouse, Alsace. Ger. Pat. 288,728, June 23, 1914. Addition to Ger. Pats. 284,877 and 286,916 (this J., 1915, 1140; 1916, 109).

In place of phenols, etc., pyrazolone, its sulphonic acids, or their derivatives are condensed with oxazines or leuco-oxazines.—F. W. A.

Azo dyestuffs on the fibre: Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 288,750, Mar. 6, 1914.

The material is padded with non-sulphonated symmetrical or unsymmetrical ureas or thioureas obtained from aminonaphthols, other than 2-amino-3-naphthol, and then treated with non-sulphonated diazo-compounds. Red, blue, etc., dyeings are obtained, of excellent fastness to boiling, cross dyeing, and chlorine. The ureas are obtained by passing phosgene into an alkaline solution of the aminonaphthol, or by the action of phenyl or naphthyl isocyanate on the aminonaphthol.—F. W. A.

Dyeings on vegetable fibres: Production of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 288,963, Aug. 30, 1914. Addition to Ger. Pats. 283,742 and 285,230 (see Fr. Pat. 472,893: this J., 1915, 486).

N-alkyl- or N-alkaryl-derivatives of benzoyl-1.7-aminonaphthol, or their derivatives substituted in the benzoyl residue, are used in place of benzoyl-1.7-aminonaphthol or its derivatives substituted in the benzoyl residue. They are obtained, in presence of an indifferent solvent and in presence or absence of a substance to combine with the hydrochloric acid produced, by the action of 1 mol. of benzoyl chloride or its substitution products on alkyl or alkaryl-1.7-aminonaphthols, obtained by alkaline fusion of the corresponding monoalkyl- or monoalkaryl-1-naphthylamine-7-sulphonic acid. —F. W. A.

Fast mixed dyeings with vat and mordant dyestuffs; Production of ——. R. Wedekind und Co., Uerdingen. Ger. Pat. 289,908, Aug. 5, 1913. Addition to Ger. Pats. 275,570 (see Fr. Pat. 451,533, this J., 1913, 598), 278,103, and 283,716, (this J., 1915, 1088).

The reduced vat dyestuff is added to the liquid used for oiling, the goods aged as usual, dried at 60°—70° C., well rinsed with water, and padded with the mordant dyestuff and the mordant. In case fast vat and mordant dyestuffs are used, the mixed shade obtained is of excellent fastness. Indanthrene Golden Yellow G, Indanthrene Yellow GN extra, and Hydron Blue G may be dyed together with Alizarin in this manner.—F. W. A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Hydrochloric acid; Improvement in the manufacture [*purification*] *of* ——. H. Friedrich. Chem.-Zeit., 1916, **40**, 10—11.

The hydrochloric acid gas is washed and cooled by spraying it with sulphuric acid saturated with hydrogen chloride in a vertical tower containing three concentric compartments. The spraying liquid is collected at the base, cooled, and used over and over again until it will take up no more arsenic; then it is removed and purified from arsenic to prepare it for further use. The gases from the pan and the hearth are introduced separately into the top of the central compartment, where they mix and pass downwards, then upwards into the second compartment, and finally downwards through the third external compartment, the second and third compartments being sprinkled with the sulphuric acid. Thus the central portion is the hottest and the outer portion the coolest, and by regulating the spray the gas can be cooled to any desired extent. The purified and cooled hydrogen chloride is led away from the base of the external compartment to the absorption apparatus. As the outer wall of the tower remains cool, it may be made of ordinary acid-resisting brickwork.—E. H. T.

Aqua regia: Mechanism of reactions in ——. E. Briner. Comptes rend., 1916, **162**, 387—389.

When concentrated nitric acid (1 part) and hydrochloric acid (3 parts) are allowed to interact in a closed vessel, a liquid phase containing NOCl and Cl_2 develops below the aqueous portion (compare Briner and Durand, this J., 1912, 981). The reaction, which is endothermic in the aqueous medium, is accelerated by heating, and, for a given temperature, the pressure of the gaseous phase is constant, provided the second liquid phase be present; but if the acids be too dilute, a lower layer does not appear, and the gaseous pressure diminishes as the dilution is increased. The three-phase system is therefore monovariant and the reaction, $HNO_3+3HCl=NOCl+Cl_2+2H_2O$, perfectly reversible.—F. Sodn.

Chloric acid and chlorates; Rapid method of determining ——. R. L. Taylor. J. Soc. Dyers and Col., 1916, **32**, 66—68.

The liberation of iodine from a mixture of potassium iodide and chlorate takes place only slowly in presence of dilute hydrochloric acid, the reaction which ultimately occurs being represented by the equation,

$$KClO_3+6HCl+6KI=7KCl+3H_2O+6I.$$

The rate at which the reaction takes place depends on the amount of acid present and if that be small the reaction will not proceed to completion. It is accelerated by heat, but if a large excess of hydrochloric acid is added the reaction is finished quantitatively in half a minute. The method for the determination of chlorates based on this reaction consists in adding sufficient potassium iodide to a small quantity of the solution and then from 1½ times to twice its volume of concentrated hydrochloric acid. The liberated iodine is rapidly titrated with thiosulphate, after diluting the solution with about half its volume of water. In order to reduce the volume of the total liquid as far as possible, the solution of chlorate should be of such a concentration that not more than 10—20 c.c. is required for the determination; the potassium iodide should be added in the form o crystals. Hypochlorous and chloric acids may be determined in the same solution, if desired, by adding potassium iodide and a few drops o dilute hydrochloric acid for the determination o the hypochlorous acid, then adding about twic its volume of strong hydrochloric acid to the titrated solution and titrating again for th chloric acid. For the determination of hypochlor ite and chlorate in bleaching powder solution it is preferable to employ separate portions, i order to avoid the inconvenience of manipulatin large volumes. The hypochlorite is determine in one portion, acidified with acetic acid, and th hypochlorite and chlorate together in anoth portion, acidified with strong hydrochloric aci —J. F. B.

Bromide-ions in sea-water. L. W. Winkler. Z. angew. Chem., 1916, **29**, 68.

A sample of sea-water from Adria contained 18,375 mgrms. of chloride ion and 63·81 mgrms. of bromide ion per litre. The ratio between the bromide and chloride was thus 1 : 288·0 ± 0·36, and this ratio also applies with close approximation to sea water in general.—C. A. M.

Iodine; Catalytic method for the separation of solid —— from solutions. L. Pisarshevski and N. Averkiev. J. Russ. Phys.-Chem. Soc., 1915, **47**, 2057—2060.

The action of chloric acid on iodide ions in an acid solution, which results in the deposition of iodine, thus, $6H^{\cdot} + 6I' + ClO_3' = 3H_2O + Cl' + 3I_2$, is greatly accelerated by the presence of a small concentration of ferri-ions, which act as a catalyst: the iodine is precipitated as a fine powder or as more or less large, well-formed crystals, according to the concentration of the iodine solution, the amount of catalyst added, the composition of the liquid, and certain other factors. The ferri-ions are converted into ferro-ions according to the equation, $Fe^{\cdot\cdot\cdot} + I' = Fe^{\cdot\cdot} + I$ the ferro-ions being then oxidised thus: $6Fe^{\cdot\cdot} + 6H^{\cdot} + ClO_3' = 3H_2O + Cl' + 6Fe^{\cdot\cdot\cdot}$. The method is applicable to the separation of iodine, not merely from solutions of pure iodides but from the brine obtained on leaching the ashes of seaweed with water, and is carried out as follows: To the iodide solution, acidified with excess of sulphuric or hydrochloric acid, are added (1) potassium chlorate in the proportion indicated by the above equation, or a greater proportion if other substances capable of oxidation are present; and (2) a small volume of a solution of ferric (or ferrous) salt in three times its weight of water.—T. H. P.

Iodine; Electrolytic method of obtaining solid —— from solution. L. Pisarshevski and S. Tjelm J. Russ. Phys.-Chem. Soc., 1915, **47**, 2060—2063.

The authors describe preliminary attempts to devise a method of separating iodine electrolytically from solutions containing iodides, bromides, and chlorides (compare Specketer, this J., 1898, 695). Lead electrodes, or a lead anode and a carbon cathode, give good results; the lead anode becomes coated with a thin layer of lead iodide, which prevents further combination with the iodine, the latter being deposited as a crystalline crust easy to remove.—T. H. P.

Sulphites, thiosulphates, and polythionates; Studies on ——. A. Sander. Z. angew. Chem., 1916, **29**, 11—12, 16. (See also this J., 1915, 225, 277.)

Action of mercuric chloride on thiosulphates and polythionates. The action of excess of mercuric chloride on alkali thiosulphates, trithionates, and tetrathionates has been studied by allowing weighed quantities to react in aqueous solution, weighing the precipitates produced, and estimating the sulphur in the precipitates, if any, by extraction with carbon bisulphide. The white or yellowish precipitate obtained consists of the double compound of mercuric sulphide and mercuric chloride, $Hg_3S_2Cl_2$, the equations representing the reactions being as follows:—

(a) $2Na_2S_2O_3 + 3HgCl_2 + 2H_2O = Hg_3S_2Cl_2 + 4NaCl + 2H_2SO_4$.

(b) $2K_2S_3O_6 + 3HgCl_2 + 4H_2O = Hg_3S_2Cl_2 + 4KCl + 4H_2SO_4$.

(c) $2K_2S_4O_6 + 3HgCl_2 + 4H_2O = Hg_3S_2Cl_2 + 2S + 4H_2SO_4 + 4KCl$.

In each case probably the unstable mercuric thiosulphate or polythionate is first formed, but immediately reacts with water to form mercuric sulphide and sulphuric acid (and sulphur in the case of the tetrathionate). The mercuric chloride has no oxidising action, as stated by Feld (this J., 1911, 357).

Estimation of trithionates in presence of tetrathionates. An indirect method for the estimation of trithionates in presence of tetrathionates is obtained by making use of the reactions described above, and the quantitative oxidation of both salts to sulphate by alkaline hydrogen peroxide (Eliasberg, this J., 1886, 334), according to the equations:—

$$Na_2S_3O_6 + 4H_2O_2 + 4NaOH = 3Na_2SO_4 + 6H_2O.$$
$$Na_2S_4O_6 + 7H_2O_2 + 6NaOH = 4Na_2SO_4 + 10H_2O.$$

A measured volume of the polythionate solution is boiled for 20—30 minutes with a measured volume (excess) of *N*/10 caustic soda and sufficient neutral hydrogen peroxide. The excess of caustic soda is titrated after cooling. A second measured volume of the polythionate solution is treated with excess of mercuric chloride, and the sulphuric acid set free is titrated with *N*/10 caustic soda. If x denotes the trithionate, y the tetrathionate, A the number of c.c. of soda required in the second experiment, and B the number used up in the first experiment, then $x = (3A - 2B)/4$, and $y = (B - A)/2$.—F. Sp.

Prussian blue in spent oxide; Determination of ——. E. L. Randall. J. Gas Lighting, 1916, **133**, 581.

The process is based on the fact that when titanous chloride is gradually added to a dilute solution of an alkali ferricyanide a light green coloration is produced which deepens to an intense green and then slowly becomes reddish brown, the reaction being quantitative in the presence of a large excess of ammonium or alkali thiocyanate. Not less than 0·1 grm. of the ferricyanide should be present, a satisfactory degree of dilution being about 0·6 grm. per litre for the potassium and about 2 grms. per litre for the sodium salt. The titanous chloride (1% solution) is standardised against ferrous ammonium sulphate or potassium ferricyanide. Results within 0·3% of the theoretical were obtained in determinations made on solutions of the latter salt. Alkali ferrocyanides alone and mixed with ferricyanides were also satisfactorily determined, the former being oxidised by a dilute solution of potassium permanganate, the slight excess of which was removed by the addition of thiocyanate before titration. For the determination of Prussian blue in spent oxide, the following procedure is suggested. After the removal of free sulphur by extraction with carbon bisulphide the material is treated with sodium hydroxide and a little ferrous sulphate (to convert any cyanide into ferrocyanide), the mixture filtered and the filtrate agitated with lead carbonate to remove sulphides. The solution is then neutralised and diluted to a definite volume, of which an aliquot portion is treated with permanganate and titrated after the addition of sodium thiocyanate, the potassium or ammonium salt not being permissible.—W. E. F. P.

Chromium hydroxide. Amphoteric metallic hydroxides. III. J. K. Wood and V. K. Black. Chem. Soc. Trans., 1916, **109**, 164—171.

When chromium hydroxide was exposed to caustic soda solution at 25° C., in the presence of air, sodium chromate was very slowly developed, and the concentration of the chromate increased with that of the alkali used. It is believed that the alkali solution at first contains chromite, and that this is oxidised to chromate by atmospheric oxygen. Chromium hydroxide is therefore amphoteric and, judging by the relation of alkali to chromate in the experiments recorded, behaves as a polybasic acid.—F. Sodn.

Ferrocyanogen compounds: New constitutional formula for ——. G. Denigès. Bull. Soc. Chim., 1916, **19**, 79.

Recent progress in electrical smoke precipitation. Cottrell. *See* I.

Solubility of naphthalene in ammonia as a cause of stoppage of pipes. Hilpert. *See* III.

Use of nitre cake as a substitute for vitriol in the textile bleaching trades. Hannay. *See* VI.

Roasting of blende. De Lummen. *See* X.

Detection of magnesia derived from the waste liquor of the potash industry [in river water]. Pfeiffer. *See* XIXB.

PATENTS.

Sulphuric acid; Method for recovery of the waste —— in benzol manufacture. Phoenix A.-G. für Bergbau und Hüttenbetrieb, Gelsenkirchen. Ger. Pat. 289,162, June 12, 1914.

THE waste acid is mixed with ammonia water (gas liquor) and with benzol wash-oil, tar-oil, or coal-tar, in order that a concentrated solution of ammonium sulphate and an acid-free tar product may be obtained by one operation. J.B.C.K.

Sulphuric acid: Treatment of waste —— from the manufacture of benzene. Phoenix A.-G., Gelsenkirchen. Ger. Pat. 289,524, Dec. 2, 1914. Addition to Ger. Pat. 289,162 (preceding abstract).

AMMONIA water, in which at least some of the ammonia is present as chloride, is added to the mixture of waste acid and tar oil or the like, and steam is passed through the mixture. Owing to the reactions which occur, the temperature rises considerably, and the benzene and its homologues and hydrochloric acid are distilled off and collected. —A. B. S.

Aluminous compounds; Production of ——. H. Spence, W. B. Llewellyn, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 2018, Feb. 9, 1915.

IMPURE solutions obtained by the treatment of unground calcined coal measures or shales (see Eng. Pats. 3805 and 22,590 of 1912; this J., 1913, 363, 1066) are purified and a neutral or basic solution of aluminium sulphate obtained by treating the solutions first obtained, after removal of the shales, with a suitable source of alumina, such as bauxite, readily decomposed aluminium silicates, alkali or alkaline-earth aluminates, or basic sulphate compounds of alumina. The details of the method are as follows: The excess of potash is removed by crystallisation as alum, and the solution is then heated to a temperature which may range from 55° C. to the boiling point, according to its sp.gr.; and bauxite is added in sufficient quantity to obtain a neutral solution of aluminium sulphate. The intimate contact with the aluminous material is maintained until the iron, which is present in the ferric state, is removed. In general higher temperatures than 55° C. and higher specific gravities than 1·3 are advantageous in rapidly effecting the solution of the alumina and removal of the iron. Higher specific gravities and lower temperatures are advantageous in preventing the precipitation of basic insoluble compounds, as neutralisation is approached—for example, specific gravities of about 1·35 to 1·45 at temperatures of about 65° to 85° C. Lower specific gravities and lower temperatures are advantageous for economical purification in substantially neutral or basic solutions: for example sp.gr. 1·25 to 1·30 at temperatures of about 50° to 60° C. Higher temperatures and lower specific gravities are advantageous for rapid purification, and assist solution of the alumina, as for instance temperatures of about 80° C. to the boiling point, and sp.gr. about 1·30 to 1·35.—J. B. C. K.

Cyanogen compounds; Process for forming ——. J. E. Bucher, Providence, R.I., U.S.A. Eng. Pat. 2286, Feb. 12, 1915.

WHEN nitrogen and an alkali or alkaline-earth metal, in the gaseous state, are passed through a molten catalytic agent such as carbonised iron, with or without additional carbon, cyanogen compounds are formed with the base metal. A mass of material, preferably carbon, is immersed in the molten catalyst in order to break up the stream of gaseous matter as it enters the bath, and thus to allow longer and more intimate contact between the catalyst and the gas. The carbon mass projects above the surface of the bath and is used as an electrical resistance heater, while at the same time it replaces the carbon used up by the reaction. The base-forming material may be an alkali metal in the form of vapour, and the metal and the nitrogen may be heated to 800—900° C. before entering the bath. By employing the lowest practicable temperatures and providing suitable linings to the furnace employed, soda-ash may be used in place of sodium, and any excess of sodium introduced or formed in the bath can be recovered from the sodium cyanide produced. By using a mixture of catalysts, lower working temperatures may be employed—ferro-manganese with potassium in place of sodium, and nickel and cobalt are named in this connection. If the body of the molten catalyst be kept fairly deep, the pressure required to force the nitrogen and metallic vapour through it will intensify the heat of the reaction, which is exothermic in character when the sodium is produced from sodium carbonate in an electric resistance furnace attached to the catalytic reaction chamber. The apparatus comprises a receptacle of cast-iron suitably lined, and provided with tuyères through which the gaseous reagents are passed into the molten iron within the furnace. The gaseous reagents are supplied to the tuyères through a conduit and electrode of graphite, and also through a conduit connecting with the secondary chamber, in which sodium carbonate is reduced, when sodium is employed as base metal of the reaction.—J. B. C. K.

Sulphuration [sulphitation] of liquids: Apparatus for the ——. L. C. Grevemberg, Calumet, La. U.S. Pat. 1,172,133, Feb. 15, 1916. Date of appl., Feb. 26, 1915.

THE apparatus consists of a series of separate units each including a casing having a liquid-outlet at the bottom and a gas-outlet at the top. Liquid is introduced through a nozzle in the upper part of each casing, and a gaseous bleaching agent, such as sulphurous acid, is introduced through a nozzle in the lower part of the casing, and by means of a number of superimposed baffles the descending liquid is discharged in a finely-divided state and after being thus brought into intimate contact with the gaseous bleaching agent, is passed through a funnel-shaped collector into the lower part of the casing, by means of a jacketed tube. The exhaust gas which issues from the lowest unit passes through this jacket on its upward path to the next higher member of the series and the liquid in its descent is likewise directed from the collecting chamber of the highest unit, into the absorbing chamber of the next lower unit, on the counter-current principle. —J. B. C. K.

Potassium chloride and other salts; Process for crystallising ——. E. Krüger, Stockelsdorf. Ger. Pat. 288,729, Aug. 18, 1912.

The solution of the chloride salt flows continuously through a mechanically cooled and operated crystallising vessel, and thence into a second cooling vessel, where the temperature is reduced to that of the atmosphere. By mechanical means, fresh surfaces of the solution are continually brought into contact with the atmosphere, and the salt which separates from the solution is fished out automatically. By lengthening the apparatus the temperature of the mother liquor, as it issues from the cooler, can be reduced to any desired extent.—J. B. C. K.

Calcium chloride compounds [with milk sugar]; Process for preparing non-deliquescent —— soluble in water. E. Ritsert, Frankfort. Ger. Pat. 288,966, Aug. 7, 1914.

Equivalent quantities of hydrated calcium chloride and milk sugar are combined, the physical properties of the compounds depending on the manner of preparation. Crystallised calcium chloride and anhydrous milk sugar are fused together, and the melt is ground with 10 % of water, forming a stable white powder. Alternatively, crystallised calcium chloride is fused on the water bath, 10—40 % of water is added, and the solution mixed at 70° C. with the equivalent of hydrated milk sugar; if removed from the water bath at 50° C., the pasty mass solidifies to a white, hard plaster, with evolution of heat; if the mixture be heated further on the water bath it becomes transparent and the mass on solidification is colloidal, resembling alabaster; if heating be continued the mass remains transparent but becomes viscous and sticky, only solidifying after several days. If the melt be heated with 60—80 % of water calculated on the original crystallised calcium chloride, the milk sugar-calcium chloride compound separates on cooling in well defined crystals which are stable in air and soluble in water. Crystals of similar composition are obtained by cooling or evaporating concentrated solutions of milk sugar and calcium chloride. —J. F. B.

Tungsten carbide or molybdenum carbide; Production of pieces of any desired size and shape (tools, etc.) of ——. Voigtländer und Lohmann Metall-Fabrikations-Ges.m.b.H., Essen. Ger. Pat. 289,066, Jan. 3, 1914.

Tungsten carbide or molybdenum carbide, or a mixture of the two, is very finely powdered, compressed in graphite moulds, and heated nearly to the melting point of the carbide until crystallisation takes place and converts the mass into a compact material, suitable for use as draw-plates, tools, bearings, etc.—A. S.

Vanadium; Method for obtaining precipitates rich in ——. G. Fester, Breslau. Ger. Pat. 289,245, July 30, 1914.

Acid solutions containing the vanadium in the form of the higher oxide are reduced and then precipitated fractionally by means of oxides, hydroxides, or carbonates of stronger bases. Trivalent vanadium resembles aluminium in its chemical affinities, and it can be precipitated from solution before the more basic divalent metals, such as iron, zinc, manganese, and calcium. —J. B. C. K.

Ammonia from its elements; Manufacture of ——. A. Classen, Aachen. Ger. Pat. 289,795, Apr. 1, 1913.

For the preparation of ammonia from its elements by the action of electrical discharges, contact masses are used containing finely divided metals, alloys, metallic compounds, etc., as obtained by the aid of gelatose, glue, albumin, or their salt-like compounds, and with or without metallic oxides in an extremely finely divided condition. —A. S.

Double silicates, felspar, etc.; Decomposition of ——. Siemens u. Halske A.-G., Siemensstadt. Ger. Pat. 289,909, Apr. 17, 1914.

In the decomposition of double silicates, such as felspar, by heating with a reducing agent (carbon) in an atmosphere of chlorine, very large quantities of chlorine are consumed, a large proportion of which goes to the formation of silicon tetrachloride. According to the present patent, limited quantities of chlorine and of carbon are used, so that only the aluminium and potassium are converted into chlorides, whilst the silicon remains in the form of silica. The chlorides may be recovered by leaching, or the product may be used directly as a fertiliser. By this process the same results are obtained, so far as the alumina and potash are concerned, with one-fourth of the quantity of chlorine and of carbon consumed when the supplies of these are not restricted.—A.S.

Sulphur from sulphur gases; Process for recovering elemental ——. W. F. Lamoreaux and C. W. Renwick, Isabella, Tenn., U.S.A. Eng. Pat. 2834, Feb. 22, 1915.

See U.S. Pat. 1,140,310 of 1915; this J., 1915, 716.

Chlorides; Reduction of ——. F. Meyer and H. Kerstein, Berlin. U.S. Pat. 1,173,012, Feb. 22, 1916. Date of appl., Apr. 29, 1914.

See Ger. Pat. 281,091 of 1913; this J., 1915, 613.

Hydrogen; Manufacture of ——. K. Schaefer, Charlottenburg, Assignor to Berlin-Anhaltische Maschinenbau-A.-G., Berlin. U.S. Pat. 1,172,908, Feb. 22, 1916. Date of appl., May 16, 1914.

See Eng. Pat. 25,710 of 1913; this J., 1915, 871.

Preparation of masses, especially powder, of pure boron, titanium, and zirconium [for incandescence lighting]. Ger. Pat. 289,063. *See* IIB.

VIII.—GLASS; CERAMICS.

Porcelain glazes; Influence of the alumina : silica ratio on the behaviour of ——. R. Rieke and W. Steger. Sprechsaal, 1915, **48**, 381—382, 390—392. Z. angew. Chem., 1916, **29**, Ref., 70. (See also this J., 1915, 493.)

The coefficient of expansion is greatest in the tender porcelains with a low content of silica, and least in hard porcelains which are rich in alumina and silica. It increases proportionately with the fluxes, but independently of the alumina-silica ratio. Glazes with more than 9—10 mols. SiO_2 are turbid. Glazes with only 6—8 mols. SiO_2 or 0·3—0·4 mol. Al_2O_3 tend to craze.—A.B.S.

Advisory Council for Industrial Research. *See* X.

Patents.

Porcelain, pottery, glass, and the like electrically conductive for the electrolytic deposition thereon of metallic coatings; Rendering articles of ——. P. Marino, London. Eng. Pat. 2698, Feb. 19, 1915.

The surface of unglazed porcelain, pottery, or roughened glass is made electrically conductive by painting with a mixture consisting of solutions of an alkali arsenite and ammonium "fluorhydrate" containing 10 % of double nitrate of silver and ammonium, with the addition of ammonia sufficient to dissolve the precipitate formed, and then, whilst still moist, treating with a hot solution of sodium or potassium hydroxide. The surface is afterwards painted with a solution of a suitable reducing agent, such as phosphorous acid or ferrous sulphate. —B. N.

Glass : Tank furnace for melting ——. O. Gobbe, Jumet, Belgium. Ger. Pat. 288,778, Mar. 16, 1913.

The top of the tank is built of ⊐-shaped blocks so that cold air may be blown into the hollow portion, thereby cooling the surface of the molten glass and preventing it from attacking the walls of the tank so readily as usual.—A. B. S.

Glass furnace. C. Menzel, Lommatzsch. Ger. Pat. 289,827, Feb. 4, 1915.

In a furnace of the type of a Siemens regenerative glass furnace, the furnace chamber contains only one or two large pots, over which the heating gases flow from inlets on one of the long sides of the chamber to outlets on the opposite side. The charging and working openings are in the end walls of the furnace chamber.—A. S.

Grog dust ; Production of —— as a shortening material. M. Bertram, Neustädtel. Ger. Pat. 288,721, Oct. 15, 1914.

Clay is made into a slip with water and is then mixed with a large proportion of combustible material, dried, and burnt. Even when burnt at high kiln temperatures the product is very friable. —A. B. S.

Enamelled coating ; Production of —— on iron by means of a bond. Westf. Stanz- u. Emaillierwerke A.-G. vorm. J. und H. Kerkmann, Ahlen. Ger. Pat. 289,103, Sept. 11, 1913.

Copper, nickel, bronze, or other metal, except silver, in the form of a powder, is added to the enamel mixture. On heating the coated sheet, a partial fusion of the metal occurs and produces a particularly resistant enamel.—A. B. S.

IX.—BUILDING MATERIALS.

Recent progress in electrical smoke precipitation. Cottrell. *See* I.

Patents.

Cement for building construction : Manufacture of ——. J. J. W. H. Van der Toorn, The Hague. Eng. Pat. 13,081, Sept. 13, 1915. Under Int. Conv., Sept. 14, 1914.

A mixture of particles of titaniferous iron-sand and cement with sand and water is used in place of cement and sand alone, for preparing plates, blocks, pillars, etc., for building construction purposes. The product is characterised by a high specific gravity and great resistance to compression, and when mixed with water it sets quickly.—J. B. C. K.

Cement kiln ; Gas-fired rotary ——. J. H. Schütt, Elmshorn. Ger. Pat. 288,727, Apr. 15, 1913. Addition to Ger. Pat. 256,391.

The interior of the kiln tapers gradually from the burner to the sintering zone, and then again becomes wide ; the sintering zone is cooled externally by air. The kiln-gases pass through the sintering zone, suffering very little reduction in temperature, and are then cooled in the wider calcining zone. The action of the gases may be intensified by increasing the rate of rotation of the kiln, with resulting increase in output for the usual quantity of gas.—A. B. S.

Wood : Preservation of —— by means of negatively substituted phenols. F. Heller, Kasniau. Ger. Pat. 288,695, June 10, 1914. Under Int. Conv., Oct. 28, 1913.

Phenols with negative substituents are mixed with aqueous solutions of alkali hydroxides or carbonates and of aluminium sulphate, in such proportions that, on warming, a clear solution is obtained in which aluminium hydroxide is present in the form of a sol. The wood is impregnated with the warm solution and, on cooling, the aluminium hydroxide separates in the gel form. —A. S.

Preservation of wood ; Manufacture of non-explosive preparations particularly suitable for the ——. *Process of preserving wood.* F. Bub, Halle. Ger. Pats. (A) 289,243, Feb. 8, 1914 ; (B) 289,504 and (C) 289,505, Feb. 10, 1914.

(A) Mono- and poly-nitro derivatives of phenols and their homologues are neutralised with inorganic bases, and mixed with sulpho salts of aromatic hydrocarbons or their substitution products. (B) The wood is treated with a mixture of copper sulphate (with or without zinc chloride) and at least 10% of mercuric chloride, or the solutions of the salts may be used consecutively. (C) The wood is treated with a mixture of zinc chloride (or zinc chloride and lead chloride) and at least 10% of mercuric chloride, or with the solutions consecutively in such proportions that the salt in the pores of the wood contains 10% of mercuric chloride.—C. A. M.

Lithographic stones ; Manufacture of artificial ——. V. H. J. Hereng, Ixelles-Brussels, Belgium. U.S. Pat. 1,172,796, Feb. 22, 1916. Date of appl., May 27, 1913.

See Eng. Pat. 12,640 of 1913 ; this J., 1914, 82.

Production of oil from bituminous minerals. Ger. Pat. 289,249. *See* IIb.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Advisory Council for Scientific and Industrial Research. Engineering, Mar. 24, 1916.

The Advisory Council for Scientific and Industrial Research is appointing standing committees of experts to report on proposed researches of great importance submitted to it. Strong committees in mining and metallurgy have already been formed. Each committee will have two sections. Sir William Garforth is chairman of the mining committee and of its non-metals section, and Mr. Edgar Taylor will preside over its metals section. Sir Gerard Muntz has accepted the chairmanship of the metallurgy committee and of its non-ferrous section, and Sir Robert Hadfield, F.R.S., is chairman of its ferrous section. A similar committee for engineering is contemplated.

Grants have already been made to the Institution of Mechanical Engineers in aid of researches on "Hardness Tests," and on "The Properties and Composition of Alloys" ; to the Institution of Electrical Engineers, for researches on "The Heating of Buried Cables," and on "The Properties of Insulating Oils" ; to the Institute of Chemistry, for investigations relating to "Laboratory Glass" and "Optical Glass" ; to the Institution of Mining and Metallurgy, for researches on "Methods of Extracting Tin and Tungsten" ; to the Institute of Metals, for researches on "The Corrosion of Non-Ferrous Metals" ; to the Institution of Gas Engineers, for investigations relating to "Refractory Materials" ; to the Manchester Association of Engineers, for "Experiments on Tool-Steel"; and to the National Physical Laboratory, for researches on "Optical Glass."

The Advisory Council has also recommended a grant in aid of a research bearing upon the manufacture of hard porcelain, undertaken by the governing body of the Stoke-on-Trent Central School of Science and Technology in conjunction with the Staffordshire Potteries Manufacturers' Association, the object being to establish the manufacture of hard porcelain in this country.

British spelter works. Times, March 21, 1916.

An agreement has been reached between the spelter producers in this country and the Munitions Department on the subject of new works, with a view to increasing British spelter production. The producing companies are to be allowed to deduct from their excess profits the difference between the cost of new production during the war and before the war; they are also to receive from the Munitions Department a "reward" for extending their works, in that they will be allowed to deduct from their excess profits, before taxation, 50 % of the pre-war cost of construction.

As a result of this arrangement at least one company is arranging to double its smelting capacity, and others will probably follow.

Blende; Roasting of ——. M. de Lummen. Chem. Trade J., 1916, **58**, 255—257.

Furnaces of the Hasenclever, Delplace, and Hegeler types are the only ones employed to any extent in blende roasting, the process being operated in conjunction with the manufacture of sulphuric acid. The efficiency of the Hasenclever furnace is low, the fuel consumption high (20—25 % of the weight of raw ore), and the gases poor in sulphur dioxide, owing to difficulty of operation, rapid cooling during hand-rabbling, and excessive height of the roasting compartments. The Delplace furnace, also hand-operated, has lower roasting compartments, smaller working doors, and arrangements for preheating the air, resulting in easy and efficient working, low fuel consumption (10 % of the weight of raw ore), and gases richer in sulphur dioxide (7 %). The Hegeler mechanical roasting furnace is employed almost exclusively in the U.S.A. where labour is expensive and coal cheap. The furnace yields an imperfectly roasted product, has a high fuel consumption (25 % of the weight of raw ore), and requires about 40 h.p. for operation; the gases contain only 3—4½ % of sulphur dioxide, and the cost of roasting (about the same as in the Hasenclever) is much higher than in the Delplace furnace. Of the mechanical furnaces tested in Europe during recent years for roasting blende, that invented by de Spirlet has given the most promising results, but no type has yet been definitely adopted.—W. E. F. P.

Nickel; Influence of tungsten on ——. R. Irmann. Metall u. Erz, 1915, **12**, 358—364. Z. angew. Chem., 1916, **29**, Ref., 12—13.

An alloy of nickel with 47 % W was prepared in an electric crucible furnace from almost chemically pure tungsten and cube nickel containing S 0·019, Mn 0·028, Zn 0·018, and Cu 0·107 %. This alloy was used in the preparation of other alloys with less tungsten. The alloys with up to 30 % W were dissolved for analysis in *aqua regia* with the addition of bromine; those with over 30 % W were fused with potassium bisulphate in a platinum crucible. The equilibrium diagram shows two maxima, at 6 and 14·3 % (atomic) W respectively; the former would correspond to the compound $Ni_{16}W$, the latter to the compound Ni_6W. The alloys with these compositions exhibit also maximum resistance to acid corrosion, a minimum occurring in the neighbourhood of an eutectic composition. Nickel possesses a considerable resistance to attack by 65 % sulphuric acid, which is increased four-fold by the addition of 5 % W, and twelve-fold by the addition of 10 % W; from 10 to 18 % W the resistance increases more slowly, and at about 25 % W diminishes considerably, increasing again from 30 % W. The electrical resistance increases almost proportionally to the tungsten content, up to 23 % W. The tensile strength diminishes rapidly with increasing tungsten content, attaining a minimum with 25 % W, and then rises again just as rapidly. The ductility of nickel is adversely affected by the addition of tungsten: it is possible to form into sheets only those alloys with under about 18 % W. The structure changes gradually from coarsely to finely radiated with increasing tungsten, and with more than 20 % W begins to be granular. The alloys will only have practical value, when through suitable metallic additions the resistance to acid is increased and the ductility improved, and the alloys themselves become cheaper.—T. St.

Recent progress in electrical smoke precipitation. Cottrell. *See* I.

Patents.

Iron ores and iron ore briquettes; Process for preventing disintegration of —— during smelting. Det Norske A/S for Elektrokemisk Industri, Christiania. Ger. Pat. 289,727, Jan. 18, 1914.

The ore or briquettes are treated with a small quantity of a chloride, *e.g.*, sodium chloride, or a mixture of chlorides, capable of producing a protective coating, similar to a glaze, around the particles of ore. The chloride may be added to the ore before it is briquetted, or it may be added, in the solid state or in solution, to the ore charge before this is introduced into the furnace, or it may be fed into the furnace with the heating gases.—A. S.

Iron and other metal articles; Continuous annealing of ——. W. Möllhoff, Neuenrade. Ger. Pat. 289,766, Mar. 30, 1913.

Annealing is effected in a closed chamber filled with combustible reducing gases, which are displaced by an inert gas, preferably waste combustion gases, before opening the chamber for the withdrawal or introduction of the articles.—A. S.

Iron or steel; Process of alloying zinc with ——. B. F. Dimm, Erie, Pa., U.S.A. Eng. Pat. 2389, Feb. 15, 1915. Under Int. Conv., Feb. 19, 1914.

Iron or steel articles are provided with a coating of zinc by any known galvanising process, and then maintained at about 600° F. (315° C.) until the zinc coating has been absorbed by the iron, forming an alloy to a depth of not less than the original thickness of the zinc coating, and generally to a greater depth. The article thus prepared may be tinned or re-galvanised: it is non-scaling and non-rusting, may be heated to redness without dispelling the zinc, and will take a high and lasting surface polish. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 15,058 of 1892; this J., 1892, 924.)—T. St.

Metals: Process for atomising —— in a state of fusion and projecting them on to the surface of a body of any kind for the purpose of forming on such bodies adherent or detachable metallic films. F. C. Ucar, Madrid. Eng. Pat. 2413, Feb. 15, 1915.

In a process depending on the maintenance of an electric arc between electrodes of the metal to be atomised and the action of a blast upon the latter, the arc is produced without preliminary contact of the electrodes (see Eng. Pat. 2349 of 1915; this

J., 1915, 1258) against which one or more gaseous currents are caused to impinge so as not to reach the arc.—W. E. F. P.

Clad metals: Process of working ——. W. M. Page, Philadelphia, and W. Tassin, Chester, Pa., Assignors to Duplex Metallic Co. U.S. Pat. 1,171,637, Feb. 15, 1916. Date of appl., Apr. 28, 1910.

A STRONG, highly conductive, metal conductor is produced by rolling a copper-clad billet down to wire-rod size through blunt-edged oval grooves, the temperature during rolling being maintained between 1800° F. (about 980° C.) and 1300° F. (about 700° C.). The rolled metal is allowed to cool slowly.—T. ST.

Compound metallic articles [iron or steel united to an alloy of copper and aluminium]: Process for making ——. I. Langmuir, Assignor to General Electric Co., Schenectady, N.Y. U.S. Pat. 1,171,856, Feb. 15, 1916. Date of appl., Apr. 9, 1913.

UNION is effected by bringing the metal and alloy into contact, at the melting point of the latter, in the presence of a reducing gas (hydrogen) and a flux of cryolite; the cross-section of the product is reduced by mechanical means.
—W. E. F. P.

Furnaces: Crucible ——. E. Hall, Birmingham. Eng. Pat. 4991, Mar. 31, 1915.

IN a crucible furnace employing solid fuel, clinkering is avoided, and an efficient air supply ensured, by the provision of an air-admission box within which a detachable grate frame is supported so as to have an air space at each side. The box has an air inlet at the front, and a cover having a central opening corresponding with the dimensions of the crucible chamber above; the walls of the box taper downwards to the bottom, which is open and communicates with the ash-pit.—W. E. F. P.

Furnaces [; Crucible ——]. H. J. Yates, Birmingham, and S. N. and E. R. Brayshaw, Manchester. Eng. Pat. 7966, May 29, 1915.

A FURNACE of the injector type has a regenerative chamber at the back for heating the gaseous fuel and air, and a deep cover mounted on wheels or runners which traverse rails fixed to the furnace structure. An upper extension of the crucible chamber is formed by an opening in the thick cover, this extension being connected with the top of the regenerative chamber by a horizontal flue over which (*i.e.*, on top of the cover) a preheating chamber for the charge is located.—W. E. F. P.

Crucible-furnace. W. M. Brown, Johnstown, Pa. U.S. Pat. 1,171,500, Feb. 15, 1916. Date of appl., Apr. 2, 1914.

THE crucibles stand on vertical columns which pass through the bottom of the heating chamber, and means are provided for raising the columns to lift the crucibles to the level of the top of the furnace. The top of each column is reduced, thus forming a shoulder, and on the reduced portion is an annular ring. A refractory block stands on the ring, and a reduced portion extends into the ring on the top of the column.—T. ST.

Furnaces [for melting metals]: Rotary ——. F. W. Stevenson, Coventry. Eng. Pat. 6433, Apr. 30, 1915.

A HORIZONTAL, cylindrical tilting furnace, mounted on hollow trunnions through which gaseous or liquid fuel and air are introduced, is provided with a pouring spout at the side and has, at the top, an opening, serving as a charging door and waste gas outlet, upon which a combined feeding-hopper and preheater is movably seated. The hopper is supported from a staging above, has a perforated lid, and is adapted to be raised clear of the furnace when the latter is to be discharged.—W. E. F. P.

Ore-roasting apparatus. H. T. Benson, Denver, Colo., Assignor to W. S. Barnes, Philadelphia, Pa. U.S. Pat. 1,171,583, Feb. 15, 1916. Date of appl., Aug. 11, 1915.

A ROASTING cylinder, mounted to rotate about a horizontal axis, is closed at the feed end by a stationary hood, to which are attached a vertical conduit for the discharge of gaseous products and a horizontal feed-pipe terminating in a vertical shoot through which a stream of ore is conducted to the bottom of the cylinder; at the discharge end the roasting cylinder is closed by a cap, through the centre of which a horizontal pipe, adapted to discharge a vertical, fan-shaped blast, projects into the interior. Shelves sloping towards the centre and downwards towards the discharge end are disposed along the inside of the cylinder, by the rotation of which the ore is raised and dropped alternately while being propelled towards the discharge end.
—W. E. F. P.

Furnace and furnace parts: Metallurgical ——. *Furnace part.* T. W. Muckle, Assignor to W. W. Case, jun., Denver, Colo. U.S. Pats. (A) 1,172,222 and (B) 1,172,223, Feb. 15, 1916. Dates of appl., June 1 and Aug. 16, 1915.

(A) THE interior of the furnace is divided into an upper muffle chamber and a lower combustion chamber by a removable, horizontal plate resting upon projections from the walls but not in contact with the latter; the plate acts as a support for the muffle, the mouth of which is directly above the burner aperture. The combustion chamber contains a number of vertical baffles, triangular in cross-section, by which the horizontal flame is diverted towards the sides of the furnace, whence it passes through the spaces between the plate and walls and around the muffle. (B) The burner aperture has an external, conical attachment, enclosing the nozzle of the burner, and consisting of a fixed lower part upon which an upper part is movably seated for the purpose of regulating the admission of air to the combustion chamber.—W. E. F. P.

Furnace: Electric —— for the recovery of zinc or other volatile metals. O. Schneemilch, Schoppinitz-Wilhelminenhütte. Ger. Pat. 288,616, Dec. 12, 1913.

THE furnace is of the shaft type, the cross-section increasing towards the bottom. A tube of conducting material, open at both ends, and situated in the vertical axis of the shaft, allows of the passage of air for cooling purposes, and in a three-phase system forms the neutral point. Openings situated in steps, one above the other, are left in the brickwork of the furnace. Some of the openings serve for the reception of condensers for the distilled metals, and the others are closed at their inner ends by electrodes which form a part of the inside surface of the shaft. On each level the condensers are arranged between the electrodes. The lines of force thus pass radially through the charge, and very little heat is wasted.
—T. ST.

Furnace: Electric metallurgical —— for th extraction of zinc and the like. Coswiger Braunkohlenwerke G.m.b.H., Coswig, Anhalt. Ger. Pat. 288,684, Jan. 19, 1913.

THE electrodes are embedded, within a closed-i box-like vessel, in material which becomes electrically conducting on being heated, and are s disposed as to encircle the vessel containing th charge. The heating is entirely due to the resistance in the circuit. One or more vessels suitably connected with the chamber containing the charge serve for the reception of the material distilling over. These receivers may be heated, if desired, either electrically or by the waste gases from the charge.—T. St.

Zinc: Method of condensing metallic vapours, especially those of —— in the electric furnace. A/S Metalforedling, Drontheim, Norway. Ger. Pat. 289,193, Mar. 27, 1914.

The gases and metallic vapours pass from the furnace down inclined tubes sufficiently long to ensure the condensation of the metal to the liquid state. Uptakes containing coke are provided for the escape of the non-condensable gases, the coke being subsequently treated for the recovery of any contained metal.—T. St.

Zinc: Process of obtaining ——. E. Fleischer, Dresden, and Bunzlauer Werke Lengersdorff und Co., Bunzlau. Ger. Pat. 289,720, June 7, 1912.

A mixture of ore and reducing agent (carbon) is treated in externally heated retorts with reducing gases (*e.g.*, a mixture of carbon monoxide and nitrogen), the temperature of which is at least 1000° C., and the gases from the retorts are led through a condenser maintained at a temperature between the melting point and vaporising point of zinc, *e.g.*, at 500°—600° C.—A. S.

Ferrosilicon; Process of producing ——. H. C. Harrison, Assignor to Electro Metallurgical Co., Niagara Falls, N.Y. U.S. Pat. 1,171,719, Feb. 15, 1916. Date of appl., June 12, 1912.

A charge consisting of hard impermeable agglomerates containing silica, carbon slightly in excess of that required to reduce the silica, and an iron compound, is fed through a vertical shaft into an electric furnace. The reduction of the silica gives rise to carbon monoxide, which is partly consumed in the lower part of the shaft in reducing the iron compound, the remainder being burnt in the upper part of the shaft to preheat the charge.—T. St.

Ferromanganese, ferrosilicon, and other alloys which take up carbon; Remelting of —— in electric furnaces. Ges. für Elektrostahlanlagen m.b.H., Siemensstadt, and W. Rodenhauser, Völklingen. Ger. Pat. 289,418, July 26, 1912.

Ferromanganese and similar alloys are melted directly under a layer of carbon, such as coke, thus offering a ready source of carbon to the molten charge. The carbon-containing lining of the furnace is thereby attacked only to a slight extent. Moreover, in addition to protecting the molten metal from the air, coke has the advantage over the usual slags that when the solid alloy is added to the bath, it cannot carry slag with it into the molten metal.—T. St.

Ores: Hydro-electrolytic treatment of ——. R. R. Goodrich, Tucson, Ariz. U.S. Pat. 1,171,782, Feb. 15, 1916. Date of appl., May 25, 1915.

In the electrolytic deposition of a metal from solution, the electrolyte is circulated through a system of cells arranged in groups, with progressively increasing electrode area in successive groups, and is also circulated independently through the cells in each group. The amount of solution supplied to each group by the main circulation is so regulated that the auxiliary circulation of the electrolyte through the cells of the group maintains the composition of the electrolyte in each group practically constant. The electrodes of each cell are connected in parallel and those of successive groups in series. —A. S.

Metals; Method of treating ——. F. L. Bishop, Pittsburgh, Pa. U.S. Pat. 1,171,832, Feb. 15, 1916. Date of appl., Feb. 26, 1913.

The metal is heated by means of induced electric currents while in the magnetic field of an alternating electric current and protected from the action of injurious gases, the object being to modify the molecular structure.—W. E. F. P.

Alloy for deoxidising purposes. K. Wagenmann, Aachen, and M. Welter, Düdelingen, Luxemburg. Ger. Pat. 288,701, July 27, 1913.

The alloy consists of aluminium, magnesium, and manganese. The presence of the aluminium, which alloys easily with both magnesium and manganese, allows of the formation of a completely homogeneous ternary alloy, which can easily be produced without segregation or loss by methods other than those usually adopted for the preparation of magnesium alloys.—T. St.

Gun-barrels; Method of hardening ——. F. Werner, Berlin. Ger. Pat. 288,922, June 20, 1914.

The end of the barrel opposite to the muzzle having been hermetically sealed, the muzzle is heated to redness and quenched. Gun-barrels break down chiefly at the muzzle, and by hardening in the manner described the life of the barrel is doubled.—T. St.

Zirconium compounds; Method for the recovery of the valuable constituents in ——. Dr. North Kommandit-Ges., Hanover. Ger. Pat. 288,969, July 29, 1914.

Molten iron rich in carbon is completely saturated with the zirconium compound and the iron is then dissolved in acid or burnt away by great heat. The residue approaches metallic zirconium in its properties. It has an extremely high melting point and can be utilised for all purposes, like the allied metals of the platinum group.—T. St.

Precious metals; Extraction of —— from pyrites. Gewerkschaft Hoffnung Christine, Brühl. Ger. Pat. 289,260, Oct. 11, 1913.

The pyrites is smelted without loss of sulphur, conveniently in an electric furnace, with the formation of a fluid slag and a matte. The proportion of sulphur in the latter is adjusted, on the one hand, either by the addition of sulphur-free iron, or by partially roasting, or, on the other hand, by the addition of sulphur as ore, and the product is then treated with sulphuric acid. The iron is dissolved, and copper, nickel, and precious metals are left as sulphides.—T. St.

Silver coatings on metals or alloys; Production of ——. A. Geserick, Beendorf. Ger. Pat. 289,701, Nov. 6, 1913.

Coatings of silver are produced on metals or alloys, including copper and brass, by immersing them in, or rubbing them with, a semi-liquid or pasty mixture containing an antimony or bismuth salt in addition to the usual constituents (silver chloride or nitrate, alkali salts, and organic acids or acid salts).—A. S.

[Ore] retort discharging machines. Simmonds Engineering Co., Assignees of J. J. Simmonds, Iola, Kas., U.S.A. Eng. Pat. 3147, Feb. 26, 1915. Under Int. Conv., Mar. 9, 1914.

Metallurgical furnaces: Securing rabble arms to shafts of ——. R. Haddan, London. From Furnace Patent Co., Philadelphia. Eng. Pat. 16,939, Dec. 1, 1915.

Zinc; Process for recovering —— from zinciferous materials. F. C. W. Timm, Hamburg, Germany. U.S. Pat. 1,172,321, Feb. 22, 1916. Date of appl., Oct. 7, 1913. Renewed Dec. 31, 1915.

See Ger. Pat. 268,427 of 1912; this J., 1914, 143.

Method and apparatus for recovering sludge [from gas washers]. U.S. Pat. 1,171,696. *See* IIa.

Preparation of masses, especially powder, of pure boron, titanium, and zirconium [for incandescence lighting]. Ger. Pat. 289,063. *See* IIb.

Production of pieces of any desired size and shape (tools, etc.) of tungsten carbide or molybdenum carbide. Ger. Pat. 289,066. *See* VII.

Rendering articles of porcelain, pottery, glass, and the like electrically conductive for the deposition thereon of metallic coatings. Eng. Pat. 2698. *See* VIII.

XI.—ELECTRO-CHEMISTRY.

Anode and Wehnelt effects. G. Oesterheld and E. Brunner. Z. Elektrochem., 1916, **22**, 38—40.

The anode effect is manifested in the electrolysis of fused salts by the sudden cessation of the development of gas bubbles, and at the same time the anode becomes covered with scintillating points and is no longer "wetted" by the fused electrolyte. In the electrolysis of fused sodium beryllium fluoride a gradual increase of current produced at first an increase of voltage in the bath above the decomposition potential (2—3 volts), until at a certain current strength, varying with the area of the anode, a sudden rise in voltage occurred, with a fall in current, accompanied by the anode effect. No definite current or current density could be determined at which the transition from normal electrolysis to the anode effect occurred. The composition of the electrolyte had considerable influence, increasing concentration of beryllium fluoride causing a marked increase in the critical current density.—G. F. M.

Conductivity and electrical excitability of liquid insulators [benzene, petroleum spirit, etc.]. Holde. *See* IIa.

Electrolytic method of obtaining solid iodine from solution. Pisarshevski and Tjelni. *See* VII.

XII.—FATS ; OILS ; WAXES.

Varrentrapp's reaction : Applications of —— in the fat and soap industry. W. Schrauth. Seifenfabr., 1915, **35**, 877—879. Z. angew. Chem., 1916, **29**, Ref., 31.

The so-called Varrentrapp's reaction, according to which oleic acid when fused with an excess of potassium hydroxide yields potassium palmitate and hydrogen, is applicable to all unsaturated fatty acids, which in this way may be converted into saturated fatty acids containing a smaller number of carbon atoms. For example, clupanodonic acid, which is the cause of the characteristic odour of marine animal oils, is slowly transformed into saturated fatty acids and it is possible in this way to obtain up to 85% of a perfectly white solid distillate from the mixed fatty acids of the oil, provided that glycerol is absent. Marine animal oils of the best quality yield tallow-like fats, which when mixed with other fats give good lathering soaps, whilst the fatty acids from refuse marine animal oils yield products which resemble the fatty acids of palmnut and coconut oils both in properties and composition.—C. A. M.

"Poli oil," a new adulterant of ghee (Indian clarified butter-fat). J. H. Barnes and A. Singh. Analyst, 1916, **41**, 72—73.

A troublesome plant or weed (*Carthamus oxyacantha, Compositae*) known locally as *poli*, and by other names, grows amongst the wheat in North-West India. The seeds of the plant yield a yellow oil which is used as an illuminant and for food : the oil is also used to adulterate ghee. A specimen of the fresh oil had the following chemical and physical characters :—Sp.gr. at 15·5° 15·5 C., 0·9272 ; iodine value, 167·4 ; saponif. value, 174·2 ; acetyl value, 60·5 ; acid value, 5·9 ; Reichert-Meissl value, 0·61 ; optical rotation in 200 mm. tube, *nil* ; refractive index at 28 C., 1·4818 ; refractive index at 40° C., 1·4755. These figures differ from those recorded by Crossley and Le Sueur (this J., 1898, 992), probably due to the sample examined by these authors not being fresh. All the safflower oils contain considerable quantities of unsaturated fatty acids and, consequently, have a tendency to undergo polymerisation. There is, however, no difficulty in detecting the presence of the fresh or stale oil in ghee. (See also Bolton and Revis, this J., 1910, 1076 ; Kesava-Menon, this J., 1910, 1128 ; Vakil, this J., 1915, 320.)—W. P. S.

Whale oil : Prohibition of trade in ——. Board of Trade J., Mar. 23, 1916.

Under date March 18th the Minister of Munitions gives notice that Regulation 30a of the Defence of the Realm (Consolidation) Regulations, 1914, shall include whale oil.

Recovery of grease from wool scouring. Chambers. *See* V.

Patent.

Extraction process. E. O. Barstow, Assignor to J. Griswold, jun., Midland, Mich. U.S. Pat. 1,171,108, Feb. 15, 1916. Date of appl., Jan. 22, 1912.

The material is extracted with a "chlorinated solvent," which, after separation by distillation from the extract, is neutralised by upward filtration through a layer of dry slaked lime or other neutralising agent, and used for the extraction of fresh material, and so on.—C. A. M.

Catalytic agents ; Soluble —— and process of making the same. N. Sulzberger, New York. U.S. Pat. 1,171,902, Feb. 15, 1916. Date of appl., Jan. 10, 1914.

A solution of an oleate is treated with a solution of a derivative of palladium or other metal of the platinum group in the absence of any substance to preserve the colloidal state, and which will prevent the resulting metallic oleate from depositing its metal in a catalytically active condition at 50° C. or less. Palladium oleate is a yellowish oil, insoluble in water, but soluble in ether, fats, and oils and which decomposes spontaneously with deposition of palladium.—C. A. M.

Soap containing a perborate, percarbonate, or like oxygen-yielding salt ; Method of making blocks, bars, and the like of ——. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, Frankfort, Germany. Eng. Pat. 8483, June 8, 1915. Under Int. Conv., June 9, 1914.

See U.S. Pat. 1,153,167 of 1915 ; this J., 1915, 1062.

Preparation of a rubber substitute. Ger. Pat. 288,968. *See* XIV.

Process of obtaining aromatic palm spirit as a by-product in the manufacture of edible palm oil. Ger. Pat. 288,765. *See* XVIII.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Ink-spots on paper ; The blackness of ——. W. Mecklenburg. Z. Elektrochem., 1916, **22**, 23—27

To compare the blackness of inks, a Tyndall mete was used in conjunction with a spectro-mono chromator. The author gives a table of result obtained by examining with olive-green light, of about $\lambda = 566 \mu\mu$. spots produced on filter paper by an iron-gall ink, free from artificial dyes, varying degrees of blackness being produced by diluting the ink. The relative degree of "blackness" is defined from the equation

$$S = 100 \left(1 - \frac{R_K}{R_P}\right)$$

where R_K is the reflection of the spots and R_P is the reflection of the paper. The maximum blackness of an iron-gall ink recorded was 82 % and corresponded to that of the original ink, a mixture of 70 % of ink and 30 % of water gave a relative blackness of 80 %; 40 % of ink and 60 % of water, blackness 76 %; and 98 % of water to 2 % ink, blackness 31 %.—W. G. C.

Patents.

Lampblack; Process of obtaining ——. F. K. Meiser, Nürnberg. Ger. Pat. 288,990, Mar. 10, 1914.

The oil from which the lampblack is made is brought to the desired temperature before being admitted into the vessel in which it is burned. This is effected by pumping it through a heating or cooling device by means of a pump the speed of which can be regulated.—C. A. M.

Plastic composition [shellac substitute] and method of making it [from viscose]. J. M. Taylor, Bridgeport, Pa. U.S. Pat. 1,172,073, Feb. 15, 1916. Date of appl., Jan. 14, 1915.

Viscose is mixed with substantially equal parts of phenol (or its homologues) and formaldehyde, and the mass is heated to form a hard, dense, relatively infusible solid, having properties similar to those of shellac.—B. N.

Printing-inks; Preparation of dark ——. C. Grüne, Oranienburg. Ger. Pat. 288,879, July 9, 1914.

Kieselguhr, or a mixture thereof with carbon compounds which yield charcoal when heated, is ignited in the absence of air, and the resulting product ground up with a binding agent either directly or after impregnation with dyestuffs which will give coloured lakes on a kieselguhr base.
—C. A. M.

Drying oils from the high-boiling fractions of turpentine oil residues [from manufacture of artificial camphor, terpineol, etc.]; Process for obtaining ——. Chem. Fabr. Flörsheim Dr. H. Noerdlinger. Ger. Pat. 289,655, Aug. 1, 1914.

Residues obtained in the manufacture of artificial camphor, terpineol, etc., from oil of turpentine, are freed from easily volatile constituents, and then heated and subjected to the action of air or other oxidising gases. Products having a viscosity similar to that of Venetian turpentine can be obtained, and the drying properties can be improved by addition of siccatives or catalytically active substances.—A. S.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Acetone substitutes and ——. G. Noyer. Caout. et Gutta-Percha, 1916, **13**, 8805—8806.

Certain mixtures of solvents have appeared on the market as substitutes for acetone as solvents for nitrocellulose and other cellulose esters. They appear to contain ethyl alcohol, ethyl acetate, alkyl formates, and traces of acetone. The possibility of utilising such mixtures as precipitants for reclaimed rubber, and as solvents for extracting resins from resinous rubbers, has been investigated. t is found that in the former case some 30 % of he rubber remains unprecipitated, and that in the extraction of Jelutong, the yield of rubber is 20 to 25 % lower than when acetone is used. Such losses are not compensated by the lower price of the substitute, the solubility of the rubber in which is due to the presence of ethyl acetate and the formic esters.—E. W. L.

Caoutchouc; Lævulinic acid and ——. G. Noyer. Caout. et Gutta-Percha, 1916, **13**, 8801—8805.

Lævulinic acid can be converted by means of phosphorus pentasulphide into methylthiophen, which yields isoprene on reduction. Lævulinic acid has hitherto been obtained by the action of dilute hydrochloric acid on starch, a yield of only 10—12 % being obtained. It is found, however, that a considerable amount of lævulinic acid is produced when sawdust is hydrolysed with dilute acids under pressure in the preparation of glucose and of alcohol; this accounts for the low yields of these two substances. It is estimated that 1 ton of sawdust yields, on hydrolysis by Simonsen's method (dilute H_2SO_4 at 8 atmospheres), about 250 kilos. of lævulinic acid, which can easily be separated from the residue left after distilling the alcohol.—E. W. L.

Rubber exports from Ceylon. Board of Trade J. Mar. 23, 1916.

The following statistics of the exports of rubber of domestic production from Ceylon during the years 1914 and 1915, are from the official returns issued by the Ceylon Government:

To	1914.	1915.
	Lb.	Lb.
United Kingdom	21,609,644	26,898,371
United States	7,967,426	19,383,095
Other countries	4,776,029	2,522,350
Total	34,353,099	48,803,816

Patents.

Rubber substitute: Preparation of a ——. H. Bayer, Vienna. Ger. Pat. 288,968, June 3, 1914. Under Int. Conv., Oct. 26, 1913.

Sulphurised oils fluid at the ordinary temperature are treated with dilute nitric acid to obtain a product which can be vulcanised like rubber. It is not completely soluble in any known solvent, but swells up with carbon bisulphide, benzol, etc., to a gelatinous mass, which on evaporation of the solvent leaves a tough elastic residue which can be used for most purposes as a rubber substitute.
—C. A. M.

Vulcanised articles from plastic material, such as rubber; Method of producing ——. W. J. Mellersh-Jackson, London. From Rubber Regenerating Co., New York. Eng. Pat. 12,944, Sept. 9, 1915.

See U.S. Pat. 1,161,967 of 1915; this J., 1916, 130.

Preparation of substances resembling horn and ebonite from yeast and formaldehyde. Ger. Pat. 289,597. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Hides; Swelling of —— *in presence of hydrogen ions.* G. Povarnin. J. Russ. Phys.-Chem. Soc., 1915, **47**, 2064—2073.

The work of other investigators, notably Paessler and Appelius (this J., 1902, 1461), in this direction is discussed. The velocity with which hide-substance swells in pure water is expressed by the equation, $\log.[M/(M-Q)] = 0.4343k_1t$ (1), where M represents the maximum swelling, Q the swelling after the time, t, and k_1 is a constant. The swelling in presence of acids depends on the following considerations:—(*a*) The velocity of swelling is directly proportional to the velocity of the acid ions in penetrating the membrane (hide), and this velocity is proportional to $\sqrt{t}$, as was shown by Morse and Pierce (Z. physik. Chem., 1903, **45**, 589) for gelatin; in absence of acid, the rate of swelling is proportional to the velocity with which the ions of water pass through the membrane, that is, to t. (*b*) The rate of swelling is inversely proportional to the quantity of hide-substance dissolving at the surface of contact of hide and liquid and, since this quantity is directly proportional to the time, the rate of swelling is inversely proportional to t. (*c*) The maximum swelling, M, for a given acid is equal to some constant maximum, M_0, multiplied by k_0, which is a coefficient varying with the nature of the acid; it may be assumed that k_1 of equation (1) is in general equal to some magnitude, k/2. (*d*) The rate of swelling is proportional to the index of basicity, n, of the acid, if the acid is completely dissociated, and in general it should be proportional to the number of free hydrogen ions in the solution of the given acid. From these theoretical foundations, the equation, $\log[M/(M-Q)] = 0.4343 . n . k . \sqrt{t}$, is derived. Paessler and Appelius's results for five acids at concentrations of 0·1—0·6% are expressed satisfactorily by this equation, 0.4343k having the value 0·274, whilst n is equal to 1, or with strongly dissociated dibasic acids, 2: M is a variable magnitude, depending on the character and concentration of the acid.—T. H. P.

Limits of sensitiveness of colour reactions of proteins and peptolytic enzymes. Rakuzin and others. *See* XIXa.

Patents.

Bating hides; Process for ——. W. P. Thompson, Liverpool. From G. Eberle und Co., Stuttgart, Germany. Eng. Pat. 22,753, Nov. 19, 1914.

Very effective bating substances are produced by the autodigestion of various animal organs such as the pancreas, liver, or bowels, by means of the enzymes they contain. The organs are minced and the pulp digested for at least 20 hrs. at 40°—42° C. Meat scraps or casein may be mixed with the pulp, and peptolytic enzymes from other sources may also be used. The mass is then heated to 65°—70° C. to destroy enzymes, and thereupon separates into a liquid and solid portion. The former part is the more active and is absorbed by kieselguhr or sawdust for convenience in use.
—F. C. T.

Leather coloured with aniline dyestuffs; Preparation of waterproof colour-fast ——. W. Neuhoff, Mülheim. Ger. Pat. 289,188, Oct. 2, 1912.

The dyed leather is treated first with a dressing consisting, in the main, of a drying oil and calcium citrate, and then with a finish of albumin and varnish.—C. A. M.

Substances resembling horn and ebonite from yeast and formaldehyde; Preparation of ——. H. Blücher, Leipzig, and E. Krause, Berlin. Ger. Pat. 289,597, Feb. 13, 1915.

Yeast which has been treated with formaldehyde is dehydrated as much as possible, warmed and then compressed, or the yeast may be first mixed with solutions of albuminous substances which can be subsequently precipitated or coagulated and the resultant precipitate treated with formaldehyde, dehydrated and compressed whilst heated. *Examples:* (1) One kilo. of yeast paste containing about 15% of dry substance is stirred with 150 grms. of 40% formaldehyde, the mixture dried, ground, and compressed into moulds at 90° C. using a pressure of 200—300 atmospheres. (2) 15 grms. of blood albumin is dissolved in a corresponding amount of water, mixed with 1 kilo. of yeast paste, then heated to boiling and the coagulated substance separated, mixed with 150 grms. of 40% formaldehyde, dried, and compressed. If the compression is carried out at lower temperatures the product is attacked by water, whilst at temperatures above 60° C. the granular structure of the substance changes into a vitreous structure similar to that of ebonite. (See also this J., 1916, 322.)—T. C.

Method of treating waste products of animal carcases, slaughterhouse refuse, and the like. Ger. Pat. 289,525. *See* XIXb.

XVI.—SOILS; FERTILISERS.

Soil micro-organisms: Factors influencing the longevity of —— *subjected to desiccation, with special reference to soil solution.* W. Giltner and H. V. Langworthy. J. Agric. Res., 1916, **5**, 927—942.

Cultures of *Pseudomonas radicicola*, grown on "nitrogen-free ash agar," were suspended in physiological salt solution, in the same containing 0·1% of agar, gelatin, or gum arabic, in nutrient broth, in milk, and in the aqueous extract of a garden soil. The inoculated liquids were then subjected to desiccation in sterile sand, and the number of organisms persisting was determined at intervals. It was found that the rate of decrease in the number of organisms was markedly less in the broth, milk, and soil portions than in the others, and this is ascribed, in the cases of the broth and milk, to the presence of proteins. The longevity of the same organism was greater when desiccated in quartz sand than in a clay-loam garden soil. The texture and the moisture-retaining property of an air-dry soil are not the only factors determining longevity; a rich clay-loam for example contains substances which exert a protective influence. The effect of desiccation was investigated by inoculating five air-dried soils, sand, sandy loam, clay, clay-loam, and muck, with a solution extracted from a rich garden loam. For six weeks each soil contained sufficient moisture to favour bacterial growth; during the last two months the soils were desiccated. Six months after inoculation the largest number of organisms was found in the clay-loam, followed by the sandy loam, muck, clay, and sand in the order mentioned. The nature of the organisms predominating in each type during the period of desiccation was also determined. In the sand, *B. mycoides* was the most abundant spore-bearer, and among the organisms not forming spores, an actively motile, non-capsule-forming facultative anærobe was found which was both the most abundant and the most resistant. This organism consisted of rods, with rounded ends, 0·6μ by 1·3—1·5μ; it reduces nitrates and produces ammonia from Dunham's solution; it stains readily with aqueous alcoholic fuchsine; it renders nutrient broth turbid, forms a white surface growth on a gelatin stab, but is non-liquefying. It forms a glistening, translucent, grayish-white, very abundant growth on agar. A similar organism, also showing the greatest longevity, was found in the other soil samples. In addition, the plates from the sandy loam clay-loam, and muck showed chromogenic coc and an interesting slime-forming organism whic was particularly abundant in the last-named It was a non-motile rod, 0·4μ by 0·6—0·7μ, not forming spores or capsules; facultative, stained readily with fuchsin, turned nutrient broth very turbid, gave a spreading, translucent, orange-yellow slimy growth on agar, liquefied gelatin, and gave an alkaline reaction with litmus milk. Van Suchtelen demonstrated the presence of a slime in soil solution and suggested that it might affect the living organisms in the soil. None of the predominant organisms isolated during the period of desiccation corresponded with the four kinds which predominated in the original soil solution used for inoculation.—E. H. T.

Humus of arid soils; Nitrogen content of ——. F. J. Alway and E. S. Bishop. J. Agric. Res., 1916, **5**, 909—916.

The method of determining the nitrogen in humus proposed by Hilgard and Jaffa consisted in removing the lime and magnesia in two equal portions of the soil samples with 0·5—1·0 % hydrochloric acid, and washing with distilled water: the humus in one portion was extracted with 6—7 % ammonia solution, and in the other with 4 % potash or 3 % caustic soda solution: the ammonia extract was then used for the humus determination, and the other for that of the humus nitrogen by the Kjeldahl method. Hilgard suggested subsequently that an ammonia extract should also be used for the nitrogen estimation, after it had been boiled with magnesia. This method was tested and found to be unsatisfactory; better results were obtained by extracting 10 grms. of air-dried soil with 500 c.c. of a 4 % potash solution, the bottle being shaken every hour for nine (working) days. Working on five soil samples, the figures obtained were in fair agreement with those found by the Hilgard-Jaffa method. It was therefore used to determine the humic nitrogen in sixteen samples of arid Californian soils. Of these, five contained as much as 10 % of nitrogen in the humus; six virgin soils averaged 8·5 %, varying from 4·0—12·0 %, and 10 cultivated soils averaged 8·1 % (5·6—11·8 %). In agreement with the results of Hilgard no humid or semi-arid soil was found to contain humus with such a high content of nitrogen.—E. H. T.

Grass; Cropping of young —— after heavy dressings of fertilisers. H. Neubauer, G. Hillkowitz, and P. Schneider. Fühling's Landw.-Zeit., 1915, **64**, 534. Z. angew. Chem., 1916, **29**, Ref., 98—99.

When grass land is dressed with nitrogenous fertilisers, *e.g.*, ammonium sulphate, the greater part of the effect is produced in about 4 weeks in warm weather, and it is recommended that after this period, the grass should be cut, and another dressing of fertiliser applied to the soil. In this way five crops of grass would be obtained in the course of the season, and not only would the total yield be considerably increased, but the nutritive value of the hay would be greater, as loss of nutritive substances occurs owing to lignification of the plant tissues as the grass becomes older. Against these advantages must be set the increased cost of labour and for fertilisers and the expenses attached to the installation of apparatus for artificially drying the young grass.—A. S.

Ammonia; Action of —— on superphosphates, and the use of the resulting mixtures. Gerlach. Z. angew. Chem., 1916, **29**, 13—14, 18—20.

Moist or dry superphosphate readily absorbs gaseous ammonia with evolution of heat, forming ammonium sulphate and tricalcium phosphate. When the gas was passed into the superphosphate contained in a slowly revolving drum for 20 mins. at 17° C., 91 % of it was recovered in the product; with a larger drum and a bigger charge at 22° C., all the ammonia used was recovered after 50 minutes' working; at 21° C. and under 30 mm. pressure the recovery was 83 % in 20 mins. The action proceeded equally well when 25—30 kilos. of phosphate was treated. In every case the heat evolved sufficed to expel the water present, and the product was obtained as a dry mass which could be easily powdered. A typical analysis gave: ammonium sulphate 33·71 %, dicalcium phosphate (+$2H_2O$) 2·74 %, tricalcium phosphate 30·10 %, gypsum 22·55 %, iron and aluminium phosphates 2·96 %, insoluble matter 4·26 %, and hygroscopic water 3·42 %. Although the phosphoric acid is rendered insoluble by this treatment, a large proportion of it dissolves in citric acid and in water saturated with carbon dioxide. There is no appreciable loss of nitrogen as ammonia during storage. The efficacy of the product as a nitrogenous and phosphatic fertiliser was tested during three successive years on oats, mustard, and barley, grown in different soils in pots and in walled plots. The experiments proved that its efficiency was equal to that of ammonium superphosphates, which are mixtures of treated and dried calcium phosphates with ammonium sulphate. These require more sulphuric acid for their production than the product described above, and the costs of evaporating the ammonium sulphate solution and of drying the crude superphosphate are obviated in the case of the latter.—E. H. T.

Nitrogen and nitrogenous fertilisers: Sources of ——. J. Vogel. Leipziger Oekonom. Soc., Nov. 27, 1915. Chem.-Zeit., 1916, **40**, 12—13.

In the year before the war, Germany consumed 217,000 metric tons of inorganic nitrogen, of which 100,000 tons was imported as Chili saltpetre and 5000 tons as calcium nitrate. 95,000 tons was produced at home as ammonium sulphate, and 17,000 tons (one-third imported) as calcium cyanamide was also used. In the first year of the war, only 12½ % of the total quantity was obtained or produced. With the aid of the Government grant of 7½ million pounds, large quantities of calcium cyanamide and ammonium salts were produced from atmospheric nitrogen, but the greater part of the supply was used for military purposes and agriculture had to go short. The solution of the difficulty lies in the increased and more scientific use of organic nitrogenous manures; inorganic artificial fertilisers should be used principally for winter crops, animal manures, and in particular the liquid portion thereof, for summer crops. Analyses have shown that the nitrogen content of the liquid collected in the catchment pits near the cattle sheds averaged 1·25 %, but after it had been conveyed through a wide delivery pipe to the main reservoir only 0·67 % remained, and in certain cases the loss of nitrogen amounted to 80 % or more. The cause of this loss was traced to aeration during transference; by avoiding contact with air, particularly in discharging, the nitrogen content was raised to 1·20 %.—E. H. T.

Patents.

Potash salts and other salts; Method of denaturing ——. M. Issleib, Magdeburg. Ger. Pat. 289,944, Feb. 2, 1915.

Potash salts or other salts are rendered unsuitable for the preparation of other chemical compounds by addition of about 5 % each of sugar and starch flour.—A. S.

Decomposition of double silicates, felspar, etc. Ger. Pat. 289,909. *See* VII.

Means for preventing rot and mould and for fighting parasitic plant diseases, apart from wood preservation. Ger. Pat. 289,220. *See* XIXb.

XVII.—SUGARS ; STARCHES ; GUMS.

Starch in raw potatoes : Determination of ——. E. Ewers. Z. öffentl. Chem., 1915, **21**, 232—233. Z. angew. Chem., 1916, **29**, Ref., 61.

Twenty grms. of the uniformly ground potato is heated for 15 to 17 mins. on the water-bath with 50 c.c. of dilute hydrochloric acid (20 c.c. of sp.gr. 1·124 per litre) in a flask containing 100 c.c. at 20° C. The mixture is then diluted to about 90 c.c. with cold water, cooled to 20° C., treated with 1·25 c.c. of sodium molybdate solution (prepared by fusing 30 grms. of MoO_3 with 25 grms. of sodium carbonate, dissolving the melt in water and diluting to 250 c.c.), made up to 100 c.c. at 20° C., filtered, and polarised in a 200 mm. tube. The percentage of starch is obtained by multiplying the saccharimeter reading (in Ventzke divisions) by 0·44007. —C. A. M.

Tyrosinase from beets and potatoes. Gonnermann. *See* XVIII.

Patents.

Sugar and sugar preparations [pilé sugar] ; Preparation of dry or crystallised ——. E. Shaw and G. S. Baker, London. Eng. Pat. 2851, Feb. 22, 1915.

Juice or syrup is passed through a steam-heated spiral passage as described in Eng. Pat. 27,185 of 1913 (this J., 1915, 43), whereby it is heated to about 270° F. (132° C.). It then enters a horizontal stirring apparatus, where it is crystallised by the addition of 10—40 % of syrup at about 120° F. (49° C.), a finely and evenly grained dry mass being thus produced. By varying the temperature and amount of the cooling syrup, the size of the crystals may be regulated.—J. P. O.

Sugar juices and cane and beet sugar containing solutions : Method of rendering cane and beet —— *more suitable for filtration.* A. Wijnberg, Amsterdam. Eng. Pat. 3854, Mar. 10, 1915.

Juice or syrup, preferably at boiling point, is treated with 0·5 to 1·0 % of decolorising carbon on the weight of sugar present. Colloidal pectins and gums are adsorbed, and a liquor which previously could not be filtered owing to the formation of a slimy layer on the cloths, may thus be made freely to pass through a filter-press, giving a hard cake capable of being readily washed with water or steam. The spent carbon may be revivified by boiling successively with hydrochloric acid and sodium hydroxide and sodium carbonate, and washing first with water containing a trace of acid, and finally with hot water ; or when necessary it may be re-burnt in absence of air. Decolorising carbon is defined as technically pure amorphous carbon containing 90 % or more of pure carbon. —J. P. O.

Sugar juices : Continuous saturation of ——. R. Kuhl, Bedburg. Ger. Pat. 289,644, Mar. 29, 1914.

Juice is forced alternately upwards and downwards through a series of long vertical pipes. Sulphur dioxide is admitted at the lower end of each of those pipes up which the liquid rises, its even distribution being accomplished by means of a fine grating. The degree of saturation of the liquid may be regulated by cutting out of circuit one or more of the series, by means of a valved by-pass pipe.—J. P. O.

Apparatus for sulphuration [sulphitation] of liquids. U.S. Pat. 1,172,133. *See* VII.

Preparations of sugars and formaldehyde. Ger. Pat. 289,312. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

Breweries : Germicidal power of ultraviolet rays, and the sterilisation of water and disinfection of transport casks in ——. E. Moufang. Allgem. Zeits. Bierbrau. u. Malzfabr., 1915, **43**, 151—155. Z. angew. Chem., 1915, **28**, Ref., 636.

Casks of 7—100 litres capacity, coated with pitch, were exposed for various periods to rays from special mercury lamps of 230 and 350 volts ; 200 c.c. of sterile wort was then introduced into each and the time elapsing before the wort showed signs of the development of organisms was noted. In unexposed casks the wort remained apparently sound for 36 hours ; in casks exposed for 15—20 secs. to the 350-volt lamp this period was increased to 80 hours, and an exposure of 60 secs. increased it still further to 96 hours. More intense radiation or longer exposure led to undesirable heating of the casks and vaporisation of constituents of the pitch, so the experiments were not extended. In iron or enamelled casks, or in uncoated wooden ones this difficulty would not arise, and far more complete disinfection might be attained. The author considers that the water used for washing yeast and rinsing casks and bottles might be conveniently sterilised by ultra-violet rays. —J. H. L.

Methyl alcohol in presence of ethyl alcohol : Determination of ——. G. Reif. Arbeit. Kais. Gesundheitsamte, 1915, **50**, 50—56. Z. angew. Chem., 1916, **29**, Ref., 82.

The method proposed depends on the fact that methyl iodide reacts in the cold with methyl sulphide to form trimethylsulphine iodide, whilst ethyl iodide does not form a similar compound. The trimethylsulphine iodide behaves as a salt of hydriodic acid and may be estimated volumetrically by titration with silver nitrate solution. To determine methyl alcohol in brandy, the alcohol is first separated and converted into ethyl iodide as described by Wirthle (this J., 1912, 790), the ethyl alcohol being at the same time converted into ethyl iodide ; the mixture of the two iodides is then treated with methyl sulphide.—W. P. S.

Liqueurs ; Determination of the total quantity of essential oils (essences) in ——. C. F. Muttelet. Ann. Chim. Analyt., 1916, **21**, 50—55.

According to a recent French law the total quantity of essential oils in liqueurs must not exceed 0·5 grm. per litre. To determine the total quantity of essential oils in these beverages, 200 c.c. of the sample is mixed with 75 c.c. of water and distilled, 200 c.c. of distillate being collected ; 50 grms. of sodium chloride is dissolved in the distillate, the solution extracted three times with petroleum spirit of b.pt. about 40° C. (10 c.c., 5 c.c., and 5 c.c.), the petroleum spirit solution dried with anhydrous sodium sulphate, transferred to a weighed flask, and the solvent evaporated by passing a slow current of air through the flask while the latter is maintained at about 30° C. The evaporation is continued until the weight of the contents of the flask does not diminish by more than 2 mgrms. after continuing the air current for 5 mins. Experiments with aniseed essence (a mixture of the essential oils of aniseed, fennel, sassafras, and coriander) and Chartreuse essence (a mixture of the essential oils, etc., of mint, angelica, hyssop, cinnamon, nutmeg, and cloves) showed that the loss of essential oil, as estimated by the method, amounted to less than 10 % of the quantity present.—W. P. S.

Tyrosinase from beets and potatoes. M. Gonnermann. Chem.-Zeit., 1916, **40**, 127—128.

Samples of tyrosinase from beets and potatoes, prepared in 1901 and since kept in glycerin solutions, still behaved as oxidases, producing a bluish-red coloration in solutions containing ferrous sulphate and catechol. Tested in the manner described by Kobert (this J., 1911, 937) the sample from potatoes, even in very dilute solutions, gave rise to agglutination of blood corpuscles; the other, on the contrary, produced hæmolysis, and further tests demonstrated the presence of a saponin. The saponin must have been very intimately combined with the tyrosinase, for the sample was prepared by precipitating beet juice with alcohol, in which saponins are soluble. The author concludes that whilst the tyrosinase of potatoes appears to be a single substance and produces agglutination of blood, that of beets is combined with a hæmolytic saponin.—J. H. L.

Preparations of diastase and their uses. Pollak. *See* VI.

Lævulinic acid and caoutchouc. Noyer. *See* XIV.

Limits of sensitiveness of colour reactions of proteins and peptonising enzymes. Rakuzin and others. *See* XIXa.

Patents.

Acetone and alcohol; Sterilisation of mashes in the production of —— [by means of Bac. macerans]. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 287,659, Feb. 15, 1914. (Cp. this J., 1915, 729, 976, 1067.)

The mashes are heated with small quantities of acids to 100° C. once or several times.—J. H. L.

Aromatic palm spirit as a by-product in the manufacture of edible palm oil; Process of obtaining ——. L. Bernegau, Berlin-Halensee. Ger. Pat. 288,765, Mar. 20, 1914. Addition to Ger. Pat. 288,209 (this J., 1916, 186).

The fresh palm fruit is extracted, with or without the aid of heat, with alcohol in a vacuum distillation apparatus, and the distillate mixed with that subsequently obtained by distilling the residue with steam. Finally the pulp is separated from the seeds, and treated as described in the original patent. The palm spirit thus obtained may be used in the preparation of liqueurs.—C. A. M.

Spirit rectifying and distillation apparatus; Dephlegmating and condensing arrangement for ——. R. Hübner, Züllichau. Ger. Pat. 289,039, Aug. 6, 1913.

The condenser which receives the vapours leaving the dephlegmator is fixed in a cylindrical space between two parallel vertical branches of the dephlegmator.—C. A. M.

Water for brewing and malting purposes; Process for improving ——. E. Jalowetz, E. Richter, and A. Schückher, Vienna. U.S. Pats. 1,172,528 and 1,172,998, Feb. 22, 1916. Dates of appl., Jan. 18 and Nov. 7, 1912.

See Fr. Pat. 444,962 and Eng. Pat. 25,582 of 1912; this J., 1912, 1196; 1913, 838.

Preparation of substances resembling horn and ebonite from yeast and formaldehyde. Ger. Pat. 289,597. *See* XV.

XIXa.—FOODS.

Proteins and peptonising enzymes; Limits of sensitiveness of the colour reactions of ——. M. A. Rakuzin, E. M. Braudo, and G. F. Pekarskaja. J. Russ. Phys.-Chem. Soc., 1915, **47**, 2051—2056.

A number of proteins of different types and also various proteolytic enzymes have been examined to ascertain which of the following colour reactions each gives and with what sensitiveness: the biuret, Millon's, Liebermann's, Adamkiewicz's, the xanthoprotein, Molisch's, Pettenkofer's, and Ostromyslenski's (dark-red colour obtained on adding powdered picramic acid to a neutral solution of the protein). The compounds examined were egg-albumin, peptone from egg-albumin, glutin (α-gelatin), β-gelatin, chondrin, elastin, casein, nucleic acid, nuclein, agar-agar, gluten, pepsin, trypsin, diastase, and pancreatin. Only egg-albumin, its peptone and its adsorption products give all the above reactions. Casein from cows' milk (nucleo-albumin) and nutrose (sodium caseinate) give all except Liebermann's reaction. Glutin gives only the biuret, Molisch's, and Ostromyslenski's reactions, and chondrin gives these and also the xanthoprotein reaction. Nucleic acid gives only Molisch's and Ostromyslenski's reactions. Agar-agar gives only Molisch's and Pettenkofer's reactions. Molisch's reaction is given by all the above proteins and enzymes. Elastin gives only the biuret and Molisch's reactions It is noteworthy that the sclero-proteins—chrondrin, glutin, and elastin—do not give Millon's reaction, although, according to Abderhalden, elastin yields 0·34% of tyrosine. The biuret reaction is given by all the proteins except nucleic acid and agar-agar, and Liebermann's and Adamkiewicz's reactions are given only by egg-albumin and its peptone. Pepsin, which approximates to the proteins in elementary composition, gives only Molisch's reaction. Trypsin, on the other hand, gives the biuret, xanthoprotein, and Molisch's reactions; diastase and pancreatin give the biuret and Molisch's reactions. None of the four enzymes gives Pettenkofer's reaction, and neither pepsin nor trypsin gives Ostromyslenski's reaction. The most sensitive of the protein reactions is that of Milion, which detects 1 part of protein, per 13,560. Any one reagent is differently sensitive towards different proteins, this depending on the varying proportions of the amino-acids present. Of the reactions for tryptophane, that of Adamkiewicz is more sensitive than that of Liebermann.—T. H. P.

Preparations of diastase and their uses. Pollak. *See* VI.

"Poli oil," a new adulterant of ghee (Indian clarified butter fat. Barnes and Singh. *See* XII.

Tyrosinase from beets and potatoes. Gonnermann. *See* XVIII.

Patents.

Meat or fish; Treatment of fresh —— for preserving same in the open air. Monvoisin, Barrat, et Robin, Montreuil-sous-Bois, France. Eng. Pat. 22,669, Nov. 17, 1914. Under Int. Conv., Nov. 17, 1913.

Immediately after the animal is slaughtered, the surface of the meat is treated with a volatile disinfectant, as sulphurous acid. The meat is then placed in a vacuum at a low temperature to cool it rapidly and allow the sulphurous acid to evaporate, after which it is rapidly desiccated in a current of dry, hot, sterilised air. The meat slowly becomes warm again under the influence of the air current and regains its normal appearance, but is so dry as not to putrefy subsequently and can be kept in the open air in the usual manner. Instead of sulphurous acid, a physical agent, as ultra-violet rays, may be used. The process is applicable to fish.—J. H. J.

Iron; Process of introducing —— into foods, drugs, and beverages. H. L. Marsh, Philadelphia, Pa. U.S. Pat. 1,171,739, Feb. 15, 1916. Date of appl., Jan 27, 1915.

A solution of ferric saccharate, containing no free alkali, is heated under pressure to about 300° F. (150° C.), when the iron is rendered soluble, and the solution can be added to beverages, foods, and drugs.—J. H. J.

Milk: Preparation of sugar-free ——. W. Müller and G. Pathemann, Neuenahr. Ger. Pat. 289,093, Jan. 7, 1915.

Homogenised milk is submitted to dialysis in thin layers at 60° C., when removal of the sugar takes place so rapidly (in about 4 hrs.) that decomposition does not occur and the addition of a preservative is unnecessary. The separation of the cream during dialysis is also reduced to a minimum.—J. H. J.

Cereal product: Process of desiccating a fermented ——. M. Franzie, The Hague. U.S. Pat. 1,172,270, Feb. 22, 1916. Date of appl., Apr. 8, 1915.

See Eng. Pat. 2607 of 1915; this J., 1916, 324.

XIXb.—WATER PURIFICATION; SANITATION.

Magnesia derived from the waste liquor of the potash industry: Detection of —— *[in river water].* O. Pfeiffer. Z. angew. Chem., 1916, **29**, 7—11.

The methods of Precht and Noll for the estimation of magnesium in river water which receives the waste liquor from potash works are criticised. Precht estimates magnesium chloride only, by evaporating a sample of the water to dryness and extracting the magnesium chloride with alcohol. Noll concentrates one litre of the water to 250 c.c., filters off the alkaline-earth carbonates, and determines magnesia in the filtrate. His assumption that the ratio of magnesium chloride to sulphate is the same in the filtrate as in the original water is incorrect, as the equilibrium is disturbed by concentration, particularly that of the reversible reaction:—

$$MgCl_2 + Ca(HCO_3)_2 \rightleftarrows CaCl_2 + Mg(HCO_3)_2.$$

In Precht's process, on the other hand, the magnesium chloride is regenerated when the water is evaporated completely to dryness. Any calcium chloride in the water is also estimated as magnesium chloride, but this is only a slight objection to the process, since calcium chloride is only likely to be introduced into the rivers under consideration from a few ammonia-soda factories in the Elbe district, and, further, calcium chloride in water is similar in its principal effects to magnesium chloride. Noll's results are considerably influenced by the material of the vessel in which the evaporation is carried out. Experiments with Elbe water from Tochheim, to which known amounts of magnesium chloride and sulphate were added, gave much more accurate results by Precht's process (for magnesium chloride) than by Noll's (for total magnesium). With waters rich in sulphate, *e.g.*, in the Weser district, Precht's method naturally shows much lower results than Noll's, but good results are obtained by extracting magnesium sulphate with a little hot (boiled) water from the residue left after the extraction of magnesium chloride by alcohol. The author concludes from his own experiments that Noll's method gives neither the actual amount nor the correct proportion of magnesium chloride and sulphate in river water, and that even if the correct figure for the total magnesia were obtained, it would be impossible to calculate how much waste carnallite liquor had been introduced, since the ratio of magnesium sulphate to magnesium chloride in river water is usually much more than in carnallite (1 : 10). This is especially true in the Weser district. Precht's method, however, estimates magnesium chloride (including calcium chloride from ammonia-soda factories) with sufficient accuracy to calculate the quantity of carnallite added, after subtracting the salt derived from the ammonia soda factories, which is relatively small in quantity and practically constant. The content of magnesium chloride and sulphate and calcium chloride fixes a limit to the quantity of waste liquor that can have been added to the water. Neither Noll's nor Precht's process gives any information about the equilibrium of the salts in the original water, but this is of no practical importance, since the effect of the salts depends only on the amounts introduced and not on the way they ionise or mutually react in solution.

—F. Sp.

Patents.

Sewage: Apparatus for introducing gases into intimate contact with liquid ——. G. W. Mottram, Deepcar, Yorks. Eng. Pat. 2421, Feb. 16, 1915.

In a vertical cylindrical sewage tank, the apparatus takes the form of a vertical rotating shaft carrying a pair of arms at its lower end. The shaft is hollow and compressed air is supplied through it to the arms, which are made of perforated pipes or of plain metal pipes carrying earthenware pipes. These earthenware pipes are arranged concentrically round the metal pipes and spaced from them by distance pieces to provide an air passage. The earthenware pipe is porous preferably along one section of its length only. In a rectangular tank, the air diffusing pipes are supported at each end on wheels running along rails on the bottom of the tank, or are suspended from arms supported on wheels on rails on the top of the walls of the tank. The air supply is brought by flexible piping to one of the supporting arms which takes it to the air diffusing pipe.—J. H. J.

Sewage: Apparatus for the disposal of ——. W. Beattie, London. Eng. Pat. 7995, May 29, 1915.

The apparatus consists of a brick chamber containing a number of vertical, transverse, wire gratings through which the sewage is passed. At the inlet portion of the chamber is a baffle plate to prevent fat being carried forward on to the gratings. The chamber is closed by a cover. The gratings provide a nidus for the bacteria which break down the solids in the sewage.—J. H. J.

Sewage and the like; Apparatus for the destructive distillation of ——. J. Menzies, H. W. Dennis, and H. M. Moll, London. Eng. Pat. 8666, June 11, 1915

The apparatus consists of a rectangular enclosed framework in which is a series of shelves placed above each other in zig-zag fashion. The shelves are hollow and are heated by gas. A series of scrapers, every fourth and fifth of which are without teeth, is mounted on an endless band and travels over the shelves. The material is fed in through a hopper discontinuously, just after a scraper has passed across the point of entry, and is made to travel over all the shelves by the scrapers from the top to the bottom of the apparatus. The gases given off are withdrawn through a flue by a centrifugal fan, and part of the ammonia liquor produced is returned to the apparatus in a fine spray to allay dust.—J. H. J.

Sewage: Purification of ——. G. W. and J. F. Naylor, Denby Dale, Yorks. Eng. Pat. 9989, July 9, 1915.

A tank is used with a porous floor under which pipes are laid for diffusing air through the floor to aerate the sewage. The floor of the tank is divided into sections, either zones, quadrants, parallel strips, or squares. The pipes under the floor are placed parallel or crossing each other, and have alternate perforated and blank lengths, so as to supply air to alternate sections of the floor. The air is supplied under a low pressure through valves controlled by a clockwork arrangement which is worked so as to supply air to the various sections alternately or in any desired combination.—J. H. J.

Sewage-purifying material; Preparation of a ——. J. von Kruszewski, Berlin. Ger. Pat. 288,291, May 20, 1914.

Coked fæcal sludge is finely powdered and mixed with a very small quantity of a soluble or sparingly soluble copper compound. A suitable mixture contains, for example, 1 grm. Cu per kilo., and 1 kilo. is sufficient for 1 cb.m. of sewage. The product has pronounced germicidal properties.
—A. S.

Water; Removing gases absorbed in ——. C. Hülsmeyer, Düsseldorf-Grafenberg. Ger. Pat. 288,158, Nov. 12, 1913.

Dissolved gases are separated from water by filtering it through a layer of turnings or shavings of suitable material, or through a bed of fibrous material, such as hemp or horsehair. The water enters a receptacle at the bottom, flows upwards through a funnel-shaped distributing plate having openings increasing in size from the centre towards the periphery, and then passes through the filtering layer, and is drawn off through an outlet pipe which passes through the cover of the vessel and extends downwards to below the level of the water. Below the open end of the outlet pipe is a funnel-shaped plate which prevents the liberated gases from entering the pipe. The gases collect in the upper part of the vessel and are discharged at intervals through a valve controlled automatically by a float.—A. S.

Water; Rapid removal of dissolved oxygen from ——. Permutit A.-G., Berlin. Ger. Pat. 288,488, Feb. 8, 1914.

Water is freed from dissolved oxygen by treating it with sodium sulphite and then filtering it through porous organic or inorganic materials coated or impregnated with an oxide, especially cobalt oxide, capable of exerting catalytic action.—A. S.

Water; Preparation of a filter material for drinking ——. W. Schuler, Isny. Ger. Pat. 289,061, Feb. 4, 1914.

Small coke, with or without the addition of powdered vegetable or animal charcoal, is mixed with powdered magnesium silicate, as talc or asbestos, and with tar or a mixture of tar and petroleum, or petroleum or a similar hydrocarbon alone. The mixture is suitably shaped and baked out of contact with air. The material produced has great permeability and durability and conducts electricity.—J. H. J.

Water; Process for rendering —— which has been treated with sodium hypochlorite suitable for drinking. K. Jörss, Rostock. Ger. Pat. 289,495, Aug. 20, 1913.

The water is treated with metallic iron in presence of carbon dioxide, when the hypochlorite is decomposed and the iron oxidised to ferric oxide or to bicarbonate. The water is then filtered through a natural double silicate containing calcium oxide as the interchangeable base.—J. H. J.

Rot and mould; Means for preventing ——, and for fighting parasitic plant diseases, apart from wood preservation. F. Pfenning, Berlin-Wilmersdorf. Ger. Pat. 289,220, Oct. 30, 1913.

The compounds formed by the introduction of alkyl and organic acid radicles into mono- and dinitrophenols possess antiseptic properties at least equal to those of the original compounds and are non-explosive. They have also the advantage of possessing a low melting point, which makes them easy of application for the purpose in view. The compounds are soluble in oils and the like, and may be applied as such solutions or as emulsions with soap.—T. St.

Waste products of animal carcases, slaughter-house refuse, and the like; Method of treating ——. A. Sommermeyer, Berlin. Ger. Pat. 289,525, Feb. 26, 1914.

The pulpy mass containing water, solid matter, and fat is run into a vessel divided into a lower compartment, where the material settles into layers according to the different densities of the substances present, and an upper compartment heated by steam coils. The two compartments communicate by a tube which passes through the layer of fat in the lower compartment, and inside this tube is a smaller tube which opens through the side of the first into the aqueous layer, the upper portion extending through the steam coils. The steam escaping from this inner tube is passed through the heating coils of a second similar receiver into which the thickened material from the first can be transferred by pressure. As the evaporation proceeds, the temperature is reduced, whereby the danger of scorching the material is avoided, and the value of the glue-substance preserved.—T. St.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Aloes; New colour reaction for ——. C. E. Stacy. Analyst, 1916, 41, 75.

A pink coloration is obtained when potassium ferricyanide solution is added to a cold aqueous extract of Barbadoes aloes; the coloration does not develop if either the reagent or test solution is in excess. The reaction may be obtained with a solution containing 1 part of aloes per 10,000 parts. In most cases, the coloration appears after 5 to 15 mins., but its appearance may be rendered more rapid by heating the mixture just to boiling. In more concentrated solutions the colour is deep crimson or blood-red. The substance giving the reaction is only slightly soluble in petroleum spirit, benzene, and chloroform, and is insoluble in ether and ethyl acetate. Socotrine and Cape aloes, and commercial aloin, give a green coloration with the test, whilst aqueous extracts of *Cascara sagrada* or rhubarb do not give any reaction. The coloration yielded by Barbadoes aloes is destroyed by acids and by excess of alkalis; small quantities of alkalis intensify the reaction, at the same time modifying it by introducing a brown tint.—W. P. S.

Cephalin from egg yolk, kidney and liver; Composition of ——. P. A. Levene and C. J. West. J. Biol. Chem., 1916, 24, 111—116.

Preparations of cephalin extracted from egg yolk and from the brain or liver, and also from the kidney, in which it is now shown to occur, were found to possess identical properties and composition, the most convenient source of cephalin being the brain.—T. C.

Carvone. A. Müller. J. prakt. Chem., 1916, 93, 10—24.

When carvone is heated with excess of hydrochloric acid of sp.gr. 1·19 in a sealed tube for 3 hours at 120°—125° C., isomerisation occurs and a

yield of 87% of carvacrol is obtained. A yield of 98—99% of carvacrol can be obtained by saturating carvone with hydrogen chloride, heating the resulting addition product (8-chloro-Δ^6-terpen-2-one) at 210°—220° C. under a reflux condenser whilst passing air through it, and then distilling *in vacuo*; the addition of zinc chloride and glacial acetic acid prescribed by Reychler (this J., 1892, 771) is unnecessary. Carvenone can be obtained in a similar manner from dihydrocarvone by heating it with hydrochloric acid in a sealed tube at 120°—130° C. (yield 75—81%), or by saturating it with hydrogen chloride and heating the resulting 8-chloroterpan-2-one in a current of air under a reflux condenser (yield 10—15% after 1—2 hours). A suggested new method of synthesising terpenes, based on the condensation of phenols with aldehydes, is outlined. For example, *o*-cresol is condensed with acetone to form *bis-p*-methyl-*m*-hydroxybenzene-dimethylmethane, from which 1-methyl-4-isopropyl-2-hydroxybenzene and 1-methyl-2.4-dihydroxybenzene are obtained by hydrolysis, the former being subsequently converted into carvomenthol by means of Sabatier and Senderens' process of catalytic hydrogenation.
—A. S.

β-Phellandrene. L. Francesconi and E. Sernagiotto. Gaz. Chim. Ital., 1916, **46**, I., 119—127.

β-Phellandrene from the essential of *Bupleurum fruticosum* (see this J., 1912, 202) differs from that obtained from other sources by its higher optical activity; the rotatory power of the fractions consisting mainly of β-phellandrene ranges from +65° to +19° with rise of boiling point. Experiments confined mainly to the action of nitrosyl chloride, nitrous acid, and potassium permanganate respectively on the fractions containing the terpene, made with a view to explain this difference, led to the conclusion that the β-phellandrene of *B. fruticosum* oil has a rotatory power of at least 65°, and that the fractions of lower rotatory power, and the β-phellandrene isolated from other sources, are mixtures of optical enantiomorphs, with the dextro-rotatory form predominating.—A. S.

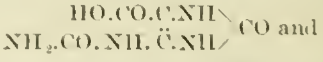
Iododihydroxypropane (Alival), a new iodine preparation. R. Lüders, J. Emmert, and O. Better. Deutsche med. Wochenschr., 1915, **41**, 648. Chem.-Zeit., 1916, **40**, Rep., 5.

Of a large number of iodine preparations examined, the iodo-derivatives of glycols proved most satisfactory, especially the α-iododihydroxypropane introduced by the Höchster Farbwerke under the name of "Alival." The new compound forms white lustrous crystals of m.pt. 48°—49° C., easily soluble in water, alcohol, and ethyl acetate, and readily resorbed. It is different from the compound described in the literature under the same name. It is stated by Better, as a result of clinical tests, to be superior to all iodine preparations hitherto known for the treatment of tertiary syphilis.—A. S.

Uric acid; Oxidation of —— in alkaline solution. R. Behrend and R. Zieger. Annalen, 1915, **410**, 337—373.

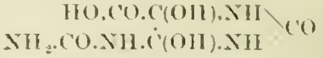
The suggestion of Behrend (Annalen, 1904, **333**, 141) that the oxidation of uric acid to allantoin passes through the intermediate stages of uric acid glycol and glycolurilhydroxycarboxylic acid, is found to be untenable, since uric acid glycol on treatment with alkali and subsequent acidification gives no allantoin, and when evaporated with excess of concentrated caustic potash, gives no potassium uroxanate. On the contrary, when treated with weak alkali it is rapidly decomposed with evolution of ammonia, and the product shows no murexide reaction, nor could any crystalline substance be obtained from it. The alloxan ring has therefore been broken. It is tentatively suggested that the intermediate stages between uric acid and glycolurilhydroxycarboxylic acid may be

(1)



$$\left.\begin{array}{r}\mathrm{HO.CO.C.NH}\\ \mathrm{NH_2.CO.NH.\ddot{C}.NH}\end{array}\right\rangle\mathrm{CO}\ \text{and}$$

(2)



$$\left.\begin{array}{r}\mathrm{HO.CO.C(OH).NH}\\ \mathrm{NH_2.CO.NH.\dot{C}(OH).NH}\end{array}\right\rangle\mathrm{CO}$$

Attempts to prepare compound (2) by heating alloxanic acid or its methyl ester with urea and acetic anhydride were unsuccessful and produced allantoin. But since solid acid potassium urate suspended in a little water and oxidised by potassium permanganate equivalent to one atom of oxygen gives only very small quantities of allantoin, while if the same salt is dissolved in sufficient water and oxidised in the same way, 58—74% of allantoin is produced, and oxidation of solid acid potassium urate with addition of two molecules of caustic potash in excess produces 72% of allantoin, there is some support for the view that uric acid is only oxidised to allantoin when it is first split up in the way suggested.—F. Sp.

Urea in urine; Determination of —— by the urease method. D. D. van Slyke and G. E. Cullen. J. Biol. Chem., 1916, **24**, 117—122.

The slower rate of aeration and consequent prolongation of the time required to drive the ammonia over into the standard acid, recommended by Fiske (this J., 1916, 140), in the determination of urea by the urease method, is unnecessary if the directions given in the original method (J. Biol. Chem., 1914, **19**, 211) are followed. When test-tubes instead of bottles are used to hold the standard acid, thus giving a greater depth of absorbing liquid, every trace of ammonia is rapidly absorbed if a moderate current of air is used for the first minute, followed by as fast a current as is possible without spattering. A drop of caprylic alcohol is more effective than kerosene in preventing foaming. Although urease in aqueous extracts containing primary and secondary phosphate preserves most of its activity for several weeks when kept at 0° C., it may, from some unknown cause, rapidly lose its activity, so that it is safest to use a freshly-prepared solution of a standard preparation of dry urease. In blank experiments to determine the purity of the reagents, the chief source of the correction is usually the potassium carbonate employed.—T. C.

Hydrogenation of an acetylenic alcohol. J. S. Zalkind. J. Russ. Phys.-Chem. Soc., 1915, **47**, 2015—2050.

It has been shown previously that, in presence of colloidal palladium, acetylenic γ-glycols absorb two atoms of hydrogen per molecule rapidly, subsequent absorption of hydrogen to give the saturated compound then proceeding considerably more slowly. When δ-phenyl-β-methyl-Δ^γ-butin-β-ol, $HO.C(CH_3)_2.C:C.C_6H_5$, is hydrogenised in anhydrous alcoholic solution, in presence of colloidal platinum at the ordinary temperature, no "break" occurs in the rate of absorption when the amount absorbed corresponds with two atoms of hydrogen per molecule. The resultant product of the reaction, β-phenylethyldimethylcarbinol, $C_6H_5.CH_2.CH_2.C(CH_3)_2.OH$, is a viscous liquid, b.pt. 114° C. under 85 mm., sp.gr. 0·9778 at 0°/4° C.
—T. H. P.

Anhydrous alcohols; Preparation of ——. L. W. Winkler. Z. angew. Chem., 1916, **29**, 18.

Alcohol can be completely dehydrated by distilling it in presence of calcium filings, any ammonia formed by the action of water on the contained nitride being eliminated subsequently. The filing are sifted in a coarse sieve to free them from powdered nitride, and traces of oil and more nitride are removed by shaking vigorously with dry carbon tetrachloride in a glass-stoppered flask, transferring to a loosely stoppered funnel, washing with the same solvent, and then drying in carbon dioxide. The alcohol is distilled with the purified metal (20 grms. to the litre), and ammonia is removed from the distillate by dissolving alizarin in it (a few centigrms. to the litre), and then adding a solution of about 0·5 grm. of tartaric acid in 10 c.c. of the distilled alcohol until the reddish-blue colour has turned to a pure yellow. After the addition of a few more drops of the acid solution, the alcohol is re-distilled, care being taken to exclude atmospheric moisture.—E. H. T.

Alcoholic products; Netherlands Customs duties on ——. Board of Trade J., Mar. 23, 1916.

A Dutch Royal Decree of the 29th January, 1915, provides that, until the 31st December, 1917, inclusive, the Customs duties on alcoholic products established by the Royal Decrees of the 13th January, 1910, and the 23rd February, 1912,* are to be levied at the following rates:

Article.	Rate of Import Duty.	
	Former.	New.
	Fl. cts. *Per kilo.*	Fl. cts. *Per kilo.*
Chloral hydrate	2 00	2 20
Sulphuric ether	3 40	3 70
Acetic ether	1 90	2 05
Collodion	3 00	3 25
Chloroform, *spiritus nitri dulcis*, and all other similar products prepared from or with alcohol	2 35	2 60

A Decree of the Dutch Minister of Finance, dated the 19th October, 1915, states that, as alcohols other than *ethyl alcohol* (such as propyl alcohol, butyl alcohol, isobutyl alcohol and amyl alcohol [fusel oil]) are no longer regarded as alcohol for the purpose of the Spirit Law, preparations such as amyl acetate, amyl nitrate, amyl nitrite, butyl chloride, butyl xylol, cycloform, zaponlac, etc., can no longer be classed as "all other similar products prepared from or with alcohol." *Aldehyde* is to be classed with "all similar substances prepared from or with alcohol," and is therefore to pay duty at the rate shown above.

The classification of various articles has been determined by Ministerial Decrees of the 20th October and the 7th December, 1915, as follows:

Article.	Classified as—	Rate of Duty.
Butyl xylol	Oils not specially mentioned	Fl. cts. 100 kilos. 0 55
arnishes such as zapon lac, consisting of guncotton in acetone and amyl acetate, whether mixed or not with mineral and other oil	Paints ground in oil	5% *ad valorem*
myl acetate and valerianic amyl oxide	Perfumery	5% „

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* See this Journal, 1910, 297.

Alkaloids of calabar beans. V. Action of phenyl isocyanate. Phenylated homologues of eserine and geneserine. M. Polonovski. Bull. Soc. Chim., 1916, **19**, 46—59.

etermination of the total quantity of essential oils (essences) in liqueurs. Muttelet. *See* XVIII.

Patents.

p-Dimethylaminophenylarsinic acid; Derivatives of ——. W. P. Thompson, Liverpool. From Soc. Anon. les Etablissements Poulenc Frères, Paris. Eng. Pat. 22,521, Nov. 14, 1914.

Contrary to the usual experience with dimethylaniline derivatives containing an acid radicle in the *para*-position, dimethylaminophenylarsinic acid can be easily nitrated with a mixture of nitric acid or an alkali nitrate and sulphuric acid in water. According to the conditions of nitration it gives either the mono-nitro compound, $N(CH_3)_2 : NO_2 : AsO(OH)_2 = 1:2:4$, along with 4-N-methylnitrosaminobenzene-1-arsinic acid, or the former only, or a mixture of two dinitro derivatives. The mono-nitro compound by treatment with alkali and subsequent reduction, gives 3-3′-diamino-4-4′-dihydroxyarsenobenzene, which is thus obtained by a simpler and cheaper process than had previously been used.—B. V. S.

Para[hydr]oxy-meta-aminophenylarsinic acid; Preparation of ——. A. Mouneyrat, Paris. Eng. Pat. 3087, Feb. 25, 1915.

p-Hydroxy-*m*-aminophenylarsinic acid is obtained by the electrolytic reduction of *p*-hydroxy-*m*-nitrophenylarsinic acid. The electrolysis is effected by a current of 2 amps. at 3½—4 volts in a double cell, the outer cell containing the solution of the nitro-compound in a large excess of caustic soda over a layer of mercury as cathode, the inner cell containing a nickel anode immersed in caustic soda solution.—B. V. S.

p-[Hydr]oxyphenylarsinic acid: Manufacture of ——. F. W. Kay, Liverpool. Eng. Pat. 6322, Apr. 28, 1915.

The acid is obtained as a thick syrupy solution by the method described in Ger. Pat. 205,616, from phenol and arsenic acid, and is purified through the medium of the sodium salt, which is easily crystallisable.—B. V. S.

Pseudo-ionone to ionone; Conversion of ——. G. Schultz, Munich, and E. Göttelmann, Mainz. Ger. Pat. 288,688, July 21, 1914.

Pseudo-ionone is converted to ionone by heating it with acetic, propionic, butyric, or benzoic acid, phenols, or phenolcarboxylic acids for a long time at 150°—180° C. By repeated heating of the higher boiling fraction containing unchanged pseudo-ionone, a yield of 70% can be obtained. —F. Sp.

Perfumes and flavouring materials; Solvent and fixing medium for ——. E. Sachse und Co., Leipzig. Ger. Pat 288,952, Mar. 30, 1915.

Alkyl esters of acetylsalicylic acid are used as solvents and fixing mediums for perfumes and flavouring materials.—A. S.

Mercuric iodide preparation; Manufacture of a —— *for therapeutic use.* Kalle und Co. Ger. Pat. 288,965, Feb. 5, 1914.

A mercuric iodide preparation, rapid and painless in its therapeutic action, is obtained by mixing neutral aqueous solutions of casein salts and mercuric iodide in the required proportions, precipitating the insoluble adsorption compound by means of an organic acid, and converting the precipitate into a water-soluble colloid by treatment with alkali.—F. Sp.

Trichlorobutyl alcohol; Process for preparing esters of ——. R. Wolffenstein, Berlin. Ger. Pat. 289,001, Nov. 22, 1913.

Trichlorobutyl alcohol is converted into the acid malonic ester by the usual methods of esterification. This ester and its salts possess the same analgesic properties as the original alcohol, without its anæsthetic action.—J. F. B.

Esters of amino-acids (amino-acid esters of acetone-chloroform); Preparation of ——. R. Wolffenstein, Berlin. Ger. Pat. 289,126, Sept. 21, 1913.

Amino-acid esters of acetone-chloroform are made by the condensation of monohalogenacetic esters of trichlorotertiarybutyl alcohol with secondary aliphatic amines. They form with acids easily soluble salts which are strong soporifics, *e.g.*, the hydrochlorides of diethylglycine tertiarytrichlorobutyl ester and of dimethylglycine tertiarytrichlorobutyl ester.—F. Sp.

Ureas and thioureas of the aromatic series; Process for preparing mixed ——. Farbenfabr. vorm. F. Bayer und Co., Elberfeld. Ger. Pat. 289,163, June 13, 1914.

Two different amino-acids of the aromatic series, at least one of which belongs to the naphthalene series, having amino-acid residues substituted in their amino groups, are treated in molecular proportions with phosgene, thiophosgene, or a substitute for these. The mixed ureas and thioureas so obtained possess therapeutic properties analogous to those specified in Ger. Pat. 278,122 (this J., 1914, 825). They are mostly yellow to brown in colour and precipitated from aqueous solution by salt or alcohol. Those which contain free hydroxyl groups yield azo-dyestuffs when coupled with diazo-compounds.—J. F. B.

Ureas and thioureas of the naphthalene series: Manufacture of ——. Farbenfabr vorm F. Bayer und Co. Ger. Pats. (A) 289,270 and (B) 289,271, May 3, 1914, and (C) 289,272, May 13, 1914. Additions to Ger. Pat. 278,122 (see Fr. Pat. 471,933; this J., 1915, 347).

(A) The process described in the principal patent is altered by starting from naphthylaminesulphonic acids substituted in the amino group by aromatic aminoacidyl radicles other than those of the benzene series, or their derivatives, and these compounds, as well as those of the principal patent and the previous additions, may be treated with thiophosgene and its equivalents instead of with phosgene, so as to produce the corresponding thioureas. In the case of di- or polysulphonic acids, the acid or neutral sodium salts are used, of which the latter are more soluble. Their diazo compounds are generally yellow, and give orange to bluish-red dyes when coupled with R-salt. The new ureas and thioureas are white or brown powders, which can be separated from their aqueous solutions by common salt. They possess valuable therapeutic properties. (B) Instead of the aminoacylated 1.8-aminonaphtholsulphonic acids of the principal patent, other aminoacylated aminonaphtholsulphonic acids are used. The products derived from these are relatively harmless to the organism but strongly destructive to blood parasites. Examples of starting materials are *p*-aminobenzoyl-2-amino-8-naphthol-3.6-disulphonic acid, 2.5.7- or 2.8.6-aminonaphtholsulphonic acid, 2-amino-5-naphthol-1.7-disulphonic acid, 1-amino-5-naphthol-2.7-disulphonic acid, etc. (C) Aminonaphthalenesulphonic acids substituted in the amino group by the aminophenylurea radicle are used for the preparation of ureas and thioureas. The di- and polysulphonic acids form acid and neutral sodium salts of which the latter are usually the more soluble. The diazo derivatives of the acids when coupled with R-salt form yellowish-red to bluish-red dyes.—F. Sp.

Mercurial quinoline derivatives; Preparation of ——. Chem. Fab. von Heyden A.-G. Ger. Pat. 289,246, June 13, 1913.

Derivatives of quinoline which contain one or more acid salt-forming groups are heated, either in the form of their mercury salts or mixed with mercury compounds which form mercury salts, until the mercury-quinoline compound becomes soluble in alkali. Solid compounds containing mercury are thereby obtained, and by suitable choice of the substituent groups in the quinoline, the separation of mercury in the organism may be graded to suit the patient. *Examples*—Hydroxymercuri-β-8-hydroxyquinolinecarboxylic acid, hydroxymercuri-8-hydroxyquinoline-5-sulphonic acid, hydroxymercuri-2-phenylquinoline-4-carboxylic acid, hydroxymercuriquinoline-8-sulphonic acid, mercuri-8-hydroxyquinoline chloride.—F. Sp.

Silver glycocholate compound easily soluble in water; Preparation of a ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 289,182, July 7, 1914. Addition to Ger. Pat. 284,998 (this J., 1915, 1166).

A soluble silver glycocholate compound is produced by treating silver salts with glycocholates in the presence of ammonia. The acid radicle of the silver salt may be removed either by carrying out the reaction under such conditions that the by-product separates spontaneously, or the compound which it forms with the base of the glycocholate may be precipitated with the silver glycocholate, or left in solution with it, to be separated by extraction or precipitation reagents respectively, or it may be removed by the addition of a base, or converted by some suitable reagent into a salt adapted for separation.—F. Sp.

Trialkylhydantoins; Preparation of ——. A. Einhorn, Munich. Ger. Pat. 289,248, Apr. 10, 1914.

Diethylhydantoin, in spite of its close analogy to diethylbarbituric acid, is not a useful soporific, but the trialkylhydantoins (2.4-diketo-5.5.3-trialkyltetrahydroiminazoles) prepared by alkylating 2.4-diketo-5.5-dialkyltetrahydroiminazole, are therapeutically valuable on account of their hypnotic action.—F. Sp.

Alkaloids of the morphine series; Process for preparing —— and their salts containing no N-methyl groups. F. Hoffmann-La Roche und Co. Ger. Pat. 289,273, Dec. 9, 1914. Addition to Ger. Pat. 286,743 (this J., 1916, 197).

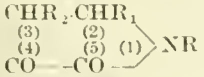
Cyanogen chloride or bromide is allowed to act on the compounds obtained by acetylating the free hydroxyl groups of alkaloids of the morphine series. *Example.*—A solution of 100 parts of diacetylmorphine in 100 parts of chloroform is added to 100 parts of chloroform containing 20 parts of cyanogen chloride, and the mixture is heated to 55°—60° C. for an hour. The remainder of the process is the same as that of the principal patent.—F. Sp.

N-Allylnorcodeine and N-allyldihydronorcodeine Preparation of ——. F. Hoffmann-La Roche und Co. Ger. Pat. 289,274, May 11, 1915.

O-Allylnorcodeine and its reduction product are inactive towards rabbits, even in large doses. The N-allyl derivatives, however, prepared by introducing the allyl group into norcodeine and dihydronorcodeine, are energetic antidotes to morphine, considerably surpassing atropine and other known antidotes in this respect.—F. Sp.

Diketopyrrolidine derivatives ; Preparation of ——. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 289,247, Aug. 23, 1914.

Derivatives of diketopyrrolidine which are valuable in the treatment of gout and rheumatism of the joints, are produced by reducing diketopyrrolidines of the general formula :



$$\begin{matrix} \underset{(3)}{CHR_2}\cdot\underset{(2)}{CHR_1} \\ \overset{(4)}{CO}-\overset{(5)}{CO} \end{matrix}\overset{(1)}{>}NR$$

(in which R and R_1 are any radicle, and R_2 an acid radicle) with zinc and acetic acid. Two or four hydrogen atoms are taken up. *Examples.*—The reduction products of 1.2-diphenyl-3-acetyl-4.5-diketopyrrolidine, 1-*o*-methoxyphenyl-2-phenyl-3-acetyl-1.5-diketopyrrolidine, 1-*o*-2-*p*-dimethoxydiphenyl-3-acetyldiketopyrrolidine, 1-*p*-2-*p*-dimethoxydiphenyl-3-acetyldiketopyrrolidine, 1.2-diphenyl-3-benzoyl-4.5-diketopyrrolidine, and 1.2-diphenyl-1.5-diketopyrrolidine-3-carboxylic acid ethyl ester.—F. Sp.

Sugars and formaldehyde ; Preparations of ——. Bauer u. Co., Berlin. Ger. Pat. 289,342, Dec. 13, 1913.

Solid, highly concentrated preparations of sugar and formaldehyde are obtained by treating a melted mixture of lactose and dextrose with gaseous formaldehyde under atmospheric pressure. *Example* :—60 parts of dextrose is melted, 90 parts of lactose is added, 36 parts of gaseous formaldehyde is led into the mixture, and 150 parts of lactose gradually added, with constant heating and stirring. The clear liquid melt is poured on to a layer of 150 parts of lactose, the whole is cooled, powdered, and made into tablets for medicinal use. —F. Sp.

Tobacco products ; Process for reducing the nicotine content of ——. W. Ebert, Charlottenburg. Ger. Pat. 288,582, Mar. 15, 1914.

Tobacco products such as cigars, smoking or chewing tobacco, or snuff, are exposed for a long time to a moist atmosphere and then heated rapidly to about 150° C., the vapours evolved being removed by a suction device. The nicotine content is thus reduced by 35—50%, and on repeating the treatment, by 65—80%, without adversely affecting the quality of the tobacco. —A. S.

Process for preparing non-deliquescent calcium chloride compounds [with milk sugar] soluble in water. Ger. Pat. 288,966. *See* VII.

Process for obtaining drying oils from high-boiling fractions of turpentine oil residues [from manufacture of artificial camphor, terpineol, etc.]. Ger. Pat. 289,655. *See* XIII.

Process of introducing iron into foods, drugs, and beverages. U.S. Pat. 1,171,739. *See* XIXa.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

iradiation ; Changes in —— *effected by a preliminary bath of bichromate.* Lüppo-Cramer. Phot. Ind., 1915, Heft 29. Z. angew. Chem., 1916, 29, Ref., 41.

F bromide- or other gas-light paper or ordinary dry plate is immersed for 20—30 seconds in a 0·5% solution of potassium bichromate, rinsed, and then developed as usual, the high lights will be toned down and a general effect produced similar to that obtained by treating the paper or plates with persulphate. The bichromate does not affect the developer, but the high lights in the latent image are affected more strongly than the half tones and shadows. This phenomenon is attributed to the disintegration of the silver bromide by light, with a resultant higher degree of dispersion and reactivity.—A. B. S.

XXII.—EXPLOSIVES ; MATCHES.

Rapid determination of chloric acid and chlorates. Taylor. *See* VII.

Patent.

Smokeless powder charges and smokeless powder grains for use therein. E. C. R. Marks, London, From Ordnance Improvement Co., New York. Eng. Pat. 5927, Apr. 20, 1915.

The charge is composed of a number of flat or spherically curved discs having a plain, scalloped or grooved periphery and one or more longitudinal perforations, and provided on one face with projections of relatively small area, which keep the grain from close contact with the adjacent grain, thus leaving free communication over nearly the whole surface of the disc. The other face of each grain may have recesses which correspond and interlock with the projections on the adjacent grain and the discs thus arranged in interspaced relationship may be kept in position by means of a binding device passed through longitudinal openings. The ignition powder charge may be placed in a hollow cylinder fitting into axial openings in the grains.—C. A. M.

XXIII.—ANALYSIS.

Differentiation of natural and artificial asphalts. Graefe. *See* IIa.

Distinguishing natural and artificial asphalts. Bratter. *See* IIa.

Solubility of naphthalene in ammonia as a cause of stoppage of pipes. [Determination of naphthalene.] Hilpert. *See* III.

Properties of wool and a new chemical method for the detection of damaged wool. Von Allwörden. *See* V.

Rapid determination of chloric acid and chlorates. Taylor. *See* VII.

Determination of trithionates in presence of tetrathionates. Sander. *See* VII.

Determination of Prussian blue in spent oxide. Randall. *See* VII.

Nitrogen content of humus of acid soils. Alway and Bishop. *See* XVI.

Determination of starch in raw potatoes. Ewers *See* XVII.

Determination of methyl alcohol in presence of ethyl alcohol. Reif. *See* XVIII.

Determination of the total quantity of essential oils (essences) in liqueurs. Muttelet. *See* XVIII.

Determination of lactose and sucrose in milk-chocolate. Von Fellenberg. *See* XIXA.

Limits of sensitiveness of colour reactions of proteins and peptonising enzymes. Rakuzin and others. *See* XIXA.

Detection of magnesia derived from the waste liquor of the potash industry [in river water]. Pfeiffer. *See* XIXB.

Determination of urea in urine by the urease method. Van Slyke and Cullen. *See* XX.

New colour reaction for aloes. Stacy. *See* XX.

Trade Report.

Prohibited exports. Order in Council, March 16, 1916.

THE headings "Sugar, refined and candy" and "Sugar, unrefined" in the list of goods the exportation of which is prohibited to all destinations are replaced by the heading "Cane and beet sugar, unrefined or refined, including candy." The exportation of the following is prohibited to all destinations :—Acetic acid ; ferro-molybdenum ; ferro-silicon ; ferro-tungsten ; photographic sensitive films, plates, and printing paper, whether exposed or not ; platinum, salts of ; radium ; tungsten. On and after March 27th, 1916, the exportation of "Manufactured fuel" is prohibited to all destinations abroad other than British Possessions and Protectorates. The exportation of the following is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic Ports), Italy, Spain, and Portugal :—Absinthe ; barium sulphate ; calcium sulphate ; iron sulphates ; sodium sulphate and bisulphate (including nitre cake) ; strontium sulphate ; glucose and malt sugar ; salt, rock and white, except table salt.

Switzerland : Prohibited exports.

A DECREE of the Swiss Federal Council, dated March 6th, prohibits the exportation of the following articles from Switzerland, as from March 8th :—Alkaloids and glucosides of all kinds, and their salts and combinations in so far as exportation is not already prohibited ; calcium carbide ; formaldehyde preparations and derivatives—in so far as exportation is not already prohibited ; glass and glass wares of all kinds, with the following exceptions, viz., vitrifications, enamel, glass beads, glass mounted in metal (unpainted), paintings on glass and "*lithophanies*" ; glycerin, crude, and glycerin lye ; ferro-silicon, in the rough ; iron wares of all kinds, with the exception of machines other than for textile industries, watches and detached parts thereof, instruments and apparatus—in so far as exportation is not already prohibited ; manganese, chromium, molybdenum titanium, uranium, vanadium, and wolfram (tungsten ore), in the metallic state, even combined one with another or with other metals, unmanufactured, or in powder, bars, wire and sheets—in so far as exportation is not already prohibited ; metallic arsenic, cadmium, cobalt ; metals and metallic compositions not specially provided for in the Tariff.

Application of science to industry in Australia. Report of Special Committee. Board of Trade J., Mar. 16, 1916.

As the result of a conference representative of science and industry in Australia, which was convened by the Prime Minister of the Commonwealth early in January, a Committee was appointed to formulate a scheme for the application of science to industry. The Report of this Committee has been approved generally by the Cabinet. The following extracts are taken from the Committee's Report :—

The Committee recommend the formation of a Commonwealth Institute of Science and Industry, under the control of directors possessing the highest business and scientific attainments, acting with the advice and co-operation of a council, representing science and the primary and secondary industries of Australia.

Among the functions which, it is recommended, should be assigned to the proposed Institute are the following :—(*a*) To consider and initiate scientific researches in connection with, or for the promotion of, primary or secondary industries in the Commonwealth ; (*b*) the collection of industrial scientific information and the formation of a bureau for its dissemination amongst those engaged in industry ; and (*c*) the establishment of national laboratories.

In conclusion the Committee puts forward the following recommendations for immediate action, and these recommendations have been accepted by the Cabinet :—

(1) That until the Institute be established an advisory council be appointed by the Governor-General in Council particularly to carry out the objects expressed in resolutions (*a*) and (*b*) above.

(2) That the Federal and State Munitions Committees, heads of the Commonwealth and State scientific departments, and bodies representative of Commonwealth manufacture, commerce, agriculture, mining and engineering, the universities and technical colleges, and private enterprises be invited to suggest branches of industrial scientific research, in which investigation would be of immediate practical use to producers and manufacturers.

(3) That the advisory council be appointed forthwith, and that when appointed it should take steps immediately to initiate research work into the most pressing matters needing investigation, and seek the co-operation of existing institutions, and also utilise the resources of staff and equipment at the Commonwealth's disposal at the present time.

(4) The Committee suggest for the consideration of the advisory council that the following problems among others, are pressing :—The sheep-fly pest improved methods of extracting zinc from Australian ores, including the commercial manufacture of electrolytic zinc ; the utilisation of brown coal with recovery of by-products ; the introduction of a mechanical cotton picker ; the eradication o the prickly pear ; the production of aluminium and ferro alloys ; the recovery of potash, manufacture of alkali, and condensation of sulphurou acid gas, at present being wasted ; the cultivation of useful indigenous grasses and salt bushes ; and the manufacture of fine chemicals, drugs, and explosives.

(5) That funds be placed at the disposal of th advisory council for the above purposes.

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Official Notices.

ANNUAL GENERAL MEETING, 1916.

In accordance with the provisions of By-law 64, notice is hereby given that the Annual General Meeting will be held at the University of Edinburgh at 10.30 a.m. on Wednesday, July 19th, 1916. A programme of the proceedings will be issued later.

In accordance with the provisions of By-law 24, those members whose names are printed in *italics* in the List of Council will retire from their respective offices at the forthcoming Annual Meeting.

Dr. Charles Carpenter has been nominated to the office of President under By-law 20; Profs. F. G. Donnan and Henry Louis have been nominated Vice-Presidents under By-law 21. Messrs. H. Hemingway and D. Lloyd Howard have been nominated Vice-Presidents under By-laws 21 and 32, and Mr. Thos. Tyrer and Dr. R. Messel, F.R.S., have been reappointed Hon. Treasurer and Hon. Foreign Secretary respectively.

Members are requested to nominate on or before May 22nd next, fit and proper persons to fill four vacancies among the ordinary Members of Council. Forms for this purpose can be obtained from the Secretary of the Society.

By-law 23:—An Ordinary Member of Council shall be nominated by ten or more members upon Form B in the Schedule, a copy of which form shall be furnished by the Secretary upon the written or verbal request of any member, but a member shall not be eligible to sign more than one such nomination form, and the member nominated shall sign the declaration set forth on the form. A nomination shall be declared invalid by the Council if:

a. The member thereon nominated is disqualified for election, or ineligible to be elected, as provided by the By-laws.

b. The nomination is not made on the authorised printed form or substantially not in the manner directed thereon.

c. The nomination form is signed by less than ten members not disqualified or not ineligible to nominate as provided by the By-laws.

d. The nomination form is not received before or upon the day appointed therefor.

e. The member nominated has not signed the declaration printed upon the form.

A member whose nomination aforesaid is declared to be invalid, shall receive notice thereof from the Secretary, and shall not be submitted for election.

T. F. Burton,
Acting Secretary.

RESIGNATION OF THE SECRETARY.

The Secretary of the Society, Mr. C. G. Cresswell, has resigned. The Council has appointed Mr. T. F. Burton to act as Secretary *pro tem.*

Canadian Section.

Meeting held at Toronto on Thursday, 10th February, 1916.

PROF. J. WATSON BAIN IN THE CHAIR.

THE BEET SUGAR INDUSTRY IN CANADA.

BY DR. MICHAEL POTVLIET.

A clayey loam is the best soil for beet crops, although sometimes a more or less sandy loam, as in Berlin, Ontario, gives a good crop of high percentage beets. Heavy clay is not advisable, but if this type of soil gets an application of lime in the fall, before ploughing, good results can be expected. Lime in the soil is very important. As a rule this view is neglected by the farmers. Lime is absolutely necessary on marshy land, which as a rule is more or less sour. Quicklime should not be used. A finely powdered lime rock is the most suitable.

The ploughing of a beet field is very important. Starting the first year up to 6 in. deep, the ploughing in following years should increase in depth, and it is not uncommon in Colorado to see the power engines plough as deep as 2 ft. The rows in a beet field are usually 18 in. apart. For the sowing, which usually takes place in April, about 15 lb. of beet seed per acre is used. After the plants show four leaves, they are thinned out, leaving a strong plant every 10 in. Thorough cultivation is necessary; it keeps the soil airy and prevents rot-bacteria doing their ruinous work. Most of the failures in the raising of beet crops are due to insufficient cultivation. According to weather conditions, the harvest starts in the middle of September. In Colorado, about 80% of the beet plants grow to maturity; in Michigan and Canada, only about 65%.

The beets, after being ploughed out, are topped. Beside the leaves, a small part of the beet, the crown, also is cut off. The beet tops are rather valuable; if they are left on the field for cattle food, about 40% gets lost by trampling under. If the beet plants show attack by diseases it is advisable to haul the tops from the field in order to prevent the over-wintering on the field of the bacteria in the tops. If the cause of the diseases is ploughed under again, it undoubtedly will affect the following crop. The yield of a beet crop differs according to climatic conditions, and the work done in the field. The average for California is 12 tons; Colorado, 11 tons; and for Michigan and Canada 10 tons per acre. As a rule, the more work that is done in the beet field, using the proper quality of beet seed, the higher the yield. Even in Canada, yields of 18 tons to the acre are not uncommon.

The beet seed question is a very important one, and especially now during the war. Before the war, the price was about $10.00 per 100 lb.; at present it is $25.00 and higher. Home-grown beet seed is still very scarce. In Utah, U.S.A., experiments have been made to raise beet seed on a large scale, apparently with some success. The Dominion Sugar Company is experimenting in this direction, in the vicinity of Berlin, Ont., and last year was able to raise a quantity of good quality beet seed.

Growing beet seed is rather expensive to start with. Planted with imported beet seed for the first year, the grown beets are very carefully tested, and the beets with the highest sugar selected and separated. After being siloed, these selected beets, stecklings, are planted out in the second year. The seed raised from those mother beets in the second year, is planted out again, the harvested beets are selected and after siloing again, planted, etc. The seed crop in the fourth year will net about 1200 lb. per acre. During the following selection special care is taken not only as to the amount of sugar but also as to the weight of the root. For a factory slicing the beets from 8000 acres, it would require 100 acres planted for beet seed. This would mean that if the Dominion Sugar Company was going to raise the amount of beet seed necessary for its three factories, *i.e.*, about 225 tons, 375 acres planted with stecklings would be required. Considering the yearly rotation of crops, from 2000 to 2400 acres would be necessary. If the war continues for another year or so, something must be done, otherwise our sugar industry will be seriously affected.

The sugar beets are hauled to the factory and by hydraulic carrier transported from the beet sheds into the washers; an elevator brings the beets to an automatic scale from which they pass to the cutter, which cuts the beets into cossettes or chips of a special form, so that afterwards the diffusion can be easily performed. The cossettes are filled into cylindrical vessels of which from 6 to 14 form a battery, where the sugar is extracted, and as soon as the concentration of the raw beet juice is high enough it is drawn off and purified by lime. The resulting extracted cossettes (pulp) is pressed and dried, and forms a cattle food of high value. The limed raw juice is treated with carbon dioxide, to precipitate the excess of lime, and after sufficient heating, the raw juice is filtered through filter-presses. A fairly pure juice runs off, only needing another light purification with lime, and the same carbonatation. The heated juice is then filtered again and taken up in the evaporator. The separated cake from the filter-presses is a first-class fertiliser, as it contains besides albumin-nitrogen from the beets, a certain percentage of phosphoric acid and a large quantity of calcium carbonate in a finely divided form.

The evaporators convert the rather diluted juice into a heavier syrup, which after being decolorised with sulphur dioxide and carefully filtered, is transferred to the real sugar boiling pan, where the clear syrup is converted into a crystalline mass. The syrup is separated from the crystals in centrifugals, and after proper washing, a pure white sugar is obtained. The more or less damp sugar, after drying and cooling, is packed and automatically weighed in barrels or bags, ready for shipment. The separated syrup from the centrifugal machine is concentrated again in the vacuum pan, whereby again a crystalline mass is formed. Separated by the centrifugal machine, a slightly yellow sugar is obtained, which is remelted, filtered, and added to the syrup from which the white sugar is boiled. The remaining syrup from this yellow sugar is the molasses. It is not possible to extract all the sugar present in the molasses in the ordinary way.

In most of the factories in the United States, this sugar is extracted by the Steffen lime process, which is based on the formation of an insoluble calcium saccharate. Fine lime powder is carried into the diluted molasses under constant cooling, and the saccharate is filtered, washed, and introduced into the raw juice from the battery. By treatment with carbon dioxide the saccharate is decomposed into sugar juice and calcium carbonate, which is separated in the filter presses.

Another method for the recovery of sugar from molasses is the barium process, which in principle is practically the same as the lime process. A concentrated solution of barium hydroxide is mixed with concentrated molasses, and the barium saccharate is washed and introduced into the raw juice drawn from the battery. Carbon dioxide liberates the sugar, and barium carbonate remains in the filter presses. Owing to the high price of barium compounds, the barium carbonate from the presses, after drying, is reduced in an electric furnace to barium oxide.

Almost all the countries in Europe, excepting England, Portugal, and Turkey, are supplied with their home-grown beet sugar, and besides this, export yearly about 2,500,000 tons. Some of the countries have only recently started to raise beets. Roumania, for example, started to raise beets and built its first factory in 1897. Their Government helped this industry by paying the sugar manufacturers a premium of $1.50 per 100 lb. finished product. Besides, all the necessary machinery was imported duty free. Almost every other country helped their new industry by paying a certain premium, which was withdrawn as soon as it was proved that the industry could do without assistance.

Assuming the population of Canada for the present at 8,000,000 and the use of sugar per head per annum at 85 lb., the total amount of sugar consumed would be 680,000,000 lb. The Dominion Sugar Company, with its factories at Berlin and Wallaceburg, Ont., in 1915 produced 37,000,000 lb. of refined beet sugar. The Chatham plant of the same Company, will increase the output to about 70,000,000 lb. From this it follows that still about 600,000,000 lb. of sugar have to be imported to cover the total sugar consumption. This sugar is mostly imported cane sugar from the Central American Islands and Cuba and raw beet sugar from Europe for refining purposes. Canada should produce the whole of the necessary 300,000 tons of sugar per year, but only one-tenth of the total sugar consumed in Canada will be produced in the country during this year. Thus there is a big opening for the farmers to raise sugar beets, and there is certainly sufficient good land. Holland has only 12,600 sq. miles and 28 sugar factories, whilst the Province of Ontario, with 285,000 sq. miles, has only three factories. By raising sugar beets, the conditions for the farmer are so much better than, for example, by raising wheat for export. In the first case, all profits from the crop come into the farmer's pocket, whereas in the latter, a large portion of the value of the crop goes to transportation charges and the agents. Besides this direct gain, the farmer who raises sugar beets has a very important indirect gain. When any kind of crop is raised on a field where previously sugar beets were raised, the yield per acre is increased, owing to the care taken with the beet crop and to the work in the soil done by the beets themselves. The average yield from any crop in beet-raising Europe is by far higher than the average yield in Canada or the United States.

Experiments in Colorado and especially in California, showed that on land previously planted with sugar beets, the following increases in yield after beets were obtained:—Wheat 24%, rye 15%, barley 25%, oats 42%, peas 86%, potatoes 102%. The farmers around Wallaceburg have the same experience. There is a decided increase in beet-growing each year, and while the farmers in previous years were indifferent, lately they have found this was profitable.

Assuming that the mineral compounds in the beet tops are returned to the field as manure and the yield per acre is 12 tons of beet roots, there will be taken from the soil: potash, 85 lb.; phosphoric acid, 19 lb.; nitrogen, 30 lb.

Analysis shows that the average amount of potash in the soil is 0·35% or 14,000 lb. per acre-foot. Of this amount of total potash, about 450 lb. is available, so it is obvious that a crop of beets takes out quite a quantity of potash, as do more or less all other crops, yet there is plenty of available potash left. The same can be said in regard to phosphoric acid. The amount of available phosphoric acid in the soil per acre-foot is 450 lb. and a beet crop of twelve tons of roots takes out only 19 lb. The total amount of available nitrogen is not so abundant. Crop rotation however, will supply the necessary nitrogen.

Edinburgh Section.

Meeting held at Edinburgh, on Wednesday, March 15th, 1916.

PROF. J. WALKER IN THE CHAIR.

DETERMINATION OF THE HARDNESS OF NATURAL WATERS, AND THE USE OF METHYL RED AS AN INDICATOR.

BY SYDNEY A. KAY, D.SC., AND SUSAN H. NEWLANDS, M.A., B.SC.

University of Edinburgh.

The methods of determining the hardness of natural waters depending on the use of a standard soap solution have been largely superseded by alkalimetric methods, originally described by Hehner (Analyst, 1883, **8**, 77). The soap test, however, notwithstanding its empirical character and admitted limitations, may be usefully retained as affording a measure of the soap-destroying power of a water, more especially if a standard soap solution prepared with a saturated fatty acid is used. Potassium myristate, for example, unlike sodium oleate, has been found to give accurate results with solutions containing both calcium and magnesium salts (H. Masters and H. L. Smith, Trans. Chem. Soc., 1913, **103**, 992; this J., 1913, 447). Another method of using a standard soap solution consists in titrating the water with potassium palmitate, not in the ordinary manner until a lather is obtained, but using phenolphthalein as an indicator (Blacher, Grünberg, and Kissa, Chem.-Zeit., 1913, **37**, 56; this J., 1913, 158).

The object of this paper is to describe methods which are mainly modifications of those devised by Hehner, and are more accurate, yet no less expeditious, than the original methods.

Relation between electrical conductivity and hardness.—Before beginning the chemical examination of a water, it is always worth while measuring its electrical conductivity. A convenient apparatus for this purpose is the Dionic Water Tester, and the measurement occupies but a few moments. The conductivity of natural waters, expressed in the usual units (gemmhos), varies from about 30 for a soft water like that of Loch Katrine, to 1000 for some hard or alkaline waters common in England, and to about 50,000 for sea water. Samples of rain water, collected locally, were found to vary from 6 to over 50. In the case of most drinking waters containing but a small amount of sodium salts, the conductivity is approximately proportional to the hardness, and at 20° C. every 20 units of conductivity correspond, very roughly, to one degree of hardness. The following figures indicate the value of the rule, although the agreement between the observed and calculated values is here somewhat unusually good.

I. Conductivity and hardness.

	Conductivity at 20° C.	Hardness in degrees.	
		(calc.)	(found)
Dundee water..........	72	3·5	2·8
Edinburgh water	75	3·5	3·3
" "	112	5·5	5·0
" "	210	10·5	11·5
Eskbank water	540	27·0	27·3

"Temporary" hardness. Hehner's method consists in finding the so-called "alkalinity" of the water by titrating a measured quantity with $N/50$ sulphuric acid in presence of a suitable indicator. Hehner used phenacetoline or methyl orange. Lacmoid and alizarin have also been recommended. With methyl orange, the end-point of the titration is by no means sharply defined and we prefer to use methyl red. Like methyl orange, methyl red is a derivative of aminoazobenzene, viz., $(CH_3)_2N.C_6H_4.N:N.C_6H_4.COOH$, but it is a weaker acid and a more sensitive indicator than methyl orange.

Methyl red is yellow in a neutral solution, *i.e.*, when the concentration of hydrion is about 10^{-7}-normal, and it becomes red when the hydrion concentration rises to about 10^{-5}- or one-hundred-thousandth-normal. Methyl orange, on the other hand, does not begin to appear red until the acidity of the solution is more than ten times greater, *i.e.*, about 10^{-4}-normal. In practice, this means that methyl orange changes colour comparatively slowly and that there is an uncertainty in the end-point of an ordinary titration amounting to at least 0·5 c.c. of $N/100$ acid; whereas, using methyl red, a single drop of $N/100$ acid is sufficient to decide the end-point. Methyl red is more sensitive to carbonic acid than methyl orange, and in the titration of carbonates and bicarbonates the solution must be heated to the boiling-point in order to remove carbon dioxide. Methyl red may be used with advantage in place of methyl orange for all ordinary purposes in volumetric analysis. It is very much better than methyl orange for titrating ammonia or solutions containing ammonium salts, as, for example, in the Kjeldahl determination of nitrogen. Methyl red can also be used in artificial light with far less difficulty than methyl orange

The determination of "temporary" hardness or, more correctly, of bicarbonate hardness is carried out as follows:—Measure 100 c.c. of the water into a porcelain casserole and add 2 c.c. of methyl red solution (0·05 grm. dissolved in 1 litre of 80% alcohol). Run in $N/50$ hydrochloric acid until the liquid becomes light red. Heat until boiling, boil for about one minute, and continue the addition of standard acid until a permanent reddish tinge, which is not destroyed by further boiling, is obtained. An alternative method of procedure, which is more convenient and expeditious, is to add a slight excess of acid (about 1 c.c.) and then, after boiling for about one minute, to titrate back with $N/50$ baryta solution.

It is inadvisable to boil the water before beginning the titration, because crystalline calcium and magnesium carbonates, which may be precipitated on boiling a hard water, interact very slowly with the dilute standard acid. Should there be any objection to boiling the water, the titration may be carried out at the ordinary temperature by adding excess of acid and passing a current of air through the liquid for a few minutes in order to remove the carbon dioxide.

Each c.c. of standard acid required for 100 c.c. of the water corresponds to 1 part of calcium carbonate in 100,000 or 1° of hardness. Some natural waters contain sodium carbonate, and the "alkalinity" may be partly due to the latter. In that case a correction referred to under "permanent" hardness must be applied.

The accuracy of the process has been repeatedly tested by titrating prepared waters containing known amounts of calcium and magnesium bicarbonates. Duplicate titrations of natural waters, carried out independently by different operators, were in satisfactory agreement. The following results may be cited in illustration.

A titration of the North Pentland water in which the carbon dioxide was removed by a current of air gave 10·65°. Using methyl orange as indicator, the same sample gave 11·1°, and the end-point was uncertain.

II. Prepared waters.

Composition in degrees hardness.	Bicarbonate hardness.	
	(calc.)	(found).
1. 5° $MgCO_3$	5·00°	5·03°
2. 5·45 $CaCO_3$ 5 $MgCO_3$	10·45	10·50
3. 10 $CaCO_3$ 5 $MgSO_4$	10·00	10·04

III. Natural waters.

	Bicarbonate hardness (duplicate titrations).
1. Dundee water	1·70 1·70
2. Laboratory tap water	2·43 2·43
3. North Pentland water	10·64 10·67
4. Eskbank water	20·60 20·64

"*Permanent*" *hardness.* "Permanent" hardness, determined according to Hehner's method, corresponds more closely to "mineral acid" hardness than to the residual hardness found after boiling the water. The latter is a somewhat empirical result and frequently gives doubtful information as to the actual composition of the water. Briefly, Hehner's method consists in evaporating a measured volume of the water with a known quantity of sodium carbonate. The dry residue is extracted with a little recently boiled distilled water, filtered and washed, and the filtrate is titrated with $N/50$ sulphuric acid. The difference between the amount of sodium carbonate added to the water and that found in the filtrate is a measure of the "permanent" hardness.

The experience of most analysts must have shown that the results obtained by this method are of doubtful accuracy, and the reasons are not far to seek. Calcium and magnesium carbonates are by no means quite insoluble in water, and the solubility is greatly augmented by carbon dioxide which is unavoidably present in distilled water in contact with air. Further, when sodium carbonate is added to a solution of a magnesium salt, the precipitated basic carbonate dissolves in excess of sodium carbonate, and the formation of this soluble double salt may entirely vitiate the results. Thus, the hardness of a synthetic water, containing magnesium sulphate equivalent to 5°, was found to be only 3·5°, and on washing the precipitated magnesium carbonate with a little more water the result fell to 3·3°, then to 3·1°, showing that 40% of the magnesium carbonate had dissolved.

In a modification of this method devised by Wartha (compare Pfeifer, Z. angew. Chem., 1902, **15**, 193, and Procter, this Journal, 1904, **23**, 8), the water is evaporated with a mixture of sodium carbonate and sodium hydroxide, in order to take advantage of the smaller solubility of magnesium hydroxide as compared with the carbonate.

We propose a new modification which consists in (1) evaporating the water with potassium carbonate, (2) extracting the potassium carbonate from the residue with aqueous alcohol instead of with water. The reasons for the adoption of this procedure are that calcium and magnesium carbonates are practically insoluble in 90% alcohol; that the soluble double salt of magnesium already referred to is decomposed by alcohol with reprecipitation of magnesium carbonate; and that potassium carbonate is more readily soluble in dilute alcohol than sodium carbonate.

The determination is carried out as follows:—In a platinum basin mix 100 c.c. of the water with 10 c.c. of $N/25$ potassium carbonate. (If the "permanent" hardness is believed to exceed 15°, more potassium carbonate must be used.) Evaporate to dryness on the steam-bath. Pour 10 c.c. of 20% alcohol into the basin and bring the liquid into contact with the whole of the residue. Replace the basin on the steam-bath until the liquid is hot again, and then filter through a 5½-cm. paper, receiving the filtrate in a casserole or flask of resistant glass. Rinse the basin very carefully four times with cold 90% alcohol, using about 5 c.c. each time, and then wash the filter five times with the same alcohol. Titrate the filtrate with $N/50$ hydrochloric acid, using methyl red as indicator, as described under "temporary" hardness. The platinum basin and the filter, containing the precipitated carbonates of calcium and magnesium, are set aside for the determination of total hardness to be described later.

If the original water contained sodium carbonate, there can be no "permanent" hardness, and in the foregoing determination more alkali will be found in the filtrate than was added to the water as potassium carbonate. The excess of alkali represents the amount of sodium carbonate present in the water and it must be deducted from the "alkalinity" of the water in order to ascertain the actual bicarbonate hardness.

Total hardness. Total hardness may be determined in three ways:—(1) The sum of the bicarbonate hardness and the "permanent" hardness gives the total hardness of the water. (2) If 100 c.c. of the water be first neutralised (as in determining bicarbonate hardness) and then evaporated with a known quantity of potassium carbonate, the amount of the latter required to precipitate the calcium and magnesium salts is equivalent in this case to the total hardness instead of the "permanent" hardness of the water. (3) The carbonate precipitate, set aside from the determination of "permanent" hardness, represents the total calcium and magnesium salts in 100 c.c. of the water. The precipitate is dissolved in a measured quantity of hydrochloric acid and the excess of acid is titrated with baryta solution. (In order to ensure complete solution of the carbonates, at least twice the equivalent amount of decinormal acid must be used.) The procedure is as follows:—Five c.c. (or 10 c.c. if the total hardness exceeds 10°) of decinormal hydrochloric acid is measured into the platinum basin containing the precipitate and warmed cautiously until almost boiling. The acid is brought into contact with the whole interior of the basin, warmed again, and then poured while hot through the original filter. The basin is carefully rinsed and the filter washed four to five times with small quantities of water. The filter paper is placed in the acid filtrate which is then boiled for a minute and titrated with $N/50$ baryta solution.

These methods for determining "permanent" and total hardness were tested with prepared waters, containing varying amounts of calcium and magnesium salts, and the error does not exceed, as a rule, about 0·2°. The same error was observed in the results obtained for solutions containing only bicarbonate hardness and in blank experiments with distilled water. For example, in three experiments with solutions containing magnesium carbonate only, the "permanent" hardness (which was nil) was found to be 0·03°, 0·2°, and 0·25° respectively. Several natural waters were also analysed volumetrically and the results for total hardness compared with those obtained by the routine gravimetric method.

IV. Prepared waters.

Composition in degrees hardness.	Permanent hardness.		Total hardness.	
	(calc.)	(found)	(calc.)	(found)
1. 2° $MgSO_4$	2·0	2·0	2·0	2·0
2. 5 $MgSO_4$	5·0	5·1	5·0	5·1
3. 10 $MgSO_4$	10·0	10·2	10·0	9·9
4. 7·2 $CaSO_4$ 5 $MgCO_3$	7·2	7·1*	12·2	12·1
5. 9·7 $CaCO_3$ 2 $MgSO_4$	2·0	2·2	11·7	11·7

* Three consecutive determinations gave 7·07°, 7·12°, and 7·07°.

V. Natural waters.

	Permanent hardness.	Total hardness.	
	(found)	(vol.)	(grav.)
1. Dundee water	1·35† 1·2	2·8 2·8	— —
2. Laboratory tap water ..	1·15 0·95	3·45 3·3	— 3·3
3. North Pentland water....	1·05 1·1	11·5 11·7	— 11·5
4. Eskbank water	6·4 6·7	26·7 27·1	— 27·3

† Upper figure in each case found by S.H.N. and lower figure by S.A.K.

In connection with the methods described, the following precautions are noteworthy :—

(1) The evaporation on the steam-bath is best conducted in such a manner as to avoid contamination of the contents of the basin with oxides of sulphur (from coal gas flames) or other impurities in the laboratory atmosphere. Without this precaution a loss of alkali always occurs during the evaporation and an error, amounting to at least 0·2 c.c. of the standard acid, is introduced. A steam-bath with an external source of steam, and provided with a condensing cover, is a convenient arrangement. An inverted glass basin or one-half of a cistern " ball-cock " float forms a suitable condensing cover. It is cooled with a stream of tap-water. If the amount of steam be properly regulated, 100 c.c. of water can be evaporated in about an hour and a quarter.

(2) The diluted alcohol must be prepared with pure " absolute " alcohol, not from rectified spirit, which is usually acid.

(3) Care must be taken to avoid the use of soft glass vessels, otherwise serious errors may occur. For example, 100 c.c. of distilled water, heated for two hours on the steam-bath in an ordinary flask, acquired an alkalinity corresponding to no less than 2·4 c.c. of $N/50$ acid. Titrations must therefore be done in porcelain vessels or in flasks of resistant glass, and the latter should also be used for wash-bottles.

(4) Filter-papers are sometimes acid or may acquire acidity through exposure to the laboratory atmosphere. This may occasion error and the remedy is obvious.

DETERMINATION OF CALCIUM AND MAGNESIUM IN NATURAL WATERS.

BY SYDNEY A. KAY, D.SC., AND SUSAN H. NEWLANDS, M.A., B.SC.

University of Edinburgh.

Various more or less rapid volumetric methods have been used hitherto for the determination of calcium and magnesium in natural waters. Some analysts determine both the calcium and the magnesium directly ; others ascertain the total hardness and the amount of either the calcium or the magnesium.

Hempel's convenient volumetric method of determining calcium by precipitation as oxalate, followed by titration with potassium permanganate is frequently utilised in water analysis. Thresh, for example, commends this method in his " *Examination of Water and Water Supplies*," and combines it with a direct determination of magnesium by a turbidimetric method. Winkler (Z. anal. Chem., 1914, **53**, 409) determines calcium by a soap method in which the water is titrated with potassium oleate, as in Clark's process, coprecipitation of magnesium being prevented by the addition of Rochelle salt. Another plan, devised by Wartha (cf. Pfeifer, Z. angew. Chem., 1902, **15**, 193), and since followed by many analysts, is based on the fact that lime-water, when added to a solution containing both calcium and magnesium salts, precipitates the magnesium as hydroxide but not the calcium. In connection with Wartha's method, Procter (this Journal, 1904, **23**, 8), makes the useful suggestion that filtration, with consequent exposure to carbon dioxide, is best avoided.

The object of this paper is to describe a new volumetric method of determining calcium and magnesium in natural waters which requires no standard solutions other than those necessary for the determination of total hardness, and is carried on concurrently with the latter process.

When a water is evaporated with an excess of alkali carbonate and the excess of the latter removed with dilute alcohol (see previous paper), the residue consists of a mixture of calcium and magnesium carbonates. We here suggest a simple method of separating the two carbonates and of determining the amount of calcium carbonate in the mixture. If the total hardness of the water has also been determined, the hardness due to magnesium can then be ascertained by difference.

In qualitative analysis, the separation of calcium from magnesium is based on the familiar fact that magnesium is not precipitated by ammonium carbonate in presence of ammonium chloride. Magnesium carbonate in other words, dissolves in ammonium chloride solution, and it appeared possible that a separation of the two carbonates might be effected in this way. When, however, the mixed carbonates were extracted with a 1 % solution of ammonium chloride, an appreciable amount of calcium carbonate dissolved, together with the magnesium carbonate. This result was not unexpected, for it is well known that the precipitation of calcium carbonate by ammonium carbonate is noticeably reversible. Freshly precipitated calcium carbonate dissolves instantly in excess of ammonium chloride. As regards the relative solubilities of calcium and magnesium carbonates in ammonium salts, a few rough experiments showed that, at the ordinary temperature, magnesium carbonate is only about 4½ times more soluble than calcium carbonate in a 1 % solution of ammonium chloride. All attempts to effect a quantitative separation of the two carbonates in this way were, therefore, unsuccessful.

A few experiments were tried with a solution of ammonium chloride containing soluble calcium salts—the purpose of the latter being to diminish the solvent action of the ammonium chloride on the calcium carbonate—and in other experiments ammonium chloride containing alcohol was used, but these methods were also found to be unreliable.

The problem was finally solved in a fairly satisfactory manner by extracting the mixed carbonates with a solution of ammonium carbonate, instead of ammonium chloride. The success of the method depends on the following facts, som of which are rarely stated in text-books of qualitative analysis.

(1) When ammonium carbonate is added to a solution of calcium chloride, the precipitated calcium carbonate dissolves in a large excess of the reagent. On boiling the solution, however, the calcium carbonate is reprecipitated as a mixture of the more stable and less soluble calcite and arragonite.

(2) At the ordinary temperature, magnesium carbonate is not immediately precipitated by ammonium carbonate, but a precipitate appears on heating the solution to the boiling point. When more ammonium carbonate is added, the precipitate dissolves again, and reprecipitation does not occur on boiling. Magnesium chloride solution, accordingly, gives no precipitate with excess of ammonium carbonate, even on boiling. The complex nature of the equilibrium is thus apparent. For the present purpose, the important facts are that magnesium carbonate dissolves in excess of hot ammonium carbonate solution, whereas calcium carbonate is practically insoluble.

Based on these observations, the following method was finally adopted for the determination of calcium and magnesium.

(1) The total hardness of the water is ascertained by one or other of the methods described in the previous paper.

(2) The hardness due to calcium salts is determined by evaporating the water with ammonium carbonate. The residue, consisting of calcium and magnesium carbonates together with some ammonium sulphate or chloride equivalent to the "permanent" hardness of the water, is extracted with ammonium carbonate solution which dissolves the magnesium carbonate, but is practically without action on the calcium carbonate. The amount of the latter is then ascertained.

Very many experiments were made before the details of this process were finally settled, and the procedure may be briefly described.

Measure 100 c.c. of the water into a platinum basin, add 10 c.c. of a 2% solution of ammonium carbonate (2 grms. of the solid and 1 c.c. of concentrated ammonia in 100 c.c.), and evaporate to dryness on the steam-bath. Pour 15 c.c. of the same ammonium carbonate solution into the basin, bring the liquid into contact with the whole of the residue, and allow the basin to remain on the steam-bath for about two minutes. Filter through a 5½-cm. paper, retaining the undissolved carbonate as far as possible in the basin. Repeat the extraction twice, using about 10 c.c. of ammonium carbonate each time. Rinse the platinum basin four times with 90% alcohol, and wash the filter with the same alcohol until the filtrate is free from alkali. (Litmus paper is too insensitive for this purpose and absence of alkali may be ascertained by allowing about 5 c.c. of the filtrate to drop into a little water containing methyl red and a trace of *N*/50 acid.) Dissolve the calcium carbonate, which now alone remains in the basin and on the filter, in a measured volume of *N*/10 hydrochloric acid (usually 5 c.c. to 10 c.c.) and titrate the excess of acid with *N*/50 baryta solution, as described under total hardness in the previous paper.

The amount of calcium in the water, expressed in degrees of hardness, is then calculated, and the difference between the total hardness and that due to calcium gives the hardness, in degrees, due to magnesium.

As degrees of hardness are expressed in terms of calcium carbonate, it is a simple matter to convert the results into milligrams of calcium and magnesium per litre, or any other more convenient units.

The following are some of the results obtained in the analysis of prepared waters containing varying amounts of calcium and magnesium salts, and the figures indicate the degree of accuracy attained. The experimental results for magnesium are not shown in the table; they may be obtained, of course, by subtracting the calcium hardness from the total hardness, found volumetrically.

Prepared waters.

Composition in degrees hardness.	Calcium hardness, (calc.)	Calcium hardness, (found).
1. 5° $MgSO_4$	0°	0·2°
2. 5·35 $CaCO_3$	5·35	5·5
3. 14·8 $CaSO_4$	14·8	14·6
4. { 2·85 $CaCO_3$ 2 $MgCO_3$	2·85	2·9
5. { 2·85 $CaCO_3$ 12 $MgCO_3$	2·85	2·7
6. { 22·2 $CaCO_3$ 9·7 $MgCO_3$	22·2	22·2
7. { 2·95 $CaSO_4$ 2 $MgSO_4$	2·95	2·75 { 2·70 2·77 2·77 2·70
8. { 3·61 $CaSO_4$ 10 $MgSO_4$	3·61	3·65
9. { 14·5 $CaSO_4$ 5 $MgSO_4$	14·5	14·9 { 14·6 15·1 14·8 15·1
10. { 22·2 $CaSO_4$ 10 $MgSO_4$	22·2	23·5
11. { 9·7 $CaCO_3$ 2 $MgSO_4$	9·7	9·8

Water No. 1 contains only magnesium sulphate, and an apparent calcium hardness of 0·2° was found. The same experimental error was repeatedly observed in blank experiments with distilled water. The hardness of Nos. 2 and 3 is due to calcium salts only, and the results show that no calcium carbonate was dissolved by the ammonium carbonate. Nos. 4, 5, and 6 contain calcium and magnesium bicarbonates in varying proportions. No. 5 shows that a satisfactory separation is obtained in the case of a water containing an excess of magnesium, whilst in No. 6 calcium hardness predominates. Nos. 7, 8, 9, and 10 contain "permanent" hardness only. In No. 7, with a total hardness of about 5°, the results of four consecutive determinations of calcium agree closely, although they are all lower than the calculated amount. Nos. 9 and 10 are hard waters, and all the results are higher than the calculated values. No. 11 contains both bicarbonate and sulphate hardness.

The calcium and magnesium in several natural waters were determined, and the following table shows the results obtained, together with those found by the gravimetric method. The volumetric results for magnesium were obtained by subtracting the calcium hardness from the total hardness.

Natural waters.

	Hardness in degrees.				
	Calcium.		Total.	Magnesium.	
	volum.	gravim.	volum.	volum.	gravim.
Dundee water ..	1·9 1·9 1·8	—	2·8	0·9 0·9 1·0	—
Laboratory tap water	2·2	2·3	3·4	1·2	1·0
North Pentland water	9·7	9·3	11·7	2·0	2·2
Eskbank water..	19·6	17·8	27·1	7·5	9·6

The Dundee sample is a very soft water, and the results of three consecutive determinations are shown. The laboratory tap water is also a soft water, and the values for calcium and magnesium are the mean of two concordant determinations. It may be pointed out that, when the calcium and magnesium in a litre of this water were determined gravimetrically, only 23 mgrms. of calcium carbonate and 11 mgrms. of magnesium pyrophosphate were obtained, and it is doubtful whether in those circumstances the gravimetric results are more accurate than the volumetric. The North Pentland sample is a water of moderate hardness which is almost entirely "temporary." The calcium hardness is the mean of four determinations—highest 9·9, lowest 9·4—all higher than the gravimetric result. The figures for the Eskbank sample, which is a very hard water, are less satisfactory. The calcium hardness, which is the mean of five determinations, is 1·8° higher than the gravimetric result. The magnesium hardness involves the errors in both the total and the calcium hardness and is, accordingly, 2° low.

For the synthetic waters Nos. 9 and 10, which, like the Eskbank sample, are hard waters containing sulphate, high values for calcium were also obtained. Several analyses of moderately hard synthetic waters were made in which the magnesium carbonate was extracted with a solution containing 1% of ammonium chloride in addition to ammonium carbonate, but the results for calcium were then somewhat too low. When the hard water No. 10 was evaporated with the same ammonium carbonate-chloride mixture, and the subsequent extraction made with ammonium carbonate alone, the calcium hardness was again found to be 23·5°, *i.e.*, 1·3° too high.

It may be possible to improve the method by some other modification, but if the procedure is thereby complicated it loses any value it may have as a simple and expeditious process which may be found accurate enough for practical purposes.

It may be useful to summarise briefly the methods described in this and the preceding paper.

1. The conductivity of the water is determined. This gives an indication of the probable total hardness.

2. The bicarbonate hardness is ascertained by itrating 100 c.c. of the water with $N/50$ hydrochloric acid, using methyl red as indicator. The difference between the total hardness, calculated from the conductivity, and the bicarbonate hardness, affords a rough estimate of the "permanent" hardness.

3. For the determination of "permanent" and total hardness, 100 c.c. of the water is evaporated with potassium carbonate.

4. One hundred c.c. of the water is evaporated with ammonium carbonate, and the hardness ue to calcium salts is ascertained. The magnesium ardness is found by difference.

The whole examination, including the time required for the evaporations, may be completed in about three hours.

Liverpool Section.

Meeting held on Wednesday, January 26th, 1916.

MR. JOHN GRAY IN THE CHAIR.

UGGESTED FORMATION OF A CHEMICAL NTELLIGENCE BRANCH OF THE BOARD OF TRADE.

The HON. SECRETARY (Dr. Holt) gave a brief view of the proposals of Dr. M. O. Forster for the formation of a Chemical Intelligence Department of the Board of Trade, and the discussion that took place on them before the London Section (see this Journal, 1915, 759, 1173).

The CHAIRMAN cordially supported the proposition of establishing a Chemical Intelligence Department. Many industrial concerns had their own Scientific Intelligence Departments, and he thought that if the proposed Government Department would ask and receive the assistance of such firms, many initial difficulties would be overcome, and the Intelligence Department could more quickly become of practical use. There were no doubt difficulties as to how the information could best be collected and made available for all the many purposes for which it would be required, but these could be overcome, more especially if there were a fixed purpose and definite objective. He did not think that it would be sufficient to get purely technical chemical information. They must endeavour to improve methods of production by greater efficiency in management. The collection of information on this and kindred subjects should, and no doubt would, form one of the subjects with which the proposed Intelligence Department would deal.

Prof. W. C. McC. LEWIS agreed in principle with the scheme of a Chemical Intelligence Department, but considered that the present one should be modified, especially by the deletion of the techno-educational section. That section tended to make the scheme heterogeneous, and one could scarcely expect harmonious working if the committee were partly responsible to two Boards. The techno-educational section was evidently introduced to take account of research work in universities and colleges. To link this on as an appendage to an industrial scheme appeared to him unsatisfactory. The matter was too great to be dealt with in that way. It required separate treatment, for although technical research ought to be carried out in universities to a greater extent than it had been, nevertheless, it must be clear that the progress of the purely scientific side was absolutely essential and must be pursued with increased vigour.

He therefore suggested that a new committee, which might be called a Chemistry Committee, should be formed and attached to the Board of Education. It could most conveniently form a part of the Standing Advisory Committee on University Grants.

The recently instituted Advisory Council of the Privy Council dealt with only one side of research, viz., the cost of equipment and materials. There was no adequate attempt made to deal with research studentships, and with the salaries and number of assistant staff. Yet this was the real crux of the matter; for it was fairly generally recognised that the miserable salaries paid to assistants and the absence of anything like reasonable prospects had been one of the most potent factors in retarding chemical research in our universities. Unless some attempt were made to remedy this state of things, the greater attractions of industry—though they were nothing phenomenal—would leave us after a time with the second-class brains of the country in our universities to train the future generation of chemists.

It was necessary to obtain Government assistance towards increasing both the salaries and number of assistant staff as well as towards the institution of research studentships. Such work the proposed Chemistry Committee might undertake. It was suggested that a graded increase in the salaries of assistant staff might be made which would work out at an average of £100 per annum per individual. The scheme, which included this increase in salary on existing posts, and also an increase in number of such posts by 40%, together with the foundation of research studentships each of the value of £100 (of which four would be available for an "average" institution), could be carried out at a total cost of £30,000 per annum. Although this was a large sum, it was small compared with the magnitude of the object in view, and furthermore it did not represent any considerable addition to the Board of Education estimates which annually reach the figure of £15,500,000.

The progress of chemical industry was far more dependent upon the chemical life of our universities than was perhaps generally recognised. For that reason, therefore, it was hoped that chemical industrialists would realise that the position of chemistry in universities and colleges was a very vital one for themselves.

Mr. Tainsh thought that the scheme of Dr. Forster, though admirable on paper, was so full of difficulties that in practice its value would not be at all commensurate with the cost it would entail. The scheme was to help to place this country in a position of supremacy so far as chemical industries were concerned. This would be determined by the quality and quantity of the available information. The information might be provided by a central department, but the difficulty would be that the requirements would be quite special. For example, how many chemists could discover in a new compound its value for, say, the preparation of smokeless powder? It appeared to him that the case for information would be better met by a well-established technological library in each of the large centres. They would then be able to find what they wanted.

Prof. E. C. C. Baly said that there was not an intelligent person in the country who would not agree to the suggestions of Prof. Lewis, but they were rather of the nature of a corollary scheme to the proposition before them that evening. Any consideration of research that was not *ad hoc* to the present crisis was of very little present value. An organisation such as Prof. Lewis had suggested was not likely in his (Prof. Baly's) opinion to solve the problem.

He thought that the scheme of Dr. Forster was doomed to absolute failure as it would not achieve the one thing that was really necessary, namely, closer co-operation between the manufacturer and the chemist, so that the former could make use of the greatest amount of information which academic research could give. This Society should act as a co-ordinating body of manufacturers with a central headquarters where they could go with suggestions or obtain information.

Prof. Robinson thought that a list of patents should be published in the English language so as to save needless reference to journals. It might be one of the duties of the proposed Department to prepare such a list.

Dr. Holt did not see much use in formulating schemes for the consideration of Government, as it was almost certainly a waste of time. The public must be taught to value chemistry and chemists, and it was the business of their Society to see that this was so. He thought that the education section of the scheme of Dr. Forster was designed to do this. He read a letter from Prof. Armstrong regretting that he could not attend the discussion, and suggesting that their Society should itself become a chemical intelligence department.

This suggestion caused considerable discussion, many members expressing their views as to sending a resolution to Council on the subject. Finally the following resolution was carried :—

"The Liverpool Section would suggest to the Council that the present crisis demands their serious consideration with the view of their formulating a definite forward policy, and maintains that before a Chemical Intelligence Department at the Board of Trade need be established it is desirable that the Society of Chemical Industry organise itself from within."

Nottingham Section.

Meeting held at Nottingham, on Wednesday, March 22nd, 1916.

MR. JOHN WHITE IN THE CHAIR.

A STUDY IN THE PROPERTIES OF CERTAIN CHLORO-HYDROCARBONS.

PART I.

BY SOSALE GARALAPURY SASTRY.

In an earlier paper (this Journal, 1916, **35**, 94) the author was able to show that some of the chloro-derivatives of ethylene and ethane were liable to slight decomposition under the influence of heat and moisture and that the decomposition products attacked certain metals with which they came in contact, to a greater or less extent according to the nature of the metal. It was further tentatively stated that in the case of tetrachloroethane and pentachloroethane the decomposition took place according to the scheme represented by the following equations :—

(i.) $CHCl_2.CHCl_2 = HCl + CCl_2 : CHCl$.

(ii.) $CHCl_2.CCl_3 = HCl + CCl_2 : CCl_2$.

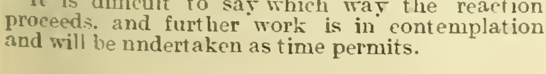
The hydrochloric acid liberated attacked the metals in question, and naturally of all the metals that were tested aluminium, being the most electropositive, was attacked most easily. It was further stated that dichloroethylene and trichloroethylene were the safest solvents to employ. The present investigation was undertaken to ascertain if the decomposition occurred in the way expected.

Fifty c.c. of freshly distilled (146°—147° C.) tetrachloroethane (quite neutral to litmus) was heated with 5 c.c. of water under a reflux condenser for 28 hours. The mixture showed an acid reaction after three hours. After the heatin was over the mixture was titrated and required 1·1 c.c. of $N/1$ sodium hydroxide. On distillin the mixture practically the whole came ove between 143° and 145° C. This would only show that tetrachloroethane is decomposed in th presence of water, hydrochloric acid being formed

In the next experiment a few drops of causti potash were added and the mixture heated. Afte heating for about an hour and a half the reactio mixture was neutral to litmus and some potassiu chloride had been formed. On distilling practicall the whole of the liquid came off between 143 and 145° C.

It was then thought that sodium acetate migh effect the decomposition in the desired way an hence 75 grms. of tetrachloroethane was heate with an aqueous solution of 60·7 grms. of sodiu acetate ($CH_3COONa,3H_2O$) for fifteen hour The two layers were separated and the chlorinate hydrocarbon layer washed thoroughly and drie over calcium chloride and then distilled. A sma portion came over between 70° and 90° C. b the major portion distilled between 140° and 146° The aqueous sodium acetate layer was thri extracted with petroleum spirit to free it from a chlorinated hydrocarbon that may have dissolv in it, and then tested for the presence of sodiu chloride. When heated with manganese dioxi and sulphuric acid appreciable amounts of chlori were given off. The only conclusion that could drawn from this experiment was that the deco position of tetrachloroethane occurs to so extent, with the production of probably a small quantity of trichloroethylene, and the hydrochloric acid evolved in the process would react with sodium acetate giving sodium chloride. Possibly if the mixture had been heated for several days more, the decomposition might have proceeded to a greater extent and trichloroethylene might have been produced in quantity sufficient to be easily identified. But the evidence of the same course of decomposition was forthcoming in other directions.

In the course of the experiments it was found that solid caustic potash reacted violently with tetrachloroethane on warming gently; 50 grms. of tetrachloroethane and 17·3 grms. of solid caustic potash were placed in a round-bottomed flask provided with a reflux condenser, and gently warmed for a few seconds and then the flame taken away. A very vigorous reaction followed with the generation of a considerable amount of heat and the evolution of gases which were at first neutral, and then slightly acid to litmus. A little later the gas as it came out of the condenser burst into a flame with a sharp click and then burnt with a luminous and very smoky flame. This gas was evolved intermittently and on two occasions the flame travelled backwards slowly, and finally entered the flask also. The reflux condenser was carefully detached from the flask, and the flame came to the mouth of the flask and burnt for a second or so and then died out. After about an hour the flask was heated once more; the evolution of this spontaneously inflammable gas again began and the experiment had to be stopped for fear of an explosion. When cool the liquid was filtered to free it from the potassium chloride and the filtrate was distilled. At first the vapours that came off ignited spontaneously on coming into contact with air, but later on the evolution of the gas ceased and the liquid began to distil. The first portion came off between 54° and 55° C., the next portion between 87° and 90° C., and then the temperature rose gradually to 145°—147° C. by which time practically everything had distilled over. The above experiment was repeated with the same result. It is evident, therefore, that under the influence of solid caustic potash tetrachloroethane decomposes into dichloroethylene, trichloroethylene, and probably perchloroethylene. The production of trichloroethylene was expected as the result of the splitting off of a molecule of hydrochloric acid, but it was difficult to account for the presence of other products of decomposition. Once it is known that dichloroethylene is produced it is easy to understand that the inflammable gas that was evolved during the process is chloroacetylene. This would confirm an observation by Ghosh (Chem. Soc. Trans., 1915, **107**, 1597) who records that in all the cases of condensation in which *s.*-dichloroethylene was employed, chloroacetylene was invariably formed. The explanation is that dichloroethylene loses a molecule of hydrochloric acid under the conditions of the experiment, and produces chloroacetylene which is an inflammable gas. (For properties of chloroacetylene *vide* Annalen, **203**, 88; Ber., **23**, 2783.) But the difficulty of the problem lies in accounting for the production of dichloroethylene. This, however, can be explained by assuming that two molecules of tetrachloroethane together split off two molecules of hydrochloric acid in the manner shown below; this accounts for the production of both dichloroethylene and perchloroethylene.



$$\begin{matrix} ClHC{-}{-}Cl & H{-}{-}C.Cl_2 \\ ClHC{-}{-}Cl & H{-}{-}C.Cl_2 \end{matrix} \rightarrow \begin{bmatrix} ClHC{-}{-}C.Cl_2 \\ ClHC{-}{-}C.Cl_2 \end{bmatrix} \rightarrow \begin{matrix} CHCl : CHCl \\ CCl_2 : CCl_2 \end{matrix}$$

It is difficult to say which way the reaction proceeds, and further work is in contemplation and will be undertaken as time permits.

Since the reaction with solid caustic potash introduced some unexpected complications, aqueous caustic potash was next employed: 50 grms. of tetrachloroethane was heated with 17·3 grms. of caustic potash dissolved in 20 c.c. of water for about an hour. A lively reaction followed, and potassium chloride was formed in quantities. The reaction mixture was filtered and washed with water, dried over calcium chloride, and then distilled. Nearly 50% of the liquid came over between 87° and 89° C. and then the temperature rose very gradually at the rate of about one degree in two seconds. By the time the temperature had reached 147° C. everything had distilled over. This again confirms the view that trichloroethylene is the chief decomposition product of tetrachloroethane under these conditions.

With alcoholic potash the reaction progressed in the normal manner (as in the preparation of acetylene from ethylene dibromide, $CH_2Br.CH_2Br$, by the action of alcoholic potash). In a round-bottomed flask provided with a reflux condenser 100 grms. of tetrachloroethane dissolved in 50 c.c. of alcohol was treated with 34·6 grms. of caustic potash also dissolved in alcohol. The flask was cooled since a considerable development of heat took place. After the action was complete the potassium chloride was filtered, and the filtrate distilled. More than 50% of the liquid came over between 70° and 71° C. and then the temperature rose to 78° C., when the remaining portion came over. The portion that distilled over at 70°—71° C. was redistilled and it was found that there was no alteration in the boiling point. This was rather puzzling since the boiling point did not correspond to that of any of the chlorinated hydrocarbons that were expected in the products of decomposition. Working on the idea that trichloroethylene might form a constant boiling mixture with alcohol, the portion boiling at 70°—71° C. was washed thrice with water, and then dried over calcium chloride and redistilled. It distilled over completely at 87°—88° C. Therefore it is evident that trichloroethylene forms a constant boiling mixture with alcohol. To confirm this equal volumes of absolute alcohol and trichloroethylene were mixed and distilled. More than 75% of the mixture distilled over at 70°—71° C. and then the temperature rose to 78° C. Next equimolecular proportions of alcohol and trichloroethylene were mixed and distilled. About 60% of the liquid came over at 70°—71° C. and the remaining portion at 87°—88°. The exact proportions required for this constant boiling mixture have not been found, and the work is reserved for a future occasion. The yield of trichloroethylene in the above experiment was nearly 90% of the theory, which shows that tetrachloroethane decomposes quantitatively in the normal way under the influence of alcoholic potash into trichloroethylene and hydrochloric acid.

In this connection it appeared rather interesting to study the behaviour of tetrachloroethane towards sodium ethoxide: 6·8 grms. of sodium was dissolved in a small quantity of absolute alcohol and 50 grms. of tetrachloroethane added to the well-cooled solution in small quantities. A brisk action ensued and heat was developed and the flask had to be cooled before more tetrachloroethane was added. The mixture was well shaken during the process and was finally heated on a water-bath for two hours. At the end of that time the sodium chloride that had been formed was separated by filtration and the filtrate, which was quite neutral to litmus, was distilled. The major portion of the liquid came off at 70°—71° C. and the remainder at 78° C. The first portion was treated with water three times, dried over calcium chloride, and distilled; the whole distilled over at 87°—88° C. The yield of the trichloroethylene was almost quantitative. This would show that the reaction proceeded according to the equation.

$$CHCl_2.CHCl_2 + C_2H_5ONa = CHCl{:}CCl_2 + NaCl + C_2H_5OH,$$

and it is extremely unlikely that the corresponding ether was first formed and decomposed later on as in the equations.

$$CHCl_2.CHCl_2 + C_2H_5ONa \rightarrow -NaCl \quad CHCl_2.CHCl(OC_2H_5)$$

$$CHCl_2.CHCl\,(OC_2H_5) + [H_2O] \rightarrow CHCl{:}CCl_2 + C_2H_5OH + [H_2O].$$

In the next experiment twice as much sodium ethoxide as in the foregoing one was used, still with the same results, except that in the early stages a little inflammable gas was given off. For lack of suitable apparatus this gas could not be isolated and examined, but has hitherto been supposed to be chloroacetylene. There is, however, a possibility that the gas may be dichloroacetylene, CCl:CCl, which judging from other corresponding compounds would be more or less unstable and would ignite on coming in contact with air.

The action of potassium phenoxide on tetrachloroethane did not furnish anything new; trichloroethylene was produced and phenol recovered unchanged (compare Tiemann and Reimer's reaction).

All the experiments enumerated above were tried with pentachloroethane, and in every case the reaction progressed on similar lines with the production of perchloroethylene according to the equation.

$$CCl_3.CHCl_2 + KOH \rightarrow KCl + CCl_2{:}CCl_2 + H_2O,$$

the only difference being that inflammable gases were not given off except when solid caustic potash was used.

The case of *s*-dichloroethylene was very interesting. It was not acted upon by solid caustic potash. In fact it could be distilled quite easily and harmlessly over solid caustic potash. Even aqueous caustic potash did not react with it. But alcoholic potash decomposed it with the production of chloroacetylene. (Compare Ghosh, *ibid.*)

A very interesting outcome of this comparative inertness of dichloroethylene towards solid and aqueous alkalis, coupled with its high solvent power towards fats, etc., and its non-inflammability, is the possibility of its use in soap analysis for the estimation of free fats, in place of the inflammable and costly petroleum spirit. Mr. J. H. Gill and the author are investigating the problem and the results will be communicated to the Society as soon as possible.

The only other chlorinated hydrocarbon experimented upon was trichloroethylene. This also is relatively stable towards solid and aqueous alkalis. Trichloroethylene was distilled several times over solid caustic potash without any change, but alcoholic potash reacted easily and the usual inflammable gas was given off. It is very difficult to say whether this is chloroacetylene or not. Judging from the behaviour of other chlorinated hydrocarbons towards alcoholic potash one would be compelled to suppose that a molecule of halogen acid splits off, and that would mean that the gas evolved was dichloroacetylene, CCl : CCl. Further work is required before anything can be said definitely, and it is the intention of the author to continue the work as time permits.

In conclusion the author desires to thank Mr. T. H. Gray and Mr. J. H. Gill for the interest they have taken in the work, and also Messrs. Gerard Bros., Ltd. (Soap Works, Nottingham), for placing the resources of their laboratory at the disposal of the author.

THE SWELLING OF GELATINOUS TISSUES.

BY H. R. PROCTER AND D. BURTON.

(See this J., Apr. 15, 1916, 404—409.)

ERRATA.

Page 404, column 2, the first four lines should follow the line " Figure I . . . the quantities," and in footnote * add "H. R. Procter and J. A. Wilson, *ibid.*, 1916, **109**, 307."

Page 405, col. 1, line 5 from bottom, for " Fig. 2 " read " Fig. 1."

Page 409, col. 1, line 35, for " pure " read " puer."

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on Monday, March 27th, 1916.

MR. F. W. RICHARDSON IN THE CHAIR.

A QUANTITATIVE CHEMICAL METHOD OF DETERMINING THE AMOUNT OF SEASONING OF TEAK WOOD.

BY ANUKUL CHANDRA SIRCAR, M.A., PH.D., F.C.S.

The proper seasoning of teak wood is a matter of the utmost practical importance, but no work has hitherto been done in the direction of devising any method by which seasoned teak wood can, with certainty, be distinguished from unseasoned or partially seasoned teak wood.

Romanis (Chem. Soc. Trans., 1887, 868) has shown that alcohol extracts from teak wood about 6% of a soft resinous substance and that the extracts from freshly cut (*i.e.*, unseasoned) teak and from teak that has been long exposed to the air (*i.e.*, seasoned teak wood) are of a different nature—the former being entirely soluble in chloroform whereas the latter is only partly so, and further, that the percentage composition of that part of the resin which is soluble in chloroform is quite different from that of the part insoluble in chloroform.

In a previous paper (Journal Asiatic Society of Bengal (New Series), 1912, **8**, No. 8) the work of Romanis was extended and it was shown that teak wood sawdust yields on steam distillation either a crystalline or an oily substance or a mixture of the two according as the wood is seasoned, unseasoned, or partially seasoned. Further, it was pointed out that the occurrence of the crystalline substance in seasoned teak wood and its absence in unseasoned teak wood served to distinguish between the two, and that in the case of partially seasoned teak wood the amount of the former as compared with the amount of the latter could be taken as a criterion of the amount of seasoning of the sample of wood examined.

The present investigation was undertaken with a view to finding out a method of completely separating the crystalline and the oily substance from a mixture of the two, and thereby arriving at a quantitative method of determining the exact amount of seasoning of any sample of teak wood.

It was found that there was a wide difference in the solubility of the crystalline and the oily substance in methyl alcohol—the former being sparingly soluble, whereas the latter is extremely soluble in that solvent. Advantage was taken of this property of methyl alcohol in separating the crystalline and the oily substance from a mixture of the two.

The method of procedure was as follows:—100 grms. of freshly made sawdust from the sample of teak wood to be examined was subjected to steam distillation and exactly one litre of distillate collected. When the distillate had cooled to the ordinary temperature, it was shaken with 100 to 125 c.c. of ether, which easily dissolved the crystalline as well as the oily substance contained in the distillate, yielding a light yellow solution and leaving a colourless aqueous solution. The ethereal solution was separated and allowed to evaporate at the ordinary temperature in a shallow dish, when the crystalline or the oily substance, but more frequently a mixture of the two, remained in the dish. After the ethereal extract had been weighed, it was carefully washed with 1·5 c.c. of methyl alcohol, which at once dissolved the whole of the oily substance. The methyl-alcohol solution was quickly filtered through a very small funnel and the filtrate received in a small beaker. The filter-paper, the diameter of which was not more than one inch, was washed with a drop or two of methyl alcohol and the filtrate mixed with the original. The crystalline substance, free from any admixture of the oily substance, was left behind on the filter-paper or in the glass dish as beautiful white branching needles. The methyl alcohol was allowed to evaporate at the ordinary temperature and the weight of the brown oily substance left behind in the beaker carefully noted. 1·5 c.c. of methyl alcohol was found to be sufficient to dissolve the whole of the oily substance contained in the ethereal extract. Care was therefore taken in all the experiments performed not to use more than 1·5 c.c. of methyl alcohol, for any excess of methyl alcohol would naturally dissolve a part of the crystalline substance. This point is of great importance in the successful working of the method, for, as will be shown later, it is from the weight of the oily residue that the seasoning of any sample of teak wood can be determined.

To ascertain whether the whole of the crystalline and the oily substance in any sample of teak wood could be obtained by steam distillation of its sawdust, 100 grms. of very old teak wood (*i.e.*, seasoned wood) sawdust, and also 100 grms. of sawdust from the wood of a freshly cut teak tree (*i.e.*, unseasoned wood) was subjected to prolonged steam distillation, the distillate collected in fractions of one litre each, and the different fractions examined in the usual way. The results obtained are tabulated below:—

Old teak wood.

Fraction of distillate.	wt. of the ethereal extract.
	grms.
1st litre	0·0280
2nd litre	0·0175
3rd litre	0·0191
4th litre	0·0180
5th litre	0·0165
6th litre	0·0174
7th litre	0·0160
8th litre	0·0152
9th litre	0·0174
10th litre	0·0172

In each case the ethereal extract consisted of white crystals, without the slightest admixture of any oily substance.

From these results it was concluded that:—

1. The oily substance is totally absent in very old teak wood (*i.e.*, perfectly seasoned teak wood).

2. The crystalline substance contained in teak wood does not all come out in the first litre of distillate obtained by steam distillation of its sawdust.

3. In the case of seasoned teak wood, the crystalline substance comes out in larger quantities in the first litre of the distillate and the quantities of the crystalline substance coming out in the subsequent fractions of the distillate are practically the same.

4. The crystalline substance is not absent in fresh teak wood (*i.e.*, unseasoned teak wood), as was mentioned in the previous paper (*loc. cit.*).

5. The oily substance present in fresh teak wood appears mostly in the first litre of the distillate and in gradually diminishing quantities in the subsequent fractions of the distillate, until in the 4th to 5th fractions and afterwards it does not come out at all.

6. In the case of fresh teak wood the crystals do not come out in the first portions of the distillate, at any rate not in appreciable quantity, but they come out in larger quantities in the subsequent portions of the distillate.

7. A greater weight of ethereal extract in obtained in the case of fresh teak wood than in the case of old teak wood.

Supplementary experiments supported the above-mentioned conclusions.

It was therefore deemed advisable to collect only 1000 c.c. of the distillate in each case and determine the amount of oily substance contained in it. In order to avoid as far as possible any change in the weight of the oily substance by oxidation or change of composition in any other way, no heat was used in drying either the ethereal or methyl alcohol extract.

Some samples of differently seasoned teak wood, supplied from the workshop of Dacca School of Engineering, were next examined. The results obtained are recorded in the table on following page. From the figures in the last column it will be seen that the percentage weights of the oily substance present in the various samples of wood examined do not come exactly in the order of the dates of their purchase, *i.e.*, in the order in which they are supposed to be seasoned. But from the figures in the fourth column it will be seen that the weight of the methyl alcoholic extract (*i.e.*, of the oily residue) becomes less and less according as the wood is more and more seasoned.

It being found that teak woods that have been seasoned some time back also contain some oily substance, it becomes a question of importance to fix the amount which will represent the maximum weight of oily residue than can possibly be obtained from any sample of teak wood which is just seasoned from a commercial point of view, *i.e.*, is just fit for use.

Freshly cut teak wood.

Fraction of distillate.	Nature of the distillate.	Weight of the ethereal extract. grms.	Nature of the ethereal extract.	Weight of the methyl alcohol extract. grms.
1st litre	Cloudy, containing no crystals but only oily drops floating on the surface.	0·1000	Brown, oily.	0·0792
2nd litre ..	Cloudy, containing some crystalline as well as oily substance.	0·0868	Oily, mixed with some crystals.	0·0396
3rd litre	Cloudy, containing some crystalline and very little oily substance.	0·0578	Brown and crystalline.	0·0250
4th litre	Cloudy, containing only some crystals and no oily substance.	0·0420	Brown and crystalline.	0·0129
5th litre	Ditto	0·0521	White, crystalline.	0·0095
6th litre	Ditto	0·0434	Ditto	0·0090

Number of sample.	Date on which the wood was locally bought as seasoned.		Weight of ethereal extract. grms.	Weight of the methyl alcoholic extract (i.e. of the oily residue). grms.	Nature of methyl alcoholic extract.	% wt. of the methyl alcoholic extract with reference to the weight of ethereal extract.
1.	Very old	(1)	0·0254	0·0053	Crystalline and white	20·0
		(2)	0·0140	0·0024	Crystalline and white	17·0
2	1901.		0·0080	0·0022	Crystalline and white	27·5
3	1902.		0·0148	0·0043	Brown and crystalline	28·9
4.	August, 1905.		0·0134	0·0042	All crystals	31·5
5.	1907.		0·0204	0·0078	Brown crystals	38·0
6	April, 1908.		0·0212	0·0072	Brown and crystalline	31·7
7.	June, 1909.		0·0220	0·0088	Brown and crystalline	40·2
8.	November, 1911.		0·0232	0·0188	Oily	81·0
9.	January, 1912.		0·0374	0·0243	Oily	63·0
10.	Cut in January, 1912 and left by itself.		0·0292	0·0204	Oily	70·0
11.	Freshly-cut	(1)	0·1000	0·0792	Oily	79·2
		(2)	0·1100	0·0809	Oily	73·6

These observations were made in September, 1912.

From a reference to the table given above it will be seen that, except in the case of sample No. 9, which in all probability represented some wood not properly seasoned, in every case of seasoned teak wood the weight of the oily residue falls below 0·0200 grm., in fact the weights are never higher than 0·0188 grm. Making an allowance of another 0·001 grm., it is therefore concluded that a sample of teak wood which is just seasoned may yield up to a maximum weight of 0·02 grm. of oily residue from 100 grms. of its sawdust. If the weight of the oily residue be greater than 0·02 grm. the wood in question is unseasoned, and the greater the weight the less seasoned the sample and *vice versa.*

As a further verification of the proposed method, a large number of unknown but differently seasoned samples of teak wood, supplied from the workshop of Eastern Bengal State Railway were examined. The results obtained were extremely satisfactory and fully justified the safe applicability of the method in determining the amount of seasoning of any sample of teak wood.

Thus, the conclusion is that from a determination of the amount of oily substance present in any sample of teak wood, the degree to which it has been seasoned can be found.

In conclusion I beg to express my best thanks to Dr. E. R. Watson for the help and encouragement which I have received from him throughout the course of this investigation.

ACTION OF "DRIERS" ON OLIVE OIL.

BY W. MCD. MACKEY AND HARRY INGLE.

Our attention was drawn early in the war to the prevalence of fires in cloth mills employed in the manufacture of khaki goods, and it occurred to us that there might be some action of the metallic salts, used in the mordanting or other

TABLE I.

Time, mins.	8·5% Khaki soap.	7% Khaki soap.	2% Co soap.	2% Mn soap.	2% Cr soap.	2% Pb soap.	2% Ni soap.	2% Fe soap.	2% Cu soap.	2% Cu soap.	2% Al soap.	2% Al soap.	2% Zn soap.	2% Soda soap.‡	Olive oil.
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
18			100	87											
20			132	97											
21				110											
22				130											
23			183	155											
24				179											
24½			200												
25			stopped	200	88		92								
28			†	•		92			82	84					
30		82			124	101	101		85	87	86·5	83			84
31													83		
32	192				147										
32½	202														
33	•				165										
35						120	127								
35½					200										
40					•	169	193						92·5	92	
40½							200								
41½						200	•								
45		142				•			102	107	95	93			92·5
50								98	114	119	97	95		96	94
55		202						102	116·5	120			100·2		94·8
60		•						107	113	113	99·5	97·5	102·5	98·5	95·4
70								141	106·5	106			107	100	96
74								197							
75								•	105	104	102·5	100·5			96·4
80													113·5		
90									stopped	101	106	103	120	102	
100													132·5		
105										101·5	106·5	106			97·3
110													171		
112													202		
120										103	125	112	•	105	98
130											206			105·5	
150										104	•	215		stopped	
180										102		•			99·5
										stopped					stopped

• Thermometer withdrawn. Fired on standing. † Did not fire. ‡ The soap used for making other soaps.

processes connected with dyeing, on the oils used as lubricants in the subsequent spinning and weaving operations.

A sample of khaki cloth was incinerated (ash, 1·36% on the weight of the cloth), the ash treated with dilute hydrochloric acid, the solution filtered, and the filtrate neutralised and precipitated with a pure tallow soap (yield, 6% of "khaki soap" on the weight of the cloth). This was dissolved in a "safe" olive oil and tested (two experiments, see Table I.) in the Mackey Cloth Oil Tester (this Journal, 1896, 90). The rapid development of heat observed in these tests formed a basis for the continuance of the work. Only a qualitative analysis of the khaki ash was made; it showed the presence of a considerable proportion of chromium with a little iron.

It was decided to prepare similar soaps of various metals and try their action on a "safe" oil in the tester. For this purpose a pure tallow soap was used to precipitate the soaps of lead, cobalt, nickel, chromium, iron, aluminium, copper, and zinc, which, after washing, were dried and melted.

Two per cent. of each of these (on the oil) was dissolved in a "safe" olive oil (iodine value, 85) and the solutions tested on cotton wool in the Cloth Oil Tester with the results given in Table I.

Some of the results in the table are rather difficult to explain. Thus (a) Cobalt: a known "drier," though it heated rapidly on the cotton wool, did not fire. (b) Nickel: a weak "drier" with linseed oil, gave approximately the same result as lead, a good "drier" with linseed oil. (c) Copper; a maximum temperature of 120° C. in 55 minutes (second experiment) and then a slow decline. (d) Aluminium: a non-drier, in contrast with the copper experiments, finished by firing.

Table II., in conjunction with a summary of the results on Table I., gives the comparative stability of the higher and lower oxides of each of the metals and also the known action of these metals or soaps on drying oil, and in this connection it must be remembered that olive oil, like linseed, is an unsaturated oil.

TABLE II.

Driers and their action on oils.

Metal.	Stability of oxides and their compounds.	Heat generation in the Tester. Time to reach 200° C.	Action as drier at ordinary temp. on drying oil.
Cobalt	Lower oxidation products stable	24½ mins.	Strong
Manganese	do.	25 ,,	,,
Chromium	do.	35½ ,,	Weak
Lead	do.	41½ ,,	Strong
Nickel	Intermediate	40½ ,,	Weak
Iron	Higher oxidation products more stable	74 ,,	,,
Copper	do.	Did not attain 200° C.	Non-drier
Aluminium	One oxidation product only	130 mins.	,,
Zinc	do.	112 ,,	,,

The general conclusions to be drawn from these results seem to be that, in its oil-soluble form, a metal which exists in more than one state of oxidation acts as a "drier" or oxygen carrier, provided that the lower oxides are more stable than the higher. In Table I it will be noticed that cobalt, manganese, chromium, and lead are all to the left, *i.e.*, showing very quick rise of temperature; iron and copper (higher oxides more stable) appear in the centre of the table; aluminium and zinc (one state of oxidation only) appear well to the right.

It seems clear also that metals analogous to chromium form compounds with drying oils or simply unsaturated oils like olive oil, which may prove dangerous under the conditions obtaining in cloth mills.

We thought it of interest to try the action of a chromium soap on mineral oil, and also the action of mineral oil as a retarder of spontaneous heating under the conditions of the experiments given in Table I.

The addition of 25% mineral oil to a "dangerous" oil has been shown by one of us (this J., 1895, 940), as indeed would be expected, to retard spontaneous heating—in fact, to make a "dangerous" oil "safe." In the case of the olive oil holding a chromium soap in solution it will be seen by Table III that the addition of even 50% mineral oil, though it reduces the liability to spontaneous heating, does not render the oil "safe" according to the formula adopted for classifying cloth oils, *i.e.*, an oil is considered "safe" if, when tested in the Cloth Oil Tester, it does not attain a temperature of 200° C. in two hours: dangerous when it does (see this J., 1895, 940).

TABLE III.

Time. Mins.	2% Cr soap in olive oil.	2% Cr soap in 75% olive oil and 25% mineral oil.	2% Cr. soap in 50% olive and 50% mineral oil.	2% Cr soap in mineral oil 0·906 sp. gr.
	° C.	° C.	° C.	° C.
25	88			
28	102	82		
30	124	85·5	82	83
32	147	88·2	84	84
33	165	90	85	85
35½	200	94	87·5	87
40	*	106	91	89·5
45	—	137	94	92
50	—	193	97·5	93·5
50½	—	200	—	—
60	—	*	108	96
75	—	—	134	96·5
90	—	—	181	96·5
94	—	—	200	96·5
105	—	—	*	96·5
120	—	—	—	96·5 Expt. stopped.

* Thermometer withdrawn. Fired on standing.

DISCUSSION.

Mr. F. W. RICHARDSON asked if the composition of the khaki ash was known. He thought it would be mostly Cr_2O_3 which was very stable; the ash must also contain some other metallic compounds. He did not understand how from a hydrochloric acid solution one could get a soap. Ignited chromic oxide was not usually considered to be soluble in hydrochloric acid. He thought it very remarkable that an aluminium soap could give the effects noticed and would be glad of some further explanation.

Mr. LOWSON asked if cobalt salts were largely used as "driers" and if so in what form.

Mr. W. Harrison asked if the heating effects were greater with a drying oil.

Mr. Richardson suggested that experiments should be made on the cloth itself in the oil tester.

Mr. Mackey said that the cloth might have been teased into loose wool; but the cloth had been scoured and therefore would contain little or no oil. The danger of spontaneous heating was either in the yarn or the unscoured cloth. If the unscoured cloth were teased and tested in the oil tester no doubt there would be a rise of temperature; but the draught would have to be checked, as the amount of oil in unscoured cloth was small compared with that in the cotton wool under the ordinary conditions of experiment.

Dr. Ingle in reply said that the amount of khaki ash at their disposal was small and they had not made a quantitative analysis. He had found, as stated in the paper, chromium with some iron, and, in one of the samples, zinc (no doubt from the waterproofing process). He had found no difficulty in dissolving the ash, perhaps because the temperature was kept low during the ignition, ammonium nitrate having been used as an oxidising agent. At any rate, out of 1·36% of ash, only 0·08% remained insoluble in the acid. In reply to Mr. Harrison, drying oils had not been tried in the present investigation, but it was obvious that, as they gave a rapid rise of temperature in the oil tester with no "drier," they would give a more rapid rise if a "drier" were added. With reference to the use of cobalt salts as "driers," he had come across a few boiled oils containing cobalt, but doubtless cobalt was too expensive. Usually it was added as a resinate.

DEPILATION OF HIDES AND SKINS.

BY J. E. PICKLES.

Contribution from the Leather Industries Dept., University of Leeds.

A common method of unhairing hides and skins is by means of sodium sulphide in conjunction with milk of lime. At the present time the high price of sodium sulphide is almost prohibitive, and a substitute for this material, which would give the same effects, *i.e.*, a much shorter liming and a greater swelling action than lime alone, would be very much welcomed by the leather trade generally.

About 1860 the use of a mixture of sulphur with lime and sodium carbonate was proposed by Lufkin, and used in the United States with some success (see Eng. Pat. 2053 of 1860), and at the suggestion of Prof. Procter, I have made a series of experiments with these materials to determine the best methods for their practical use. The results of these experiments may be of interest.

When sodium sulphide is dissolved in water it is hydrolysed with the formation of sodium sulphydrate and hydroxide, and it has been proved that the sulphydrate is the active depilatory agent, the caustic soda serving to swell the hide fibres: 78 parts of sodium sulphide produce 33 parts of sulphydrion, SH (neglecting the weight of the sodium), and 40 parts of caustic soda.

If sulphur is boiled with milk of lime, a certain amount of calcium sulphydrate is formed, together with some polysulphides, the latter being not detrimental, if not actually advantageous, to the process.

As the results of my experiments, I have found that if ½ lb. sulphur is boiled with lime, the same unhairing effect is obtained as with 1 lb. of sodium sulphide or 3 lb. of $Na_2S.9H_2O$ ordinarily used.

To obtain the same amount of caustic soda in the lime, as if the sulphide had been actually used, is of course a simple matter, since if sodium carbonate is added to the lime water calcium carbonate and sodium hydroxide are produced; roughly 11 oz. of anhydrous sodium carbonate or 33 oz. of soda crystals will give the same amount of caustic soda that is obtained from 1 lb. of sodium sulphide or 3 lb. of $Na_2S,9H_2O$.

The procedure is as follows: the calculated amounts of sulphur and of sodium carbonate are weighed, the sulphur is added to the lime when slaking, and if necessary boiled with the lime until all sulphur is dissolved. This gives a yellow liquid. The soda can be added during or after the slaking.

This lime has been used in the experimental tannery of the University of Leeds on two packs of calfskins for chrome tanning, using sulphur and soda calculated to replace 5% of sodium sulphide on weight of lime; the goods were ready for unhairing in 4 days, and as far as could be seen there was no difference between these skins and skins unhaired with sodium sulphide.

The lime was also used on one pack of hides for chrome sole leather. In this case more soda was added to the lime in order to increase the swelling. The hides were unhaired in 4 days.

It has also been used for skins intended for vegetable tanned dressing leathers with equally good results.

From these experiments it seems that these two materials would be a good substitute for sodium sulphide, with the advantage that the swelling can be controlled by increasing or decreasing the amount of soda, if more or less swelling is required than is given by sodium sulphide alone. By the omission of the soda an effect very similar to that of an "arsenic lime" is obtained.

POTASH IN THE BANANA STALK.

BY R. H. ELLIS, F.I.C.

Some weeks ago I was asked to make an examination of the banana stalk with a view to the use of its fibre for pulp for paper making or possible use in other directions.

In the course of the examination I noticed that the juice of the stalk was sufficiently alkaline to cause irritant action on the skin and this led me to examine it further, with the result that I found that it contained a large percentage of potash and practically no soda.

The following figures give the composition of ash:—

	per cent.
Silica (SiO_2)	9·61
Iron oxide (Fe_2O_3)	0·16
Alumina (Al_2O_3)	3·49
Lime (CaO)	1·69
Magnesia (MgO)	1·68
Potash (K_2O)	45·90
Soda	trace
Sulphuric acid (SO_3)	2·10
Carbonic acid (CO_2)	31·11
Chlorine (Cl)	1·52
Phosphoric acid (P_2O_5)	2·74
	100·00

The following figures have been confirmed by Dr. A. J. Hanley, of the Agricultural Department Leeds University.

	Ellis.	Hanley.
Moisture in original stalk %	91·6	92·7
Dried matter in original stalk %	8·4	7·3
Ash in original stalk %	2·4	1·5
Potash in original stalk %	1·14	0·9
Ash in dried matter %	29·9	20·5
Potash in dried matter %	13·73	12·35
Potash in ash %	45·9	59·1

Dr. Hanley also extracted the juice by pressur in a small meat press, and found it to contain 0·7 potash.

From the above figures it will be noted that th dried matter is as rich in potash as kainit.

Thus, from my figures, 1 ton of banana stalks will yield 188 lb. of dried matter containing 13·7% of potash (K_2O), or 54 lb. of ash containing 47·5% potash, or 25 lb. of pure potash.

Considering that large quantities of banana stalks come into the country every week and that there is a great demand for potash, the question of this refuse is worth the attention of municipal sanitary authorities. I am told that over 4000 stalks come into Leeds every week. When stripped they have an average weight of 4 lb. each or 16,000 lb. in all, representing 1340 lb. (about 12 cwt.) of dried matter as rich in potash as kainit.

Discussion.

Mr. **George Ward** thought it possible that the refuse from Corporation destructors might contain potash, seeing that a large percentage of it came from vegetable produce. He suggested that a careful analysis of the ashes should be made.

The **Chairman** suggested that Corporations would be serving a good purpose if they set apart all the refuse from the markets, so that it could be examined and treated.

NOTE ON A FIELD METHOD FOR DETERMINING DISSOLVED OXYGEN IN WATER.

BY JAMES MILLER.

In the method described by me (this Journal, 1914, 185) phenosafranine is used as the indicator, but it seems that this substance is somewhat difficult to obtain and another indicator is desirable. I find that methylene blue can be substituted, determinations made with both indicators giving the same results.

Communication.

THE DETERMINATION OF THE SPECIFIC GRAVITIES OF FIXED OILS IN THE TROPICS.

BY C. HAROLD WRIGHT, B.A. (CANTAB.), F.I.C., AGRICULTURAL CHEMIST, FIJI.

It is not easy to determine the specific gravity of an oil at 15·5° C. in the tropics, because this temperature is generally below the dew point of the air. Hence if a specific gravity bottle or Sprengel tube be cooled to 15·5° C. moisture condenses on the outside. By cooling the oil with ice it is possible to determine its specific gravity at 15·5° C. with a Westphal balance; but this is not a very convenient method, because when the temperature of the air is between 25° and 30° C. it is very difficult to maintain the oil at 15·5° C., and whilst the oil is cooled moisture condenses on the surface of the oil and the platinum wire attached to the plummet.

A far more convenient and quicker method is to determine the specific gravity of an oil at the temperature of the air (water at 15·5° C. = 1), and from the result so obtained to calculate the specific gravity at 15·5° C., as explained below. For this purpose a specific gravity bottle with perforated stopper is most convenient. It is necessary to know the weight of water held by the specific gravity bottle at 15·5° C., but for reasons given above this cannot be determined directly. If, however, the weight of water held by the bottle at any given temperature is known it is possible to calculate the weight of water which the bottle would hold at 15·5° C., as explained below.

The procedure is as follows:—The specific gravity bottle after being dried and weighed is almost filled with distilled water, and placed in a beaker containing tap water, which reaches up to the neck of the bottle; in the same beaker is placed a thermometer graduated to 0·1° C. After allowing to stand until a steady temperature has been reached, the thermometer is read, and the stopper inserted, after which the bottle is dried on the outside and weighed. After again drying the specific gravity bottle, it is almost filled with the oil of which the specific gravity is to be determined, and placed together with a thermometer in a beaker containing water, and allowed to stand until the temperature is steady; the stopper is then inserted, the bottle is wiped on the outside and weighed.

Having found, as explained above, the weight of water held by the specific gravity bottle at a given temperature, the weight of water held by the bottle at 15·5° C. can be calculated as follows:—

Let w_t = weight in air of water held by the bottle at t° C.,

d_t = weight in air of 1 c.c. of water at t° C.,

$d_{15 \cdot 5}$ = weight in air of 1 c.c. of water at 15·5° C.,

and a = the coefficient of cubical expansion of glass.

Then the volume of the bottle at t° C. is w_t/d_t c.c., and the volume of the bottle at 15·5° C. is

$$\frac{w_t}{d_t[1+(t-15 \cdot 5)a]} \text{ c.c.}$$

Therefore the weight of water held by the bottle at 15·5° C. is

$$\frac{w_t \times d_{15 \cdot 5}}{d_t[1+(t-15 \cdot 5)a]} \text{ grms.}$$

I have calculated the value of the factor

$$\frac{d_{15 \cdot 5}}{d_t[1+(t-15 \cdot 5)a]}$$

for each degree centigrade from 20° to 30°. The weights in air of 1 c.c. of water were taken from a table in Sutton's *Volumetric Analysis*, 10th Edition, 1911, p. 26, giving the weights in air of 1 litre of water at various temperatures. According to this table the weights in air of 1 c.c. of water at 15° and 16° C. are 0·99811 and 0·99796 respectively; the weight in air of 1 c.c. of water at 15·5° C. was taken as 0·99804 (the arithmetic mean). The value of a was taken as 0·0000258. The values of the factors thus obtained are given in the following table.

Table I.

Temperature.	Factor.
20° C.	1·00067
21°	1·00085
22°	1·00106
23°	1·00125
24°	1·00146
25°	1·00170
26°	1·00192
27°	1·00214
28°	1·00240
29°	1·00265
30°	1·00293

Hence if the weight of water held by the specific gravity bottle at any particular temperature is known, the weight of water held by the bottle at 15·5° C. can be found by multiplying this weight by the factor opposite the observed temperature.* The following results will show the method of performing the calculation, and also the accuracy attained. The weights of water held by a Sprengel tube in Fiji were 21·3340 grms. at 26·5° C., and 21·3308 grms. at 27·1° C. Hence the weight of water held by the Sprengel tube at 15·5° C. is

(i.) 21·3340 × 1·00203 = 21·3773 grms.
(ii.) 21·3308 × 1·00216 = 21·3769 grms.

Mean 21·3771 grms.

The weight of water held by the same Sprengel tube at 15·5° C., when determined directly in England (in 1907) was 21·3797 grms. This value differs from the above mean by 0·0026, which is a difference of about 0·0001 in 1. This slight difference may be due to the fact that the coefficient of cubical expansion of this Sprengel tube is not the same as the value taken above. The recorded values of the coefficient of cubical expansion of glass vary considerably; and if it were desired to determine the weight of water held by a specific gravity battle or Sprengel tube in the tropics with great accuracy, it would be advisable first to determine the coefficient of cubical expansion of the specific gravity bottle or Sprengel tube.

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* The factors for intermediate temperatures can be easily calculated by the method of differences. Thus, at 25·7° C., the factor is 1·00170 + 0·7 × 0·00022 = 1·00185.

Having found as explained above the weight of oil held by the bottle at a temperature, say t° C., and the weight of water held by the same bottle at 15·5° C., then on dividing the first weight by the second there is obtained the specific gravity of the oil at t° C. (water at 15·5° C. = 1). From this value the specific gravity at 15·5° C. can be easily calculated.

I have shown (this J., 1907. **26.** 513) that the modulus of expansion of 16 fixed oils varies from 0 000651 to 0·000745. The mean value is 0·000693, and can be taken as 0·0007 for purposes of calculation. Hence if S_t = specific gravity of any oil at t° C. (water at 15·5° C. = 1) and $S_{15\cdot5}$ = specific gravity of the same oil at 15·5° C. (water at 15·5° C. = 1), then

$$S_{15\cdot5} = S_t \times \frac{1 - 0\cdot6007 \times 15\cdot5}{1 - 0\cdot0007t}$$

$$= S_t \times \frac{0\cdot98915}{1 - 0\cdot0007t.}$$

In the paper referred to I gave the values of the factor $\frac{0\cdot98915}{1 - 0\cdot0007t}$ for each degree centigrade from 10° to 25°. This table is suitable for use in a temperate climate, but in a tropical laboratory higher temperatures are often met with. In the following table the values of the above factor are given for each degree centigrade from 20° to 35°.

TABLE II.

Temperature.	Factor.
20° C.	1·00319
21°	1·00391
22°	1·00462
23°	1·00534
24°	1·00605
25°	1·00677
26°	1·00749
27°	1·00821
28°	1·00892
29°	1·00965
30°	1·01037
31°	1·01109
32°	1·01181
33°	1·01254
34°	1·01327
35°	1·01399

Hence the specific gravity of an oil at 15·5° C. can be found by multiplying the specific gravity as determined above by the factor opposite the temperature at which the determination was made.* An example will make the calculation clear. A specific gravity bottle was found by the method described above to hold 24·9979 grms. of water at 15·5° C. When filled with "dilo" oil (*Calophyllum inophyllum* oil prepared in Fiji) it held 22·9568 grms. of oil at 29·0° C. Hence the specific gravity of the "dilo" oil at 29·0° C. (water at 15·5° C. = 1) is $\frac{22\cdot9568}{24\cdot9979} = 0\cdot9183$, and the specific gravity at 15·5° C. (water at 15·5° C. = 1) is $0\cdot9183 \times 1\cdot00965 = 0\cdot9271$.

Obituary.

IVAN LEVINSTEIN.

Ivan Levinstein, a Past-President of this Society, died at Hale, Cheshire, on March 15th. Born at Charlottenburg, Germany, in 1845, he received his early education in chemistry at Berlin University and Technical High School, and under Professor Weber he carried out an extended research on the preparation of aniline dyestuffs.

Coming to Manchester in 1864, he commenced the manufacture of aniline dyestuffs and other products at Blackley—a bold undertaking for a youth of 19, and one which exemplifies the great courage and enterprise which always characterised his life. His early manufactures were confined to magentas, violets, Bismarck brown, Chrysoidine, and "Blackley blue," but under his forceful direction the firm rapidly extended its field of operations, and in 1887 was transferred to Crumpsall. Since that time the production of the firm has increased enormously, until to-day it is the largest dyestuff manufactory in this country, entirely independent and making all the necessary intermediate products.

Small though the British colour industry is in comparison with that in Germany, we owe it mainly to Levinstein's wonderful perseverance that it is still in existence. With the greatest courage and tenacity he worked for an amendment of our Patent Laws with a view to securing more protection for the industry, and in so doing incurred the hostility of the large German colour works, which resulted in the sudden cutting off of the whole of the firm's trade with the German works in intermediate products. Despite the great personal loss which this action involved, he did not relax in his advocacy of compulsory working licences, and contested many legal actions against the German works on this point. His perseverance eventually resulted in the passing of the Patent Law Amendment Act, in 1902, and of the present Patent Act in 1907, in which a compulsory working clause was incorporated. A direct result of the passing of this Act was the establishment at Ellesmere of a factory for making synthetic indigo. Levinstein's wide grasp of the importance of Patent Legislation to the industries of this country may be gathered from his Presidential addresses to this Society (this Journal, 1902, 893; 1903, 843).

He took a very active interest in education in Manchester, and in addition to being for many years a member of the Court and a governor of the Victoria University, he was for a long period connected with the Manchester Institute and Technical School, and was one of the founders of the School of Technology. His services to technical education were recognised by the award of the degree of Master of Technical Science by Manchester University. For many years he was a Director of the Manchester Chamber of Commerce, and had also been President of that body, a position which he resigned when he became a member of Mr. Chamberlain's Tariff Commission. He also founded and for many years edited the "Chemical Review," the first chemical trade journal published in this country. The Chemical Section of the Royal Jubilee Exhibition, held in Manchester in 1887, owed its great success largely to the fact that Levinstein was its Chairman.

Levinstein had the distinction of occupying the Presidential chair of this Society during two successive years (1901—1903). It was during his Presidency that the Journal was changed from a monthly publication to a bi-monthly one—a result largely due to his energy and vigorous methods. He was Chairman of the Manchester Section of the Society from 1889 to 1894, an Ordinary Member of Council from 1894—1897, and Vice-President from 1897 to 1900 and again from 1903 to 1906.

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* The factors for intermediate temperatures can be easily calculated by the method of differences.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

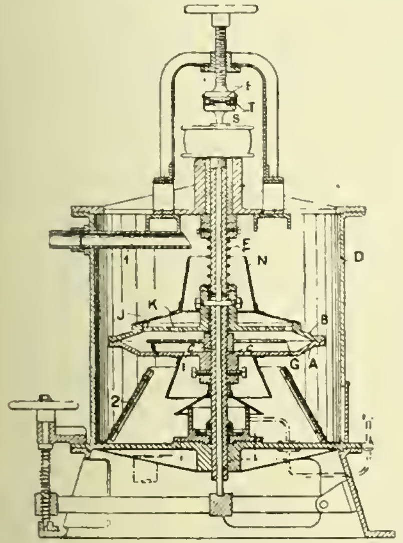
PATENTS.

Separating materials; Apparatus for ——. E. Kardos, Ilford, Essex. Eng. Pat. 3339, Mar. 2, 1915.

THE apparatus is adapted to separate and disintegrate brittle materials, such as enamel, glass, porcelain, silica, or crystalline matter, from tough, non-brittle materials such as metals, *e.g.*, to remove enamel from enamelled metal. A number of radial beaters of gradually decreasing length are mounted on a rotating horizontal shaft in a casing, and are closely bounded in the lower half of the casing by a grid through which pulverised material is discharged. The mixed material is fed on to the smaller beaters and the non-brittle residue is discharged at the other end of the casing.—W. F. F.

Separators; Centrifugal ——. C. S. Watson, Newcastle-on-Tyne. Eng. Pat. 8325, June 4, 1915.

THE liquid to be separated is fed through the pipe, 1, into the casing, N, and passes through the holes, J, K, into the space between the dished plates, A, B, which are rotated about the shaft, C. The solid portion, driven by the centrifugal force to the periphery of the chamber, forces B upwards in opposition to the spring, E, and passes out between he edges of the discs into the outer compartment of the casing, D. The upward movement of B is imited by the rod, S, and the adjustable ball bearing and screw device, T, F. The liquid passes over and under the disc, G, which serves to force all the liquid to pass through that part of the chamber where the greatest centrifugal force is exerted, and then escapes through the perforaions, I, in the lower disc, into the inner casing, 2.—W. H. C.



Centrifugal machines. O. Lobeck, Leipzig, Germany. Eng. Pat. 14,720, Oct. 18, 1915.

THE filtering medium is formed by a layer of wadding or wool held between two concentric perforated shells, which form the peripheral wall of the drum. Instead of being continuous the perforated plates may cover openings in the drum wall, which is otherwise non-perforated. The upper edge of the drum has a flange projecting inwards, and a shock-absorbing disc is provided in the lower part of the drum into which the liquid is fed.—W. H. C.

Compressed gases; Bottles for ——. The Scottish Tube Co., Ltd., and J. T. Thomson, Glasgow. Eng. Pat. 11,059, July 30, 1915.

THE body of the bottle consists of a tube, into which dished end-pieces are inserted and the joints welded. A boss on the upper end-piece is provided with a thread for screwing on a cap and with an inwardly projecting threaded flange, for attaching a valve.—W. H. C.

Drying plant. W. J. Kenney, Wilmette, Ill., Assignor to Underfeed Stoker Co. of America, Chicago, Ill. U.S. Pat. 1,172,291, Feb. 22, 1916. Date of appl., Mar. 2, 1912.

AIR passes from the atmosphere through the hollow top wall of a furnace and down a passage in the rear wall and mixes with the products of combustion. The mixture is then drawn through an opening in the rear wall into the drying chamber. The air necessary for combustion is forced into the closed ash-pit of the furnace.—W. H. C.

Dehydrating apparatus. W. A. Wood, Dunellen, N.J., Assignor to Air Utilities Co., New York. U.S. Pat. 1,172,575, Feb. 22, 1916. Date of appl., Aug. 9, 1913.

THE material is treated in a number of separate chambers having common air supply and exhaust mains with connecting pipes to each chamber. Dampers operated simultaneously are provided to direct the air through the chambers at any desired level.—W. F. F.

Drying apparatus. G. H. Benjamin, New York. U.S. Pat. 1,172,576, Feb. 22, 1916. Date of appl., Mar. 16, 1915.

THE material is fed on to horizontal, perforated, superposed, rotating discs, and air is forced in the opposite direction over the discs, the amount supplied between any two discs being variable. Air is also forced axially through the series of discs.—W. F. F.

Dryer. F. A. Hetherington, Indianapolis, Ind. U.S. Pat. 1,173,188, Feb. 29, 1916. Date of appl., Apr. 28, 1915.

THE material is fed through a horizontal rotating drum in a casing, and dried by means of hot furnace gases, which may be regulated by dampers so as to pass through either the drum or casing in the opposite direction to that of the material. The gases are drawn through by a centrifugal fan.—W. F. F.

Dehumidifying and cooling air; Method for ——. W. H. Carrier, Assignor to Buffalo Forge Co., Buffalo, N.Y. U.S. Pat. 1,172,429, Feb. 22, 1916. Date of appl., Aug. 4, 1909.

AIR is brought into intimate contact with a finely divided spray of liquid which has been previously cooled to a lower temperature than the air. The "free moisture" is then removed from the air, the latter treated with a finely divided spray of moisture-absorbing non-freezing liquid, which has been cooled to a still lower temperature, and the "free moisture" again removed.—W. H. C.

Furnace. T. G. Selleck, Milwaukee, Wis. U.S. Pat. 1,172,398, Feb.22,1916. Date of appl., May14,1915.

The heated products of combustion pass from the combustion chamber beneath and around a series of treating chambers built in the furnace behind the combustion chamber and return to a stack at the front of the furnace. The flue beneath the treating chambers has transverse partitions provided with series of openings or ports not in alinement.—W. H. C.

Calcining chemical products; Process and apparatus for ——. H. Howard, Brookline, Mass. U.S. Pat. 1,173,428, Feb.29,1916. Date of appl., Apr.30,1915.

The apparatus consists of a heated rotary plate with concave upper face. A liquid charge is fed to the outer edge of the plate and by an arrangement of a scraper and conveyor the calcined charge is removed also from the outer edge.—B. V. S.

Heat regeneration; Process of ——. H. L. Doherty, New York. U.S. Pat. 1,173,999, Feb. 29, 1916. Date of appl., Dec. 31, 1909. Renewed Mar. 21, 1913.

A current of air is brought into contact with the heated material leaving the combustion zone of a heating or calcining chamber, the volume of air being sufficient to take up all of the sensible heat of the material. The heated air current is divided into two streams. One of these streams, of less volume than is required to complete the combustion, is then passed into the combustion zone of the chamber near the fuel inlet. The other stream is subdivided into a major and minor portion; the major portion is united with the products of combustion, while the minor portion is introduced into an intermediate region of the combustion zone, in order to complete the combustion. The commingled streams of heated air and products of combustion are used to preheat the relatively cold unheated material on its way to the combustion zone.—J. B. C. K.

Refrigerating processes and apparatus. C. Cortesi, E. Prassone, E. Erani, and A. Contin, Rome. Eng. Pat. 1853, Feb. 5, 1915.

Heaters or evaporators for sea water and other feed water. W. Magoolaghan, Liverpool. Eng. Pat. 6137, Apr. 24, 1915.

Chemical reactions between solid matters and gases or gas mixtures; Method of effecting ——. J. R. C. Rudolphs, Nacka, and A. G. Thisell, Stockholm, Sweden. U.S. Pat. 1,173,390, Feb. 29, 1916. Date of appl., June 27, 1911.

See Fr. Pat. 430,388 of 1911; this J., 1911, 1301.

Catalytic agents and process of making them. A. Mittasch, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,173,532, Feb.29,1916. Date of appl., July10,1913.

See Eng. Pat. 12,977 of 1913; this J., 1914, 182.

Conveying and grading of materials; Apparatus for the simultaneous ——. H. Marcus, Cologne, Germany. U.S. Pat. 1,173,597, Feb. 29, 1916. Date of appl., Nov. 25, 1911.

See Eng. Pat. 26,678 of 1911; this J., 1912, 860.

Apparatus for exhausting lamp bulbs and other articles and testing the vacuum therein. Eng. Pat. 3410. *See* IIb.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coke fuel for steam-boilers. E. W. L. Nicol. London and S. Distr. Jun. Gas Assoc., Mar. 24, 1916. J. Gas Lighting, 1916, **133**, 695—698.

The following comparative figures are given showing the results obtained with coke used with the London Coke Committee's apparatus, the price of which is stated to be £6 6s. 0d. per furnace. The steam consumption for the blowers is 3%.

	Bituminous coal. Natural draught. Hand fired.	Gas coke. "L. Coke C." blowers. Hand fired.	Gas coke and coke breeze. "L. Coke C." blowers. Hand fired.
Cost per ton delivered	25s.	25s.	Breeze at 10s. Average at 17s. 6d.
Duration of trial, hours	6·50	7·25	7·66
Type of boilers (2)	Cornish	Cornish	Cornish
Total grate area, square ft.	58	58	58
Amount of fuel used, lb.	6720	7500	4200 coke 4200 breeze
Fuel burnt, per square foot grate area per hour, lb.	Max. 16·1	Limited to 16·1	Limited to 17·1
Water evaporated, lb. actual	45,950	65,600	59,200
Water evaporated per boiler per hour, lb.	3530	4520	3860
Water evaporated per lb. of fuel, lb.	6·83	8·74	7·04
Water from and at 212° F. per lb. of fuel, lb.	7·74	9·80	7·99
Cost per 1000 galls. evaporated	14s. 5d.	11s. 8d.	9s. 5d
Temperature of feed water before economiser	110° Fahr.	118° Fahr.	107° Fahr.
Temperature of feed water after economiser	218° Fahr.	196° Fahr.	193° Fahr.
Per cent. CO_2	Not taken	16·0 average	16·25 average
Steam pressure	45 lb.	58 lb.	52 lb.
Net working efficiency of plant, deducting 3 per cent. of steam used under bars for blowing	Not ascertained, probably about 70—72 %	85% approx.	80·9% approx.
Financial saving effected by adopting coke fuel and forced draught	—	19%	34·6%

—W. H. C.

Benzol and toluol; Extraction of —— [*from coal gas*] *by American gas oil and "green oil."* J. Bond and H. Pooley. Midland Assoc. of Gas Engineers and Managers, Mar. 23, 1916. J. Gas Lighting, 1916, **133**, 688—692.

In washing gas with tar by the "C" process some benzol and toluol were left in the gas. After trying creosote and anthracene oil in a supplementary washer, Bond adopted American gas oil. This had a sp.gr. of 0·859 at 15·5° C., a flash point of 125° F. (52° C.), the first drop distilled at 190° C. and 28% distilled over up to 300° C. The oil was circulated for six hours in a washer through which the gas was passed, and then replaced by fresh oil, since after this time the content of benzol and toluol in the oil had decreased. The saturated oil was then treated in a Wilton dehydrator coil still into which a jet of steam was introduced, and the crude benzol recovered. By this means an extra 4 lb. of benzol and toluol was recovered per ton of coal. After the oil had been used 20 times it was still quite suitable for use. Pooley used "green oil" as an absorbing agent with success, and had obtained as an average of experiments on 61 tons of coal 9 lb. of benzene and 2·7 lb. of toluene per ton of coal.—W. H. C.

Toluol and the limestone process [of coal carbonisation]. G. Stevenson. Midland Assoc. Gas Eng., Mar. 23, 1916. J. Gas Lighting, 1916, **133**, 692—693.

Comparative tests at Long Eaton Gas Works with coal alone and with coal and 5% of limestone gave the following results per ton of coal :—with coal alone, 1·563 lb. of benzene and 0·941 lb. of toluene : with coal mixed with limestone, 2·459 lb. of benzene and 1·409 lb. of toluene.—W. H. C.

Combustion of explosive gas-air mixtures : Influenc of pressure on the ——. E. Terres and F. Plenze J. Gasbeleucht., 1914, **57**, 990—995, 1001—1007 1016—1019. J. Chem. Soc., 1916, **110**, ii., 134

The influence of pressure on the explosive limits of mixtures of hydrogen, carbon monoxide, and methane with air, and on the processes of combustion has been investigated by estimations of the products of the reactions. Increase of the initial pressure restricts the region of explosion, particularly with the mixtures containing carbon monoxide : the upper limit of explosion of methane furnishes, however, an exception to this rule. The explosion limit is not a sharply defined region, diminishing concentration leading gradually from the region of explosion through one of decreasing partial combustions to mixtures which do not ignite. With hydrogen and methane, such partial combustions are lacking at the upper limit of explosion. The explosive limits are defined as the concentrations of combustible gas at which the heat developed in unit time exactly covers the loss, so the combustion either just does or just does not proceed through the mixture. With rise of temperature these limits are extended. No essential difference exists between ignition by heating and ignition by a spark : the locality of the ignition does, however, exert a marked influence on the value of the partial combustions.

Gasoline from hydrocarbon oils of high boiling points : Production of ——. E. L. Davies. J. Ind. Eng. Chem., 1916, **8**, 114—118.

Gasoline practically free from unsaturated hydrocarbons was obtained from a high-boiling petroleum oil by mixing the vaporised oil with superheated steam and passing the mixture under pressure through a tubular cracking apparatus packed with iron or steel shavings. The yield of gasoline increased with the pressure, up to 100 lb., which was the highest pressure employed, and the best results were obtained by using about 10 lb. of steam per gallon of oil, superheating the steam to at least 600° C., and cracking at 650°—675° C. The loss of oil through carbonisation, gas formation, etc., was 10—12%, and the iron or steel shavings had to be frequently renewed. The gasoline obtained resembled commercial 72° B. naphtha (sp.gr. 0·693) in its properties and its behaviour when used in motor cycle and automobile motors. The cost of production in cents per gallon is estimated to be 1¼ times the cost of the oil used as raw material plus 0·9.—A. S.

Refractory materials and salty coals. Cobb. *See* VIII.

Oil shales in the United States. U.S. Comm. Rept., Mar. 13, 1916.

The U.S. Geological Survey estimates that in Colorado there is sufficient shale, in beds 3 ft. or more thick, to yield 20,000,000,000 barrels of crude oil. Little attention has so far been paid to these shales, although on the average they will probably yield more oil per ton than the Scottish shales. When refined by the ordinary methods the shales yield about 10% of gasoline and 35% of kerosene. The area studied by the Survey also includes parts of Utah and Wyoming.

Patents.

Fuel : Apparatus for drying ——. H. Hermansen, Assignor to Sandusky Portland Cement Co., Baybridge, Ohio. U.S. Pat. 1,173,510, Feb. 29, 1916. Date of appl., Sept. 25, 1913.

The raw fuel is fed into a revolving cylinder heated internally by a fireplace having means for causing the products of combustion to follow a tortuous path. An exhaust fan conveys the dust-laden gas from the cylinder to furnaces, pulverised fuel being added as it enters the furnace.—W. F. F.

Briquette and method of producing the same. L. J. Curtman, New York. U.S. Pat. 1,173,779, Feb. 29, 1916. Date of appl., May 20, 1913.

Granulated coal is mixed with a binder composed of crude molasses 90 parts, concentrated and neutralised syrup of sulphite pitch 9 parts, and water-gas tar 1 part, and the mixture moulded and baked.—W. F. F.

Furnaces ; System of supplying hydrogen gas to ——. G. F. Pierce, Chicago, Ill. U.S. Pat. 1,172,551, Feb. 22, 1916. Date of appl., Apr. 29, 1914.

A perforated pipe vaporiser is arranged below the grate and is automatically supplied with water in predetermined amount. Steam from a boiler is supplied to nozzles within the furnace, and also to a nozzle in the uptake to produce a forced draught.—W. F. F.

Fuel ; Method for burning ——. H. M. Chance, Philadelphia, Pa. U.S. Pat. 1,173,708, Feb. 29, 1916. Date of appl., Sept. 23, 1915.

Air is supplied to burning fuel such as culm, dust, or slack, in pulsations at such intervals that the lighter particles which are raised are permitted to settle again and thus produce stratified layers of fuel.—W. F. F.

Gas ; Apparatus for the manufacture of ——. H. A. Carpenter, Sewickley, and The Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 5267, Apr. 7, 1915.

An amplification of the apparatus described in Eng. Pat. 5142 of 1914 (see U.S. Pat. 1,091,111 ; this J., 1914, 471). A liquid spray is introduced into the interior of each of the separate gas-conduits, between each gas-retort and the stand-pipe. The gas conduits are inclined downwards from the retort to the stand-pipe, so that the cooling medium introduced into the conduit will flow into the stand-pipe. Each gas conduit is provided with a valve for controlling the communication between the retort and the stand-pipe, and the cooling medium is admitted to the conduit intermediate between the valve and the stand-pipe irrespective of whether the retort is in communication with, or is temporarily cut off from, the stand-pipe.—J. B. C. K.

Coal ; Process for carbonising ——. H. L. Doherty, New York. U.S. Pat. 1,172,682, Feb. 22, 1916. Date of appl., Dec. 27, 1909.

MOLTEN lead or lead alloy heated to a temperature not above 1200° F. (650° C.) is circulated continuously through a heating chamber and distillation chamber where crushed coal is fed on to it. The volatile matter is withdrawn and condensed, and the coke residue removed at the outlet. —W. F. F.

Gas producers and the like ; By-product recovery from ——. N. Testrup, London, T. Rigby, Dumfries, and Wetcarbonizing, Ltd., London. Eng. Pat. 3677, Mar. 8, 1915.

To increase the yield of by-products, the tar condensed from the gases of producers or blast-furnaces, using fuels such as peat or bituminous coal, is distilled and the oil condensed. The residual pitch is added to the fuel in the producer either by spraying into the distillation zone when molten, or by mixing with the fuel in solid form, so that its volatile constituents are distilled before the residue reaches the combustion zone.—W. F. F.

Gas producers. J. Y. Johnson, London. From W. Wood, Philadelphia, Pa. Eng. Pat. 15,585, Nov. 4, 1915.

THE body portion of the producer rotates in water seals between the fixed base and top. Stirring bars with bent or curved lower ends are supported at adjustable heights on a fixed cross beam, and extend through openings in the top at various distances from the centre. The bars are rotated by worm gearing.—W. F. F.

Water-gas generators. F. J. Bancroft and J. B. Hansford, New Barnet. Eng. Pat. 5737, Apr. 16, 1915.

FUEL is fed into the generating chamber at regular and predetermined intervals, and in comparatively small quantities at a time, so that a uniform depth of fuel is maintained—while simultaneously clinker and other unconsumed products are broken up and withdrawn. The several contrivances used for carrying out the operations of feeding in fuel, breaking up clinker, extracting and conveying the same outside the apparatus, may be operated in proper timed relation.—J. B. C. K.

Gas-scrubbers. T. V. Miles, and Newton Chambers and Co., Sheffield. Eng. Pat. 8766, June 14, 1915.

IN a tower scrubber or washer the upper end of the tower is provided with a ring of adjustable nozzles projecting inwards and converging downwards beneath a gas-inlet, which inlet may be formed by tapering the upper end of the tower. Steam at low pressure is delivered through these nozzles and draws the gas into the scrubber through the inlet above the nozzles. The steam is condensed on the dust particles carried by the incoming gas, and the water of condensation together with the gas then pass through a number of superposed grids over which water is sprayed. The gas escapes through an outlet at the lower end of the scrubber, while the dirty water is drawn off separately.—J. B. C. K.

Gas-washing ; Method of and apparatus for ——. H. A. Brassert and C. J. Bacon, Chicago, Ill. U.S. Pat. 1,172,930, Feb. 22, 1916. Date of appl., Dec. 8, 1915.

GAS enters at the bottom of the washer and passes upwards successively through a large number of rows of vertical hurdles, a pair of water and gas distributing trays, a further similar set of hurdles, and several rows of closely spaced inclined baffles, to the outlet at the top. The gas thus moves upwards alternately in a body at 15—25 feet per sec., and in a number of small streams at 5—15 feet per sec. Water is sprayed in at the top of the washer.—W. F. F.

Crude oil stills ; Process of and apparatus for removing deposits from ——. L. Mooney, Bayonne, N.J. U.S. Pat. 1,174,888, Mar. 7, 1916. Date of appl., Sept. 16, 1915.

THE bottom of the still is provided with a chain, or series of chains or other devices, which can be lifted or moved from the outside. The coke-like deposit forms over and around this chain, or series of chains, and on lifting these, the deposit is broken up and may be removed from the still by aid of a conveyor.—J. B. C. K.

Hydrocarbons ; Conversion of heavy —— *into lighter hydrocarbons.* W. A. Hall, New York. U.S. Pat. 1,175,909, Mar. 14, 1916. Date of appl., July 24, 1914.

SEE Eng. Pat. 17,121 of 1913 ; this J., 1914, 1149.

Motor-fuel ; Process of making ——. W. A. Hall, New York. U.S. Pat. 1,175,910, Mar. 14, 1916. Date of appl., Jan. 23, 1915.

SEE Eng. Pat. 6069 of 1915 ; this J., 1915, 1015.

Continuous coking of liquids. U.S. Pat. 1,175,079. *See* III.

Production of methane or hydrogen from waste liquors [*e.g.*, *from paper factories*]. Ger. Pat. 290,126. *See* XIXB.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Wood distillation ; Process of ——. H. M. Angle and F. J. Root, Chicago, Ill., Assignors to The Wood Reduction Co., New York. U.S. Pat. 1,174,537, Mar. 7, 1916. Date of appl., Aug. 7, 1911.

THE wood is compressed in a dry condition into blocks less than 8 ins. in cross-section, and is then arranged in the form of a column, inside a tubular retort of but slightly greater cross-section, and subjected to carefully regulated heat throughout the length of the column.—J. B. C. K.

Lamp bulbs and other articles ; Apparatus for exhausting —— *and testing the vacuum therein.* The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 3410, Mar. 3, 1915.

THE lamp bulbs are mounted on a rotary carrier and are connected without valves to a final exhausting pump also rotating with the carrier. Connection to a preliminary exhausting pump is made through the central standard of the machine, so that the entire exhausting operation is completed in one rotation. A heating hood is provided over the bulbs, and a vacuum testing device is automatically brought into operation during the rotation of the carrier.—W. F. F.

Electrode ; Arc-light ——. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co. U.S. Pat. 1,173,370, Feb. 29, 1916. Date of appl., June 13, 1914.

THE electrode is composed of 6 to 9·5 parts of rare earth fluorides, and 4 to 0·5 parts of thorium fluoride, together with a conducting body.—B. N.

III.—TAR AND TAR PRODUCTS.

Coal tar : Dehydration of ——. Petit. Het Gas. J. Gas Lighting, 1916, **134**, 79.

At Douai coke-oven works, the tar is freed from water by allowing it to stand. In a recent case of the water failing to separate, the trouble was traced to the fact that the saturated tar-oil from the benzene works had been pumped into the settling tank.

Naphthol pitch. P. M. Grempe. Färber-Zeit., 1915, **26**, 322—323.

Naphthol pitch is a by-product obtained in the purification of β-napthhol by distillation, and its application is somewhat limited by its content of condensation products of β-naphthol. About 600 tons of naphthol pitch is sold annually in Germany for the manufacture of asphalt and roof-felting, for the production of iron lacquers, and for impregnating wood.—F. W. A.

Toluol and the limestone process of coal carbonisation. Stevenson. *See* IIa.

Extraction of benzol and toluol from coal gas by American gas oil and green oil. Bond and Pooley. *See* IIa.

Action of ozone on organic compounds. Aldehydes of the pyridine and piperidine series. Harries and Lénárt. *See* XX.

Determination of alcohol in presence of phenol. Ehrlich. *See* XX.

Patent.

Coking of liquids [tar, etc.] ; Continuous ——. R. P. Perry, Montclair, N.J., Assignor to Barrett Manufacturing Co., New York. U.S. Pat. 1,175,079, Mar. 14, 1916. Date of appl., May 19, 1915.

Tar or other liquid hydrocarbon is spread in a thin film upon a continuously moving surface, and heated above 1000° F. (540° C.) until the volatile constituents have been expelled, and the residue has become coked. The heated surface is moved at a uniform speed, and the coke deposit continuously and automatically removed as it forms.—J. B. C. K.

Removing deposits from crude oil stills. U.S. Pat. 1,174,888. *See* IIa.

IV.—COLOURING MATTERS AND DYES.

Indigo : Product obtained in the manufacture of natural ——. A. G. Perkin. Chem. Soc. Trans., 1916, **109**, 210—215.

A chemical examination was made of "seeth water," the liquid from which the indigo precipitate settles out at the conclusion of the oxidation process. The analysis of evaporated samples derived from the Purtabphore factory in India, representing 0·75% of the original liquid, and corresponding to about 4% of the plant, gave the following results : Ash 27·23, nitrogen 2·25, volatile acids 23·8, succinic acid 2·21, brown matter 5·58, crystallised indigotin 0·18. This amount of indigotin would represent a loss of about 5% on the total cake indigo obtained. A second sample gave but 0·10% of indigotin, representing a more trivial loss. Owing to the impossibility of obtaining fresh leaves no conclusions could be drawn as to the extent to which the presence of the brown matter is due to alteration of the indoxyl during the process of manufacture. —G. F. M.

Action of ozone on organic compounds. Aldehydes of the pyridine and piperidine series. Harries and Lénárt. *See* XX.

Patents.

Sulphide dyestuffs and production thereof. M. Wyler and E. A. Littlewood, Manchester. Eng. Pat. 4035, Mar. 15, 1915.

Yellow to orange sulphide dyestuffs are produced by heating to 200°—220° C. a mixture of formanilide or formyltoluidines, benzidine or tolidine or dianisidine, *p*-aminoacetanilide, and sulphur. The products give bright shades on unmordanted cotton, very fast to washing. *Example.*—20 grms. of benzidine and 40 grms. of *p*-aminoacetanilide are added to 76 grms. of formanilide at 110° C., and 300 grms. of ground sulphur added slowly whilst the temperature is gradually raised to 170° C. The mixture is then heated to 200°—220° C. for 12—18 hrs. with stirring. When cold the melt is ground ; the powder is preferably concentrated or purified by dissolving in strong sodium sulphide solution and precipitating by mineral acid, oxidation by air, or other suitable method.—F. W. A.

Di-1-aryl-5-pyrazolones : Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 289,290, Feb. 7, 1912.

The dihydrazines obtained from the tetrazo compounds of aromatic diamines or their sulphonic acids when condensed with the esters of β-ketonic acids yield pyrazolone derivatives containing two pyrazolone rings separated by one or more aromatic groups ; these derivatives are taken up by fibres in a colourless form from a bath containing sodium chloride and can subsequently be combined with diazo compounds to give yellow to orange-red azo dyestuffs.—T. C.

Colouring matters or dyes ; Fast light-proof —— *and process of making same.* N. W. Turkin, Moscow, Russia. U.S. Pat. 1,173,330, Feb. 29, 1916. Date of appl., Jan. 9, 1914.

See Eng. Pat. 5737 of 1913 ; this J., 1914, 742.

Dyestuffs of the safranine series ; Basic yellow-red —— *and process of making same.* R. Burckhardt, Assignor to Durand & Huguenin, Ltd., Basle, Switzerland. U.S. Pat. 1,174,820, Mar. 7, 1916. Date of appl., Mar. 1, 1915.

See Ger. Pat. 287,271 of 1914 ; this J., 1916, 171.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Wool fat ; Recovery of ——. E. E. Ayres, jun. Met. and Chem. Eng., 1916, **14**, 317—318.

Wash waters obtained by scouring wool with a weak aqueous solution of soap and alkali are treated in a continuous centrifuge, at 140° F. (60° C.), whereby 90% or more of the contained fat is recovered as a pale yellow product which is relatively easy to purify ; the remainder of the fat may be precipitated with the impurities by adding a trace of acid and again passing through a centrifuge. Sulphur dioxide is considered the best bleaching agent. The odour of the fat is effectively improved by treating with dilute sulphuric acid, but this causes darkening.—F. Sodn.

Kraft [sulphate wood pulp] process ; Chemical control of the ——. O. Kress. Paper, 1916, **17**, 30—32.

The following complete method for the analysis of the fresh "white" digestion liquor includes a determination of the sulphite and thiosulphate, the latter of which, especially, in presence of caustic soda, behaves similarly to sodium sulphide and plays an important part in the digestion:—Total alkali is determined by titrating 2 c.c. of the liquor with $N/2$ acid in presence of methyl orange; the result includes Na_2CO_3, $NaOH$, Na_2S, and $\frac{1}{2}Na_2SO_3$. Another portion is treated with excess of barium chloride solution, made up to 100 c.c., and the clear liquid similarly titrated; the result indicates alkali as $NaOH$ and Na_2S. The sulphide, sulphite, and thiosulphate are determined by adding 2 c.c. to a measured amount of $N/10$ iodine solution, acidified with acetic acid and diluted with about 200 c.c. of freshly boiled water, ascertained by previous trial to be within 0·5 c.c. of the end-point; the titration is then completed with iodine in presence of starch. The thiosulphate and sulphite are determined by adding to 5 c.c. of the liquor in a 250 c.c. measuring flask an excess of an alkaline solution of zinc chloride: the liquid is made up to 250 c.c. and allowed to settle; 50 c.c. of the clear solution is neutralised with $N/1$ acid in presence of methyl orange; the sulphites are thereby converted into bisulphites. When the latter are titrated with iodine the following reaction takes place:

$$NaHSO_3 + H_2O + I_2 = NaHSO_4 + 2HI;$$

thus 1 mol. of bisulphite liberates acid equivalent to $3NaOH$. The titration is made with $N/10$ iodine, the solution decolorised by 1 drop of thiosulphate, then titrated again with $N/10$ sodium hydroxide. From the acidimetric result the amount of sulphite is calculated and the difference from the iodimetric value gives the thiosulphate. The examination of the spent "black" liquor includes determinations of the total alkali after incineration and caustic alkali after precipitation with excess of barium chloride. The latter value must be corrected for sulphides if these are present in the black liquor. The sulphide is determined volumetrically with a solution of 16·746 grms. of zinc in nitric acid made sufficiently ammoniacal to remain clear when diluted to 2 litres (1 c.c. 0·10 grm. Na_2S): ammoniacal nickel ammonium sulphate is used as a spot indicator. 50 c.c. of black liquor is diluted to 1000 c.c. and 20 c.c. of this diluted to 100 c.c. for titration. For an approximate rapid determination of sodium sulphide in the "white" liquor, advantage may be taken of the fact that the sulphide remains in solution after precipitation of carbonate and sulphite by barium chloride and is equivalent to twice the difference between the alkalimetric values towards phenolphthalein and methyl orange.—J. F. B.

Cellulose: Adsorption of acids by ——. A. Leighton. J. Phys. Chem., 1916, 20, 188—194.

About 1 grm. of purified cotton was shaken for 3 hours with 100 c.c. of aqueous acid of varying concentrations, then centrifuged for 1 hour, and the acid retained by the cotton determined. The liquid separated from the cotton was also titrated. It was found that hydrochloric, sulphuric, and phosphoric acids do not form compounds with cellulose at ordinary temperatures. Cellulose adsorbs sulphuric acid more than phosphoric acid, and the latter more than hydrochloric acid, whilst the presence of any of these acids reduces the amount of water which can be adsorbed by cotton: differences in the results obtained by titration of the residual solution and gravimetric determination of the acid retained by the cotton are due to the former method giving only the selective adsorption of the acid. Selective adsorption does not occur with phosphoric acid, and is more pronounced with hydrochloric than with sulphuric acid. Selective adsorption was only pronounced at high concentrations of the acids.—C. A. M.

Cellulose and starch: Acetylation and acetolysis of ——. J. Böeseken, J. C. van den Berg, and A. H. Kerstjens. Rec. Trav. Chim. Pays-Bas, 1916, 35, 320—345.

The acetylation of carbohydrates of high molecular weight requires a catalyst which forms an unstable compound with the hydroxyl group. Thus sulphuric, hydriodic, hydrobromic, and hydrochloric acids are active in the order named, corresponding with the order of stability of their compounds with the hydroxyl group. Of the catalysts examined, only hydrobromic acid, hydriodic acid, and acetyl iodide are comparable with sulphuric acid. The primary function of the catalyst is to act as a common solvent of the carbohydrate and the acetic anhydride, and the rate of acetylation is limited by the rate of diffusion of the acetylating mixture in the carbohydrate, which is much slower than the actual acetylation. The difference in the rates of acetylation of cellulose and starch is probably due to the difference in the surface exposed, and the influence of catalysts on both reactions is approximately of the same order. The relative surface of colloidal carbohydrates is probably approximately measured by the velocity of acetylation, because this depends on the diffusion of the acetylating mixture in the carbohydrate. The chemical reaction consists of a succession of processes of acetylation and hydrolysis (or acetolysis). It is doubtful whether mono- and di-acetates of cellulose have ever been obtained directly, since if the reaction is stopped before the cellulose has all dissolved, the acetate in solution is the triacetate, and the undissolved cellulose contains practically no combined acetic acid. If the general formula of the polyglucoses is written $(C_6H_{12}O_6)_n—(n—1)H_2O$, n becomes lower as the molecule is hydrolysed, and the acetyl number increases gradually from 62·5 (for cellulose triacetate) to 77 (for dextrose pentacetate). A proportional figure for the degree of acetolysis is obtained by assuming that the carbohydrate molecule $(C_6H_{12}O_6)_n—(n—1)H_2O$ combines with $(3n+2)$ molecules of acetic acid, forming the triacetate of molecular weight $(162n+18)+(3n+2)42$. The acetyl number is then $\frac{1000(3n+2)}{48n+17}$, from which n can be calculated. It gives the average number of dextrose groups in the products of hydrolysis. It is probable that as long as the acetyl number is about 62·5, the cellulose has only split into groups of approximately equal size, without forming simple molecules such as cellobiose acetate or dextrose pentacetate; otherwise there would be a larger proportion of the product soluble in alcohol and ether. When the acetyl number begins to exceed 62·5, n increases very rapidly with time, indicating profound acetolysis of the molecule.—F. Sp.

Enzymes of a cellulose-destroying fungus from the soil, Penicillium pinophilum. Clark and Scales. *See* XVI.

Proposed method for the profitable utilisation of waste sulphite liquor. Tartar. *See* XVIII.

Patents.

Wool, yarn, wood pulp, paper and the like; Testing ovens for ascertaining the amount of moisture in ——. G. S. Smith, and Taylor and Parsons, Ltd., Bradford. Eng. Pat. 6931, May 8, 1915.

In conditioning ovens of the type described in Eng. Pat. 26,276 of 1911 (this J., 1912, 981), in which the material to be dried is contained in cans supported on a turntable, rotating on a central bearing and seated circumferentially at the angle formed between the vertical cylindrical wall of the oven-casing and its conical bottom, each can is surrounded by a cylinder. When a can is to be weighed, it is brought under the orifice in the oven-lid by lifting the turntable off its seating and rotating it to the desired position; the manipulation of a lever then closes the orifice in the turntable by means of a plate thus cutting off access of hot air to the can from below; at the same time it raises the turntable further, so that the upper edge of the cylinder around the can is pressed against a seating in the orifice of the lid, thus isolating the rest of the oven when the cover is removed.—J.F.B.

Safety-paper for checks [cheques] and similar devices; Method of making ——, and the safety-paper itself. J. B. Weis, Assignor to Perfect Safety Paper Co., Holyoke, Mass. U.S. Pat. 1,172,414, Feb. 22, 1916. Date of appl., Jan. 6, 1911.

Safety paper is made by adding a soluble ferrocyanide and aniline or an aniline salt, either alone or in conjunction with a ferric salt insoluble in water but decomposable by weak acids in presence of the ferrocyanide, and a salt of manganese easily decomposable by alkalis or bleaching agents. Suitable components are: 96% of pulp, 0·5% of ferric phosphate, 2% of manganese ferrocyanide, 0·5% of sodium ferrocyanide, and 1% of aniline hydrochloride.—J. F. B.

Pulp-reducing apparatus. Apparatus for reducing stock to pulp. Process for reducing pulp. C. W. Shartle, Middletown, Ohio. U.S. Pats. (A) 1,173,747, (B) 1,173,749, and (C) 1,173,750, Feb. 29, 1916. Dates of appl., (A) Nov. 25, 1912, (B) Apr. 13, 1914, and (C) Oct. 16, 1915.

(A) A breaking engine comprising an open tub is arranged so as to allow the finer stuff contained therein to overflow as fresh material is introduced; means are provided to transfer the overflow from a receiver to a screen, which delivers its tailings to a beating engine, also arranged so as to overflow and to deliver its overflow to the screen, so that the stuff is continuously treated until reduced to the proper fineness and the fine pulp separated from the coarse. (B) In a similar system a digester is interposed between the breaking engine and the screen, so that the finer overflow passes through the digester to the screen. Both the digester and the beating engine are adapted to deliver the stuff to a settling box which discharges to the head of the screen, and the overflow from the beating engine is caused to pass through a conduit in which a fender is disposed, so as to skim light impurities from the material on its way to the head of the screen. (C) The process consists in treating stock suspended in water by apparatus to reduce its coarseness, causing the fine stock and water to overflow by raising the general level of the mixture in the container, separating impurities from the overflowed stock, separating the fully refined stock from the coarser particles, and returning the latter for further treatment.—J. F. B.

Paper pulp process. C. W. Shartle, Middletown, Ohio. U.S. Pat. 1,173,748, Feb. 29, 1916. Date of appl., Mar. 3, 1913.

The pulp is suspended in water so as to remove the heavy impurities, the fine pulp is then separated from the coarse pulp and most of the water removed from it; the water thus removed and any entrained pulp in it is mixed with the pulp which is undergoing the prior stage of treatment.—J. F. B.

Plastics [from cellulose] and methods of making same. W. T. Bonner, Washington, N.C., Assignor to K. P. McElroy and R. F. Steward, Washington, D.C., and M. C. Massie, New York. U.S. Pat. 1,173,336, Feb. 29, 1916. Date of appl., May 20, 1908.

A dry carbohydrate, *e.g.*, cellulose, is treated with ammonia (NH_3), or an anhydrous compound of the NH_3 type. A compound of the product thus obtained, with carbon bisulphide, constitutes, when dissolved in water, the new plastic composition. The solution is neutral, coagulable, and free from fixed mineral matter.—E. W. L.

Plastics [from cellulose esters] and processes of producing same. W. T. Bonner, Trenton, N.J., Assignor to K. P. McElroy and R. F. Steward, Washington, D.C., and M. C. Massie, New York. U.S. Pat. 1,173,337, Feb. 29, 1916. Date of appl., May 6, 1911.

A plastic mass, which may be shaped and hardened, is produced when an organic ester of cellulose, *e.g.*, cellulose acetate, is dissolved in a "fluent" reaction product of formaldehyde and a phenol.—E. W. L.

Silk; Loaded —— and process of loading the silk. I. Kreidl, Vienna. U.S. Pats. 1,173,195 and 1,173,196, Feb. 29, 1916. Dates of appl., May 26 and 27, 1910.

See Fr. Pats. 415,657 and 416,238 of 1910; this J., 1910, 1300, 1373.

Acetyl-cellulose; Process of producing coating compositions of ——. L. Clément and C. Rivière, Paris, Assignors to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,173,931, Feb. 29, 1916. Date of appl., Nov. 3, 1913.

See Fr. Pat. 461,058 of 1913; this J., 1914, 20.

Fibrous matters; Apparatus for separating —— from admixtures. J. J. Werst, Delft, and P. M. H. L. Collée and J. M. Egmond, Assignors to Naaml. Vennootschap Neo Cellulose Maatschappij, Rotterdam, Netherlands. U.S. Pat. 1,175,854, Mar. 14, 1916. Date of appl., Nov. 15, 1913.

See Fr. Pat. 449,059 of 1912; this J., 1913, 482.

Plastic or solid material [substitute for celluloid] and process of producing same. Eng. Pat. 1894. *See* XIV.

Production of methane or hydrogen from waste liquors [e.g., from paper factories]. Ger. Pat. 290,126. *See* XIXb.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Weighting of silk as a chemical reaction. F. Fichter and E. Müller. Färber-Zeit., 1915, **26**, 253—257, 289—291. (Compare this J., 1915, 1008.)

Stannic acid gel is shown to have a considerable affinity for phosphoric acid and for soluble phosphates as such, and this is considered to explain the phosphate treatment of silk by the adsorption of the sodium phosphate.—F. W. A.

Half-silk and silk; Dyeing of black on ——. P. Schweitzer. Färber-Zeit., 1915, **26**, 63.

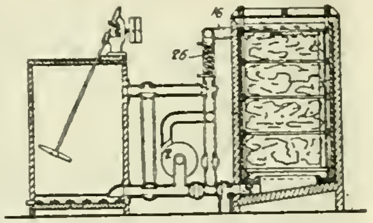
Bloomy shades of black are produced on half-silk by substantive cotton dyestuffs; dyeings faster to perspiration, potting, washing, and ironing, are obtained by using diazo blacks, *e.g.*, Diaminogen B, Sambesi Black D, or Diazo Brilliant Black B. For example, a full black of greater general fastness is produced by dyeing for one hour near the boil with 10% Diaminogen B, 0·7% Diamine Green B, and 3·5% Neutral Wool Black G: 3—5% of acetic acid (9° Tw., sp.gr. 1·045) and 20 grms. of sodium sulphate crystals per litre of dye-bath are added: the dyeings are rinsed, diazotised with 3% sodium nitrite and 9% hydrochloric acid, again rinsed, and finally developed in a bath containing 0·8% Diamine Powder CS and 2% sodium carbonate on the weight of the goods for 20 mins.
—F. W. A.

Patents.

Bleaching-machine. S. Barker, Providence, R.I. U.S. Pat. 1,173,160, Feb. 29, 1916. Date of appl., Nov. 10, 1914.

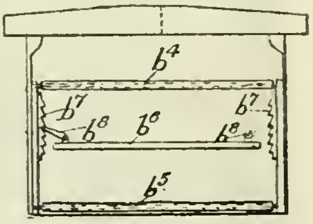
A valveless bleaching machine consists of an open tank connected at one end with a reversible rotary pump, and at the opposite end with a clamping head mounted on a frame. Pipes at the bottom and end of the tank are connected with the pump. The open end of a hollow perforated beam is clamped against the pipe passing through the end of the tank, so that the flow of bleach liquor through the tank, hollow perforated beam in the tank, rotary pump, and pipes is completely reversible, eliminating valves previously used for this purpose.—F. W. A.

Bleaching : Apparatus for ——. H. R. Anders and M. E. U. Schoedler, Perth Amboy, N.J., Assignors to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,173,474, Feb. 29, 1916. Date of appl., Apr. 4, 1913.



The mixing and bleaching vats are connected by the pipe system, shown in the diagram, included in which is a pump, 2, and provision is made for heating the liquid in the pipe, 16, by the coil, 26; passages are provided for the liquors through both the front and rear walls and near the top of the bleaching vat, which slopes at the bottom towards the pump. —F. W. A.

Dyeing apparatus. A. R. Whitehead, Leeds, and J. Farrar, Halifax. Eng. Pat. 3535, Mar. 8, 1915.



To prevent the displacement of loose material by dye-liquor which is being circulated, the dyeing apparatus is fitted with a cage, the top and bottom of which are composed of a number of hinged doors, b^4 and b^5, made in the form of racks or grids or perforated to allow the circulation of the dye-liquor; a number of grates, b^6, retained in position by racks, b^7, are fixed to the side of the cage and engage with pawls, b^8.—F. W. A.

Dyeing machines ; Hank ——. J. Farrar, Halifax, and A. R. Whitehead, Leeds. Eng. Pat, 5895, Apr. 20, 1915.

Uniform dyeing is achieved by rotating the hanks suspended in the dye liquor. The hank sticks are mounted detachably in a removable frame, and are rotated by a series of gear wheels from a ratchet wheel which is rotated intermittently by a pawl actuated by a cam and kept in gear by a spring or weight; the pawl automatically engages the ratchet wheel when the frame carrying the hank sticks is lowered into the vat.—F. W. A.

Azo dyestuffs [*on the fibre*] ; *Production of insoluble yellow* ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. Eng. Pat. 8489, June 8, 1915.

Diazotised esters of 4-nitro-2-aminobenzoic acid are combined on the fibre with β-naphthol. The yellow dyeings produced are of excellent fastness to washing and of great resistance to chlorine and to chlorate, and may be discharged by means of hydrosulphite.—F. W. A.

Dyeing or washing machines. Klauder-Weldon Dyeing Machine Co., Assignees of J. Benosch, Amsterdam, N.Y., U.S.A. Eng. Pat. 3766, Mar. 9, 1915. Under Int. Conv., Mar. 10, 1914.

See U.S. Pat. 1,120,647 of 1914 ; this J., 1915, 75.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Potash from fir wood mill waste. H. F. Zoller. J. Ind. Eng. Chem., 1916, **8**, 105—108.

The amounts of potash (K_2O) extracted in 24 hours by water at 80°—90° C. from three 1 lb. samples of ash taken from an incinerator in which Douglas fir mill waste was burnt, were 3·2, 3·6, and 4·8 grms. respectively, and, from a similar sample of cedar ash, 1·4 grms. The "ash" contained much charcoal and a large quantity (sometimes over 16%) of sodium chloride, the latter probably being due to impregnation of the wood with sea-water. With more efficient incinerators larger quantities of potash could be recovered, but more trustworthy information must be obtained before it is possible to determine whether potash can be recovered economically by the incineration of wood waste as compared with the utilisation of the latter by destructive distillation or for the production of paper pulp or alcohol. —A. S.

Alkali halides ; Approximate determinations of the boiling points of some ——. L. H. Borgström. Tidskriften Teknikern, 1915, **24**. J. Chem. Soc., 1916, **110**, ii., 138.

The following boiling points are the means of several determinations, which varied 10°—20° C.: —LiCl, 1360° ; NaCl, 1490° ; NaBr, 1455° ; NaI, 1350° ; KCl, 1500° ; KBr, 1435° ; KI, 1420° C.

Magnesium citrate : Effect of keeping on officinal ——. E. Léger. J. Pharm. Chim., 1916, 13, 209—214. (See also this J., 1915, 571 and 609.)

The employment of increased temperatures, even as low as 50° C., in the preparation of magnesium citrate results in the formation of a product which, although initially completely soluble in 2 parts of water, is converted partially on keeping into the less soluble citrate containing $13H_2O$; after a year a sample originally soluble was found to contain 34·5% insoluble in the above quantity of water at 70° C. On the other hand an air dried sample under similar conditions contained only 0·7% of insoluble citrate. The conversion of the heptahydrate into the tridecahydrate apparently does not take place through the nonahydrate, since the latter is almost insoluble in boiling water, whereas the magnesium citrate formed on keeping the officinal product is at all stages completely soluble in boiling water.—G. F. M.

Ammonium sulphate ; Use of nitre-cake in the manufacture of ——. J. Gas Lighting, 1916, **134**, 74.

A memorandum issued by the Sulphate of Ammonia Association recommends the partial substitution of nitre-cake for sulphuric acid in ammonium sulphate saturators. The nitre-cake from nitric acid plants usually contains more free acid (30 to 40%) than that from sulphuric acid plants (20 to 35%), but as it contains up to 2% of nitric acid, it cannot be used for this purpose. The maximum amount of nitric acid in the nitre cake should be 0·05%. In the process recommended, nitre-cake is dissolved in water to a solution of 100° Tw. at 200° F. (sp.gr. 1·5 at

93° C.), which is mixed with ten times its volume of 70% chamber acid, or its equivalent. The salt produced will contain from 23 to 24% of ammonia.

Chilean nitrate industry. U.S. Comm. Rept., Mar. 7, 1916.

Production and exportation of nitrate in Chile continues to increase. The figures for January, 1916, compared with those of three previous years, are :—

	Production. Quintals.	Exports. Quintals.
Jan., 1916	5,641,671	6,247,402
„ 1915	2,082,549	1,879,895
„ 1914	4,584,495	4,779,862
„ 1913	5,163,925	6,015,312

The total production of nitrate in Chile during 1915 was 38,147,000 quintals and exports 43,984,000 quintals, leaving a stock on the Chilean coast at the end of 1915 of 16,374,000 quintals.

Chromium oxide analysis. A. J. Field. J. Ind. Eng. Chem., 1916, 8, 238—239.

The sample is finely powdered, and 0·5 grm. mixed with 3 grms. of sodium peroxide in a platinum crucible, which is then placed inside a larger porcelain crucible and heated with a small flame to just above the melting point of the mass for 20 mins. Under these conditions the platinum is attacked only slightly by the peroxide. The melt is dissolved in water, and the solution boiled for 15—20 mins. to destroy excess of peroxide. The presence of peroxide may be detected by adding one drop of the neutralised solution and 2 drops of 5% oxalic acid solution to 5 c.c. of a 1% solution of sulphanilic acid, when a pink coloration is produced if peroxide be present. The chromate solution is filtered, neutralised with hydrochloric acid, diluted to 250 c.c., and 100 c.c. treated with 10 c.c. of concentrated hydrochloric acid, diluted to about 300 c.c., treated with 3 grms. of potassium iodide, and the liberated iodine titrated with $N/10$ thiosulphate. The results may be checked by means of a gravimetric method. The chromate solution, obtained as described, is neutralised with acetic acid, 0·5 c.c. of glacial acetic acid added in excess, the solution diluted to 400 c.c., heated to boiling, and the chromium precipitated with a dilute solution of barium acetate, added drop by drop. The barium chromate is collected in a Gooch crucible, washed with dilute alcohol, dried, and weighed.—A. S.

Cerium group oxides; Solution of —— by certain acids. W. S. Chase. J. Ind. Eng. Chem., 1916, 8, 239—240.

Whilst cerium oxide alone is practically insoluble in mineral acids, when the mixed oxides of the cerium group, *e.g.*, the residue left after the extraction of thorium from monazite sand, are treated with acids, the whole dissolves. A considerable excess of the acid is necessary, but if hydrogen peroxide be added in order to reduce the cerium to the cerous condition, the rate of solution is greatly accelerated, and it is possible to dissolve the mixed oxides rapidly in sulphuric, nitric, or hydrochloric acid, even when the acid is diluted to a considerable extent.—A. S.

Gold; Nitrogen compounds of ——. E. Weitz. Annalen, 1915, **410**, 117—222.

An extended study was made of the nitrogen compounds of gold obtained by the action of ammonia solution or solutions of ammonium salts in presence of ammonia on chloroauric acid. These substances are nearly all explosive when dry, and they were accordingly analysed in the moist condition by determining the ratio Au : N. Chloroauric acid with ammonia gave rise to precipitates called by the general name "explosive gold chloride," which were mixtures of sesquiammine auric oxide, $Au_2O_3.3NH_3$, and diaminoiminodiauric chloride $NH(AuCl.NH_2)_2$. $N/5$-Chloroauric acid gave with ammonium chloride and ammonia the non-explosive diamino-auric chloride, $Au(NH_2)_2Cl$, decomposed by water yielding an explosive compound free from chlorine. Similarly treated with ammonium nitrate a tetra-ammine-auric nitrate, $[Au(NH_3)_4](NO_3)_3$, was obtained in colourless needles which by double decomposition gave other salts containing the same cation.—G. F. M.

Colloidal carbon; Preparation and properties of ——. P. C. L. Thorne. Chem. Soc. Trans., 1916, **109**, 202—209.

An impure colloidal solution of carbon in water was prepared by adding sucrose in small quantities to concentrated sulphuric acid contained in a flask which was gently rotated; 1 part by weight of sugar to 10 parts by volume of acid were the best proportions. After standing for 24 hours, the mixture was poured into four times its volume of cold distilled water, and when the larger particles of carbon were filtered off, a suspensoid sol of a yellow to dark reddish-brown colour was obtained. The solution was freed from acid by prolonged dialysis. It contained negatively charged particles which were readily precipitated as a brown powder on the addition of an electrolyte (*e.g.*, barium chloride), and when the powder was filtered off a brown solution of a non-colloidal character was obtained. The sol exhibited but few particles under the ultra-microscope; it also reduced gold chloride. Icing sugar may be used in place of ordinary sucrose, but dextrose and rice starch are much less satisfactory. If the sugar be dissolved in water before adding it to the acid, no dispersion of carbon takes place. Fuming sulphuric acid or hot zinc chloride solution, in place of sulphuric acid, gave a more diluted sol, but phosphoric oxide in presence of a drop of water or of sulphuric acid gave a liquid similar to that produced with sulphuric acid alone. Colloidal carbon can also be obtained by passing a current of 0·4—4 amps. at 200 volts through caustic soda solution containing 2—3 grms. per litre, the electrodes being of ordinary arc carbon, of crude gas carbon, or of Acheson graphite. The anode, from which the sol originates, should just touch the surface of the liquid, and the cathode is immersed. The solution is very sensitive towards electrolytes and is stable only in the presence of alkali. The ultra-microscope reveals a large number of particles with vigorous Brownian movements. A solution was flocculated by adding barium chloride, and the collected particles washed, dried, and analysed. They contained 66·61% of carbon, 1·99% of hydrogen, and 15·25% of an incombustible residue consisting chiefly of silica with a trace of iron, both derived from the arc carbon used in making the sol. The washings contained organic compounds. No sols could be obtained with the carbon reduced from carbon dioxide by magnesium, or with that produced by the interaction of chlorine and acetylene, or with purified animal charcoal. Thus for the production of a stable suspensoid sol of carbon, the element must be in a special state, and organic matter must be present. The stability is favoured by the presence of alkali, and the presence of a trace of some electrolyte is probably essential in all cases.—E. H. T.

Determination of sulphur dioxide and trioxide in flue gases. Nestell and Anderson. *See* X.

Potash from kelp. Laucks. *See* XVI.

New methods for the analysis of lime-sulphur solutions. Chapin. *See* XIXB.

Determination of sulphuric acid in presence of phosphoric acid. Von Fellenberg. *See* XXIII.

PATENTS.

Sulphuric acid ; Method of making ——. W. S. Landis, Niagara Falls, N.Y., Assignor to F. S. Washburn, Nashville, Tenn. U.S. Pat. 1,173,524, Feb. 29, 1916. Date of appl., Feb. 20, 1915.

SULPHUR dioxide is treated with excess of a gaseous mixture, containing more than 6% of nitrous gases, produced from a mixture of ammonia and air.—B. V. S.

Formic acid ; Process for distilling ——. A. Bräuer, Assignor to Chem. Fabr. Grünau, Landshoff und Meyer Akt.-Ges., Grünau, Germany. U.S. Pat. 1,174,663, Mar. 7, 1916. Date of appl., Oct. 6, 1915.

A HEATED drum is covered with a mixture of a formate and sulphuric acid in a thin layer, and the solid residue which remains after the liberation and escape of the formic acid vapour is scraped off before a new supply of the mixture is brought on to the drum.—J. B. C. K.

Hydrofluosilicic acid ; Manufacture of ——. P. A. Racicot, Lowell, Mass. U.S. Pat. 1,175,294, Mar. 14, 1916. Date of appl., Mar. 12, 1915.

SILICON tetrafluoride and hydrogen fluoride are passed into a container and the mixed gases are treated with water.—E. H. T.

Nitrate of ammonia and carbonate of sodium ; Process of producing ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. Eng. Pat. 8270, June 3, 1915. Under Int. Conv., June 23, 1914.

SODIUM nitrate is produced by the action of nitrous gases on sodium carbonate or bicarbonate and is boiled with ammonium chloride solution in such concentration that sodium chloride separates and ammonium nitrate is left in solution. The sodium chloride is then treated with ammonia and carbon dioxide with the formation of sodium bicarbonate and ammonium chloride, both of which are used again for the same series of operations.—B. V. S.

Alumina ; Crystalline fused —— and a method of making the same. L. B. Coulter, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,161,620, Nov. 23, 1915. Date of appl., Feb. 24, 1915.

FUSED alumina is crushed into grain form, graded roughly by sifting, and then subjected to a temperature of from 1500° to 1800° C. in a rotary kiln fired with oil or powdered coal, the alumina and the heating gases passing through the kiln in contrary directions. The atmosphere of the kiln is preferably kept neutral. Grains of fused alumina subjected to this treatment are stronger and tougher than untreated grains, and their abrasive qualities are increased.—J. B. C. K.

Feldspathic and phosphate rock ; Combined process of treating ——. H. P. Bassett, Catonsville, Assignor to The Spar Chemical Co., Baltimore, Md. U.S. Pat. 1,172,420, Feb. 22, 1916. Date of appl., Dec. 26, 1913.

FELSPAR is heated with an alkali bisulphate to the temperature of reaction in presence of a reducing agent, and the evolved gases are cooled to between 400° F. and 212° F. (205°—100° C.) and then allowed to act upon phosphate rock. Suitable proportions are 50 parts of felspar, 100 parts of sodium bisulphate, and 1 to 3 parts of carbonaceous matter, the mixture being heated to redness.
—J. B. C. K.

Potash felspar ; Method of producing commercial products from ——. E. L. Anderson, Assignor to J. S. Snyder, Pittsburgh, Pa. U.S. Pat. 1,174,795, Mar. 7, 1916. Date of appl., Nov. 10, 1915.

FELSPAR is subjected under pressure to the action of a solution containing a decomposing agent, *e.g.*, hydrofluoric acid, the amount of which is less than that theoretically necessary to combine with all the bases, and another reagent to combine with the bases. The temperature of the mixture is maintained above its normal boiling-point, and the water-content of the acid solution is decreased as the decomposition proceeds.
—J. B. C. K.

Lead arsenate ; Manufacture of ——. J. A. Schaeffer, Assignor to The Picher Lead Co., Joplin, Mo. U.S. Pat. 1,172,741, Feb. 22, 1916. Date of appl., Sept. 24, 1915.

VERY finely divided lead monoxide, *e.g.*, fumed litharge, suspended in water, is mixed with a solution containing one or more soluble arsenates, and the whole is heated to induce the formation of lead arsenate.—J. B. C. K.

Lead arsenate ; Method of making ——. L. Shepherd, Assignor to The Harshaw, Fuller and Goodwin Co., Cleveland, Ohio. U.S. Pat. 1,175,565, Mar. 14, 1916. Date of appl., Oct. 14, 1911.

A COMBUSTIBLE mixture of a lead compound, *e.g.*, lead sulphide, and an arsenic compound, *e.g.*, white arsenic, with a hydrocarbon fuel is ignited and the burning mass discharged into a highly heated chamber. Lead arsenate is recovered by cooling the combustion products.—E. H. T.

Nitrogen compounds ; Process for producing ——. O. Bender, Potsdam, Germany. U.S. Pat. 1,172,863, Feb. 22, 1916. Date of appl., July 2, 1914.

A SUITABLE fuel is burned by aid of air in presence of water and of a nitrogen carrier, and the nitrogen compounds formed are separated from the other products of combustion. Aluminium oxide may be used as the nitrogen carrier, the combustion may be carried out under pressure, and the gases produced may be cooled in the zone of highest temperature in order to increase the yield of the nitrogen compounds.—J. B. C. K.

Nitrogen ; Process of fixing —— and electric furnace for effecting the same. J. E. Bucher, Coventry, R.I., Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pats. (A) 1,174,667 and (B) 1,174,668, Mar. 7, 1916. Dates of appl., June 25 and Oct. 2, 1914.

(A) CYANOGEN is formed by heating carbon in a stream of nitrogen in contact with a catalytic agent. The catalyst and carbon are intimately mixed with a third substance which supplies a base for fixing the cyanogen as it is formed. The mass forms part of the electric circuit in the furnace ; when solid and at temperatures below that of the formation of the cyanogen compound the conductivity of the base-supplying material is much lower than that of the catalyst, but it rises as the material melts, so that the total resistance varies between wide limits. (B) Two or more furnaces are used, and the base-supplying material also contains oxygen, so that carbon monoxide is formed along with the cyanogen compound. The gases from the first furnace are used for preheating the second furnace, and the carbon monoxide undergoes partial decomposition into the dioxide and carbon. There is an arrangement for increasing the length of the reacting mass as its resistance decreases.—B. V. S.

Nitrogen; Molten bath process for fixing —— and means for effecting the same. J. E. Bucher, Coventry, R.I., Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,174,944, Mar. 7, 1916. Date of appl., Oct. 19, 1914.

The method is the same as in the preceding abstract except that the base-supplying material for fixing the cyanogen, which may be an alkali metal, is passed into the furnace as a gas along with the nitrogen, and the catalyst is a carbon solvent, the supply of reacting carbon being kept up by the gradual solution of excess carbon floating on the molten catalyst. The excess carbon may be directly heated by the current and the furnace may be in two parts, the one part containing a secondary carbon resistance heated in a substance with which it reacts with the formation of a volatile metal, which is passed along with nitrogen to the other part containing the primary carbon resistance immersed in the molten catalyst. —B. V. S.

Nitrogen; Fixation of ——. H. R. Moody and S. A. Tucker, New York. U.S. Pat. 1,175,007, Mar. 14, 1916. Date of appl., Jan. 15, 1913. Renewed Aug. 13, 1915.

The volatile products evolved from a furnace charge suitable for the production of an alkali or alkaline-earth carbide and also containing calcium chloride, which is heated higher than the dissociation point of the carbide, are introduced into an atmosphere containing nitrogen at a temperature sufficient for the fixation of the nitrogen. —J. B. C. K.

Chlorates and perchlorates of alkali metals; [Electrolytic] manufacture of ——. A. E. Gibbs, Wayne, Pa. U.S. Pat. 1,173,346, Feb. 29, 1916. Date of appl., May 5, 1915.

An alkali chloride solution is electrolysed and the resulting chlorine made to react with part only of the resulting alkali solution. After the separation of the chlorate thus formed, the liquor is returned to the anode chamber of the electrolysing apparatus.—B. V. S.

Bauxite-digester. H. Howard, Brookline, Mass. U.S. Pat. 1,175,147, Mar. 14, 1916. Date of appl., June 24, 1914.

Bauxite is digested with an alkaline solution in a closed vessel capable of resisting high internal pressure, and provided with a heat-retaining cover. Around the interior sides of the shell is a steam coil, supported by the vessel but free to move. The mixture is agitated, and made to circulate downwards through an open cylindrical casing placed near the bottom and then upwards over the coil, by means of a rotary propeller working in the casing.—E. H. T.

Potash; Recovery of —— from calcined alunite. C. F. Hagedorn, Chicago, Ill., Assignor to Mineral Products Corporation, New York. U.S. Pat. 1,175,439, Mar. 14, 1916. Date of appl., June 7, 1915.

Calcined alunite, suspended in water, is heated under pressure, so that practically all the potash goes into solution. The liquid is then filtered at such a temperature that the filtrate retains all the dissolved potassium.—E. H. T.

Hydrogen generation. C. Ellis, Montclair, N.J. U.S. Pat. 1,173,417, Feb. 29, 1916. Date of appl., June 6, 1913.

A mixture of a gas containing carbon monoxide but free from nitrogen, with steam in the proportions of 1 of carbon monoxide to 4—5 of steam, is passed over a mixture of caustic lime and a catalytic agent, at a temperature of about 500° C.—550° C. The catalytic agent, *e.g.*, a metallic oxide, forms about 5% of the mixture, and the gases and the heated mass come into contact on the counter-current principle. Under these conditions, the carbon monoxide is converted into the dioxide, and forms calcium carbonate. The hydrogen produced by the reduction of the steam is collected and dried.—J. B. C. K.

Sulphur dioxide; Utilisation of ——. J. B. Garner and H. D. Clayton, Pittsburgh, Pa., Assignors to Metals Research Co., New York. U.S. Pat. 1,173,566, Feb. 29, 1916. Date of appl., Mar. 4, 1915.

By treating sulphur dioxide with a gaseous fuel containing carbon monoxide and hydrogen, in presence of wood charcoal at a temperature of 500°—600° C., hydrogen sulphide is formed. —B. V. S.

Acetic acid; Process for producing ——. N. Grünstein, Assignor to Chem. Fabr. Griesheim Elektron, Frankfort, Germany. U.S. Pat. 1,174,250, Mar. 7, 1916. Date of appl., June 1, 1914.

See Fr. Pat. 473,158 of 1914; this J., 1915, 191.

Sand; Process for bleaching ——. J. G. A. Rhodin, London. U.S. Pat. 1,173,385, Feb. 29, 1916. Date of appl., Mar. 29, 1915.

See Eng. Pat. 8495 of 1914; this J., 1915, 660.

Electric furnaces [for fixation of nitrogen]. Eng. Pat. 3953. *See* XI.

Electrolytic apparatus for the production of oxygen and hydrogen gases. U.S. Pat. 1,172,885. *See* XI.

VIII.—GLASS; CERAMICS.

Patents.

Refractory materials and salty coals. J. W. Cobb. Coke Oven Managers Assoc., Mar. 25, 1916. J. Gas Lighting, 1916, **133**, 684—688.

The rapid wasting of the brick walls of coke ovens in which coal containing common salt is carbonised is not due to excessive temperature, as it occurs on the inner face of the bricks. The salt found in certain coals is very intimately mixed with the coal substance and it is almost impossible to remove it completely by washing, even if unlimited supplies of wash water could be used. From previous experiments (this J., 1910, 250) the author had determined that combination between sodium chloride and silica or alumina takes place at temperatures below that of the fusion point of the product. It is probable that at the temperature of the coke-oven the volatilised sodium chloride penetrates the inner face of the brick and forms compounds with the silica and alumina, which, as the penetration proceeds towards the back of the brick next to the heating flue, where the temperature is higher, commence to fuse, producing porosity and rottenness of structure. The subsequent disintegration is due not only to the porosity thus produced, but to the alteration in the coefficient of expansion due to the formation of these compounds. Ferric chloride is also volatilised and then decomposed and deposited locally in the body of the bricks as iron oxide, which renders the brick liable to disintegrate. If fireclay bricks are to be used they should have fine-grained faces and be of exact sizes to allow of very small joints, and any free silica in the interior mass should be fairly coarse.—W. H. C.

Glass-furnace. T. W. Connington, Clarksburg, W. Va. U.S. Pat. 1,172,674, Feb. 22, 1916. Date of appl., Jan. 31, 1911.

The furnace has refractory side and end walls, and over the central portion a roof arch is suspended,

the edges of which do not quite reach the walls. At the sides of the furnace are regenerators from which uptakes lead above the side walls, and are provided with ports opening into the furnace under the arch. The spaces between the walls and the roof arch are provided with sectional covers, the position of which can be adjusted with reference to the glass level. The space between the arch and one end of the furnace may form a drawing extension of the full depth of the glass chamber of the furnace and is provided with drawing openings with refractory floats between them.
—W. C. H.

Silicon carbide articles. T. B. Allen, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,172,659, Feb. 22, 1916. Date of appl., Sept. 17, 1912.

MAGNESIUM aluminium silicate or magnesium aluminium boro-silicate is used as a bonding material in forming articles of silicon carbide, the mixture being raised to the vitrifying point, and care being taken that no impurity is present which reacts with carborundum at this temperature.
—J. B. C. K.

Dental cements: Process for making ——. G. S. Miller, Assignor to Dental Cement Co., Ltd., Chicago, Ill. U.S. Pat. 1,172,723, Feb. 22, 1916. Date of appl., Dec. 17, 1914.

BORIC acid, beryl, and sodium-aluminium fluoride, all in the form of powders, are mixed and the mass saturated with pyrophosphoric acid. After adding the requisite amount of water the semi-liquid mass is heated until completely melted, cooled, and powdered; an additional quantity of pyrophosphoric acid is added at the time the powder is to be used as a cement.—W. C. H.

Enamel and like coatings from waste enamel and the like ware; Method for removing ——. E. Kardos, Chrome, N.J., U.S.A. Eng. Pat. 100,118, Mar. 2, 1915. (Appl. No. 2962 of 1916.)

THE materials are submitted to a continuous hammering action in an apparatus (see Eng. Pat. 3339 of 1915, page 459) adapted to break off the enamel, and to separate it automatically from its metal base, which latter is beaten to a shapeless mass, and automatically removed.—J. B. C. K.

Apparatus for separating materials. Eng. Pat. 3339. *See* I.

Crystalline fused alumina and method of making the same. U.S. Pat. 1,161,620. *See* VII.

IX.—BUILDING MATERIALS.

Plaster [of Paris]; Influence of alcohol on the setting of ——. A. Astruc and E. Canals. J. Pharm. Chim., 1916, **13**, 214—218.

ALCOHOL exercises a retarding influence on the setting of plaster of Paris. Thus 100 grms. of plaster moistened with 60 c.c. of water set in 14 mins.; the presence of alcohol to the extent of 5 % lengthened the period to 22 mins., 20 % to 40 mins., and 33 % to 85 mins., the observed rise in temperature being, in the latter cases, naturally less than in the former. This property of alcohol should be of value to the surgeon in the preparation of plaster casts, etc., in cases where considerable time is required for the work.—G. F. M.

PATENTS.

Cement furnaces and the like; Rotary ——. L. Lister-Kaye, Southam, Warwick. Eng. Pat. 3236, Mar. 1, 1915.

IN coal-fired rotary cement kilns the shape of the firing nozzle is gradually changed from a cylindrical form at one end to an expanded crescent-shaped discharging mouth at the other.
—W. C. H.

Stone slabs: Manufacture of artificial ——. M. I. Poznanski, Geneva, Switzerland. Eng. Pat. 15,195, Oct. 15, 1915.

THE slabs are formed from a mixture of cement and water with animal or vegetable fibres which have been previously impregnated with material not attacked by alkalis, such as bituminous, tarry, or resinous matters, or with alumina lakes, rubber, gutta-percha, paraffins, or ceresin, in order to prevent the cement becoming "sandy" after setting.—W. C. H.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron: Magnetic properties of electrolytic —— deposited in magnetic fields. T. Soné. Sci. Rep. Tôhoku Imp. Univ., Sendai, Japan, 1916, **4**, 313—321.

A WEIGHT of iron not exceeding 0·1 grm. was deposited on a hollow copper cylinder 12 cm. long in magnetic fields of strengths up to 2600 gauss. The electrolyte for weak fields was made by mixing a solution of 32 grms. of ferric ammonium oxalate in 800 c.c. of pure distilled water with a solution of 12·8 grms. of ammonium oxalate in 800 c.c. of water, and adding slowly during the electrolysis 80 c.c. of *N*/10 ammonia solution. The solution for strong fields consisted of 3 grms. of ferrous sulphate and ammonium chloride in 700 c.c. of distilled water. The current-density was always 0·45 and 0·19 ampère per sq. cm. for the weak and strong fields respectively. The intensity of magnetisation at various fields was then measured by the magnetometric method. The results obtained were as follows:—(1) The curve of initial magnetisation of specimens deposited in a magnetic field lies considerably higher than that of specimens obtained in zero field. (2) The loop of the hysteresis curve is considerably wider than that of ordinary iron. The magnetic field applied during the electrolysis does not seem to affect sensibly the form of the hysteresis curve; the rate at which the ammonia is added has a far greater effect. (3) The hysteresis curve becomes gradually flatter with the lapse of time, as the molecules settle down slowly. By annealing the specimens, the settling is brought about quickly.—T. ST.

Iron and iron-carbon alloys; Preparation of pure ——. J. R. Cain, E. Schramm, and H. E. Cleaves. J. Ind. Eng. Chem., 1916, **8**, 217—224.

THE preparation of a series of iron-carbon alloys of a high degree of purity for use in an accurate study of the equilibrium diagram is described. Electrolytic iron was first prepared from neutral ferrous chloride solution in a cell having porous anode cups made from alundum cement and sand; the total impurities in the deposited metal ranged from 0·024—0·033 %. The iron was melted in magnesia crucibles in an electric furnace, using graphite as a resistance-heater; an Arsem vacuum furnace (this J., 1906, 851), a Helberger crucible furnace (Fr. Pat. 391,010; this J., 1908, 1119), and a furnace of the kryptol type were used. In some experiments a gas furnace, fitted with a preheater for the air, and a surface combustion crucible furnace (Lucke, this J., 1913, 1001) were used. In order to prevent contamination of the melt by silicon, it was essential to use magnesia of very low silica content for making the crucibles. This was prepared by dissolving magnesite (3·5% SiO_2) in 70% acetic acid, diluting the slightly alkaline solution with twice its volume of water, allowing to settle, evaporating the clear solution in an iron basin until it solidified on cooling, igniting the acetate to oxide, and calcining the oxide in graphite crucibles in a gas furnace at 1550°—1650° C.; the product contained not more than 0·01% SiO_2. The ingots (about 100 grms.) were prepared by melting the electrolytic iron in a large crucible, sawing the resulting ingots into longitudinal strips, and melting these with the requisite amount of carbon in a smaller magnesia crucible in the vacuum electric furnace exhausted to about 0·2 mm. In a series of twelve iron-carbon alloys prepared in this way, with a range of carbon from 0·084 to 3·27%, the amounts of impurities were as follow:—P and Mn, traces; Ni and Co, 0·011; Cu, 0·004—0·02; S, 0·005—0·013; Si, 0·004—0·013; total, 0·030—0·047%.—A. S.

Iron; Periodic passivity of ——. A. Smits and C. A. Lobry de Bruyn. Proc. K. Akad. Wetensch. Amsterdam, 1916, **18**, 807—811. J. Chem. Soc., 1916, **110**, ii., 122—123.

HALOGEN ions and anodic polarisation tend to produce opposite effects, the latter producing the passive condition, whilst the former render passive iron active, and when an iron anode immersed in a solution of ferrous sulphate, to which chlorine ions have been added in suitable concentration, is subjected to the influence of a current, it is found that well-developed periodic phenomena are observed. The requisite concentration of the chlorine ions depends on the current density, and the relative lengths of the active and passive periods can be varied by suitable adjustment of these factors. The oscillations in the electrode potential amount to 1·74 volts, and in an experiment which the authors describe, the lengths of the two periods were each approximately equal to six seconds.

Copper-steel: Corrosion resistance of ——. D. M. Buck and J. O. Handy. J. Ind. Eng. Chem., 1916, **8**, 209—216.

FURTHER experiments have been made to determine the resistance to corrosion of steel containing small percentages of copper (see also this J., 1913, 701). In addition to large sheets exposed as roof panels, strips cut from the sheets were also exposed to the atmosphere in wooden racks. For removing the rust without attacking the underlying metal, an ammoniacal solution of ammonium citrate was found most satisfactory; the rust is completely removed in about 12 hours. The results confirm those obtained previously, the resistance to corrosion being greatly increased by small additions of copper. The effect becomes apparent with only 0·03% Cu: for commercial steel the most effective amount appears to be 0·25% Cu. The addition of phosphorus (0·1%) slightly increases the resistance to corrosion of open-hearth steel. Silicon accelerates the corroion of open-hearth and Bessemer steels when dded in amounts of 0·1—0·3%, but the quantities normally present are probably without influence. Small additions of aluminium have little influence. The rate of corrosion is markedly accelerated by high sulphur content. Steel containing 0·25% u is superior, and that containing 0·05% Cu equal, to so-called "pure" iron (0·04% Cu) in regard to resistance to corrosion. The results obtained with the small test strips corresponded ith those obtained with the large sheets.—A. S.

ilver-platinum alloys and their analysis. I. Koifmann. Arch. Sci. Phys. Nat., 1915, [iv], 40, 309—313. J. Chem. Soc., 1916, **110**, ii., 144—145.

THE action of nitric acid on silver-platinum alloys was investigated; the alloys used contained from 0·219 to 5·162% Pt, and were prepared by heating together mixtures of silver and platinum for twenty minutes at a temperature above the fusing point of silver, the mixtures being covered with a layer of pure sodium chloride. The preparation of the alloys confirmed the slight solubility of platinum in silver, and it was impossible to make an alloy containing much more than 5% Pt. When these alloys were boiled with nitric acid of varying concentrations, a brown-coloured solution was obtained, together with a more or less voluminous, black sediment, and the latter always yielded a brown-coloured solution when treated with water. The author considers that silver and platinum in an alloy cannot be separated by means of nitric acid; part of the platinum forms a colloidal solution in the nitric acid, and the remainder also passes into solution when treated with a sufficient quantity of water.

Metals; Corrosion of ——. *Third Report to the Corrosion Committee of the Institute of Metals.* W. E. Gibbs, R. H. Smith, and G. D. Bengough. Inst. of Metals, Mar., 1916. [Advance proof.] 127 pages.

THE report is based on the results of laboratory experiments dealing with the corrosive action of sea-water on specimens of hard-drawn and annealed tubes of brass (Cu 70, Zn 30), Admiralty metal (Cu 70, Zn 29, Sn 1), lead-brass (Cu 70, Zn 28, Pb 2), phosphor-bronze (Sn 3·48%), and aluminium-copper (Al 7·92%). Normal and diluted (estuary) sea-water was used, with and without aeration, at temperatures up to 60° C. and over periods up to 150 days. The corrosive action of various simple and complex liquids other than sea-water was also investigated, and experiments made to determine the extent to which corrosion was influenced by the surface condition, etc., of the alloys and by contact of the latter with coke and other substances. Uniform dezincification of brass in sea-water was promoted by aeration (particularly when violent): by increasing the amount of dissolved carbon dioxide; by reducing the concentration of dissolved salts (as in estuary and river waters): and by increasing the temperature unduly (as in a choked tube). Localised corrosion resulted from irregularities in the physical condition of the alloy and in the chemical conditions prevailing at the surface of contact of the latter with the sea-water, and was accentuated by contact with cathodic substances such as coke or carbon. None of the alloys considered proved entirely satisfactory. The 70 : 30 brass, although apparently satisfactory in ordinary sea-water at temperatures below 50° C., was untrustworthy at higher temperatures and in estuary water. Admiralty metal resisted dezincification better than 70 : 30 brass except in very dilute sea-water. Lead-brass was severely attacked by estuary water, but resisted localised and selective corrosion in normal sea-water much better than Admiralty metal or 70 : 30 brass at all the temperatures considered. Phosphor-bronze behaved well in ordinary and diluted sea-water at temperatures up to 50° C.; but at 60° C. a white oxy-salt was formed which promoted rapid selective corrosion of the tin. The rate of "complete" corrosion of this alloy was much greater than that of the others, and when accelerated locally by aeration or strain, resulted in pitting. Provided that churning of the sea-water, choking of the tubes, and other accidental causes of corrosion could be obviated, phosphor-bronze would probably prove more satisfactory in practice than any of the other alloys. Aluminium-copper was very severely attacked by diluted sea-water, but dissolved very slowly in normal sea-water at all the temperatures considered and was practically unaffected by carbon dioxide. It is suggested that corrosion may be minimised by keeping the temperature of the water as low as possible; by avoiding foaming and churning of the water during flow; and by removing any oxy-salt, as soon as possible after its formation, by means of a brush when the condenser is opened up or by adding a suitable charge of very dilute acid to the circulating water after shutting off the steam.—W. E. F. P.

Zinc by electrolysis; Determination of ——. F. Chancel. Bull. Soc. Chim., 1916, 19, 59—63.

The metal, *e.g.*, brass, is dissolved in sulphuric and nitric acids, and the latter expelled by evaporation after precipitation of the copper. The free acid is neutralised by ammonia, and if iron is present it is precipitated, the liquid, after filtering, being carefully neutralised by sulphuric acid. The liquid is then acidulated with 0·25 c.c. of *N*/1 sulphuric acid, and sodium formate is added (0·2 grm. for each 0·1 grm. of zinc). The solution is electrolysed, using a platinum wire anode and sheet platinum cathodes. Experiments have shown that the accuracy of the method is not affected by the density of the current, and good and complete deposits of zinc are obtained, if the electrode is previously amalgamated with at least 0·3 or 0·4 grm. of mercury deposited by electrolysis from an acid solution of mercuric nitrate.—B. N.

Nickel-silver; Annealing of ——. Part I. F. C. Thompson. Inst. of Metals, Mar. 29, 1916. [Advance proof.] 31 pages.

The effect of annealing at different temperatures was determined on a series of copper-nickel-zinc alloys containing Cu 60 % and Ni 7 to 28 %. An alloy with Ni 15 % and Cu 55 % was included to study the influence of the ratio of copper to zinc, and the effects of deoxidising by the addition of 0·25 % Mn, as also of the addition of an excess of manganese (1·5 %) were observed. Tensile tests made on the cast alloys showed a distinct increase of strength as the nickel content rose, without however an appreciable change in the elongation or reduction of area. Change of nickel content had very little effect on the strength under compression of the cast alloys. Deoxidation of the molten alloys with 0·25% Mn produced a marked improvement in the rolling properties. The specific volumes became less with increased nickel, and also as the ratio of copper to zinc increased. The density in the work-hardened state was slightly greater than after annealing, and also in those alloys which had been deoxidised. Annealing at different temperatures showed a well marked transition between 300° and 400° C. in the electrical resistance measurements. This transition was shown also by thermo-electric measurements in which a thermo-couple was made by tying together hard-drawn and completely annealed wires of the same alloy with platinum wire, but it was not revealed in the heating and cooling curves. The specific resistance was found to be determined chiefly by the nickel present and to equal (12 + % Ni) microhms per c.c. With the exception of the alloys with only 7% Ni the resistance was practically the same in the hard-drawn and in the annealed states. Torsion and Brinell hardness tests indicated well the temperature at which annealing started. It rose with increasing nickel content from 370° C. with 7 % Ni to 600° C. with 28·6 % Ni. The hardness curves showed a sharply localised peak about 330° C. The influence of time on the temperature at which annealing began was negligible, although the temperature of the critical point was slightly lowered by "soaking." Hardness and alternating stress tests made on commercial samples indicated that the impurities usually present are practically without effect on the properties, at the temperature of annealing. The tendency to "burn" of the commercial alloys tested was increased (a) by increasing the nickel content, (b) as the ratio of zinc to copper is increased, and (c) with the amount of impurities present.—T. St.

Tin-aluminium-copper alloys. A. A. Read and R. H. Greaves. Inst. of Metals, Mar. 29, 1916. [Advance proof.] 13 pages.

Copper-aluminium-tin alloys with 0 to 10 % Sn and 0 to 10 % Al were prepared and tested to ascertain which, if any, would be of special commercial utility. *Hardness.* In every case with constant aluminium the hardness increased with increase of tin; with constant tin it increased with increase of aluminium. *Cold bending.* As in the property of hardness, the behaviour of the alloys was largely determined by the copper content. For the series containing 90 % Cu the toughness of each binary alloy was reduced by the addition of the third metal. *Hot forging.* The difficulties of hot-working the ternary alloys are greater even than those experienced with bronzes, and far greater than with the copper-aluminium alloys. Cold-rolling, corrosion, and tensile tests were also made. The mechanical properties of the ternary alloys are in many cases good, but they never reach those of the corresponding (and cheaper) copper-aluminium alloys. The replacement of tin in a gun-metal by aluminium is of no advantage, but leads to loss of strength and greatly increased brittleness, unless about three-quarters at least of the tin is replaced, when the properties approximate but are inferior to those obtainable from copper and aluminium alone.—T. St.

Aluminium and its alloys; Analysis of ——. W. H. Withey. Inst. of Metals, March, 1916. [Advance proof.] 15 pages.

Aluminium-zinc series of alloys. 1—2 grms. of the alloy is dissolved in dilute hydrochloric acid, excess of sodium hydroxide solution added, the solution (400 c.c.) heated to boiling, and a rapid stream of hydrogen sulphide passed for 10 minutes. The precipitate is dissolved in hydrochloric acid, ammonium chloride solution added, and the slight amount of aluminium present precipitated by ammonia. The aluminium is reprecipitated twice more in this way, dissolved in hydrochloric acid, and iron determined colorimetrically. The zinc solution is exactly neutralised, and precipitated with a large excess of ammonium phosphate in boiling solution. After cooling, the precipitate is collected on asbestos in a Gooch crucible, ignited gently, and weighed as zinc pyrophosphate. The method gives a zinc sulphide which filters with the greatest ease, and effects, in the case of the richer zinc alloys, a perfect separation. No silica is ever found in the precipitated zinc. *Copper-aluminium alloys.* For alloys with over 10% Cu, estimation of the copper electrolytically, after dissolving the alloy in nitric acid, gives excellent results. When manganese exceeds 2%, however, electrolytically deposited copper is contaminated with manganese dioxide. Alloys poorer in copper are dissolved in dilute hydrochloric acid, the "flocked-out" copper separated, and the remainder precipitated as sulphide. When zinc is also present, the solution must contain at least 12 c.c. of hydrochloric acid of sp.gr. 1·1 per 100 c.c. to avoid the co-precipitation of zinc. *Alloys containing Cu, Al, Zn, Ni, Mg, and Mn.* 2 grms. of the alloy is dissolved in 30 c.c. of hydrochloric acid and 10 c.c. of nitric acid, the solution diluted somewhat, treated with 15 c.c. of concentrated sulphuric acid, and evaporated till fumes of sulphur trioxide are evolved. After cooling and treating with water, the residue of silicon and silica is filtered off, ignited and weighed in a platinum crucible, and the silica determined by loss after treatment with hydrofluoric and sulphuric acids. The silicon is estimated as the further loss after treatment with hydrofluoric and concentrated nitric acids. Any residue is fused with potassium bisulphate and the solution of the melt added to the main solution. The latter (about 300 c.c.) is heated to 70° C., and hydrogen sulphide passed till all the copper is precipitated. The copper sulphide is filtered off for determination of copper, and the filtrate boiled till free from hydrogen sulphide, treated with 15 grms. of tartaric acid, neutralised carefully with ammonia, adding only a very slight excess, treated with 5 grms. of ammonium chloride, heated to 70° C., and hydrogen sulphide again passed. After allowing the solution to stand for a few hours in a closed flask, it is filtered; the precipitate contains the whole of the iron and zinc, and part of the nickel and manganese. The filtrate is made distinctly acid with acetic acid, boiled to remove hydrogen sulphide and to coagulate any colloidal nickel sulphide, filtered, the filtrate concentrated to 800 c.c., cooled, made feebly alkaline with ammonia, and an aqueous solution of 5 grms. of sodium phosphate added slowly with vigorous stirring. After the precipitate has formed, one-third the bulk of concentrated ammonia solution is added and the whole allowed to stand overnight. Next morning, the precipitate is filtered off, washed, redissolved in hydrochloric acid, and reprecipitated after addition of 1 grm. of tartaric acid. The weighed precipitate is dissolved in very dilute nitric acid, and any silica remaining is weighed. Any manganese present in the solution is estimated colorimetrically, and the corresponding weight of manganese pyrophosphate deducted from the weight of the magnesium precipitate. The mixed sulphides precipitate is dissolved in hydrochloric acid, and the iron oxidised with a little nitric acid. The iron is removed as basic acetate, reprecipitated with ammonia, and weighed as oxide. Traces of manganese are removed by bromine, the zinc precipitated as sulphide in formic acid solution, redissolved if in large amount, and determined as pyrophosphate. The nickel is determined in the solution either volumetrically or by dimethylglyoxime. Manganese is estimated on a separate portion of the alloy by the bismuthate method, as manganese largely remains in solution with the aluminium. Results obtained on mixed solutions containing known amounts of Al, Mg, Fe, Zn, and Ni are given, and demonstrate the accuracy of the method. The author gives an account of the method used for the complete analysis of several samples of the purest commercial metal containing from 99·0 to 99·5% Al. Sodium is now rarely found as an impurity. It may be determined by dissolving the metal in nitric acid, igniting the nitrates, and extracting with water. —T. St.

Furnaces; Electric —— as applied to non-ferrous metallurgy. A. Stansfield. Inst. of Metals. Mar., 1916. [Advance proof.] 26 pages.

A summary is given of the use of the electric furnace in non-ferrous metallurgy, dealing with the electrolytic production of aluminium, sodium, calcium, magnesium, and cerium, and the electrothermic production of silicon, tungsten, molybdenum, chromium, vanadium, and titanium, chiefly for the production of ferro-alloys. The electric smelting of ordinary metals, such as lead, tin, zinc, copper, and antimony, it is stated, has lately been taken up in view of the economies that should be possible in certain cases, but much work is necessary to perfect these processes. An important recent application, in which development is possible, is the melting and alloying of the non-ferrous metals. The use of electrical heating methods for annealing, welding, and other minor metallurgical operations, and the great improvements made in the design and construction of furnaces for such purposes, are dealt with.—B. N.

Vanadium; Preparation of metallic ——. R. Edson and D. McIntosh. Trans. Roy. Soc. Canada, 1915, [iii], **9**, 81—83. J. Chem. Soc., 1916, **110**, ii., 143—144.

The method described may be used with advantage in the laboratory, or for demonstration in the lecture-room. A flask, containing some vanadyl chloride, is fitted with a platinum wire filament attached to two heavy copper leads, and also with inlet and exit tubes. The filament is made to glow by passing a current through it, and the vanadium is deposited smoothly on the platinum as a silvery-grey coating. The experiment may be carried out either in a vacuum or in an atmosphere of dry hydrogen at low pressure. As soon as the filament reaches a white heat the deposition begins, and can be continued until the wire burns out. The vanadyl chloride is made by heating a mixture of the pentoxide and charcoal in a stream of chlorine, and need not be purified from any vanadium tetrachloride it contains.

Magnesium. W. M. Grosvenor. J. Ind. Eng. Chem., 1916, **8**, 275—276.

Before the war nearly all the magnesium used in England, France, and the United States came from Germany, but considerable quantities, of excellent quality, are now being produced in England and France, and the present production in the United States is probably slightly in excess of the home demand. For several months past the price in the United States has been practically constant at $5.50 (23s.) per lb. of magnesium of guaranteed 99% purity (the actual purity is about 99·5%, whereas the purity of the German product rarely exceeded 98% and often fell as low as 96%). It is not probable that the price will be reduced materially in the near future on account of the heavy capital expenditure for plant and experimental investigations which has been necessary. It is stated, however, that processes of manufacture depending on the electrolysis of dissolved magnesia, reduction of fused magnesium chloride with aluminium, and reduction of magnesium oxide or carbonate to slag-forming residues, etc., have been thoroughly worked out on the chemical side, and that provided the engineering problems can be satisfactorily solved it may be possible to manufacture magnesium at a total cost of 35 cents (1s. 5½d.) per lb. The specific gravity of magnesium is lower than that of aluminium by one-third and the metal when pure (over 99·5%) appears to be quite as resistant to corrosion as aluminium, whilst it is superior to the latter in heat conductivity (about one-half that of copper) and equal if not superior in electrical conductivity (also about one-half that of copper). It may be hot rolled to a tensile strength of 35,000 lb. per sq. in. and cold rolled to a much higher strength, 2—4 times that of aluminium.—A. S.

Gallium from spelter; Recovery of —— in the United States. W. F. Hillebrand and J. A. Scherrer. J. Ind. Eng. Chem., 1916, **8**, 225.

Owing to the present demand for high-grade spelter, the practice of redistillation has been adopted, and the presence of gallium in noticeable quantities has been detected in the final residue of zinc-lead dross. It appears in the form of drops, resembling mercury, on the surface of the dross after this has been exposed to the weather for some time. The drops consist of gallium with small proportions of indium and zinc and a trace of calcium. The metal or alloy "wets" glass or porcelain and adheres so tenaciously that if agitated in a glass vessel the contents can be seen only as a coating on the walls; this property is destroyed if the metal is covered with hydrochloric or sulphuric acid. Of seven samples of American zinc ores examined spectroscopically, six contained gallium and five germanium also. A sulphide ore from Missouri, probably from the Joplin district, contained more of both gallium and germanium than any of the others. (See also this J., 1913, 1072.)—A. S.

Sulphur dioxide and trioxide in flue gases: Determination of ——. R. J. Nestell and E. Anderson. J. Ind. Eng. Chem., 1916, **8**, 258—260.

THE gases are drawn through a Hawley filter (this J., 1912, 1183) to retain sulphur trioxide and then through a double-action Allihn wash bottle containing N/10 sodium carbonate and hydrogen peroxide to absorb the sulphur dioxide. When the flue gases are at a temperature above 450° C., it is necessary to cool the sampling tube inserted into the furnace or flue, or to aspirate the gases very rapidly, in order to prevent the oxidation of sulphur dioxide to trioxide under the catalytic influence of the walls of the sampling tube and of dust particles which may collect in the tube; in such cases the gases may be passed rapidly through the sampling tube into a partially exhausted 2-litre bottle and then drawn through the absorption apparatus. In a number of samples of gases from the outlet flue of a multiple-hearth roasting furnace at a large Arizona copper smelting works, the ratio of $SO_3 : SO_2$ by vol. ranged from 1 : 11·56 to 1 : 16·73. —A. S.

Tungsten ore production in the Federated Malay States. Chem. Trade J., Apr. 1, 1916.

THE output of tungsten ore in the Federated Malay States in 1915 amounted to 234 tons, against 232 tons in 1914. The value of the exports of the ore from Malaya amounted to £70,496 in 1915, £49,973 in 1914, and £68,916 in 1913. Prior to the war most of the ore went to Germany.

Copper exports from the United States.

EXPORTS of copper from the United States in 1915 amounted to 276,000 tons, against 360,000 tons in 1914. The principal destinations of the exports during the last three years were:—

	1913.	1914.	1915.
	tons.	tons.	tons.
United Kingdom ..	55,682	87,556	80,985
France	65,826	66,326	102,400
Italy	18,877	26,068	44,705
Russia	40	425	20,456
Germany	145,529	88,452	Nil
Austria	15,539	13,809	Nil
Holland	77,129	58,940	1,678

Silver-palladium alloy [platinum substitute]. Elect. World. Chem. Trade J., Apr. 8, 1916.

A SILVER-PALLADIUM alloy is recommended for use in contact and spark devices to replace platinum. An alloy of silver with 2% Pd gives satisfactory results under many circumstances. When the contacts or spark points are exposed to sulphur compounds, 5% or more Pd should be used. The alloy which gives the greatest resistance to spark erosion is that of 60% Pd and 40% Ag. Additions of palladium to silver raise the melting-point and lower the thermal conductivity.

Metals of the platinum group; Exportation of —— from Russia. Board of Trade J., Mar. 30, 1916.

SUPPLEMENTING the existing prohibition of the exportation of platinum, manufactures of platinum, and platinum ore, the Russian Minister of Finance has prohibited the exportation from Russia, by all frontiers, of all preparations containing platinum and of all rare metals of the platinum group. Exceptions from these prohibitions may be accorded in favour of allied and friendly countries.

Copper and zinc industries in Japan. Board of Trade J., Mar. 30 and Apr. 6, 1916.

THE output of copper in Japan during 1915 is estimated at between 70,000 and 75,000 tons, an increase of about 15% over the 1914 output. The exports of copper from Japan were as follows:—

	1914.		1915.	
	tons.	£	tons.	£
China	13,850	942,000	1,430	106,000
Hong Kong........	2,560	165,000	90	7,000
British India	2,440	168,000	1,220	89,000
United Kingdom ..	6,790	414,000	12,200	944,000
France	3,470	227,000	3,940	299,000
Germany	2,100	125,000	—	—
United States	4,680	296,000	7,800	561,000
Asiatic Russia	5,000	300,000	29,000	2,590,000
Other Countries ..	2,110	139,000	320	15,000
Total	43,000	2,776,000	56,000	4,611,000

Prior to the war, the zinc-refining industry in Japan was a very small one, the output for 1914 being estimated at 5000 tons. Cessation of competition, however, gave a great impetus to the industry, and the production in 1915 amounted to 16,000 to 18,000 tons, whilst it is expected to reach 25,000 tons in 1916. Exports of refined zinc from Japan in 1915 amounted to 5300 tons, valued at £416,000, mainly to the United Kingdom, France, and Russia. Imports of zinc concentrates were obtained from China and Siberia. [illegible]

Separation and determination of nickel. Walker. *See* XXIII.

PATENTS.

Pig-iron; Process of producing dephosphorised, high-grade ——. P. L. T. Héroult, New York. U.S. Pat. 1,172,597, Feb. 22, 1916. Date of appl., July 30, 1912.

PHOSPHORIC pig-iron is treated with a basic slag containing iron oxide, in a non-oxidising atmosphere within an electric furnace, at a temperature just sufficient to keep the slag molten and effect combination between the latter and the phosphorus without appreciably affecting the carbon in the metal.—W. E. F. P.

Metals; Electrodeposition of ——. C. E. S. Bell and L. G. Scott, London. Eng. Pat. 3569, Mar. 5, 1915.

METALLIC type moulds are produced electrolytically by immersing the moulded blocks as cathodes in a current of electrolyte, the liquid being maintained at a high velocity whilst passing over the surface of the moulds, and a high current density being employed.—B. N.

Furnaces; Metal melting and other ——. I. Hall, Birmingham. Eng. Pats. 3874, Mar. 11, and 8922, June 17, 1915.

THE melting pot, and other parts of the furnace, such as the protecting tube of a thermostat, are made of iron, the phosphorus content of which is reduced to an amount, about 0·25%, just sufficient to produce fluidity for casting. Such iron is obtained by mixing 75 parts of hæmatite iron with 25 parts of Scotch or other foundry pig. Pots composed of this iron may be used for melting aluminium, and other furnace parts made of such iron better withstand high temperatures for prolonged periods.—T. St.

Furnace for melting, oxidising, and volatilising metals. W. H. Boorne and J. Sackett, London. Eng. Pat. 7072, May 11, 1915.

The furnace is designed primarily for the production of zinc oxide and antimony oxide. The furnace chamber consists of a horizontal cylinder, the under part or hearth of which is supported on screw-jacks, and is easily removable. A liquid fuel burner capable of delivering a large volume of heated air at a low pressure is situated about the centre of one end of the chamber. The hot gases and fume escape through an opening in the roof of the chamber, at the fuel-inlet end, into an oxidising chamber situated above. A valve-controlled air inlet is placed in the front of the oxidising chamber to admit air for completing the oxidation of any unoxidised fume passing up from the hearth, and a valve-controlled pipe or conduit opening into the top of the oxidising chamber at the rear end serves for the passage of the fume to suction condensing chambers.—T. St.

Welding: Electric —— and apparatus therefor. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 9628, July 1, 1915.

An electric resistance spot-welding machine is provided with a head, movable towards and from the work, carrying a point electrode on a carriage which may slide in the directions of movement of the head. The electrode is pressed on the work at the point to be welded, a spring supported by the carriage extending the electrode from the head towards the work, and the electrode is rotated by co-operating screw-threads as it is moved against or by the force of the spring. Current is simultaneously passed through the electrode into the work, and whilst the latter is in a softened condition the surface is cleaned, the scale broken up, and the metals intermingled by the rotation of the electrode. The electrode carriage may also be moved in a direction at right angles to the movement of the head, so as to bring the electrode on to different points to be welded.—B. N.

Copper; Process of tempering or tempering and cleaning ——. W. H. White, Dorrancenton, Pa., U.S.A. Eng. Pat. 11,240, Aug. 4, 1915.

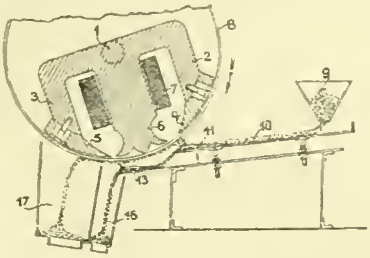
The copper is heated to red or white heat, immersed in a hardening bath till it "blows," and finally placed between two pieces of iron, steel, or stone, and hammered by striking the upper piece of iron, etc., until the red glow of the metal changes to a golden colour. The bath contains calcium hydroxide as the hardening agent, and may also contain tallow as a toughening agent, and an infusion of burdock root with borax as cleansing agents.—T. St.

Zinc-gold slimes; Treatment of ——. J. Penhale, Johannesburg, S. Africa. Eng. Pat. 14,921, Oct. 21, 1915.

A mixture of the dry material with about 10% of ts weight of litharge and an excess of wood charcoal r coke is heated in a retort to produce metallic inc, for further use in precipitation, and lead ullion from which the gold is extracted as usual. —W. E. F. P.

Magnetic material; Method of and apparatus for separating ——. F. Krupp Akt.-Ges., Magdeburg-Buckau, Germany. Eng. Pat. 100,064, Jan. 11, 1916. Under Int. Conv., Feb. 10, 1915. (Appl. No. 489 of 1916.)

N a magnetic separator of the drum type (see g.) the magnetic body which oscillates about the spindle, 1, has two side poles, 2, 3, provided with laterally adjustable shoes, 4, 5, and a common pole, 6, excited by a coil, 7. The weaker zone is formed between the shoe, 4, and the pole, 6, and the stronger zone between the latter and the shoe, 5; and a delivery drum, 8, rotates about the magnetic body in the direction indicated by the arrow. The material delivered to the trough, 9, travels down the inclined plate, 10, at the lower end of which it is divided, by a row of guides, 11, into separate streams from which the strongly magnetic portion is attracted first and caused to adhere to the drum in a form corresponding to the original streams. The material not attracted falls on to the lower table and is divided, by a row of guides, 13, into new streams from which the remaining magnetic portion is attracted by the stronger zone and caused to adhere to the drum in streams disposed between the original ones. The non-magnetic material is collected in the trough, 16, and the magnetic portions in the trough, 17, which is divided into compartments corresponding to the number and position of the adhering streams.—W. E. F. P.



Smelting [ores] and incinerating [garbage]; Method of ——. W. R. Heslewood, Assignor to Hydro Vacuum Smelting Co., Oakland, Cal. U.S. Pat. 1,160,509, Nov. 16, 1915. Date of appl., Jan. 13, 1913; renewed Apr. 26, 1915.

Smelting of ores or incineration of garbage is effected in a shaft furnace in which the charge is heated by liquid fuel injected into downwardly-sloping combustion chambers formed in the walls of the furnace near the base. Air is drawn in around the nozzles of the burners by suction, the gaseous products being withdrawn from the top of the furnace by means of a water-injector apparatus. The relative amounts of fuel and air are suitably arranged for different materials by means of valves on the fuel-supply pipes, and by regulating the water-pump of the injector respectively.—T. St.

Zinc ores and material containing zinc; Process of making briquettes from ——. O. Kippe, Osnabrück, Germany, Assignor to General Briquetting Co., New York. U.S. Pat. 1,168,401, Jan. 18, 1916. Date of appl., Nov. 19, 1914.

Zinc by-product material (zinc dust, etc.) is mixed with water containing 0·25 to 2% of a soluble salt such as the chloride or sulphate of magnesium, calcium, iron, or zinc, formed into briquettes, and allowed to dry in the air. Zinc ores may be mixed with about 8 to 10% of the zinc by product material, and similarly treated. Reducing materials such as anthracite may also be incorporated.—T. St.

Zinc ores; Process of treating ——. C. C. Titus and W. J. Barenscheer, Helena, Mont., Assignors to New England Electro-Chemical Metals Co., Boston, Mass. U.S. Pat. 1,173,467, Feb. 29, 1916. Date of appl., Aug. 31, 1914.

The dry ore is chloridised in presence of sodium chloride, the soluble chlorides extracted, and the metal contents of the solution precipitated, with ultimate replacement of their chlorides by sodium chloride. The resulting sodium chloride solution is electrolysed, the evolved chlorine being used to chloridise fresh ore, and the chlorinated anode-liquor to extract the chloridised mass.—T. St.

Furnace ; Ore-roasting ——. W. H. Motter, Denver, Colo., Assignor to M. A. Motter. U.S. Pat. 1,172,479, Feb. 22, 1916. Date of appl., May 19, 1913.

The apparatus consists of two concentric cylinders, the inner one projecting at the charging end and the outer one at the opposite end. The projecting part of the inner cylinder is provided with a screw feed and communicates with a suction fan. The projecting portion of the outer cylinder communicates with a fire-box and has a number of peripheral openings each fitted with a valved pipe for supplying air to the inner cylinder, the latter being provided at this end with a device for deflecting the products of combustion from the fire-box into the annular space between the cylinders.—W. E. F. P.

Metals, including their alloys ; Means [mould] for casting ——. C. Vickers, Niagara Falls, N.Y., Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,172,506, Feb. 22, 1916. Date of appl., Aug. 29, 1914.

The mould, adapted to be filled from the bottom is composed of a mixture of graphitised and amorphous carbon and has a riser member composed chiefly of sand.—W. E. F. P.

Ores ; Process of reducing ——. F. E. Agnew, Los Angeles, Cal. U.S. Pat. 1,174,464, Mar. 7, 1916. Date of appl., June 11, 1915.

The crushed ore is heated in presence of air in a preheating furnace to the reduction temperature, and is then passed with agitation through a heat-insulated reduction furnace, where, under exclusion of air, it comes into intimate contact with gaseous hydrocarbons introduced at the atmospheric temperature. The reduced ore passes through a cooling zone in the presence of a non-oxidising gas. The process is continuous.—T. St.

Leady matte ; Process of refining ——. N. V. Hybinette, Christiania, Norway. U.S. Pat. 1,175,266, Mar. 14, 1916. Date of appl., Jan. 25, 1915.

Bessemerised copper matte is added to the molten matte, and the resulting refined matte and crude lead are drawn off at different levels. The refined matte passes into the next bath of a series and is treated with bessemerised matte from the bath next ahead. The lead from the second bath is returned to the first bath and the refined matte passes on to the third bath, and so on.—T. St.

Chromium alloys. [Electrical resistance element.] W. B. Driver, East Orange, N.J. U.S. Pat. 1,175,724, Mar. 14, 1916. Date of appl., June 24, 1912.

An electrical-resistance element consisting of an alloy containing copper, nickel, and manganese, with about 2 to 10 % of chromium.—T. St.

Silicon alloy ; Manufacture of sheet ——. O. Graef, Bismarckhütte, Assignor to Bismarckhütte, Germany. U.S. Pat. 1,173,951, Feb. 29, 1916. Date of appl., June 24, 1914.

See Eng. Pat. 13,703 of 1914 ; this J., 1915, 967.

Apparatus for separating materials. Eng. Pat. 3339. *See* I.

By-product recovery from gas producers, [blast-furnaces] and the like. Eng. Pat. 3677. *See* IIa.

XI.—ELECTRO-CHEMISTRY.

Destruction of bacteria in large volumes of milk by means of electricity. Lewis. *See* XIXa.

Patents.

Furnaces ; Electric —— *[for fixation of nitrogen].* E. K. Scott, Belvedere, Kent, and F. Howles, Manchester. Eng. Pat. 3953, Mar. 12, 1915.

The furnace is provided with two or more electrodes having shield-like ends, arranged so as to enclose a central space preferably in the form of an inverted cone, and providing arcing gaps between the electrodes. One or more baffles or partitions may be provided to close wholly or partially the space between the walls of the furnace and the tops of the electrodes. Air inlets are so disposed as to pass air from outside the electrodes, through the arcing gaps to the space enclosed by the electrodes.—B. N.

Furnace ; Electric ——. I. Hechenbleikner, Charlotte, N.C., Assignor to Southern Electro-Chemical Co., New York. U.S. Pat. 1,173,960, Feb. 29, 1916. Date of appl., Nov. 2, 1914.

The furnace is provided with a track on which is mounted a trolley, and with water-cooled hinged clamping members, for supporting the electrode, depending from the trolley. Several stirrups are supported independently of the electrode, and are adapted to support the electrode temporarily during the time of changing the electrodes.—B. N

Leclanché cells ; Methods of and means for resuscitating —— *when apparently exhausted.* J. T. Fahy, Wellington, and A. E. Otway, Auckland, N.Z. Eng. Pat. 11,511, Aug. 9, 1915.

The material in the porous pots of Leclanché cells may be revived by the addition of a small quantity of concentrated hydrochloric acid, and for this purpose, the pot may be provided with a funnel-shaped tube passing through the pitch to the interior.—B. N.

Oxygen and hydrogen gases ; [Electrolytic] apparatus for the production of ——. *Electrolytic plant.* G. Halter, Assignor to Davis-Bournonville Co., New York. U.S. Pats. (a) 1,172,885 and (b) 1,172,887, Feb. 22, 1916. Dates of appl., (a) Aug. 27, 1913, and (b) Oct. 20, 1914.

(a) A tank, acting as the cathode, is provided with a cover, from which the anode, formed of wires united in the form of a hollow body, is suspended in the electrolyte. A separator, of porcelain or other non-conducting and oxygen-resisting material, is supported over the anode with its sides extending below the surface of the electrolyte, and the closed top is provided with an oxygen outlet. An asbestos sack is secured to and suspended from the separator, enclosing the anode below the surface of the liquid, the separator and sack constituting a complete non-conducting enclosure for the anode. Means are provided for conducting off the hydrogen from the space beneath the cover outside the separator. (b) The tank is made in the form of a narrow upright chamber, with a partition dividing the interior of the tank into narrow vertically-arranged compartments, the partition and walls of the tank forming the cathode. Each anode is formed from spaced perforated sheet metal plates, arranged so as to have a hollow oblong form in horizontal section, with curved ends and bottom, and secured at its upper edges to a horizontal conducting bar supported from the cover of the tank. A separator of non-conducting material, with attached sack enclosing the anode, is inverted over each anod and disposed lengthwise in the chamber. Th partition is formed from two plates, back to back, with their end portions curved apart and around the ends of the anodes.—B. N.

Electrolytic measuring instrument. H. S. Hatfield, Brunswick, Germany. U.S. Pat. 1,173,570, Feb. 29, 1916. Date of appl., June 22, 1914.

The instrument is provided with a rhodium cathode on a gold base, the active part of which is "line shape" and is situated on the boundary between the liquid electrolyte and the gas space.—B. N.

Flame-arc furnace for oxidising the nitrogen of the air; Electrical ——. H. Bonnevie, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,173,699, Feb. 29, 1916. Date of appl., Nov. 30, 1914.

See Fr. Pat. 476,633 of 1914; this J., 1916, 46.

Galvanic battery. W. Hickmann, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,173,965, Feb. 29, 1916. Date of appl., May 10, 1911.

See Eng. Pat. 11,906 of 1911; this J., 1911, 1123.

Electro-osmosis; Apparatus for ——. H. Illig, Assignor to Ges. für Elektro-Osmose m. b. H., Frankfort, Germany. U.S. Pat. 1,174,946, Mar. 7, 1916. Date of appl., Jan. 4, 1913.

See Eng. Pat. 29,826 of 1912; this J., 1913, 295.

Electrolytic manufacture of chlorates and perchlorates of alkali metals. U.S. Pat. 1,173,346. *See* VII.

Electric welding and apparatus therefor. Eng. Pat. 9628. *See* X.

Chromium alloys. [*Electrical resistance element.*] U.S. Pat. 1,175,724. *See* X.

XII.—FATS; OILS; WAXES.

Vegetable oils; Refining ——. C. Baskerville. J. Ind. Eng. Chem., 1916, 8, 118—121.

By the following method the loss on refining is reduced to a minimum and the "foots" may be separated immediately by means of a filter-press instead of by prolonged settling. The oil is treated with 2% of suitably prepared cellulose (less than 1% of real cellulose; 0·25—0·5% of dry cellulose is sufficient if "linters" is used), together with caustic soda (a much stronger solution than is commonly employed) and a predetermined quantity of soda ash. The whole is agitated and heated to 45°—65° C. to produce the "break" and then filter-pressed, the first portion, if turbid, being returned for re-filtration. The cellulose converts the colloidal precipitated matter into a mass which is easily separated by filtration, and the soda ash facilitates separation of soaps from the oil. In some cases it is advisable to add a small quantity of sodium chloride. The time occupied depends upon the capacity of the filter-presses. Presses which are emptied mechanically appear to be more suitable than plate filter-presses, and by using filter-cloth made of Monel metal the wear may be reduced to a minimum. The process has proved satisfactory on a commercial scale. The press-cake may be converted directly into soap or may be used as a filler for soap or soap powder; or it may be treated with acid, in which case the cellulose settles rapidly in the aqueous layer, and he black oil may be drawn off ready for use. When the cake is to be converted into black grease it is advisable to use anhydrous sodium ulphate in place of soda ash. (See also U.S. Pats. .105,743, 1,105,744, 1,114,095, and 1,130,698; his J., 1914, 930, 1162; 1915, 434.)—A. S.

Glyceryl ester of tetrachlorotetraiodoterapic acid [*from cod-liver oil*]. J. J. Cerdeiras. Anal. Fis. Quim., 1915, **13**, 439—441. J. Chem. Soc., 1916, **110**, i., 199.

A substance isolated from cod-liver oil proved on analysis to be the glyceryl ester of tetrachlorotetraiodoterapic acid, $C_3H_5(C_{17}H_{23}O_2Cl_4I_4)_3$.

Adipocere; Composition of ——. R. F. Ruttan and M. J. Marshall. Proc. Amer. Soc. Biol. Chem., Tenth Annual Meeting, Dec. 1915, 12—13.

A specimen of adipocere had the following composition:—Palmitic acid, 67·52; stearic acid, 3·3; oleic acid, 5·24; ι-hydroxystearic acid, 9·48; κ-hydroxystearic acid, 6·32; stearin and palmitin, 1·21; olein, 0·16; unsaponifiable matter, 0·87; calcium soaps, 4·41; protein, 0·665; ash, 0·578; undetermined, 0·247%. The fatty acids and traces of fats soluble in ether constituted 94·1% of the adipocere and had the following chemical and physical characters:—Sp. gr. at 100° C., 0·8436; refractive index at 60° C., 1·436; m.pt., 60°—63° C.; acid value, 201·7; saponification value, 207·0; iodine value, 6·01; acetyl value, 31·75. Adipocere is evidently the residue of pre-existing fats of animals; it is composed almost entirely of the insoluble fatty acids left after the slow hydrolysis of the fats in wet ground. Proteins have practically disappeared, and the glycerol, soluble soaps, etc., have been washed away. The hydroxystearic acids which are so characteristic of adipocere are produced by hydration of a portion of the oleic acid originally present in the fat.—W. P. S.

Chinese wood oil; Optical dispersion of —— *as an index of purity.* E. E. Ware. J. Ind. Eng. Chem., 1916, 8, 126—128.

The author makes use of the abnormally wide optical dispersion exhibited by Chinese wood oil for determining adulteration with other oils (compare Brier, this J., 1915, 1214). The oil is examined in a hollow prism in a spectrometer fitted with an autocollimating eyepiece, using a brass electrode arc lamp as source of light, and the relative dispersion for two lines in the red and blue respectively is determined. The angular difference observed by means of the spectrometer circle is taken as a measure of the dispersion and is expressed in vernier units of 6″ each. With a prism of angle 20° 1′ the value for Chinese wood oil is 269 and for soya bean oil 129 units, and the dispersion of wood oil adulterated with soya bean (or other) oil may be represented by a straight line, using percentage adulteration and angular dispersion respectively as co-ordinates. The method is as accurate as any hitherto described and, on account of its simplicity and the short time required for a determination, is specially suitable for factory control purposes.—A. S.

Fats and oils; Thermal values of ——. *I. Heat of bromination.* J. W. Marden. J. Ind. Eng. Chem., 1916, 8, 121—126.

The heats of bromination of a number of oils were determined in a small calorimeter composed of a large Dewar tube inside which is a small copper mixing chamber with a flange inside about half-way up; a cover glass resting on the flange divides the mixing chamber into compartments to contain the reacting substances and is subsequently broken by means of a paddle stirrer within the chamber. The mixing chamber is rotated, and inclined flanges on its outer surface serve to agitate the water in the Dewar tube. A smaller apparatus composed of a thin glass tube mounted inside a Dewar tube, with copper wire stirrers in both the inner tube and the Dewar tube, was used for determining the specific heats of the brominated oil mixtures, and might be used also for the determination of the heat of neutralisation, the calorimetric equivalent of the Maumené value, etc. The following values for the heat of bromination were obtained :—sandalwood oil, 274 calories ; raw linseed oil, 206 ; boiled linseed oil, 204·6 ; Chinese wood oil, 150 ; corn (maize) oil, 116·2 ; sesamé oil, 126·4 ; rape oil, 120·8 ; cottonseed oil, 117 ; sperm oil, 109 ; castor oil, 102·2—104·1 ; peanut oil, 102·2 ; olive oil, 95·4—100·7 ; neat's foot oil, 83 ; lard, 79·3 calories per grm. Iodine values calculated from the heats of bromination by means of the factor 0·816 agreed moderately well with the Hübl iodine values in most cases, but large differences were obtained in the case of sandalwood and Chinese wood oils (compare Jenkins, this J., 1897, 193).—A. S.

Oils and fats : Velocity of saponification of —— by potassium hydroxide in different solvents. E. Anderson and H. L. Brown. J. Phys. Chem., 1916, **20**, 195—213.

Definite volumes of the oils in measured quantities of the solvents were mixed at a constant temperature in a thermostat with an equal volume of potassium hydroxide dissolved in the same solvent. Aliquot portions of the mixtures were withdrawn at measured intervals and run into an excess of N/10 hydrochloric acid, the excess being subsequently titrated. By substituting the data thus obtained in the various reaction formulæ, constant values for the velocity constant, K, were obtained only with the formula for bi-molecular reactions—

$$K = \frac{2{\cdot}3025}{T_{e}t}\log.\ \frac{T_t(T_o-T_e)}{T_o(T_t-T_e)}$$

(where T_o represents the volume of N/10 alkali in 10 c.c. of the mixture at first titration, T_e the volume at the end of the reaction, T_t, the volume at time, t, and t the time in minutes after the first titration). The glycerides studied were saponified at approximately the same rate, although the velocities increased slightly with the molecular weights, butter fat, for example, being saponified more rapidly than cottonseed oil, and croton oil more rapidly than olive and castor oils. The velocity differed in different solvents. For example, it was about twice as rapid in amyl alcohol (sp. gr. 0·8140) as in ethyl alcohol of sp. gr. 0·8171, and about ten times as rapid in ethyl alcohol as in methyl alcohol (sp.gr. 0·8100). The addition of 1% of water to the alcohol increased the speed of saponification by about 4%. In the case of castor oil saponified in ethyl alcohol the temperature coefficient of the reaction $K_{25°} \div K_{15°}$ was 2·36. An increase in the amount of alkali accelerated the speed of saponification, but no definite ratios could be established. With amyl alcohol (sp.gr. 0·8110) as the solvent, an increase in the amount of oil caused a decrease in the velocity of the reaction, whereas in the case of methyl and ethyl alcohols, increasing the amount of oil appeared to accelerate the saponification.—C. A. M.

Recovery of wool fat. Ayres. *See* V.

Catalytic reduction in the presence of platinum and palladium. Böeseken and others. *See* XX.

Patents.

Unsaturated compounds [*oils*] ; *Process and apparatus for hydrogenating* ——. *Hydrogenating unsaturated compounds.* H. K. Moore, Berlin, N.H., U.S.A. Eng. Pats. (a) 22,980, (b) 100,095, (c) 100,906, Nov. 24, 1914. (b and c, Appl. Nos. 480 and 481 of 1916.)

(a) An intimate mixture of the finely-divided compound with hydrogen is made to pass through the catalyst (*e.g.*, nickel) in such a way that while in one part of the catalyst hydrogenation is being effected, other parts are being freed from hydrogenated products and revivified by a current of hydrogen of high velocity. The fine division of the unsaturated compound may be effected by causing the hydrogen at high velocity and under pressure, to impinge upon a stream of the material, which may be delivered from a jet travelling in a circle round a fixed diaphragm of porous material, upon which the catalyst is spread and is covered by another porous layer. To facilitate the passage of the mixture, a different gaseous pressure may be maintained on each side of the diaphragm. (b) Finely divided, as distinguished from deposited, material (*e.g.*, nickel) is used as the catalyst, and the porous diaphragm which supports it may consist of fibrous material such as asbestos cloth. Means are provided for having a pressure of, say, 60 lb. on one side, and of, say, 40 lb. on the other side of the diaphragm. (c) Hydrogen in admixture with the finely divided compound and hydrogen by itself are passed in the same direction in repeated succession through the catalyst, to effect hydrogenation of the oil, etc., and revivification of the catalyst as described in (a) and (b).—C. A. M.

Albuminous products from residues obtained in oil manufacture ; Manufacture of ——. V. Grafe and K. Peche, Vienna. Eng. Pat. 3699, Mar. 8, 1915. Under Int. Conv., July 11, 1914.

See U.S. Pat. 1,169,634 of 1916 ; this J., 1916, 317.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Red lead and orange mineral ; Rapid method for the analysis of ——. J. A. Schaeffer. J. Ind. Eng. Chem., 1916, **8**, 237—238.

The method is based on the following reactions :—$Pb_3O_4 + 4HNO_3 = 2Pb(NO_3)_2 + H_2O + H_2PbO_3$; $PbO_2(\text{or } H_2PbO_3) + H_2O_2 = PbO + H_2O(\text{or } 2H_2O) + O_2$. One grm. of the sample is treated with 15 c.c. of nitric acid of sp.gr. 1·2, and when the red colour has disappeared, exactly 10 c.c. of hydrogen peroxide (1 part of a 3% solution to 3½ parts of water) is added, the mixture stirred, and complete decomposition of the lead dioxide ensured by adding a little hot water. The solution is then diluted with hot water to 250 c.c. and titrated with permanganate solution (1 c.c. = 0·005 grm. Fe). A blank test is made with the same volumes of hydrogen peroxide solution and nitric acid. The difference between the two titrations multiplied by 3·058 gives the percentage of red lead, or multiplied by 1·067 that of lead dioxide.—A.S.

Colophony ; Action of nitric acid on and auto-oxidation of ——. L. Paul. Seifensieder Zeit., 1915, **42**, 640—641, 659. J. Chem. Soc., 1916, **110**, i., 218—219. (Compare this J., 1915, 1062, 1153.)

The action of nitric acid on colophony proceeds even at the ordinary temperature. γ-Pinic acid yields a so-called nitro-product, m.pt. 125°—130° C. whilst when diluted with water the product give α-pinic acid, m.pt. 100—105° C. The action of nitri acid on finely divided colophony furnishes substance, m.pt. 120°—125° C., the nitro-compoun separating as a yellow, pasty mass, which give a substance of m.pt. 135°—136° C., on treatmen with water. Explosive properties are not observe with the substances obtained by the action o nitric acid. The nitro-compound obtained fro γ-pinic acid is readily soluble in water containin sodium carbonate, and from the solution sodiu chloride throws down a frothy precipitate ver difficultly miscible with water. Addition of hydrochloric acid to the filtrate yields a yellow precipitate which is soluble in water, and, like β-pinic acid, has m.pt. 120°—125° C.; the residue from the extraction becomes transparent at 122° C. The formation of the β-pinic acid is attributed to the action of the nitric acid. If the use of sodium chloride is omitted from the preparation of α-pinic acid, and the nitro-product is precipitated, the latter shows a considerably lower melting point; washing with water yields, not β-pinic acid, but a product resembling α-pinic acid. It is concluded that the primary transformation product is α-pinic acid, which is only converted into the β-compound by oxidation, and that the basis of the auto-oxidation of colophony is not the latter itself, but α-pinic acid, which undergoes conversion into β-pinic acid. The α-compound is formed by treating colophony with alkali or nitric acid or by storing it in a closed vessel; nitration takes place only to a very subordinate extent.

Patents.

Flatting finish composition [*paint*] *and process of making same.* C. Ellis, Montclair, N.J. U.S. Pat. 1,173,183, Feb. 29, 1916. Date of appl., Dec. 26, 1914.

A mixture of white lead, linseed oil, and hydrogenated vegetable oil.—W. F. F.

Paint; Process of making ——. H. Hackl and H. Bunzel, Heufeld, Germany. U.S. Pat. 1,175,751, Mar. 14, 1916. Date of appl., Mar. 13, 1914.

See Fr. Pat. 469,711 of 1914; this J., 1915, 92.

Plastic compositions [*artificial resins*]; *Process of making* ——. B. B. Goldsmith, New York. Re-issue No. 14,087, Mar. 14, 1916, of U.S. Pat. 1,168,626, Jan. 18, 1916. Date of appl., Feb. 5, 1916.

See this J., 1916, 317.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Plastic or solid material [*substitute for celluloid or leather*] *and process of producing same.* S. J. Peachey, Stockport. Eng. Pat. 1894, Feb. 6, 1915.

Indiarubber is converted into a chlorine derivative by dissolving it in carbon tetrachloride or other solvent, which does not react with chlorine but is a solvent of the product to be obtained (hydrocarbons being excluded), and treating with chlorine or a gaseous mixture containing chlorine. A filling agent, such as camphor, may be incorporated with the material. The solvent is removed by evaporation or distillation or the new derivative may be precipitated by alcohol or other miscible solvent which has no solvent action on the substance.—B. N.

Rubber; Process and apparatus for the manufacture of ——. J. Schadt, Medan, Dutch East Indies. Eng. Pat. 12,002, Aug. 19, 1915. Under Int. Conv., Aug. 26, 1914.

Undiluted latex is poured into shallow horizontal trays, to a uniform depth of 1—2 mm., and is exposed to the sun or air, or both, until sufficient moisture has evaporated, when the thin films or sheets of rubber are removed from the trays, stretched on frames, and further dried by exposure to sun or air. The films may then be pressed together into thicker sheets or blocks. It is claimed that the product obtained in this way is very uniform. (See also Vriens, this J., 1915, 1104.)—E. W. L.

XV.—LEATHER; BONE; HORN; GLUE.

Chestnut extract; Contribution to the knowledge of ——. L. Pollak. Collegium, 1915, 435—440. J. Amer. Leather Chem. Assoc., 1916, **11**, 163—166.

Lignin was estimated in dried chestnut extract, and in chestnut wood before and after extraction, by Cross and Bevan's phloroglucinol absorption method (this J., 1907, 942). The extract residue absorbed 4·2—5·7% of phloroglucinol, the wood 4·1—4·6% before extraction, and 4·4% after extraction. The absorption value of the extract, in view of the almost identical values for new and spent wood, is explained by the continual breaking down of the lignin complex during the extraction into "ketocyclohex," the absorbent of phloroglucinol. This process is always accompanied by the formation of pentoses. The author considers the high proportion of non-tans in chestnut extract to be due to the breaking down of wood, and not to decomposition of tannin by heat and pressure. Attempts to identify extracts by the phloroglucinol absorption figure were unsuccessful. —F. C. T.

Lime liquors; Analysis of tannery ——. H. G. Bennett. Collegium (London), 1915, 258—266, 313—322, 329—335. J. Amer. Leather Chem. Assoc., 1916, **11**, 98—130.

The determination of alkalinity by titration with $N/10$ acid, using such indicators as methyl orange, methyl red, or phenolphthalein, is unsatisfactory owing to vague end points caused by hydrogen sulphide and protein hydrolysis products. The author suggests an indirect determination by boiling the lime liquor with excess of standard sulphuric acid until all hydrogen sulphide is expelled and then titrating the excess of acid, and a direct method whereby peptones and similar bodies are first precipitated by boric acid and the filtrate then titrated with standard acid using methyl orange. In the determination of ammonia by distillation, the indicator should be methyl orange (not methyl red or carminic acid) on account of the hydrogen sulphide in the distillate. The ammonia is expelled from the liquor by boiling for exactly 15 mins. with excess of magnesium sulphate, collected in excess of boric acid solution (Winkler, this J., 1913, 485; 1915, 79), and titrated with $N/10$ hydrochloric acid. To minimise hydrolysis of proteins to amino-acids and still liberate the maximum of ammonia, the soluble proteins and sulphides may be precipitated with zinc sulphate and the filtrate distilled with alkaline permanganate. The estimation of sulphides by distillation is best effected by boiling with excess of magnesium sulphate and not with acid. The hydrogen sulphide is collected in $N/10$ iodine solution, or in standard sodium hydroxide where it is estimated by Mohr's residual method with excess of arsenious acid and subsequent titration of the excess with iodine. For the estimation of soda a development of Procter's method is proposed; calcium is precipitated by ammonium oxalate, the filtrate evaporated, and the residue ignited, dissolved in boric acid solution, and titrated with $N/10$ acid. Caustic lime can only be accurately determined with some trouble, involving the determination of sodium, sulphur, and ammonia. If the sodium is in excess of the amount required to form sodium sulphydrate (which is neutral to phenolphthalein), the excess must be regarded as caustic soda, and together with the ammonia must be deducted from the total alkalinity to give the caustic lime. In an alternative method for total alkalinity, ammonia is removed by formaldehyde, which also converts sulphydrates into hydroxides. If the liquor is titrated after the addition of neutral formaldehyde, ammonia may be neglected, all hydroxides and sulphydrates are estimated, and error due to escaping hydrogen sulphide is eliminated. A correction is introduced for acids produced by reaction of the formaldehyde with amino-acids. The author gives several precautions to be observed to ensure accuracy in the determination of nitrogen according to Ronchèse (this J., 1907, 811), when the ammonium sulphate produced by the Kjeldahl digestion is treated with formaldehyde and the liberated sulphuric acid titrated. A classification of the nitrogenous substances of lime liquors according to a scheme of fractional precipitation is proposed. —F. C. T.

Patents.

Tanning materials and process of preparing the same. H. Wade, London. From Robeson Process Co., New York. Eng. Pat. 11,509, Aug. 9, 1915.

See U.S. Pat. 1,147,245 of 1915 ; this J., 1915, 915.

Tanning of hides and skins ; Method for the ——. G. Durio, Turin, Italy. U.S. Pat. 1,173,182, Feb. 29, 1916. Date of appl., Feb. 21, 1913.

See Fr. Pat. 448,321 of 1912 ; this J., 1913, 438.

Impregnating [hides] electro-osmotically ; Treatment of materials [tanning extracts] and ——. B. Schwerin, Assignor to Elektro-Osmose A.-G. (Graf Schwerin Ges.), Frankfort, Germany. U.S. Pat. 1,174,903, Mar. 7, 1916. Date of appl., Jan. 4, 1915.

See Eng. Pat. 21,190 of 1914 ; this J., 1915, 971.

Hides ; Process for treating ——. J. H. Yocum, East Orange, Assignor to The Clarendon-Yocum Co., Newark, N.J. U.S. Pat. 1,175,495, Mar. 14, 1916. Date of appl., June 18, 1915.

See Fr. Pat. 470,774 of 1914 ; this J., 1915, 190.

Plastic or solid material [substitute for leather] and process of producing same. Eng. Pat. 1894. *See* XIV.

XVI.—SOILS ; FERTILISERS.

Soils ; Studies on ——. *Basic exchange.* F. E. Rice. J. Phys. Chem., 1916, 20, 214—227.

Soils (33 grms.) from various parts of New York State were shaken with 100 c.c. of $N/1$ potassium nitrate solution, allowed to stand over-night, and filtered. In portions of the filtrate the hydrogen ions were determined by Sörensen's method (this J., 1909, 950), and the lime requirement in pounds CaO per acre was determined by Veitch's method, while other portions were used for qualitative tests of the bases present, and titration with $N/50$ sodium hydroxide solution. It was found that in the case of so-called "acid" soils part of the cation of the salt was adsorbed, while an equivalent quantity of bases from the soil was dissolved. The extracts thus obtained showed greater acidity than the original soils. This was attributed to the formation of hydrated aluminium oxide in the hydrolysis, together with equivalent quantities of free acid, and since the latter was strongly ionised while the former was slightly ionised and possibly in a colloidal state, the resultant solution was distinctly acid. Water-soluble acid was found in only two samples of acid soils. Basic (as distinguished from "acid" soils) gave up to the salt solution more base than they adsorbed, but this was attributed not to basic exchange, but to solution of excess of the base.—C. A. M.

Phosphorus in soils ; Comparison of methods for the determination of ——. W. O. Robinson. J. Ind. Eng. Chem., 1916, 8, 148—151.

Accurate results can be obtained by the fusion method, by Washington's method ("Chem. Anal. of Rocks," Wiley and Sons, New York, 1910, p. 162), and by Fischer's method (Internat. Mitt. Bodenkunde, 1913, 2, 511). Vanadium does not interfere if it be reduced with ferrous sulphate and the phosphorus precipitated with molybdate at 15°—20° C., with shaking ; it is not necessary to add sulphurous acid to prevent re-oxidation of the vanadyl salt. If the phosphomolybdate precipitate be converted into magnesium ammonium phosphate and the latter determined gravimetrically, without allowing the precipitate to stand too long, it is not necessary to reduce the vanadium, but a large excess of the reagents must be used and the mixture digested and agitated mechanically to ensure complete precipitation of the phosphomolybdate. Tungsten and titanium in the quantities present in soils do not interfere with the gravimetric determination of the phosphorus. The composition of the feathery precipitate sometimes formed on dissolving the phosphomolybdate in ammonia depends upon the nature of the bases present in the solution before precipitation. Its formation can be prevented or reduced to a negligible amount by operating so that the phosphomolybdate precipitate does not adhere to the sides of the containing vessel and by washing it thoroughly.—A.S.

Soil ; Enzymes of a cellulose-destroying fungus (Penicillium pinophilum) from the ——. E. D. Clark and F. M. Scales. Proc. Amer. Soc. Biol. Chem., Tenth Annual Meeting, Dec. 1915, 31—32.

Penicillium pinophilum was found to be one of the most active destroyers of cellulose yet isolated from the soil. Cultures grown on solutions containing ammonium sulphate or peptone as a source of nitrogen, reduced added filter paper to a soft, pulpy condition in about 2 weeks ; the individual fibres of the paper were frayed out, separated, and transparent. Enzyme preparations made from the cultures contained sucrase, emulsin, and amidase in a very active state, whilst lipase, diastase, and catalase were less active. Tests for peptic, tryptic, and ereptic enzymes and for peroxidase gave negative results but it was not impossible that these enzymes were present in the growing fungus.—W. P. S.

Phosphatic manuring ; Accumulated fertility in grass land in consequence of ——. W. Somerville. J. Board Agric., 1916, 22, 1201—1209.

To ascertain the residuary value, from an arable point of view, of basic slag applied to grass land, five distinct soil types were used for growing oats, wheat, and mustard in pots. Ten pots were used for each soil, five being filled with soil that had received phosphatic dressings in previous years, and the remainder with untreated soil. The treated grass land soil was found to be the more fertile, and the increased fertility varied with the amount of slag that had been applied, with the period of time during which the soil had been treated, and with the nature of the soil. The average increase shown by five crops in the five soils was 27 %. As the treated soils showed a higher nitrogen content than the untreated, and as the latter responded to the subsequent application of rape meal, whereas the former did not, it is inferred that the accumulated fertility in the grass land was due to the nitrogen stored up by the leguminous plants which thrive in soil dressed with basic slag, the phosphatic residues contributing but little to the accumulated fertility. The application of the rape meal caused an increase of only 5 %, hence it is calculated that the nitrogen stored up in an acre was greater in amount than that present in 7 cwt. of rape meal. The residuary value of the phosphate applied to grass land is considerable.—E. H. T.

Nitrogen: The increase of —— in fermenting manures. W. E. Tottingham. J. Biol. Chem., 1916, **24**, 221—225.

In a mixture of cow and horse manure, with and without barley straw litter, the amount of nitrogen present showed an increase after two weeks and after four weeks of fermentation, the gain being much greater in the case of the littered manure. Later the nitrogen decreased, and after 12 weeks there was an absolute loss. Similar experiments on cow and horse manure (2 : 1) in lots of 6·25 kilos., kept in loosely covered galvanised iron buckets in a warm room for 4 weeks, showed a gain of 4·76 % of nitrogen with a coarse wheat straw litter, a gain of 3·71 % with a finer wheat straw, and a loss of 5·22 % when no litter was used. The gains were much smaller than those previously obtained with barley straw. Although bacteriological examination failed to indicate the presence of azotobacter, quantitative tests proved that the manure contained nitrogen-fixing organisms of considerable activity. Investigations on field plots are being made to ascertain if the nitrogen fixation is of agricultural importance. It would appear that a manure gains in nitrogen and appreciates in value by restricting its fermentation in the early stages.—E. H. T.

Insoluble nitrogen in fertilisers; Activity and availability of —— as shown by chemical and vegetation tests. F. R. Pember and B. L. Hartwell. J. Ind. Eng. Chem., 1916, **8**, 246—251.

The results described were obtained by pot experiments on oats and rye under greenhouse conditions in the Rhode Island Agricultural Experiment Station. The nitrogen of "garbage tankage" and of aluminium nitride had no effect on the growth of the plants. The nitrogen of blood which had been extracted with water, and of "animal tankage" proved as available as the nitrogen of unwashed blood. Castor pomace and rape meal gave good results as sources of water-insoluble nitrogen for oat plants, whilst Kanona tankage gave poor results. Calcium cyanamide, applied at the rate of 165 lb. of nitrogen per acre, proved injurious to young plants, but the plants recovered and made fair growth subsequently. The nitrogen of soot had an availability of 56 compared with 80 for the nitrogen of dried blood, whilst that of oxamide was about equal to that of blood and of sodium nitrate. With regard to chemical methods, the use of alkaline permanganate gave results agreeing much more closely with those obtained by vegetation experiments than did neutral permanganate.—A. S.

Citrate-insoluble phosphoric acid; Proposed new method for [determination of] ——. C. H. Hunt. J. Ind. Eng. Chem., 1916, **8**, 251—253.

The sample is digested as in the American official method for the determination of total phosphoric acid (Bull. 107, U.S. Dept. Agric., Rev. Ed., p. 4), excess of ammonia is added to an aliquot portion of the solution, and the P_2O_5-content of the precipitated tricalcium phosphate is determined. The ratio between the citrate-insoluble P_2O_5 and the P_2O_5 thus precipitated by ammonia is fairly constant, and by dividing the latter value by 1·5, a result is obtained which does not differ from the content of citrate-insoluble P_2O_5 determined by the official method, to a greater extent than do results obtained by different analysts using the latter method. It may prove possible to obtain still more concordant results by using different factors for different types of fertilisers. The method does not appear to be applicable to superphosphates, probably because a large proportion of the calcium is removed with the water-soluble phosphoric acid.—A. S.

Potash from kelp. I. F. Laucks. Met. and Chem. Eng., 1916, **14**, 304—308.

Kelp (*Nereocystis luetkeana*) at Puget Sound is cut by a system of knives which operate several feet below the surface of the water. The mechanism is worked from a "scow," secured to a tug; at high tide it has a cutting capacity of 100 tons of green kelp (containing 92—93 % water) in 6 hours, and at low tide a greater capacity. A conveyor passes the material, as cut, to a chopping machine, from which it is received by another conveyor and piled on deck. Unloading is effected by hand, to a conveyor which delivers to storage bins. Much potash liquor is squeezed out by natural compression in the bins, and the residual moisture is expelled in a direct-heat rotary drier, provided with dust chambers, the feed being shredded, to ensure uniform drying and a product fine enough to mix with other fertilisers. Loss of nitrogen during drying is prevented by feeding the kelp at the fire end of the drier and regulating so as to retain 5—10 % of moisture. The potash is readily recovered from the dried product by leaching, and, with 80 % muriate at $35 (£7 6s.) per ton, the working of kelp is considered profitable. The cost of harvesting and unloading the green kelp is 49 cents (2s.) per ton, and that of drying, 25—50 cents.—F. Sodn.

Germination; Influence of hydrogen peroxide on ——. E. Demoussy. Comptes rend., 1916, **162**, 435—438.

Seeds of garden cress, seven years old, did not germinate when kept at 27° C. partly immersed in water; but at 10°—14° C., 25 % of the seeds germinated, though this temperature is much less favourable to the germination of fresh seeds than the higher one. In water containing 0·25 % of hydrogen peroxide, renewed daily, 40 % of the seeds germinated at 27° C. and 45 % at 10—14° C. The negative results obtained in pure water at 27° C. are attributed to asphyxiation of the seeds due to the rapid development of parasitic organisms at this temperature; under conditions of more complete aeration, viz., in moist sand, 25 % of the seeds germinated at 27° C. Hydrogen peroxide not only prevents the growth of parasitic organisms but also provides the seeds with oxygen. The fact that seeds sometimes give better results in the soil than in tests of germinative power carried out in warm water, has been recognised in practice, *e.g.*, with beet seeds.—J. H. L.

Composition of adipocere. Ruttan and Marshall. *See* XII.

New methods for the analysis of lime-sulphur solutions. Chapin. *See* XIXb.

Patents.

Fertilisers [from molasses refuse]. W. P. Thompson, Liverpool. From A. I. Kaplan, New York Eng. Pat. 9270, June 24, 1915.

Molasses refuse is concentrated in a triple vacuum effect to about 44° B. (sp.gr. 1·44), and 30 to 50 % of its weight of mineral phosphates, bone-meal, or guano is added. The resulting mixture is treated with the necessary amount of sulphuric acid of about 66° B. (sp.gr. 1·84), to produce, on cooling, a dry fertiliser containing potassium sulphate, soluble phosphate, and nitrogenous matter.—B. N.

Fertilisers : Process of making ——. S. B. Newberry and H. N. Barrett, Baybridge, Ohio. U.S. Pat. 1,173,303, Feb. 29, 1916. Date of appl., Mar. 15, 1912.

Pulverised natural phosphate is mixed with 5% to 24% of alkali bisulphate and heated in an oxidising atmosphere to a temperature of from 2500° to 2800° F. (1370°—1540° C.) until the sulphate is substantially decomposed. The heating is continued for from 20 to 70 minutes longer in order to expel the liberated sulphur dioxide, and to render the phosphoric acid citrate-soluble. —J. B. C. K.

Fertiliser : Process of making ——. S. B. Newberry and H. N. Barrett, Baybridge, Ohio. U.S. Pat. 1,174,176, Mar. 7, 1916. Date of appl., Oct. 21, 1911.

A charge of mineral calcium phosphate, alkali chloride, and a substance yielding sulphur dioxide, is calcined at a gradually increasing temperature until it becomes nearly white hot, by making it travel continuously towards the source of heat. It is also stirred continuously to effect its intimate contact with the gases evolved, in particular with the sulphur dioxide and steam. The chloride is converted into sulphate, which is decomposed at a higher temperature, yielding sulphur dioxide. The hydrogen chloride is recovered.—E. H. T.

Combined process of treating felspathic and phosphate rock. U.S. Pat. 1,172,420. *See* VII.

XVII.—SUGARS ; STARCHES ; GUMS.

Maple products ; Analysis of ——. *VI. Volumetric basic lead acetate test for purity of maple syrup.* J. F. Snell, N. C. MacFarlane, and G. J. Van Zoeren. J. Ind. Eng. Chem., 1916, **8**, 241—243. (See also this J., 1913, 954 ; 1914, 154, 367, 507.)

The syrup is diluted, boiled until the temperature reaches 219° F. (104° C.), filtered through cotton-wool, and cooled ; 10 c.c. is then diluted to 100 c.c., and 60 c.c. of the diluted syrup is treated with 10 c.c. of a solution of basic lead acetate, added 1 c.c. at a time, at a constant temperature, the electrical resistance of the original diluted syrup and of the mixture after the addition of each c.c. of lead acetate solution being measured by means of a dip electrode (Van Zoeren, J. Amer. Chem. Soc., March, 1916 ; see also Van Suchtelen and Itano, J. Amer. Chem. Soc., 1914, **36**, 1793). A graph is plotted with volumes of lead acetate solution as abscissæ and resistances as ordinates. With 70 genuine maple syrups, the volumetric lead number, *i.e.*, the abscissa of the point of intersection of two straight lines forming the graph, ranged from 4·9 to 6·6. Of 20 syrups containing 30% of sucrose syrup, 17 gave smooth curves. Of 20 syrups containing 40% of sucrose syrup, 18 gave smooth curves, and the remaining two gave points of intersection outside the limits for genuine syrups. Of 18 adulterated and non-maple syrups, 12 gave smooth curves, 3 gave points of intersection outside the limits for genuine syrups, and in the remaining 3 (cane molasses), the electrical resistance was not appreciably affected by addition of basic lead acetate.—A. S.

Acetylation and acetolysis of cellulose and starch. Böeseken and others. *See* V.

Determination of water in worts, sugar solutions, barley, hops, malt-combs, and yeast by the carbide method. Windisch and Glaubitz. *See* XVIII.

Patents.

Sugar-making process. J. Naylor, jun., Arlington, N.J. U.S. Pat. 1,172,303, Feb. 22, 1916. Date of appl., June 19, 1912.

The massecuite is delivered continuously to a centrifugal separator from which the sugar and molasses are discharged continuously and separately; about one-half of the molasses so withdrawn is heated to at least 200° F. (93° C.) and returned immediately and directly to the separator at the point where the massecuite enters, so that the latter is thinned and separation of the crystals facilitated.—J. F. B.

Beet slices ; Process of continuous extraction of plant slices, in particular ——. K. Philipp, Magdeburg. Ger. Pat. 289,670, May 11, 1912.

Extraction takes place in a diffusion-trough along which the slices are conveyed against a counter-current of water, and an up-and-down motion of the individual slices is produced by rotary movements of the blades of the conveyor. The end of the trough at which the fresh slices enter is deeper than the rest and a portion of the juice from this end is continuously withdrawn, heated, and pumped back, in order to heat the slices at the commencement of their travel along the trough.—J. H. L.

Beet juices (diffusion or expressed juices) ; Process of liming ——. A. Müller, Hohenau, Austria. Ger. Pat. 290,188, Oct. 22, 1912.

The raw juice, at or before its admission to a heating vessel, is treated with a certain proportion of limed but not carbonated juice from a later stage of the process, to produce an alkaline reaction. —J. H. L.

Starch in granular form and process of making the same. Starch product and method of making the same. L. P. Bauer, Chicago, Ill., Assignor to Corn Products Refining Co. U.S. Pats. (a) 1,175,113 and (b) 1,175,114, Mar. 14, 1916. Date of appl., June 21, 1915.

(a) The product consists of ungelatinised starch in relatively hard, compact pellets, which flow readily when the material is handled in bulk, and which break down in water forming a milky liquid, without residue. (b) Starch is mixed with a binding material ("mazam," a dextrin of high molecular weight) in liquid form, and the mixture is comminuted and dried in a current of air, so that no appreciable gelatinisation occurs and a product is obtained consisting of relatively hard pellets which break down in water at the ordinary temperature forming a milky liquid without residue.—J. H. L.

Sugar from sugar-cane, sorghum, and the like ; Process of and apparatus for extracting ——. W. Searby, Puunene, Hawaii. Eng. Pat. 4091, Mar. 15, 1915. Under Int. Conv., June 29, 1914.

See U.S. Pat. 1,146,456 of 1915 ; this J., 1915, 917.

Fertilisers [from molasses refuse]. Eng. Pat. 9270. *See* XVI.

XVIII.—FERMENTATION INDUSTRIES.

Water in worts, sugar solutions, barley, hops, malt-combs, and yeast ; Determination of —— *by the carbide method.* W. Windisch and M. Glaubitz. Woch. Brau., 1915, 32, 389—391, 397—398.

Application of Campbell's method (this J., 1913, 67) to barley, malt, malt-combs, and dried yeast, gave results slightly (but never more than 0·3%) higher than those obtained by drying at 105° C. by the German Congress methods. The results with hops were also 0·3—0·4 % higher than by drying in a Hoffmann apparatus. These differences may be due to slight chemical changes in the materials at the high temperatures employed in drying. Difficulties were encountered in applying the carbide method to malt worts and test solutions of sucrose and maltose. The use of sand as an absorbent material in the apparatus, was found impracticable owing to caking, and dried filter paper was therefore employed. Although only a small quantity (0·2—0·4 grm.) of liquid was used in each determination, the evolution of gas at the commencement of the action was often far too rapid, but some good results were obtained which indicated, for the test sugar solutions, about 0·1 % more water than was actually present, and for the malt wort about 0·1—0·2 % more than was found pyknometrically by application of K. Windisch's modified Balling's table.—J. H. L.

Wine; Detection of small quantities of oxalic acid in ——. H. Kreis and W. I. Baragiola. Schweiz. Apoth. Zeit., 1915, **53**, 397—400. J. Chem. Soc., 1916, **110**, ii., 158.

Oxalic acid is added occasionally to wine to decrease the quantity of calcium salts present and to increase the "residual acidity": even when the quantity of oxalic acid added is insufficient to precipitate the whole of the calcium, a small quantity of oxalic acid remains in solution owing to the solubility of calcium oxalate in the presence of tartaric acid. To detect a small quantity of oxalic acid in wine, 50 c.c. of the sample is heated to boiling, 3 c.c. of 5 % calcium chloride solution is added, and the mixture is rendered ammoniacal; acetic acid is now added to the hot solution until the latter is just acid in reaction (an excess of acid must be avoided), the mixture is cooled, submitted to centrifugal action, and the sediment examined under the microscope. Characteristic crystals of calcium oxalate will be observed if the wine contained as little as 0·02 grm. of oxalic acid per litre. Still smaller quantities (0·01 grm. per litre) of oxalic acid may be detected by treating 50 c.c. of the wine (cold) with 2·5 c.c. of 5 % calcium chloride solution, 2·5 c.c. of acetic acid, and 5 c.c. of saturated sodium acetate solution. After twenty-four hours, the mixture is shaken in order to disturb the sediment of calcium oxalate (if present); the greater part of the precipitated calcium tartrate adheres to the bottom of the vessel. The liquid is now submitted to centrifugal action, the sediment transferred to a small, drawn-out tube, again submitted to centrifugal action, and examined microscopically. The calcium oxalate contained in the cell tissue of grapes does not find its way into the must or wine.

Pineapple wine; Organisms of ——. H. Fouque. Comptes rend., 1916, 162, 433—435.

Four organisms were isolated from pineapple juice which had fermented spontaneously. Two of them, designated provisionally *b* and *d*, are *Saccharomycetes*. The yeast *d*, which appears to be the principal agent in the natural fermentation of the juice, forms cells ranging in size from 8·3 by 6·7μ to 5·8 by 3·6μ, and sporulates readily even on wort-agar but never produces more than two spores per ascus. The yeast *b* ferments pineapple juice less rapidly than *d*; it sporulates readily on gypsum blocks, producing 1—4 spores per ascus. It is probably a variety of *S. ellipsoideus*, but differs from the type in its greater invertase activity, and in the form of its giant colonies, which are conical. The other two organisms isolated, *a* and *c*, are intermediate in character between mycoderma yeasts and torulæ. They possess only a feeble fermenting power and appear to play a minor part in the natural fermentation of pineapple juice.—J. H. L.

Alcohol-water mixtures; Boiling and condensing points of ——. P. N. Evans. J. Ind. Eng. Chem., 1916, 8, 260—262.

500 c.c. of 95 % alcohol was distilled at a uniform rate of 1 drop per second in a 1 litre flask fitted with a thermometer, graduated to 0·1 C., with its bulb just below the outlet tube. The temperature was observed when 7·5 c.c. had distilled over, and distillation continued until 15 c.c. was collected. The mean of the percentages of alcohol in the liquid in the flask before and after distillation, as ascertained from the density, by the aid of Mendelejeff's table, was taken to represent the composition of the liquid, and the percentage of alcohol in the distillate was taken to represent the composition of the vapour at the temperature observed when 7·5 c.c. of distillate had been collected. After adding 15 c.c. of water to the liquid in the flask, the operations were repeated, and so on, results being thus obtained for 43 alcohol-water mixtures with different percentages of alcohol up to 95. Curves were plotted showing the relation between the composition of the vapour and of the liquid, on the one hand, and the boiling point (corrected for barometric pressure and the exposed mercury column of the thermometer) on the other. From the curves the values given in the following table were estimated, by means of which it is possible to determine approximately the alcohol content of any alcohol-water mixture from its boiling point.

B.pt., ° C.	Alcohol, weight per per cent. in:		B.pt., ° C.	Alcohol, weight per per cent. in:		B.pt., ° C.	Alcohol, weight per per cent. in:	
	liquid.	vapour.		liquid	vapour.		liquid.	vapour.
78·2	91	92	82·0	41	79	91·5	8	55
78·4	85	89	82·5	36	78	92·0	8	53
78·6	82	88	83·0	33	78	92·5	7	51
78·8	80	87	83·5	30	77	93·0	6	49
79·0	78	86	84·0	27	76	93·5	6	46
79·2	76	85	84·5	25	75	94·0	5	44
79·4	74	85	85·0	23	74	94·5	5	42
79·6	72	84	85·5	21	73	95·0	4	39
79·8	69	84	86·0	20	72	95·5	4	36
80·0	67	83	86·5	18	71	96·0	3	33
80·2	64	83	87·0	17	70	96·5	3	30
80·4	62	82	87·5	16	69	97·0	2	27
80·6	59	82	88·0	15	68	97·5	2	23
80·8	56	81	88·5	13	67	98·0	1	19
81·0	53	81	89·0	12	65	98·5	1	15
81·2	50	80	89·5	11	63	99·0	—	10
81·4	47	80	90·0	10	61	99·5	—	5
81·6	45	80	90·5	10	59	100	0	0
81·8	43	79	91·0	9	57	—	—	—

—A. S.

Sulphite liquor; Proposed method for the profitable utilisation of waste ——. H. V. Tartar. J. Ind. Eng. Chem., 1916, 8, 226—228.

Experiments made with a small-scale plant capable of treating 500 gallons, led to the following simple process for the production of alcohol from sulphite-cellulose waste lye, which has several advantages over Ekström's process (see this J., 1910, 810), among others the fact that no special yeast is required. The liquor is treated with a quantity of dilute (1 : 3) sulphuric acid equivalent to its content of total sulphurous acid, and concentrated, preferably *in vacuo*, at a temperature not above 85° C., to half its bulk, the sulphur dioxide expelled being utilised for the preparation of bisulphite solution. The concentrated liquor is treated with a small quantity of potassium permanganate (½ oz. to 500 galls. of original liquor) to oxidise any remaining sulphurous acid, made neutral to litmus by means of lime, allowed to settle, and the clear solution acidulated with 0·1 % of sulphuric acid, and fermented with brewers' yeast for 40—60 hours at 27° C., the liquid being kept agitated. The concentrated liquor contains about 6 % of fermentable sugar, and the yield of alcohol ranges from 0·76 to 0·86 % by vol. on the original liquor; in a properly controlled plant, with precautions against volatilisation, a yield of 1 % of alcohol should be attainable. The residue left after distillation is not noticeably toxic to fish when diluted.—A. S.

Enzymes of a cellulose-destroying fungus from the soil. Penicillium pinophilum. Clark and Scales. *See* XVI.

Indirect method of determining pyrimidine groups in nucleotides. Jones. *See* XX.

XIXa.—FOODS.

Milk: Destruction of bacteria in large volumes of —— by means of electricity. F. C. Lewis. J. Board Agric., 1916, 22, 1229—1238.

By subjecting cow's milk for a short time to a high voltage current, the number of bacteria is very greatly reduced, and organisms of the *coli* type, and also *B. tuberculosis*, are completely exterminated. The milk is passed from a covered receiving tank into a constant level tank, from which it flows by gravity through a horizontal stout glass tube built in sections, mounted on a slate panel, and containing three electrode chambers also of glass. In each of the latter is a copper electrode ½ in. thick, connected by a flat plate to an electric cable conveying a direct current of 2000—3000 volts. On either side of this "lethal" tube is a short aluminium earthing tube to prevent leakage of electricity, and other devices are used to protect the operator from shock. The milk passes from the lethal tube through a bent tube fitted with a thermometer into a small testing tank, of which there are two, and thence into the main container where it can be cooled. The regulation of the electric current and of the flow of milk requires 7—8 mins., but thereafter the process is continuous and almost automatic. During this treatment the chemical composition of the milk, and the enzymes in it, remain unchanged; the natural taste is preserved; the butter-forming property is unaffected; and its use as a medium for culture ferments is not invalidated. The apparatus is easily cleaned and the initial cost is low. The total cost of working with electricity at 1½d. per unit is 1¼d. per gallon of milk when an electric motor is used; with gas as motive power (2s. 8d. per 1000 cub. ft.) 0·96d., and with producer gas (anthracite 30s. per ton) 0·85d. The electrical consumption is about 0·43 unit per gallon.—E. H. T.

Goat's milk; The soluble and insoluble compounds of ——. A. W. Bosworth and L. L. Van Slyke. J. Biol. Chem., 1916, 24, 177—185.

By filtering goat's milk through a porous earthenware filter, the substances in true solution were separated from those in suspension or in colloidal solution (see this J., 1915, 297). Sugar, potassium, sodium, and chlorine were found in the former, fat and casein in the latter; albumin, inorganic phosphates, calcium and magnesium compounds, and citrates were partly in solution and partly suspended or present as colloids. The soluble portion or serum of fresh goat's milk has a faint greenish-yellow tint, is slightly opalescent, but nearly transparent. The insoluble fraction is grey to greenish-white, glistening, and gelatinous: when added to water, the liquid resembles the original milk in appearance, and except for the separation of fat globules the suspension persists almost indefinitely. When purified by shaking with water and filtering several times, the insoluble portion was found to consist of neutral calcium caseinate, di- and tricalcium phosphates, and magnesium phosphates. The aqueous suspension is neutral to phenolphthalein, but on treatment with normal potassium oxalate reacts strongly alkaline, probably owing to the formation of the soluble alkaline tripotassium phosphate. This view was confirmed by a quantitative comparison of the amounts of acids and bases present, the amount of calcium being in excess of that required to form neutral salts with the phosphoric acid and casein present. After adding normal potassium oxalate, filtering, and titrating, the acidity of the whole milk is found to be greater than that of the serum, probably because the water dissolves relatively more acid than base from the dicalcium phosphate. The lower acidity obtained when the calcium has been removed by the oxalate is believed to represent the real acidity of the milk. From the quantitative results obtained it is possible to deduce—in a provisional manner—the nature and amount of each separate salt present in the milk.—E. H. T.

Cow's, goat's, and human milk: A comparsion of the composition of ——. A. W. Bosworth and L. L. Van Slyke. J. Biol. Chem., 1916, 24, 187—189.

Whereas human milk contains no insoluble phosphate, that of goats contains tricalcium and di- and trimagnesium phosphates, and the insoluble phosphate in cow's milk is the dicalcium salt. As regards soluble phosphates, human milk contains monomagnesium and monopotassium phosphates; goat's milk, monopotassium phosphate, and cow's milk, the monomagnesium and dipotassium salts. The phosphate content of human milk is much below that of the other two kinds. Potassium citrate is present in all three kinds; cow's and human milk contain also sodium citrate. Cow's milk contains the most chloride, goat's milk the least. The latter contains calcium, potassium, and sodium chlorides, the two others only calcium chloride. The amount of total salts in human milk is about one-third of that in the other two sorts; the number of salts is greatest in goats' milk and least in human milk.—E. H. T.

Milk; Chemical changes in the souring of ——. L. L. Van Slyke and A. W. Bosworth. J. Biol. Chem., 1916, 24, 191—202.

The soluble and insoluble portions of fresh milk and of milk inoculated with *B. lactis acidi* and *B. lactis aerogenes* were separated by filtration through a porous cell and analysed. Sixty hours after inoculation the soured milk contained 78 % of unchanged lactose, and 88·5 % of that decomposed was converted into lactic acid; it contained no citric acid. The insoluble inorganic constituents were rendered water-soluble by the action of the lactic acid: the albumin passed through the filter, and the calcium caseinate was decomposed into calcium lactate and free protein, which was precipitated. The rate and extent of chemical change was investigated on a sample of fresh pasteurised skim-milk, inoculated with a pure culture of *B. lactis acidi*, and maintained at 32·3° C., samples being analysed at varying intervals during 96 hours. The lactose was mostly changed between the 10th and the 24th hours, and when 0·7 % of lactic acid was present the bacterial action was much diminished. The greatest increase in acidity takes place in the first 24 hours, the production of lactic acid being the cause in the serum, and the separation of free casein in the insoluble portion. Monocalcium phosphate goes into solution within 13½ hours as acid phosphate ($CaH_4P_2O_8$) and as lactate; the calcium present as caseinate requires 24 hours for complete solution and the insoluble magnesium 11½ hours. The albumin nitrogen in the serum is rendered soluble in 1 hours, the rate of solution increasing with the increase of acidity.—E. H. T.

Wheat flour; Chemical constitution of the proteins of —— and its relation to baking strength. M. J. Blish. J. Ind. Eng. Chem., 1916, 8, 138—144.

Ammonia-nitrogen, humin-nitrogen, basic nitrogen, and monoamino acid-nitrogen were determined in samples of flour of different baking qualities by Van Slyke's method (this J., 1911, 771, 1135; 1915, 1110) slightly modified. The results show that there are characteristic differences in the nitrogen distribution in flours of different qualities, and analysis of the gliadin, glutenin, and soluble proteins separately showed that these differences are not due to differences in the nature of the proteins present in strong and weak flours respectively; within the limits of experimental error the individual proteins were found to be identical in chemical constitution. The gliadin-glutenin ratio was found to be more nearly constant in flours of different baking qualities than has hitherto been supposed, whereas there is far greater variation in the content of so-called soluble proteins (albumin and globulin). The individual proteins differ widely in their content of ammonia-nitrogen, and it is suggested that determinations of the ammonia-nitrogen in the flour, in extracts of the flour made with various solvents, and in the crude gluten, after hydrolysis, would serve as an accurate indication of the amounts of the various proteins present (compare Bailey and Blish, this J., 1915, 1267).—A. S.

Protein hydrolysis; Comparison of the Sörensen, Van Slyke, and colorimetric methods for the determination of ——. V. J. Harding and R. M. MacLean. Proc. Amer. Soc. Biol. Chem., Tenth Annual Meeting, Dec., 1915, 15—16.

Serum albumin and globulin, gluten, fibrin, gelatin, casein, nucleoprotein, and peptone were hydrolysed by pancreatic extracts and the course of the hydrolysis followed by the Sörensen formaldehyde method, the Van Slyke method (this J., 1911, 771, 1135), and the colorimetric method described by the authors (this J., 1915, 514). The results obtained by the two latter methods agreed with each other and were higher than those given by the Sörensen method. The colorimetric method, however, sometimes gave lower results when applied to native proteins, probably due to the reaction being confined chiefly to α-amino groups.—W. P. S.

Citrus fruits; Utilisation of cull Florida ——. F. A. McDermott. J. Ind. Eng. Chem., 1916, 8, 136—138.

A considerable proportion, sometimes as much as 10 %, of the total crop of citrus fruits in Florida is unsuitable for packing, and much of this "cull" fruit is wasted. The juice from the cull fruit retains its natural flavour and may be kept without deterioration for 2 years if it be pasteurised at 63°—65° C. for 15 mins., the air being displaced by a non-oxidising gas, or, preferably, the containing vessel sealed by the vacuum method. Orange juice is best pressed from a quantity of fruit containing 10 % unpeeled, but in the case of grape-fruit the peeled fruit only should be used, with 5—10 % of unpeeled oranges to give the desired flavour. Flavouring oils of satisfactory quality may be recovered by distilling the ground peel with steam at greatly reduced pressure. The *Citromyces* moulds described by Wehmer (this J., 1913, 156) will grow on the sterilised juice in presence of calcium carbonate and convert a considerable proportion of the residual sugar into citric acid, but the juice does not contain sufficient citric acid to make the recovery of the latter worth while.—A. S.

Indirect method of determining pyrimidine groups in nucleotides. Jones. *See* XX.

Patents.

Flour or mill-stock, having a high starch content; Treatment of —— and apparatus therefor. J. S. Remington, Grange-over-Sands, Lancs. Eng. Pat. 4294, Mar. 18, 1915.

Flour is conducted into a vertical, cylindrical chamber and, while falling through the latter in a finely divided condition, is subjected to the action of dry steam, the quantity of steam admitted being insufficient to heat the flour to the bursting-point of the starch cells. The flour then falls down a zig-zag channel formed of iron plates, and heated by means of a steam jacket, so that the starch cells are burst and the moisture content of the flour is reduced. The upper chamber of the apparatus may also be heated to a suitable temperature by means of a steam jacket.—W. P. S.

Flour improver or preparation for the treatment of flour or dough. J. S. Remington, Grange-over-Sands. Eng. Pat. 4295, Mar. 18, 1915.

An extract of germs of wheat or other grain, which may be prepared by digesting the germs (200 grms.) with water (800 c.c.) at 122° F. (50° C.), is mixed with white or brown sugar (200 grms.) and solid phosphoric acid (2 grms.), and boiled until of the consistency of honey. The addition of, say, 1 lb. of the preparation to 280 lb. of flour causes the dough to be more spongy and to yield larger loaves, which keep in a moister condition than those made from untreated flour.—C A. M.

Milk; Method of treating ——. G. Sinclair, St. Paul, Minn., Assignor to C. L. Niles, Anamosa, Iowa. U.S. Pat. 1,175,876, Mar. 14, 1916. Date of appl., Aug. 13, 1914.

To prepare milk containing lactic bacteria without deleterious organisms, ordinary milk is heated slowly to about 65° C. and aerated meanwhile with sterile air, then incubated at 15° C. to allow the lactic bacteria to develop, next heated rapidly for a short time to about 82° C. to destroy any other organisms remaining, and finally cooled rapidly and if necessary again incubated at 15° C.—J.H.L.

Chocolate; Process of carameling ——. E. L. A. Savy, Courbevoie, France. U.S. Pat. 1,173,873, Feb. 29, 1916. Date of appl., Apr. 30, 1913.

See Eng. Pat. 12,362 of 1912; this J., 1912, 1144.

Tomato extract; Process of making ——. G. Frerichs, Bonn, Germany. U.S. Pat. 1,174,248, Mar. 7, 1916. Date of appl., Mar. 19, 1914.

See Ger. Pat. 269,813 of 1913; this J., 1914, 330.

XIXb.—WATER PURIFICATION; SANITATION.

Water; Modification of the method of sterilising drinking —— by sodium hypochlorite. V. Ferrand. Comptes rend., 1916, 162, 438—440.

The contaminated water is agitated with sodium hypochlorite equivalent to 0·003 grm. of chlorine per litre, allowed to stand for 10 mins. and then treated with hydrogen peroxide to reduce the active chlorine. For 100 litres of water, the quantities required are 4 c.c. of 31 % hypochlorite solution and 5 c.c. of 9 vol. hydrogen peroxide, or equivalent quantities of other concentrations. Bacteriological tests with a water containing 100,000 organisms per c.c. and more than 1000 *B. coli*, showed that by this process the latter and all anaërobic bacteria are destroyed, and the total number of organisms reduced to a greater extent than by allowing the water to stand for 1 or even 3 hours after addition of the hypochlorite and then reducing by means of sodium thiosulphate.—J. H. L.

Lime-sulphur solutions; New methods for the analysis of ——. R. M. Chapin. J. Ind. Eng. Chem., 1916, **8**, 151—156.

METHODS are described for the determination of the total (sulphide) base, total (sulphide) acid, and excess base or acid in order to ascertain whether the solution contains excess of lime or excess of hydrogen sulphide. Methods of analysis in which the results are dependent upon, or modified by, the degree of dilution are regarded as of little value. Total (sulphide) base is determined by adding 10 c.c. of the solution to 30 c.c. of water through a dry pipette delivering below the surface of the water, and titrating the liquid with *N*/10 hydrochloric acid (Tartar and Bradley, this J., 1910, 837) with methyl orange or Congo red as indicator, or, in the case of dirty solutions, with nitroprusside as an external indicator. The "reaction figure," representing c.c. of *N*/10 base or acid (hydrogen sulphide) present in 10 c.c. of the solution in excess of the quantity necessary to form neutral salts of the formula CaS_x, is determined by a method based on the fact that on adding neutral sodium tetrathionate to the solution in presence of a slight excess of ammonia, the following reaction takes place:—

$$M_2S_x + M_2S_4O_6 = 2M_2S_2O_3 + S_x,$$

and as thiosulphuric acid is a relatively strong acid, the excess alkalinity can be titrated with the aid of ordinary indicators. A quantity of *N*/10 iodine about 25% more than the volume of acid used for the total (sulphide) base titration, is treated with *N*/10 thiosulphate until the colour is nearly discharged, a little *N*/10 hydrochloric acid is added to destroy iodate, and the titration with thiosulphate completed. 5 c.c. of 10% ammonium chloride solution is added to the sodium tetrathionate solution thus prepared, the liquid diluted to 100 c.c., titrated first to alkalinity with *N*/10 caustic soda in presence of methyl red, and then to neutrality with *N*/10 hydrochloric acid, and 10 c.c. of *N*/10 caustic soda and 10 c.c. of the lime-sulphur solution added. After mixing and allowing to stand for 3 mins., the solution is titrated with *N*/10 acid. The figure obtained by deducting 10 from the c.c. of *N*/10 acid required is the "reaction figure"—plus or minus according to whether the lime-sulphur solution contains an excess of base or of acid. The total (sulphide) acid is obtained by subtracting algebraically the "reaction figure" from the sulphide base figure; by titrating with *N*/10 iodine the liquid left from the determination of the "reaction figure," and subtracting the result of the thiosulphate titration of the original sample; or, in the case of used dipping baths, by titrating a fresh sample of the solution, diluted with weak ammonia solution, with *N*/20 sodium tetrathionate solution until the sulphide is completely decomposed, an external indicator, such as nickel sulphate, being used.
—A. S.

Industrial diseases

THE "Health of Munition Workers' Committee" has issued memoranda on certain industrial diseases, including industrial fatigue, special industrial diseases, and sickness or injury due directly or indirectly to industrial occupations. The risk of illness, which may in some cases prove fatal, due to exposure to tetrachloroethane, lead, nitrous gases, and certain explosives is referred to, and also the danger of dermatitis from contact with trinitrotoluol, tetryl, mercury fulminate, etc. The symptoms noted in those employed in handling trinitrotoluol are drowsiness, headache, eczema, and loss of appetite; they are generally slight and disappear when exposure ceases, but in exceptional cases collapse may occur. Continued exposure intensifies the symptoms, while in some cases toxic jaundice has appeared and death has been known to result. The Committee has made regulations to deal with this class of work.

PATENTS.

Filtering [water]; Coagulant for ——. J. W., Block, Joliet, Ill. U.S. Pat. 1,173,698, Feb. 29, 1916. Date of appl., June 27, 1914.

ALUMINIUM sulphate and titanium sulphate are added to the water.—W. F. F.

Water; Apparatus for purifying ——. E. Claussen, Hagen, Germany. U.S. Pat. 1,173,709, Feb. 29, 1916. Date of appl., Jan. 30, 1915.

TWO superposed tanks are connected by a valved pipe controlled by a float in the upper tank, which float also closes the outlet of the lower tank when it reaches its lowest position. The outlet of the lower tank is also regulated by another float in the upper tank, the upward movement of which is limited by a stop before the water reaches its highest level. This float then fills and sinks, and is emptied by a siphon when the water level in the tank falls. The water in the lower tank is heated by means which are regulated by a float in the lower tank.—W. F. F.

Methane or hydrogen from waste liquors [e.g., from paper factories]; Production of ——. H. J. N. H. Kessener. The Hague. Ger. Pat. 290,126, Feb. 7, 1914.

WASTE liquor sludges, or the liquors themselves (*e.g.*, from paper factories), are inoculated with anaërobic bacteria capable of producing methane or hydrogen, selected with special regard to the nature of the particular waste liquors employed. Suitable nutrient salts are added and the bacteria are grown under conditions which minimise the production of free nitrogen.—J. H. L.

Filtration process for separating detritus from liquids. O. Imray, London. From W. B. Scaife and Sons Co., Pittsburgh, Pa., U.S.A. Eng. Pat. 3418, Mar. 3, 1915.

SEE U.S. Pat. 1,138,634 of 1915; this J., 1915, 680.

Method of smelting [ores] or incinerating [garbage]. U.S. Pat. 1,160,509. *See* X.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Liquorice root and liquorice extract; Constituents of ——. P. A. Houseman. Amer. J. Pharm., 1916, **88**, 97—105.

LIQUORICE root from different sources was extracted with various solvents. The amounts of extractive matter showed little difference in spite of the marked differences in flavour of the various roots and extracts. The presence of sucrose in liquorice root was confirmed, the amount being 2% of the root. The inner bark of both green and dried liquorice root, but not the outer bark or central part of the root, contains hæmolytically active saponins, in addition to the sapogenin, glycyrrhetic acid; these are extracted by 75% alcohol but not by water or by alcohol weaker than 50% by volume. A sample of glycyrrhizic acid, after purification and repeated crystallisation, gave on combustion C 58·37%, H 7·72%, N 1·09%, and after further crystallising repeatedly from glacial acetic acid and then from 50% alcohol, contained 1·89% N and melted partly with frothing at 203°—205° C. Glycyrrhizic acid oxidised with alkaline permanganate gives a white tasteless substance, whilst with fuming nitric acid it yields oxalic acid and a yellow dyestuff having a bitter taste.—T. C.

Ozone: Action of —— on organic compounds. IV. C. Harries. Annalen. 1915, **410**, 1—116.

The author discusses the relative merits of the ozone method and the catalytic hydrogenation process for the investigation of the constitution of unsaturated compounds, and also from a preparative point of view, and, whilst admitting that in the latter respect catalytic reduction is the more valuable, he reiterates the advantages of the ozone method from a constitutional standpoint. Difficulties connected with the formation of oxozonides have now largely been overcome by using ozone washed with 5% sodium hydroxide and concentrated sulphuric acid, but the formation in certain cases of very stable aldehyde or ketone peroxides as decomposition products of the ozonides still presents difficulties, which however can often be overcome by decomposing them with alkali carbonate, or reducing them with zinc dust and acetic acid in ethereal solution.

Ozonides of pinene and cyclohexene. [With R. Seitz.] Pinene treated with washed ozone (see above) yields a colourless solid ozonide, $C_{10}H_{16}O_3$. Cyclohexene similarly treated gives a mobile, highly refracting liquid ozonide, $C_6H_{10}O_3$, b.pt. 47°—52° C. at 10 mm. pressure, and an explosive, probably dimeric solid ozonide, m.pt. 60°—65° C., which is decomposed by water into cyclopentenaldehyde, adipic acid, and its corresponding half- and di-aldehyde.

Ozonides of cyclopentene. [With H. Wagner.] Cyclopentene yields according to conditions a variety of ozonides. In a freezing mixture a liquid monomeric ozonide was obtained, whilst in ethyl chloride solution cooled with carbon dioxide and ether, a crystalline, probably dimeric ozonide was produced, which was rapidly decomposed by water, and exploded violently at 94° C. With unwashed ozone (15—18%) the normal liquid ozonide was obtained in carbon tetrachloride solution, whereas mono- and di-meric oxozonides were formed when the ozonisation was conducted in chloroform solution.

Constitution of citronellal. [With F. Comberg.] Further attempts to determine whether citronellal contains the grouping $CH_2:C(CH_3).CH_2.$, or $C(CH_3)_2:CH.$ (the rhodinal structure) led to inconclusive results. From the decomposition products of the ozonide, formic and β-methyladipic acids were isolated as their calcium salts, together with aldehydes, ketones, and a large proportion of peroxides. From the latter acetone peroxide and γ-methyloctan-η-on-α-al peroxide were separated, and from their products of decomposition, obtained by warming with potassium carbonate, an aldehyde giving a semicarbazone, $C_8H_{13}ON_3$, probably that of methylcyclopentenaldehyde, an acid, $C_7H_{10}O_2$, probably methylcyclopentene-1-carboxylic acid, and 1-acetyl-4-methylcyclohexane, and β-methyladipic acid were isolated. From the nature and quantity of these products it is concluded that ordinary citronellal is a mixture of 40% of true citronellaldehyde and 60% of rhodinal. Difficult to reconcile with this result, however, is the fact that citronellal gives only one semicarbazone, all attempts to separate which have failed. Nevertheless the decomposition of the ozonide of this semicarbazone gave products from which the semicarbazone of methyloctanonal m.pt. 185° C. (from citronellaldehyde) and the semicarbazone of the half aldehyde of β-methyladipic acid (from rhodinal) were isolated. Either therefore the semicarbazone of commercial citronellal is a very difficultly separable mixture or an individual substance in which a shifting of the double linking is produced by ozonisation.

Aldehydes of the pyridine and piperidine series. [With G. H. Lénárt.] α-Pyridylaldehyde was obtained by the ozonisation of α-stilbazole (2-styrylpyridine) in hydrochloric acid solution, and was isolated as a colourless liquid of pungent odour, b.pt. 181° C. at 760 mm. In its chemical properties it bears a striking resemblance to benzaldehyde, giving with potassium hydroxide α-picolinic acid and α-pyridylcarbinol; with aqueous potassium cyanide -αpyridoin,

$$C_5NH_4.CH(OH).CO.C_5NH_4.$$

which is oxidised by nitric acid to -αpyridil; and with dimethylaniline and zinc chloride a leucobase, $C_5NH_4.CH[C_6H_4.N(CH_3)_2]_2$, which is oxidised by lead peroxide to a green dye similar to Malachite Green but giving a slightly more bluish shade. The diethylacetal of α-pyridylaldehyde can be reduced by sodium and alcohol to α-piperidylaldehyde-diethylacetal. Numerous other derivatives of α-pyridylaldehyde are described, as is also the preparation of β-pyridyl aldehyde from benzoylmetanicotine and ozone. It shows the greatest similarity in properties to the α-derivative.—G. F. M.

Catalytic reduction in the presence of platinum and of palladium. J. Böeseken, O. B. van der Weide, and C. P. Mom. Rec. Trav. Chim. Pays-Bas. 1916, **35**, 260—287.

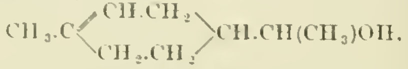
Experiments with crotonic, cinnamic, sorbic, undecylenic, trichloroacrylic, pentachloropropionic, and oleic acids showed that these acids can be reduced, in the form of their sodium salts, by means of hydrogen in the presence of colloidal palladium and that, in the case of the saturated acids, the chlorine can be replaced by hydrogen. The position of the double linkage in the molecule, in some instances, indicated that this was without influence, but further experiments with muconic, aconitic, itaconic, citraconic, mesaconic, cyclopropanedicarboxylic, ethylenetricarboxylic, and vinylglycollic acids showed that an accumulation of carboxyl groups about the double linkage impeded or moderated the reduction (maleic acid was an exception). The methods of preparing the colloidal palladium described by Paal (this J., 1904, 208) and by Skita (this J., 1913, 46) were employed. Colloidal platinum was also used as a catalyst in the reductions; the activity of this catalyst, however, varied considerably. With citraconic acid the rate at which the hydrogenation proceeded was analogous to that observed with the use of palladium. In the case of cinnamic acid, the absorption of hydrogen proceeded regularly until 1 mol. had combined with the acid: the rate of absorption then decreased abruptly but hydrogenation continued until 3 mols. in addition had combined —W. P. S.

Catalytic reduction with platinum. J. Böeseken and P. J. Bilheimer. Rec. Trav. Chim. Pays-Bas, 1916, **35**, 288—298.

On the assumption that, during the absorption of hydrogen, this gas and the unsaturated substance traverse a layer surrounding the particles of the catalyst and that, consequently, the medium should exert a marked influence on the rate of absorption, the authors have measured the rate of reduction of pinene in various solvents with a view of obtaining data concerning this influence. In formic acid or absolute alcohol the absorption proceeded very slowly and the activity of the catalyst was seriously impaired: in anhydrous ether the rate of the absorption was diminished but the activity of the platinum was not decreased. When ethyl acetate was used as the solvent the absorption proceeded regularly at first, then decreased and practically stopped, but the activity of the platinum was not affected. With acetic acid the rate of absorption decreased without the catalyst losing its activity, and similar results were observed in the case of propionic, butyric, isobutyric, and isovaleric acids.—W. P. S.

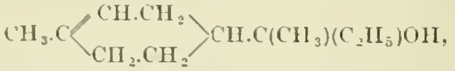
Terpineols and terpins ; Synthesis of ——. O. Wallach, H. Berthold, L. Augspurger, H. Woerlitzer, and F. Pohle. Nachr. K. Ges. Wiss. Gottingen, 1915, 1—27. J. Chem. Soc., 1916, **110**, i., 213—217.

1.4-METHYLCYCLOHEXENYL methyl ketone, obtained from β-terpineol by oxidation, yields the lower homologue of terpineol (compare this J., 1902, 1193),



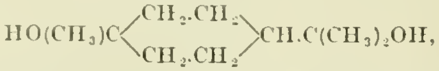
$$CH_3.C\left\langle\begin{matrix}CH.CH_2\\CH_2.CH_2\end{matrix}\right\rangle CH.CH(CH_3)OH,$$

when reduced by means of nascent hydrogen. When treated with magnesium methyl iodide it yields α-terpineol, which can thus be synthesised from the β-modification. Homo-α-terpineol,



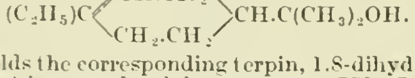
$$CH_3.C\left\langle\begin{matrix}CH.CH_2\\CH_2.CH_2\end{matrix}\right\rangle CH.C(CH_3)(C_2H_5)OH,$$

b.pt. 235°—237° C., sp.gr. 0·9390 at 20° C., $n_D-1·4850$, can be obtained in a similar manner by the action of magnesium ethyl iodide. The homologous 1.8-terpin,



$$HO(CH_3)C\left\langle\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}\right\rangle CH.C(CH_3)_2OH,$$

m.pt. 65°—67° C., is formed by shaking homo-α-terpineol with dilute sulphuric acid. The homo-α-terpineol, m.pt. 92°—94° C., b.pt. 226°—227° C., sp.gr. 0·943 at 18° C., $n_D=1·4811$, obtained from ethylnopinol, has the constitution



$$(C_2H_5)C\left\langle\begin{matrix}CH.CH_2\\CH_2.CH_2\end{matrix}\right\rangle CH.C(CH_3)_2OH.$$

It yields the corresponding terpin, 1.8-dihydroxy-1-ethyl-4-isopropylcyclohexane, m.pt. 75°—76° (with water of crystallisation) on treatment with 5% sulphuric acid solution. By treatment with bromine (1 mol.) in acetic acid and boiling until evolution of hydrogen bromide ceases, α-terpineol yields cymene, 7-hydroxy-1-methyl-4-ethyl-Δ^1-cyclohexene yields 1-methyl-4-ethylbenzene, homo-α-terpineol yields 1-methyl-4-isobutylbenzene, and the homo-α-terpineol from ethylnopinol yields 1-ethyl-4-isopropylbenzene. Both α- and β-tanacetonedicarboxylic acids may be converted into tanacetophorone by esterification with alcoholic hydrogen chloride, and treatment of the ester hydrochloride with sodium alkyloxide. Normal menthone, 1-methyl-4-propylcyclohexane-3-one, was prepared by a series of reactions from 1-methyl-4-propylcyclohexan-4-ol and from *i*-1-methylcyclohexan-3-one. It is a colourless liquid, b.pt. 215°—217° C., sp.gr. 0·8960 at 19° C., $n_D=1·4511$, having no odour of menthone.

Phenol and camphor ; Mixtures of —— in the light of the phase rule. R. Kremann, F. Wischo, and R. Paul. Monatsh. Chem., 1915, **36**, 911—921. J. Chem. Soc., 1916, **110**, i., 217.

WITH a view to the explanation of the antiseptic properties of liquid mixtures of phenol and camphor, the authors have determined the freezing-point diagram. Mixtures containing from 25% to 60% of phenol could not be crystallised, but the curves actually realised suggest that a compound is formed, and this is supposed to be present in liquid mixtures (Chlumsky's solution). The freezing-point data for the system camphor-resorcinol show the existence of a compound, but those for mixtures of camphor and β-naphthol, although incomplete, seem to show that no compound is formed by this pair of substances.

Alcohol in presence of phenol ; Determination of ——. J. Ehrlich. J. Ind. Eng. Chem., 1916, **8**, 210—211.

IN the usual method of determining alcohol in presence of phenol by distillation from a strongly alkaline solution, a portion of the phenol, liberated by hydrolysis of the sodium phenoxide, passes into the distillate. To overcome this difficulty the author treats the distillate with a slight excess of bromine water, added drop by drop, removes the excess of bromine by means of *N*/1 thiosulphate, adds excess of sodium hydroxide, and redistils. If the original phenol content is low, the first distillation may be omitted. The hydrolysis of sodium tribromophenoxide under the experimental conditions is negligible, and results obtained with test mixtures are quoted showing the accuracy of the method.—A. S.

Neucleotides ; Indirect method of determining pyrimidine groups in ——. W. Jones. Proc. Amer. Soc. Biol. Chem., Tenth Annual Meeting, Dec., 1915, 3—10.

WHEN a neucleotide, *e.g.*, yeast nucleic acid, is heated to 100° C. for 2 hours with 5% sulphuric acid, the phosphoric acid of the purine groups is set free whilst that of the pyrimidine groups remains combined. After removal of guanine with ammonia, the liberated phosphoric acid is precipitated with magnesia mixture and weighed as ammonium magnesium phosphate ; 10 mgrms. is deducted from the weight obtained (this is a correction for the small quantity of phosphoric acid liberated from the pyrimidines during the hydrolysis) and the pyrimidine phosphoric acid is the difference between this value and the total phosphoric acid.—W. P. S.

β-Hydroxybutyric acid ; Determination of ——. P. A. Shaffer and R. S. Hubbard. Proc. Amer. Soc. Biol. Chem., Tenth Annual Meeting, Dec., 1915, 27.

THE oxidation of β-hydroxybutyric acid by potassium bichromate and sulphuric acid proceeds more rapidly with increasing concentration of sulphuric acid ; at a concentration of about 10*N* the oxidation may be completed in 20 mins. If the bichromate is added in dilute solution only as fast as it is reduced, the yield of acetone is about 90% of the amount which should be formed, theoretically, from the hydroxybutyric acid present. Crotonic acid is not formed until the concentration of sulphuric acid reaches about 12·5*N*.—W. P. S.

Metatartaric acid ; Non-existence of ——. J. J. L. Zwikker. Rec. Trav. Chim. Pays-Bas, 1916, **35**, 254—259.

INVESTIGATION of the effect of fusion on tartaric acid showed that the substance obtained is a mixture of ordinary tartaric acid and a small quantity of anhydride ; the presence of the latter may be ascertained in the usual way and the anhydride may be removed by treating the fused acid with ether. The acid remaining after extraction with ether has the same refractive index, rotatory power, and melting point as pure tartaric acid, and it consists of tartaric acid in a state of superfusion. The presence of the anhydride would explain the first phase in the change of rotation of the superfused acid mentioned by Bruhat (this J., 1915, 887), and the author considers that the existence of metatartaric acid is a matter of considerable doubt.—W. P. S.

Paracetaldehyde and acetal; Estimation of mixtures of ——. K. J. P. Orton and P. V. McKie. Chem. Soc. Trans., 1916, **109**, 184—186.

The determination of acetal and paracetaldehyde in mixtures in neutral media is based upon the facts that the former is rapidly hydrolysed into alcohol and acetaldehyde in the presence of traces of strong acids, and that paracetaldehyde requires a much greater hydrogen ion concentration to convert it into acetaldehyde. The hydrion concentration for acetal should be N/5000, obtained by diluting 7 c.c. of N/100 acetic acid to 30 c.c., and that for paracetaldehyde at least N/10—N/7·5 of a strong acid, *e.g.*, 30 c.c. of N/5 hydrochloric acid. The mixed substances (0·2—0·4 grm.) are added to the acid in a small distillation flask, to which is attached a good condenser fitted with an adapter dipping into a measuring cylinder, the latter containing 10 c.c. of water or alcohol. The flask is heated gently and 7 c.c. is distilled over when acetal, or 10 c.c. when paracetaldehyde, is being determined. The acetaldehyde in the distillate is then estimated by the hydrogen sulphite or by the neutral sulphite method (this J., 1900, 280, and 1906, 202).—The method is simple and accurate.—E. H. T.

Mercurials; Standardisation of ——. D. K. Strickland. J. Ind. Eng. Chem., 1916, **8**, 253—257.

The Hempel method, in which the sample is treated with potassium iodide and standard iodine solution, and the excess of iodine titrated with thiosulphate, is used for preparations of mercurous chloride, bromide, or iodide; Rupp's method (this J., 1906, 1175) is used for mercuric chloride or iodide or ammoniated mercury; precipitation as mercuric sulphide for mercuric chloride preparations containing ammonium chloride, which interferes with Rupp's method; and the method of Rupp and Kraus (compare this J., 1905, 350) for mercuric oxide. For properly made calomel tablets, *i.e.*, those made with only lactose as diluent and sucrose solution as granulating material, Hempel's method gives accurate results, whilst decomposition of the calomel by sodium hydroxide and titration of the chloride ion with silver nitrate gives low results. The presence of lactose has no influence on the determination of mercuric iodide by Rupp's method. Ammoniated mercury ointments are heated with hydrochloric acid to extract the mercury, whilst mercurial ointments and those containing mercuric oxide or nitrate are heated with nitric acid.—A. S.

Mercury in mercury oleates; Electrolytic determination of ——. B. L. Murray. J. Ind. Eng. Chem., 1916, **8**, 257.

From 0·7 to 1 grm. of the sample is weighed into a small beaker containing mercury to serve as cathode, and 15—20 c.c. of 10% hydrochloric acid and 15 c.c. of toluene are added. The beaker is placed in a larger dish or beaker, an anode introduced, and electrolysis commenced, the current being increased slowly up to 3 ampères in about 10 mins., after which it is maintained at 3—3·5 amp. (8 volts) for about 30 mins., with the anode rotating at 800 revs. per minute. The mixture becomes heated and the mercury oleate melts. Should the liquid show signs of boiling over, cooling water is introduced into the outer vessel, but the temperature should not be allowed to fall below 60° C. When deposition of the mercury is complete, the electrolyte is removed, the cathode cup washed with water by siphoning, and the mercury is washed with alcohol and ether, and weighed.—A. S.

Mercury in mercury salicylates; Electrolytic determination of ——. B. L. Murray. J. Ind. Eng. Chem., 1916, **8**, 258.

About 0·3 grm. is weighed into a mercury cathode dish and dissolved in 10 c.c. of sodium sulphide solution of sp.gr. 1·18. After adding 20 c.c. of 10% potassium hydroxide solution, the solution is electrolysed with a current of 1 ampère at 7 volts, with the anode rotating at 500 revs. per minute. When the mercury is deposited, the electrolyte is decanted, the mercury cathode washed with water, alcohol, and ether, and weighed.—A. S.

Bismuth β-naphthol; Electrolytic determination of bismuth in ——. B. L. Murray. J. Ind. Eng. Chem., 1916, **8**, 257—258.

About 0·3 grm. of the material is heated gently in a porcelain crucible, and then for 3 mins. with the full flame of a Meker burner. The residue of bismuth oxide and bismuth is dissolved from the crucible in a mixture of 4 c.c. of nitric acid of sp.gr. 1·4 and 5 c.c. of water, the solution rinsed into a mercury cathode cup with water, and the solution (20 c.c.) electrolysed, the current being increased gradually from 1 to 4·5 ampères (6 volts) and the anode rotated at 1000 revs. per minute. Some black masses form during electrolysis, and when these have entirely disappeared (45 mins.), the rotation of the anode is stopped and the cathode is washed by siphoning, with the current on; the electrolyte should be tested for bismuth with hydrogen sulphide. The mercury cathode is subsequently washed with alcohol and ether, and weighed.—A. S.

Effect of keeping on officinal magnesium citrate. Léger. *See* VII.

Patents.

Iododihydroxypropane; Process of preparing ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. Eng. Pat. 8488, June 8, 1915.

α-Chlorohydrin is treated with an alkali or alkaline-earth iodide, preferably in absence of light. Iododihydroxypropane is obtained as a viscous oil, readily soluble in water and in alcohol, which eventually solidifies to form crystals of m.pt. 48°—49° C. The new compound is of therapeutic value as a substitute for potassium iodide and known organic iodine compounds, and may be administered intravenously as well as subcutaneously, externally, and *per os*.—F. W. A.

Arseno-compounds; Manufacture of complex ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, u. Brüning, Hoechst, Germany. Eng. Pat. 17,482, Dec. 14, 1915.

A solution of the hydrochlorides of 3.4.5.3′.4′.5′-hexaminoarsenobenzene, or a derivative, and of 3.3′-diamino-4.4′-dihydroxyarsenobenzene is heated to 80° C. or allowed to stand for some time and then poured into a large excess of glacial acetic acid. The hydrochloride of a new complex arseno-compound of unknown constitution is separated, which differs from the parent bodies by its solubility in caustic soda and sodium carbonate solutions respectively, and which has valuable therapeutic properties in the treatment of infectious diseases.—B. V. S.

Urea; Manufacture of ——. C. Bosch, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,173,550, Feb. 29, 1916. Date of appl., Jan. 23, 1915.

See Eng. Pat. 24,117 of 1914; this J., 1915, 924.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Hydroquinone [quinol] developer : The regeneration of ——. J. L. Lizius. Phot. J., 1916, **56**, 110—111.

THE quinol of a spent developer may be recovered by reducing with sulphur dioxide and then distilling with steam ; the steam distillation after reduction is necessary to separate the quinol from impurities such as sodium bromide, formed in the developing process, and sulphuric acid. The sulphur dioxide is conveniently produced by acting on spent " hypo " solution with sulphuric acid. A developing agent may be obtained in the same way from any spent developer in which a para-substituted benzene derivative has been used, but in most cases it will not be the original developer.—B. V. S.

PATENTS.

Colour photography. F. E. Ives, Woodcliffe-on-Hudson, N.J. U.S. Pat. 1,173,429, Feb. 29, 1916. Date of appl., Dec. 5, 1912.

COLOUR selection negatives are obtained by exposing together through one of them two colour-sensitive plates of the same batch sensitised to different colours, the sensitive films being in contact, or separated only by a colour screen suitable for the lower plate. The idea may be extended to three negatives where the arrangement may be, for example, a blue-sensitive top-plate carrying a yellow colour screen, a green-sensitive intermediate film carrying a red colour screen, and a backed red-sensitive bottom plate, the film sides of the two latter being together.—B. V. S.

Granular material [for photographic colour screens] ; Process of producing ——. W. F. Bleecker, Canonsburg, Pa. U.S. Pat. 1.175.221, Mar. 14, 1916. Date of appl., Jan. 15, 1915.

FOR the preparation of photographic colour screens the colour elements are obtained in spherical granules of a transparent and fusible substance such as glass, by running a fine stream of the powdered material into a hot air blast which heats the granules to the melting point, when they become spherical by the action of surface tension, while the separating action of the blast prevents coalescence. The spherical granules are sifted to uniform size and then mixed in the desired proportions and colours.—B. V. S.

XXII.—EXPLOSIVES ; MATCHES.

Bellite No. 1.

THE Home Secretary has sanctioned a new " permitted explosive," Bellite No. 1, of the following composition :—

	Parts by weight.	
	Not more than	Not less than
Ammonium nitrate	65	62
Trinitrotoluol	16	14
Sodium chloride	17·5	15·5
Starch	5·5	3·5
Moisture............................	2	—

Industrial diseases. See XIXB.

PATENTS.

Explosive. A. E. Charbonneaux, San Francisco, Cal. U.S. Pat. 1.174.516. Mar. 7, 1916. Date of appl., Jan. 14, 1914.

THE explosive consists of a nitrated hydrocarbon, such as nitronaphthalene, picric acid, barium nitrate, and lead peroxide.—B. V. S.

Priming charge. W. H. Buell, Assignor to Winchester Repeating Arms Co., New Haven, Conn. U.S. Pat. 1.174.669. Mar. 7, 1916. Date of appl., June 18, 1914.

THE priming charge consists of a mixture of an explosive salt of hydrazoic acid (azoimide), such as the lead salt, a nitro compound, such as nitrocellulose, and a substance, such as an alkali salt of hydrazoic acid, which leaves on ignition an alkaline residue.—B. V. S.

XXIII.—ANALYSIS.

Sulphuric acid : Determination of —— in the presence of phosphoric acid. T. von Fellenberg. Mitt. Lebensmittelunters. Hyg., 1915, **6**, 191—195. J. Chem. Soc., 1916, **110**, ii., 147.

THE author confirms a statement by Baragiola and Godet that the results obtained in the estimation of sulphuric acid are too high if phosphoric acid is also present. The error may be reduced to a minimum if the barium chloride solution is added drop by drop, in not too great excess, to the boiling sulphuric acid or sulphate solution, which should contain about 0·13 c.c. of concentrated hydrochloric acid per 100 c.c.

Nickel ; Separation and determination of ——. T. L. Walker. Trans. Roy. Soc. Canada, 1915, [iii], **9**, 93—97. J. Chem. Soc., 1916, **110**, ii., 152—153.

THE hot solution containing iron, nickel, cobalt, copper, and lead chlorides is oxidised with a few drops of hydrogen peroxide in order to convert all the iron into the ferric condition. After nearly neutralising with sodium carbonate, red lead is added gradually to the boiling solution, until it is seen to be in excess by the distinct red colour of the precipitate, which is heavy and granular. The separation of the iron is complete in a few minutes. After collecting the precipitate, the lead and other metals are precipitated from the filtrate as sulphides, after which the fresh filtrate is concentrated to 100 c.c., 3 c.c. of concentrated sulphuric acid and 30 c.c. of strong ammonia added, and the nickel and cobalt deposited on a rotating cathode. Nickel and iron can be separated satisfactorily in this way, but not cobalt and iron, there being about 10% loss with cobalt. Litharge does not give any better result with cobalt than does red lead. Cobalt may be deposited successfully from chloride solutions under the following conditions : To the solution of cobalt chloride containing 0·13 grm. of cobalt are added 3 c.c. of concentrated sulphuric acid, 30 c.c. of strong ammonia solution, and water to 150 c.c. Deposition is complete in twenty minutes at a rotating cathode, using 4 amps. and 5 volts. The accuracy of the dimethylglyoxime method for nickel is about the same as that of the red lead method.

Iodine in organic matter ; Electrolytic determination of ——. R. B. Krauss. J. Biol. Chem., 1916, **24**, 321—325.

THE colorimetric method of determining organic iodine with palladous chloride (this J., 1915, 1033) has proved very successful, its great sensitiveness proving of value in the investigation of tuberculous tissues. A check upon the results obtained by this method is afforded by determining electrolytically both the palladium and the iodine in the collected residues. The alcohol-acetone solution of palladous iodide is evaporated to dryness, treated with 100 c.c. water, an excess of palladous chloride and a few drops of dilute hydrochloric acid are added, and the whole heated to boiling. The iodide is filtered off, using a vacuum filtering-dome, an ordinary funnel, and a hardened filter paper. Hot ammonia solution is poured on the filter and the filtrate collected in the original vessel. When all the iodide has dissolved, the solution, diluted to 60 c.c., is electrolysed at 65° C. in a platinum dish, about 1 c.c. of ammonia solution being added. A rotating gauze platinum cathode, previously weighed, is employed, and the current should be 0·5—1·0 amp. at 5—10 volts. The palladium having been precipitated (25 mins.), the cathode is rinsed with water, then removed and washed with water, alcohol, and ether, warmed in an electric oven, cooled in a desiccator and weighed. To determine the iodine, the solution is treated with 1 c.c. of 10% caustic soda and 1 grm. of sodium potassium tartrate, covered with a watch glass, and evaporated to half its bulk. After cooling and diluting to 40—50 c.c., the halogen is deposited on a silver electrode, the current (0·01—0·05 amp., 2 volts) being reversed. When the action is finished (30—40 mins.) the electrode is dried at 300° C., cooled, and weighed. The silver-plated anode is made by electrolysing a silver-ammonium oxalate solution, a rotating circular platinum gauze electrode forming the cathode (current 1—2 amp., voltage 5—10): it is washed with ammonia and water, then ignited, boiled with water for 30 mins., and then washed in water, absolute alcohol, and absolute ether. After drying at 300° C., it is cooled and weighed. The silver iodide is removed after use by cyanide. The palladium deposited on the platinum cathode is removed by treatment with a mixture of saturated salt solution and chromic acid.—E. H. T.

Carbon and halogen; Simultaneous estimation of —— by the chromic acid method. P. W. Robertson. Chem. Soc. Trans., 1916, **109**, 215—221.

To determine carbon separately, the apparatus lesigned by the author for estimating bromine and hlorine in organic compounds (this J., 1915, 819) vas modified by inserting between the flask and he absorption apparatus, a short silica tube conaining platinised asbestos and a small U-tube ontaining glass wool moistened with sulphuric cid containing chromic acid to retain oxides of ulphur. The absorption tubes were charged with oda-lime. Oxidation is effected in a stream of xygen with about 3 grms. of chromic acid and 0 c.c. of redistilled sulphuric acid. The deterination takes 70—90 mins. and yields results oncordant with those obtained by the ordinary ombustion method. The carbon dioxide volved may also be determined volumetrically fter absorption in approximately 1·3-N caustic oda solution, or more accurately by leading the ases into a measured volume of standardised aryta contained in a 1500 c.c. flask, and titrating e excess of baryta with N/20 hydrochloric acid. o determine carbon and bromine together, the st absorption tube is charged with 10 c.c. of pproximately 1·3-N caustic soda and 2 c.c. of N-sodium sulphite (to convert hypobromite into omide), and the second tube with 10 c.c. of ustic soda, part of which adheres to the glass ads in the upright exit tube. When the comstion is completed, the contents of the two bes are washed into a flask, heated to boiling, eated with 5 c.c. of hot saturated barium nitrate lution, and the liquid filtered. The free alkali the filtrate is then titrated with N/3 nitric acid. The difference between the amount of acid used and that consumed in a blank experiment, with no organic substance, measures the combined carbon dioxide and bromine. More nitric acid and 10 c.c. of N/10 silver nitrate, (standardised against pure potassium bromide) are introduced, and the excess of silver found by titration with N/10 ammonium thiocyanate. The bromine value so obtained, reduced to N/3, is subtracted from the first titre in order to find the carbon dioxide. The analysis is completed within 2 hours. In the estimation of carbon and chlorine, a short silica tube is inserted between the tube containing the chromic and sulphuric acids and the first absorption tube, and this is heated to decompose the chromyl chloride produced. Attempts to estimate the nitrogen left in the flask (in the form of ammonium salt) by distillation with alkali proved unsuccessful.
—E. H. T.

Methoxyl in compounds containing sulphur; Determination of ——. A. Kirpal and T. Bühn. Monatsh. Chem., 1915, **36**, 853—863. J. Chem. Soc., 1916, **110**, ii., 151—155. (Compare this J., 1914, 570.)

The authors describe improvements in their modification of the Zeisel method for the estimation of methoxyl. They find that it is not necessary to use hydrogen, and that a current of carbon dioxide gives satisfactory results. The pyridine to absorb the methyl iodide is now enclosed in two small bubbling tubes wholly composed of glass, the only necessary connection being that for attachment to the remainder of the apparatus. After evaporating off the pyridine in a dish, the remaining methiodide is dissolved in water and titrated with N/10 silver nitrate solution, using sodium chromate as an indicator. With this modification of the Zeisel process there is no need for a pure hydriodic acid because the common impurities, for example, hydrogen sulphide and phosphine, do not affect the pyridine. The new method is also applicable to the estimation of the methylimide group, but is of no value for the estimation of ethoxyl, as ethyl iodide is only partly absorbed by the pyridine. This method is also satisfactory for methoxyl estimations in sulphur compounds, but here the advantage over the Zeisel process is not so great as at first appears, because the latter can be made to give accurate results if the mixture of gas and vapour from the digestion flask is first passed through a slightly acidified solution of cadmium sulphate before reaching the silver nitrate solution. In this case any hydrogen sulphide is precipitated as cadmium sulphide. The unfavourable and inaccurate results obtained by the use of cadmium iodide solution, is explained by the fact that with this reagent the cadmium sulphide produced tends to remain in part in colloidal solution, in which form it is more active and reacts with the methyl iodide, giving methylmercaptan. Experimental results are given indicating the applicability of the Zeisel method with the use of cadmium sulphate to the estimation of methoxyl and ethoxyl groups in compounds containing sulphur in various states of combination.

Chemical control of the kraft [sulphate wood pulp] process. Kress. *See* V.

Chromium oxide analysis. Field. *See* VII.

Silver-platinum alloys and their analysis. Koifmann. *See* X.

Determination of zinc by electrolysis. Chancel. *See* X.

Analysis of aluminium and its alloys. Withey. *See* X.

Determination of sulphur dioxide and trioxide in flue gases. Nestell and Anderson. *See* X.

Optical dispersion of Chinese wood oil as an index of purity. Ware. *See* XII.

Thermal values of fats and oils. I. Heat of bromination. Marden. *See* XII.

Rapid method for the analysis of red lead and orange mineral. Schaeffer. *See* XIII.

Analysis of tannery lime liquors. Bennett. *See* XV.

Comparison of methods for determination of phosphorus in soils. Robinson. *See* XVI.

Proposed new method for determination of citrate-insoluble phosphoric acid. Hunt. *See* XVI.

Analysis of maple products. VI. Volumetric lead subacetate test for purity of maple syrup. Snell and others. *See* XVII.

Determination of water in worts, sugar solutions, barley, hops, malt-combs, and yeast by the carbide method. Windisch and Glaubitz. *See* XVIII.

Detection of small quantities of oxalic acid in wine. Kreis and Baragiola. *See* XVIII.

Boiling and condensing points of alcohol-water mixtures. Evans. *See* XVIII.

Comparison of the Sörensen, Van Slyke, and colorimetric methods of determining protein hydrolysis. Harding and MacLean. *See* XIXA.

New methods for the analysis of lime-sulphur solutions. Chapin. *See* XIXB.

Indirect method of determining pyrimidine groups in nucleotides. Jones. *See* XX.

Determination of β-hydroxybutyric acid. Shaffer and Hubbard. *See* XX.

Estimation of mixtures of paracetaldehyde and acetal. Orton and McKie. *See* XX.

Determination of alcohol in presence of phenol. Ehrlich. *See* XX.

Standardisation of mercurials. Strickland. *See* XX.

Electrolytic determination of mercury in mercury oleates and mercury salicylates. Murray. *See* XX.

Electrolytic determination of bismuth in bismuth β-naphthol. Murray. *See* XX.

PATENT.

Testing ovens for ascertaining the amount of moisture in wool, yarn, wood pulp, paper, etc. Eng. Pat. 6931. *See* V.

Trade Report.

Prohibited exports. Order in Council, March 30th, 1916.

THE exportation of gum tragacanth and silica bricks is prohibited to all destinations.

The exportation of guaiacol and guaiacol carbonate, senna leaves and pods, and stramonium leaves and seeds is prohibited to all destinations abroad other than British Possessions and Protectorates.

The heading "Gums, resins, balsams, and resinous substances of all kinds, except such as contain caoutchouc" in the list of goods the exportation of which is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal is replaced by the heading:—"Gums, resins, balsams and resinous substances of all kinds, except such as contain caoutchouc, and except gum tragacanth."

The exportation of the following goods is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal:—Leather, varnished, japanned or enamelled; leather waste; spices of all kinds, other than pepper, but including pimento; starch, including dextrin, farina, and potato flour.

Trading in war material. Board of Trade J., Apr. 6, 1916.

THE Army Council has ordered that Defence of the Realm Regulation 30A (under which trading in war material is prohibited unless authorised by a permit of the competent naval or military authority) applies to the following:—Acetone; ammonal; ballistite; bellite; blastine; cordite; fulminate of mercury; guncotton; gunpowder; melinite; megadine; nitro-cellulose powder; nitroglycerine; perchlorate of ammonia; perchlorate of potash; picric acid; sabulite; tetryl; tonite; trotyl; T.N.T. (trinitrotoluol); T.N.X. (trinitroxylol).

The Minister of Munitions has ordered that Defence of the Realm Regulation 30A applies to aluminium and alumina; platinum metals, ores, residues, and bars containing the same.

Prohibited exports. Order in Council, Apr. 11, 1916.

THE exportation of the following is prohibited to all destinations:—Pig iron of all descriptions; Railway material, the following:—steel rails; steel sleepers; steel springs; steel wheels and axles. Shipbuilding material, the following:—Boiler tubes; condenser tubes; steel plates and sectional materials for shipbuilding. Soap containing more than one per cent. of glycerine. Stee in bars, angles, rods and shapes or sections; stee blooms, billets, and slabs; steel bridge, boiler an other plates not under ⅛ inch thick; steel girders beams, joists and pillars; steel ingots; steel tube of all descriptions; steel wire, except barbed an galvanised wire (the exportation of which remain prohibited to all destinations abroad other tha British Possessions and Protectorates).

The exportation of the following is prohibite to all destinations abroad other than Britis Possessions and Protectorates:—Aluminium sulphate and alumino-ferric; lacs, not including la dye; soap, soft, containing one per cent. and les of glycerine.

The exportation of the following is prohibited t all foreign countries in Europe and on the Medite ranean and Black Seas, other than France, Russi (except through Baltic ports), Italy, Spain, an Portugal:—Asphalt and solid or liquid bitumen petroleum and its products not already specificall prohibited; soap, hard, containing one per cen and less of glycerine.

Contraband of war.

BY virtue of a Royal Proclamation dated Apr 12th, 1916, the following are made "absolu contraband":—Gold, silver, paper money metallic chlorides, except sodium chloride; meta loidic chlorides; halogen compounds of carbo starch; borax, boric acid, and other boron co pounds; sabadilla seeds and preparations ther from. In Item 8 of Schedule I of the Proclam tion of Oct. 11th, 1915 (see this J., 1915, 107 "ether" is replaced by "formic ether; s phuric ether."

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Official Notice.

ANNUAL GENERAL MEETING, 1916.

In accordance with the provisions of By-law 64, notice is hereby given that the Annual General Meeting will be held at the University of Edinburgh at 10.30 a.m. on Wednesday, July 19th, 1916. A provisional programme of the proceedings is inserted loose in this issue.

Dr. Charles Carpenter has been nominated to the office of President under By-law 20; Profs. F. G. Donnan and Henry Louis have been nominated Vice-Presidents under By-law 21, Messrs. H. Hemingway and D. Lloyd Howard have been nominated Vice-Presidents under By-laws 21 and 32, and Mr. Thos. Tyrer and Dr. R. Messel, F.R.S., have been reappointed Hon. Treasurer and Hon. Foreign Secretary respectively.

Members are requested to nominate on or before May 22nd next, fit and proper persons to fill four vacancies among the ordinary Members of Council. Forms for this purpose can be obtained from the Secretary of the Society.

By-law 23:—An Ordinary Member of Council shall be nominated by ten or more members upon Form B in the Schedule, a copy of which form shall be furnished by the Secretary upon the written or verbal request of any member, but a member shall not be eligible to sign more than one such nomination form, and the member nominated shall sign the declaration set forth on the form. A nomination shall be declared invalid by the Council if:

a. The member thereon nominated is disqualified for election, or ineligible to be elected, as provided by the By-laws.

b. The nomination is not made on the authorised printed form or substantially not in the manner directed thereon.

c. The nomination form is signed by less than ten members not disqualified or not ineligible to nominate as provided by the By-laws.

d. The nomination form is not received before or upon the day appointed therefor.

e. The member nominated has not signed the declaration printed upon the form.

A member whose nomination aforesaid is declared to be invalid, shall receive notice thereof from the Secretary, and shall not be submitted for election.

T. F. Burton,
Acting Secretary.

Edinburgh Section.

Meeting held on January 19th, 1916.

PERMANENCE OF WRITING-INK.

(ABSTRACT.)

BY D. B. DOTT.

Attention was first called to the bleaching effect f air and light on writing-ink as used in modern mes, by the fact that signatures on certain ertificates had become illegible through the ading of the ink. As it was impracticable to test sample of ink by exposure of writing for a period f years. it was considered that a limited applica-on of hydrogen peroxide would be the nearest chemical equivalent to the bleaching effect of the atmosphere. Writing done by different inks was exposed to light, the paper being occasionally moistened with a 3% solution of hydrogen peroxide, the result being that the hand-writing gradually became invisible, in some cases more quickly than in others. Taking ferric tannate, indigo, and aniline-blue, as the principal substances used in making writing-ink, it was found that all of them are rapidly decolorised by warming with hydrogen peroxide solution. With solutions of these substances in test-tubes at the ordinary temperature the same change was slowly produced. The violet ink used for typewriters was less readily acted on, but was quickly bleached by sulphurous acid. Among the samples of writing-fluids tested, only those which had some form of carbon as chief ingredient, were able to resist the action both of hydrogen peroxide and of sulphurous acid. If an ink could be produced, possessing the desirable properties of perfect fluidity and being non-depositing, and at the same time incapable of being decolorised by oxidising or reducing agents, there would be good reason to believe that the writing done by such an ink would be practically permanent. In the meantime, when writing is of an important nature and is desired to endure, some form of carbon ink appears to be the only trustworthy preparation.

London Section.

Meeting held at Burlington House, on Monday. April 3rd, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

A COMPARISON OF THE BRAZILIAN AND PLANTATION METHODS OF PREPARING PARA RUBBER.

BY G. STAFFORD WHITBY.

Since the plantation producing industry was established, the questions of the relative values of "Fine hard Para" and plantation rubber, and of, on the one hand, the smoke coagulation method by which the former is prepared and, on the other hand, the methods by which the latter is prepared, have often been canvassed, yet the methods have not hitherto been subjected to a strictly comparative test. The object of the present paper is to describe such a test. For the purpose of this test, smoked sheet was selected as the typical plantation form (see Appendix A). The procedure was to prepare one sample of rubber according to the Brazilian smoke coagulation method, and another as smoked sheet from the same lot of plantation latex, and to submit the samples to vulcanisation tests as described below.

The result of the vulcanising testing of samples of fine hard Para and of ordinary plantation forms has been published from time to time, with the object of instituting a general comparison between fine hard Para and plantation rubber. The results for samples made from plantation latex according to the Brazilian method have also been published. The general tendency of such results has perhaps been to show that fine hard Para is not superior to good samples of plantation rubber, but rather the reverse. But as a rule these tests have not been published in scientific form with proper experimental details, nor have they included any data regarding the essential matter of rate of cure. The results recently published by Eaton and Grantham[1], however, are not open to this criticism. Eaton and Grantham quote vulcanisation results for five samples of fine hard Para which are certainly not superior to the results obtained by them for samples of rubber prepared according to plantation methods.

It seemed advisable to carry the question further and to ascertain whether the Brazilian method *per se* was better than, worse than, or equal to the typical plantation method *per se* in regard to the quality[2] of the rubber produced. This could only be done by applying the two methods to be compared to the same lot of latex (see Appendix B).

Preparation of the samples :—After a certain amount of practice in the technique of the Brazilian method of smoke coagulation, two sets of samples were prepared.

Latex from old trees :—The latex was taken from the old plantings on the West Country Estate of the F.M.S. Rubber Co. The area had originally been planted 40 ft. × 40 ft. amongst coffee, and a few years later the coffee had been removed and rubber planted between the original plantings. At the time of the experiment (Nov. and Dec., 1913) the original plantings were more than 15 years old, and the latex was taken from these old trees only. The area had been thinned out to about 40 trees per acre. The trees were being tapped on renewed bark, mostly by a single cut at the base, but in some cases by a V cut in the second storey.

A ball of smoke-coagulated rubber was built up by operating on four occasions. On each occasion the procedure was similar. Latex was collected, as soon as the trees had ceased dripping, from 9—10 a.m., and was conveyed to the laboratory. The operation of coagulating part of the latex on a paddle was started at once, and, with the exception of an interval for tiffin, was continued until about 4 p.m. In order to prevent the inset of natural coagulation, in the latex waiting for treatment, before the smoking operation was completed, a small amount of ammonia solution (4 c.c. of a 1 : 1 solution per litre of latex) was added at about 12.30 p.m.[3] The fuel used consisted of rubber wood together with a few nuts of the atap palm. These nuts were selected because of their close similarity to the urucuri palm nuts, which are reported as being frequently used in Brazil for the smoke coagulation process and of which specimens had previously been procured. It was not found that atap nuts alone made a convenient fuel; they did not burn sufficiently readily and the smoke did not readily get hot enough for easy working. A convenient arrangement for the fire was found in two kerosene tins (each 14 in. high) fitted together. The upper tin, which had a hole some 4 in. in diameter in the bottom, was inverted and its mouth fitted over the mouth of the lower tin. This gave an excellent dense smoke and required to be re-charged only very seldom. The temperature of the smoke at the point of exit was about 160—170° C. during the coagulating operation. This was found to be the most convenient temperature for easy and satisfactory working. If the smoke is too cool, an aqueous-tarry layer is deposited on the paddle.

The method of handling was to pour latex over the paddle, to allow excess of latex to drain off whilst the paddle was rotated, and then to put the paddle in the smoke, rotating it meanwhile. When the latex had set sufficiently to allow of the paddle being held at rest without any latex falling off, the constant rotation was stopped, but the smoking was continued for a short time longer—long enough to give a fairly firm product at the close of the day's operation but not long enough to dry up any one layer. (As it proved later, the percentage of water in the mass when tested was rather less than that usually present in fine hard Para, but not sufficiently different to render the preparation a poor copy of the Brazilian method.) As soon as one layer was finished (3—4 mins. in all), another was superimposed.

On each occasion the rubber was superimposed on that prepared on the paddle on the previous occasion, so that a large spherical mass was built up. Finally the mass weighed about 10 lb. The rubber-content of the latex used on the four occasions (which were spread over a month) was 35·8, 34·1, 35·2, 36·8%, the mean being 35·2%.[4] With latex of this strength, about 300 grms. (dry weight) of rubber could be prepared per hour by smoke coagulation on a paddle disc 6 in. in diameter. Immediately after its preparation the rubber was almost white in colour, but on keeping gradually turned dark brown on the outside. A little bright brown serum came away from the mass during the first few days following its preparation.

For the purpose of comparison a part of the latex collected on each occasion was set aside for the preparation of smoked sheet. The procedure followed in preparing the smoked sheet was essentially the same as that normally followed in ordinary estate work. It was kept strictly uniform on each occasion and was as follows. A rapid determination of the approximate rubber-content of the latex was made, and on the basis of this the latex was diluted at 12 noon (*i.e.*, about 2 hours after collection had been finished or say 5 hours after the trees had been tapped) with water sufficient to reduce its rubber content to 12·5%. The latex was then mixed with acetic acid and transferred to coagulating pans. (See Appendix C on the possible influence on quality of the time of day at which coagulation is performed). Two sheets were made on each occasion, one gallon of diluted latex being used for each. The amount of acid used was 0·5% of the weight of the dry rubber. The acid was in the form of a 10% solution. The pans were allowed to stand overnight. Next morning the surface was on each occasion similarly slightly discoloured. The coagulum was rolled out, the sheet was allowed to hang in the air for four hours in order to drain and was then placed in a smoke house. The latter was working when the sheets were introduced. The sheets were turned at intervals in the usual way. They were smoked for 22 days, the smoking being continuous during this period except for occasional intervals during the day-time to allow of sheets being turned or removed.

Latex from young trees.—In the case of the samples of which the preparation is described above, from latex derived from old trees, it was desired for the purpose of ascertaining whether the inner portion of a ball of rubber prepared in the Brazilian manner differed from the outer portion, to prepare a comparatively large mass of rubber. This involved working on several days, with the result that, instead of a single sample, several samples of smoked sheet have to be taken into account in the comparison. The samples which were prepared from young tree latex therefore afford a more precise comparison, since they were prepared on one day from a single lot of latex.

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[1] B. J. Eaton and J. Grantham, "Vulcanisation experiments on plantation Para rubber. The cause of variability." This Journal, **34**, No. 19, 989.

[2] By "quality" is here always meant vulcanising quality. The term "quality" is still widely used in the loose, brokers' sense, which refers chiefly to appearance, but a juster appreciation of the term, as referring to vulcanising properties, is gradually spreading in the rubber world.

[3] It is improbable that the ammonia will have any prejudicial effect on the quality of the rubber. The author, by another method into which an element of evaporation entered, obtained excellent rubber from latex containing much more ammonia (2%) than that used in the present connection. And, further, ammonia is frequently added to the latex for the preparation of fine hard Para in Brazil.

[4] Probably the latex was a little stronger than this—say 40%—when it issued from the trees. But the coolies usually left a little water in an occasional cup, and this became mixed with the latex

The trees were 5 years old. Most of them had been in tapping about a year, but a certain number had been in tapping only 6 months. The latex was collected from 9—10 a.m. and was taken to the laboratory. The rubber-content of the latex was 30·3%. (This is somewhat less than in the latex issuing from the tree; see footnote[4].) Rubber was made in the Brazilian fashion as described above from part of the latex, and smoked sheet was made from part exactly as described above. Owing to the more dilute nature of the latex, the smoke coagulating operation did not proceed so quickly as in the case of the old tree latex. Each layer, however, was not smoked for so long as in the other case. This was done in order to leave more water in the rubber, since the less massive nature of the rubber will cause the percentage of water to fall more quickly than in the other case; and it was desired that the water-content should, after the lapse of some months, be similar to that of the other samples and approximately that of fine hard Para. The rubber was prepared on a bamboo spindle as a thick mass.

Method of vulcanisation testing.—The vulcanisation tests were made in London 9 months after the preparation of the samples. The scheme of testing employed was that worked out by Schidrowitz. The samples were mixed on experimental mixing rolls with 8 parts of sulphur per 100 parts of rubber. The mixing procedure followed the same lines in every case, but a fixed time was not given for the mixing, the intention being to perform each mixing with the least amount of working compatible with securing a good mix. Under the conditions of working, all ordinary plantation rubbers could be mixed in not more than 15 minutes. All the samples dealt with in this paper occupied 15 minutes in all for mixing, except the two samples of creped Brazilian rubber, which required only about 12 minutes. In the former cases about 9 minutes of the period, and in the latter about 6 minutes, was occupied in breaking down the rubber and rendering it plastic before the sulphur was added. As soon as the mixing was complete, the rubber was sheeted out on the same rolls, and was then allowed to cool for five minutes before being cut off. The amount of rubber taken for each mix (200 grms.) was such that the resulting sheet of dough was of the desired thickness. All mixings were allowed to rest a week before being cured.

For the purpose of curing a disc was cut of a size convenient for cutting out a test ring later, and the dough was placed between aluminium discs in a heavy screw mould and subjected to the preliminary cure of 2 hours in a steam autoclave. For all cures the rise was 15 minutes and the temperature of cure 141° F. (40 lb. steam). Three days were always allowed to elapse after curing before the tensile tests were made. The tensile tests were made on rings by a Schopper machine. The machine, which, unlike more recent models, was not fitted with automatic recording apparatus, was run at such a speed that the figures for load and elongation could conveniently be read (by two operators) during the whole course of the stretching up to the breaking point. The thickness of the rings was in all cases round about 3 mm. It was measured by a micrometer gauge.

The figures for load and elongation obtained during the stretching of the product of the preliminary cure were plotted, and from the resulting stress-strain curve the position of the "perfect" cure was deduced. If, as was usually the case, the preliminary cure did not coincide with the "perfect" cure, the mixing was given the "perfect" cure by increasing or decreasing, as the case might be, the time of cure, and the product was put through the tensile test as before. If, as was occasionally the case, the original estimate of the time necessary for the "perfect" cure turned out to be a little incorrect, a further slight variation of the period of cure on the basis of the second cure would always enable the "perfect" cure to be secured.

The bearing of the stress-strain curves on the question of the "perfect" cure and the way in which the conditions for the "perfect" cure can be deduced from the curve obtained for the preliminary cure may be indicated briefly. It depends upon discoveries made by Schidrowitz and Goldsbrough as a result of a research into the changes occurring in the stress-strain curves for a given mix along with progressive change in the cure, and on a mathematical examination of the nature of the curves. It is not proposed to go fully into the question here, as Schidrowitz, who has already given a brief account of the principles involved,[5] has promised a detailed account, in conjunction with Goldsbrough, of his scheme of vulcanisation testing, and a special paper on the mathematical part by Goldsbrough and E. Hatschek.

The temperature of vulcanisation is kept constant for all cures, but the time of vulcanisation is varied. Considering the series of stress-strain curves which are obtained from a given mix by varying the period of cure, Schidrowitz and his co-workers found that it was possible to solve the curves mathematically and also that at a point not far from the point of inflection the curves were parallel. From the mathematical formula corresponding to the curves, it was possible to deduce theoretically the one curve of the series which represented an ideal balance of tensile properties—roughly, a balance of strength and distensibility; and it was found by actual experiment that the cure, known as the "perfect" cure, corresponding to such a curve was in fact the best cure.

The slope of the curve beyond the point of inflection, although the same for any one mix, may vary from rubber to rubber.[13] The curve corresponding to the "perfect" cure was worked out for the set of curves with each of the slopes actually found in practice. Thus, by always plotting the stress-strain curves to a convenient fixed scale, it was immediately possible, after examining the slope which the curve for a preliminary cure (2 hours) had at the straight portion beyond the point of inflection, to say where the curve for the "perfect" cure should come. It could then easily be judged from experience to what extent the period of cure would have to be altered in order to give the "perfect" cure.

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[5] P. Schidrowitz, "Variability," "The Rubber Industry," London, 1914, p. 212 *et seq.* (see this J., 1915, 842).

[13] In regard to their vulcanisation experiments, Eaton and Grantham (*loc. cit.*) state that "the inclination for the final portion of the curve was a constant not only for a given series but for the whole of the experimental samples tested." They state, however, that "all the samples," with three exceptions, "were coagulated in a similar manner from latex from the same trees"; and this probably explains their arriving at the conclusion that the type of the curve is constant. For, as is shown by an examination of the results discussed in Appendix B to the present communication, for two sets, of four and five samples respectively, prepared from two different areas, it appears that, for rubber prepared in a given form from any one area, the type of the curve *is* the same, although it may vary from area to area. The fact that in Eaton and Grantham's experiments the same area was in question in all except a few cases probably accounts partly for the uniformity in type of the curves. Further, in their experiments the stress-strain curves do not appear to be drawn to a scale very suitable for bringing out differences in type. And, in addition the method of judging the optimum cure by means of the magnitude of the product of load and elongation is more empirical and less exact than the method of Schidrowitz which is sketched here.

The slope of the curve, which represents the extension produced by increasing load, is obviously a very convenient general measure of the mechanical properties of the rubber. Schidrowitz expresses this "type" by a number representing the slope of the curve on the arbitrarily-chosen scale on which the curves are always drawn. The figure taken as the standard for "type" is 36. The extreme limits of "type" which the present author has encountered in his experimental work have been 32 and 44. Obviously, the lower the figure (*i.e.*, the flatter the curve; loads being taken as ordinates and elongations as abscissæ), the better the general mechanical properties of the rubber.

In addition to "type," the ultimate tensile figures have always been taken into account in making a judgment on the tensile properties of any sample of rubber. The rate of cure, by which is meant the time required for the "perfect" cure, under the conditions of working used for the comparison of different samples, is also of importance; for, in addition to its direct aspect, there is the consideration that a general relationship appears to exist between the rate of cure and the stability of the vulcanised product.[6] No further mechanical tests were made, nor were any direct keeping tests made; but it will be seen that the "type" and rate of cure are of wide significance.

Vulcanisation results.

As the set of samples made from a single lot of latex, derived from young trees, affords the more completely unequivocal comparison of the Brazilian and plantation methods, the results for these samples will be described first. *Latex from young trees*:—The Brazilian sample, which contained about 9% of water, was creped before mixing. The corresponding smoked sheet, which contained 0·53% of moisture, was mixed direct without creping. It may appear that in strictness the smoked sheet also should have been creped before mixing; but the object of these tests was to compare the Brazilian and plantation methods in regard to the actual utilisation of the products And, whereas the wet Brazilian rubber must be and is creped or otherwise dried before being utilised, smoked sheet need not be and by most manufacturers is not creped before being utilised. Hence a stricter technical comparison of the two methods is obtained by mixing the smoked sheet without preliminary creping. In point of fact, as the results quoted later show, creping prior to manufacture appears to have little or no effect on the tensile properties of the vulcanised product.

The rubbers behaved differently when under exactly similar conditions in the preliminary cure. The tensile figures for the preliminary cures were:—

	Brazilian rubber.	Smoked sheet.
Type	40	38
Breaking load	2030 lb. sq. in.	1564 lb. sq. in.
Elongation at break	10·44	9·40

It was clear from the stress-strain curves that the Brazilian rubber was under-cured and the smoked sheet over-cured. The latter fact could also be gathered readily from the breaking figures.

The final cures (the "perfect" cures) were as follows:—

	Brazilian rubber.	Smoked sheet.
Rate of cure	2¼ hrs.	1¾ hrs.
Type	40	38
Breaking load	2411 lb. sq. in.	2264 lb. sq. in.
Elongation at break	10·29	10·28

It is clear that the smoked sheet cures more quickly and that the "type" of the stress-strain curve for its vulcanised product, indicating general mechanical properties, is somewhat better than is the case with the rubber prepared from the same latex in the Brazilian manner. The breaking figures for the two samples are of the same order. Those for the Brazilian rubber are in fact somewhat the better; but both samples are good in this respect; and, as the exact figure obtained for the breaking load is always a little fortuitous, it cannot be said that the smoked sheet is really inferior in this regard. The results show that on the whole the Brazilian rubber is somewhat inferior to the smoked sheet.

Latex from old trees:—The percentage of moisture in the Brazilian sample was about 11%. Prior to mixing the mass was creped, with the exception of the portions retained for the comparison, described later, of the inner and outer layers. The preliminary cure, which was as follows, showed the mix to be undercured at 2 hours.

Preliminary cure.

	Brazilian rubber from old trees
Type	38
Breaking load	1832 lb. sq. in.
Elongation at break	10·78

The final cure (the "perfect" cure) is quoted later, alongside the mean of the smoked sheet results.

For comparison with the Brazilian rubber there are four samples of smoked sheet made from the four lots of latex used. The final cures of these samples gave the following results.[7]

	Sample 1.	Sample 2.	Sample 3.	Sample 4
Rate of cure	2¾ hrs.	2¼ hrs.	2¼ hrs.	2¾ hrs.
Type	36	36	36	35½
Breaking load	2040	2253	2203	2279 lb. sq. in.
Elongation at break	10·42	10·40	10·36	10·59

As the amount of Brazilian rubber prepared on each of the four occasions was approximately equal, the mean of the above samples will afford a fair comparison with the Brazilian mass.

Final cures.

	Mean of samples of smoked sheet from old trees.	Brazilian rubber from old trees.
Rate of cure	2½ hrs.	2¼ hrs.
Type	36	38
Breaking load	2192	2137 lb. sq. in.
Elongation at break	10·44	10·19

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[6] Schidrowitz, *ibid.*, pp. 215-6.

[7] These samples prove to exhibit a comparatively large amount of variation amongst themselves. This must be ascribed to the fact that, although the latex was on each occasion taken from trees on the same area, it was not taken from exactly the same trees each time: the exact composition of the group of trees varied somewhat on the different occasions.

In this case again the Brazilian rubber appears as somewhat inferior to the smoked sheet, although not so distinctly as in the former test. The "type" is poorer, but the rate of cure is equal. The breaking figures are not so good. This last was expected from the breaking figures for the preliminary cures.

Conclusion.

It could have been wished that a larger number of tests had been made; but at all events from the results described above it seems clear that the Brazilian method of preparing rubber by smoke coagulation is not superior to the plantation method of preparing it as smoked sheet when the products are tested on the system described. Indeed, it is probable, particularly when regard is had to the indications of the first of the two tests, which afforded a more precise comparison of the two methods than did the second of the tests, that the Brazilian method is *per se* somewhat inferior to the plantation method *per se*.

The question presents itself as to the causes underlying the results obtained for smoke-coagulated rubber and the relation of the method to the plantation method. Some account may be given of results which were obtained in pursuance of this question. Elsewhere[8] the author has indicated the chief points which arise for consideration in an analysis of the Brazilian method of smoke coagulation.

Effect of phenols on quality.

On the ground of other vulcanisation researches the author had a general expectation that Brazilian rubber would cure more quickly than smoked sheet prepared from the same latex, and when the case proved to be otherwise he was led on to an investigation of the effect of phenolic substances in the preparation of rubber, which seemed to throw light on one aspect of the smoke coagulation process. It was found that in the preparation of smoked sheet the introduction of even small amounts of phenols into the latex prior to coagulation appeared to be capable of prejudicing the quality of the rubber, particularly as regards the rate of cure and the type. Phenol and the cresols were selected for experiment, as being soluble in water. Several tests have been made, and the following may be quoted as typical.

A lot of diluted latex containing approximately 12·5 % of dry rubber was divided into two parts. One part was coagulated with acetic acid (in the form of a 2·5 % solution) in the proportion 0·5 % of the dry weight of rubber present. The other part was coagulated in the same way; but, prior to the addition of acid, phenols, consisting of a mixture of two parts phenol and one part mixed cresols, in the proportion of 0·35 % of the dry rubber present, were added in the shape of a 1·66 % solution. The coagula were prepared as smoked sheet in the ordinary way. It was clear from the preliminary cures that the sheet prepared from latex which had been treated with phenols cured more slowly and had a poorer "type" than the control.

Preliminary cures.

	Sheet with phenols.	Control.
Type	39	37
Breaking load............	1888	2132 lb. sq. io.
Elongation at break	10·9	10·62

The final cures were:—

	Sheet with phenols.	Control.
Rate of cure	2¾ hrs.	2¼ hrs.
Type	39	37
Breaking load............	2152	2380
Elongation at break	10·2	10·42

A similar result was obtained with air-dried sheet. Eaton and Grantham state[9] that the treatment of latex with antiseptics appears to retard the rate of cure. In the present case, however, it is improbable that the effect produced is due to the antiseptic action of the phenols. For, in the first place, the amount present is in all probability too small to allow of their functioning in this way. There was present, in the case of the test described above, only 1 part in 2400 parts of latex, and of this amount the greater would probably be removed from the sheet along with the serum. And, in the second place, the general indication of vulcanisation work by the author is that antiseptics used in the preparation of sheet exercise a slighter effect or no effect on the rate of cure and on the "type" (see, for example, the results regarding the effect of smoking quoted in Appendix A).

It seems more probable that the effect of the phenolic substances dealt with is specific. Eaton and Grantham (*loc. cit.*) have just pointed out that fine hard Para might have been expected to cure more rapidly than is the case. The results just quoted make it probable that phenols absorbed from the smoke are in part responsible for the comparatively low rate of cure. (The author thinks, on the basis of other experiments, that formaldehyde from the smoke and probably heat are also in question.) The question of the oxidation of the coagulum must, however, be considered in this connection. To that question the succeeding section is devoted.

Effect of oxidation on quality.

It seems probable that oxidation in itself has no ill-effect on the quality of rubber. Such is the general indication of vulcanisation tests on a larger number of samples. Samples of latex vary considerably in the ease with which and the extent to which the coagulum prepared under standard conditions from them darkens as a result of oxidation. The strength of the tendency to oxidation is sometimes traceable to the tapping system employed and the position of the tapping cuts on the trunk. But in no case is it noticeable that there is any connection between the depth of colour of latex rubber and its vulcanising quality. Further, no difference was found (see *infra*) between the dark, oxidised, outer portions and the light, comparatively unoxidised, inner portions of a mass of Brazilian rubber. And, in addition, the following tests regarding the effect of pyrogallol indicate the same negative conclusion as to the influence of oxidation on quality.

The addition of phenolic bodies to latex has a marked accelerating effect on the rate of oxidation; so that the rubber produced from latex to which they have been added is darker than usual.[10] The action of pyrogallol is particularly marked. In making the test just referred to, samples of smoked sheet were prepared from latex after the addition of pyrogallol to the extent of 2 % of the dry rubber content of the latex. Comparable sheets were also prepared from an untreated portion of the same latex. The results of the preliminary cure were sufficient to show the rubbers as essentially similar.

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[8] "The prime technical plantation problems of the next decade." Batavia Rubber Congress, Weltevreden, 1914.

[9] *Loc. cit.*

[10] Whitby, Koll. Zeits., **12**, 153-4. Doubtless it is the phenolic substances taken up from the smoke which direct the oxidation of Brazilian rubber.

	Sheet with pyrogallol.	Control.
Type	39	38½
Breaking load............	1940	1920
Elongation at break	10·63	10·60

The sheet prepared with pyrogallol was so dark in colour as to be almost black by reflected light, whereas the control sheet was comparatively pale. Thus it is probable that mere oxidation does not prejudice the quality of rubber.

As already stated, the author is inclined to regard the action of phenols as specific.

Comparison of inner and outer portions of mass of Brazilian rubber:—From the mass of Brazilian rubber prepared as described earlier, two samples were taken: (*a*), consisting only of the inner, wetter, and less oxidised portions; (*b*), consisting only of the outer, drier, and more oxidised portions. After drying, the samples were submitted to vulcanisation tests in the manner already described. In order that there should be no possibility of creping introducing a disturbing factor into the strictness of the comparison between the two samples, the samples were not creped prior to mixing, but were merely cut up into pieces and dried in a vacuum desiccator. The water-content of the inner portions proved to be 13·1% and that of the outer portions 4·5%. The preliminary cures showed the samples to be essentially similar.

Preliminary cures.

	(a) Inner portion of mass.	(b) Outer portion of mass.
Type	38	38
Breaking load............	1695	1730
Elongation at break	10·59	10·50

The final cures were:—

	(a) Inner portion of mass.	(b) Outer portion of mass.
Rate of cure	2½ hrs.	2½ hrs.
Type	38	38
Breaking load............	2050	2200 lb. sq. in.
Elongation at break	10·17	10·16

It is clear that the inner portion had no superiority over the outer portion. The samples are practically equal. A small variation in the breaking load when this is above 2000 lb. per sq. inch can be attributed to chance.[11]

It has been asserted that the outer portions of a ball of fine hard Para are inferior to the inner portions; and this condition has been attributed to the fact that the outer portions are heavily oxidised whereas the inner portions remain comparatively unoxidised. The data brought forward in the present communication tend to negative these contentions. But, in addition to the question of oxidation, a number of other considerations present themselves in this connection. It has been suggested that the high quality and, as it has often been assumed, superiority to plantation rubber, of fine hard Para was due to the mechanical action of the outer layers of a mass in causing pressure on the subjacent layers when, owing to desiccation, they contract. The results here recorded, however, tend to negative this suggestion; for, had it any basis in fact, the probability is that the inner portions of the mass would be superior to the outer portions.

It had suggested itself as possible that the massive condition of fine hard Para which enables it to remain for an indefinitely long period with a high water-content, might be a favourable factor in regard to quality. The hypothesis which the author had in mind was that possibly there was in regard to the Brazilian method some balancing factor which could act only in the presence of a considerable amount of water and brought all samples to the same level—to a state of equilibrium, as it were. If the massive, wet character were an element in the quality of Brazilian rubber, it might have been expected that the dry outer layers would differ from the rest of the mass. The present data, however, indicate that there is no such difference. (In point of fact the author also abandoned the hypothesis as a result of direct experiment into the effect on quality of a high water-content compared with rapid desiccation.) The explanation of the comparative uniformity of fine hard Para, as due to the fact that each mass is composed of the results of a number of separate coagulations from different lots of latex, which has been put forward by Eaton[12], seems the most likely explanation.

Effect on quality of creping prepared rubber.—The results described above have an incidental bearing on the question as to the effect of creping on quality. The mass of Brazilian rubber from old trees dealt with earlier gave, after creping, results essentially similar to those given by the samples (*a*) and (*b*), from the same mass, which were not creped, but merely dried in a desiccator. It seems clear that the creping of the prepared rubber did not appreciably affect its quality. The effect of creping when applied to the fresh coagulum is, of course, another question.

As was indicated earlier, it was noticed that the creped rubber broke down more easily on the mixing rolls than did the uncreped material. That this would be the case is, of course, well known to rubber manufacturers.

Effect of age on quality.—The results communicated in this paper lend no support to the widely-accepted view that the latex from young trees is inferior to that from old trees. An examination of them makes it clear that rubber prepared from young trees may be as good as that prepared by exactly similar methods from old trees. In point of fact, in the present case the rubber prepared from the latex of young trees proved superior to that from the latex of old trees both when prepared as smoked sheet and when prepared by smoke coagulation in the Brazilian fashion.

The conclusion that there is no presumption that young trees as tapped in ordinary plantation procedure will yield poorer rubber than old trees is, the author may say, in full agreement with the general indication of all the vulcanisation tests which he has made, alone and in conjunction with Schidrowitz. On various occasions rubber from trees varying in age from four to seventeen years has been tested.

The author wishes to make his grateful acknowledgments to Dr. P. Schidrowitz, in whose laboratory the tests described in this communication were made.

Appendix A.

Effect on quality of smoking.—It is doubtful whether, from the point of view of quality, smoked sheet is strictly the best form of plantation rubber. As regards the general question of the relative quality of rubber in the two forms, sheet and crepe, it is probable that the general apprehension as to sheet being better than crepe is just. But, as regards the question as to the relative values of smoking and air-drying, the indication of some recent experimental work is that the general apprehension to the effect that smoking improves quality is not justified. In the course of fairly extensive vulcanisation tests, in which strictly comparable pairs of air-dried and smoked samples were examined, the present author did not find any clear evidence of smoking producing an improvement of quality. In the case of latex crepes smoking appeared to have a very marked deteriorating effect on quality. In the case of sheet the deteriorating effect observed was slight or inappreciable. Eaton and Grantham appear to find smoking, in the case of sheet, to have a more clearly marked prejudicial effect than appeared in the present author's experiments.

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[11] The mass was not, of course, strictly homogeneous, since it was built up on four days; but, as the samples (b) would probably be composed mostly of the portions corresponding to smoked sheet No. 4 and part of smoked sheet No. 3, it may be taken in this case that the inner and outer portions are comparable.

[12] "Methods of coagulation and preparation of plantation Para rubber," Batavia Rubber Congress, Weltevreden, 1914, p. 22.

Thus it is possible that air-dried sheet would have given somewhat better vulcanisation results than the form selected. But, as by far the greatest proportion of plantation latex rubber is prepared for the market in the shape either of air-dried crepe or smoked sheet, smoked sheet is the best form to select for a comparison of the Brazilian method and a normal plantation procedure. And, in any case, the difference between smoked sheet and air-dried sheet would probably not have been great.

Typical results obtained by the author when comparing smoked and unsmoked sheet may be quoted. Three pairs of sheets prepared from different areas gave the following results.

	1st pair.		2nd pair.		3rd pair.	
	Air-dried.	Smkd.	Air-dried.	Smkd.	Air-dried.	Smkd.
Rate of cure	1¾ hrs.	1⅞ hrs.	2 hrs.	2 hrs.	2¼ hrs.	2⅜ hrs.
Type	37	38	39	39	39½	39½
Breaking load (lb. sq. in.)	2395	2309	2111	2211	2127	2081
Elongation at break	10·51	10·40	10·37	10·28	10·08	10·17

The present author has not encountered a erious difference between comparative samples f smoked and air-dried sheet. In no case, owever, has the smoked been clearly superior o the unsmoked sample, and in several cases it ppeared to be somewhat inferior. The widely-ccepted view that smoking markedly improves he quality of sheet—a view which appears to have nfluenced the market considerably—is probably allacious.

In the case of latex crepe, smoking may have a ery serious deteriorating effect on quality, the ate of cure and "type" being badly affected. hus, for example, one test gave the following esults. A sample of thin crepe smoked was ompared with part of the same crepe air-dried; nd it was found that the difference between the vo samples was very marked.

	Air-dried thin crepe.	Smoked thin crepe.
te of cure	2⅝ hrs.	3½ hrs.
pe	35	37½
eaking load............	2517	2091 lb. sq.in.
ngation at break	10·44	10·19

The very decided effect of smoking on the ality of latex crepes would not appear to be plicable on the lines which Eaton and Grantham c. *cit.*) suggest in regard to sheet—viz., its antiseptic effect in regard to the organic change of serum solids into vulcanisation catalysts.

The samples quoted above were smoked for three weeks. A number of tests were also made in order to determine whether, in accord with the widely-held views, prolongation of the smoking period beyond that necessary to dry the sheet had a beneficial effect on quality. Samples smoked until dry only (6 days) and for various periods up to 47 days were examined; but no evidence was found that prolongation of smoking effected any improvement of quality.

APPENDIX B.

Variation of product prepared by uniform method from different areas.—During the course of investigations into the question of variation in the quality of plantation rubber, the author has found that, even although prepared strictly according to the same procedure, the rubber from different lots of latex frequently exhibits variations in regard to vulcanisation. This shows that, in order to institute a comparison between different procedures, that is to have any claim to strictness, it is essential that the procedure should be applied to the same lot of latex. This point may justly be emphasised, as, in the past, the conditions of strict comparison do not seem to have been observed in regard to some of the tests from which conclusions, sometimes unfortunately influencing the practical development of the rubber-growing industry, have been drawn as to the effect on quality of certain procedures.

The variation which is often encountered when only small groups of trees are in question appears usually to be more marked than that encountered when larger groups are in question. It may be illustrated by the results for the rubber prepared as smoked sheet, in each case by exactly the same procedure (viz., that used for the preparation of the smoked sheet samples quoted in the text for comparison with the Brazilian samples), from the latex yielded by two adjoining groups, each of 150 trees of the same age and under the same tapping conditions.

Final cures.

	Samples from first group.	Samples from second group.
Rate of cure	2¼ hrs.	2 hrs.
Type	40	37
Breaking load............	2010	2208 lb. sq. in.
Elongation	10·25	10·35

The series of four smoked sheet samples quoted in the text (p. 496) for comparison with the sample of Brazilian rubber from old trees, offers another illustration. It will be seen that, although prepared strictly according to the same procedure, the rubbers show quite appreciable variations. This is seen most in regard to the rate of cure, which varies from 2¼ to 2⅝ hrs.—a variation of ⅜ hr. The breaking figures also vary somewhat, but not enough to constitute a serious point of variation, as such figures are often a little fortuitous. The rate of cure is a more definite figure.

It may be objected that variations such as those shown by the samples quoted are not due to intrinsic variations in the lots of latex employed, but are intrinsic and arise in part from variations in the amount of serum left in the sheets (cp. Eaton and Grantham, *loc. cit.*). This possibility can, however, be ruled out, as the rubber-content of the latex, and the dimensions of the coagulating pans and therefore the size of the coagulum, was the same in every case, and as the coagulum was in every case rolled out to the same area, *i.e.*, to the same thickness. It may be further suggested that variations occurring in the smoking at different times during a period of several weeks are in part responsible for the vulcanisation variations. This, however, is improbable, as, apart from the fact that the smoking conditions were as far as practicable uniform, the author has found experimentally that the effect of variation in the manner and temperature of smoking is not so marked as to make it probable that the possible slight variations normally occurring in any one smoking shed would be a factor in the vulcanisation variation.

The smoked sheet prepared in connection with the young tree Brazilian sample affords another example of variation. Although prepared in strictly the same way, it is found to differ markedly from the four samples just discussed, the final vulcanisation figures being:

	Smoked sheet from first area (mean of 4 samples.)	Smoked sheet from second area.
Rate of cure	2¼ hrs.	1¾ hrs.
Type	36	38
Breaking load (lb. sq. in.) ..	2192	2263
Elongation at break	10·44	10·28

It may also be noted that the two samples of Brazilian rubber differ from each other.

Naturally a larger amount of variation is to be looked for amongst the rubber from different groups of trees if the number of trees in each group is comparatively small than if the number is large. Thus the four samples quoted for comparison with the old tree Brazilian rubber exhibit a comparatively large amount of variation. The latex collected on each occasion for the test was the product of, say, 200 to 300 trees; and, although the composition of the group was similar, it was by no means exactly the same on each occasion. In the case of the bulked latex from a larger group of trees (as, *e.g.*, an average tapping section on an estate) the variation observed in the product obtained by a uniform procedure appears to be much smaller. The following results were obtained for samples of smoked sheet prepared in the same way at different times during the course of a month from the latex delivered at the factory from a given area (roughly 4500 trees or 75 acres).

	Sample 1.	Sample 2.	Sample 3.	Sample 4.	Sample 5.
Rate of cure	2h. 10m.	2 hrs.	2 hrs.	2 hrs.	2 hrs.
Type	37½	37	37	37½	37½
Breaking load (lb. per sq. in.)	2380	2210	2142	2309	2131
Elongation at break	10·42	10.38	10·35	10·39	10.39

The variation amongst the samples is very small and little if any larger than the possible experimental error. But it is to be noted that these samples, although all prepared in the same month and in the same way, show a very marked variation from some of the other smoked sheets quoted as examples. For example, throughout they cure more quickly and have a better "type" than the set of four samples prepared in connection with the old tree Brazilian sample. The areas from which the two sets of samples were prepared were adjoining, although they differed somewhat in age.[14]

It is clear that with the different groups of trees distinct variations in the vulcanising qualities of the product are to be expected even if the same method of preparation is followed; and it may even be expected that the rubber from the same group of trees will exhibit slight variations on different occasions owing to causes more or less out of control (variation in the proportion of the total yielded by individual trees, variation in tapping, etc.). Thus it is not justifiable to compare different procedures by consideration of the vulcanising properties when different lots of latex are in question; the procedures to be compared must be applied preferably to the same lot of latex or when that is impossible to latex from the same (large) group of trees.

APPENDIX C.

Effect on quality of the period for which latex stands prior to coagulation.—It will be noted that in each case the portion of the latex used in connection with the Brazilian samples for the preparation of smoked sheet was diluted and coagulated at about 12 noon, whilst the portion of the latex from which Brazilian rubber was made remained for a longer period—some of it until 4 p.m.—in an undiluted condition before being coagulated: and the point was raised as to whether this circumstance would be a disturbing factor. Experiment indicated that the effect of standing prior to coagulation of the latex was, if any, only small and would tend to favour the Brazilian rubber.

Undiluted latex was collected and was divided into three parts. Smoked sheet was prepared from the three parts at intervals during the day as follows. One part was at once diluted to a rubber-content of 12·5% and was coagulated. Another part was diluted to 12·5%, allowed to stand in this diluted condition for 7 hrs., and then coagulated. The other part was allowed to stand in its undiluted condition for 5 hours and was then diluted to 12·5% and coagulated. In the preliminary cure the samples behaved very similarly.

	Coagulated at once.	Coagulated after standing in diluted condition.	Coagulated after standing in undiluted condition.
Type	37	37	37
Breaking load (lb. sq. in.)....	1990	2080	2192
Elongation at break	10.99	10·96	11·04

It appeared in the final cures that the sample coagulated at once was slightly the poorest an the sample coagulated after allowing undilute latex to stand somewhat was the best rubber (th curves exhibited a slight difference in the rate o cure); but the difference was only slight.

DISCUSSION.

Professor ARMSTRONG—who had read a abstract of the paper, in the absence of the author—said that, if the comparison instituted by M Whitby met with the approbation of the specialis and the conclusions he had formulated were soun the communication was of importance as once mo raising the all-important issue of the relati values of Para and plantation rubbers. At th present time, over 100 millions of capital w invested in the industry in the East, yet only abo £5000 a year was being spent on research wo Bearing in mind what had happened in the Ea in the case of coffee disease, for example, which h ruined a great many people, it seemed desira that an industry of such magnitude should fully examined into—but that was not the attitude of the financial men in the City who had charge of those 100 millions. The impression he had gained recently, when in Ceylon, was that practically very little was understood and that a vast field of study lay before us; every detail of the industry should be fully inquired into. It was essential also that direct communication should be established between producer and user, so that the material might be followed throughout the course of manufacture. The supposed difference in quality between Brazilian and plantation rubber was a matter of very considerable importance—as it meant a substantial difference in price. Our neglect of the industry, on the scientific side, was a beautiful illustration of our haphazard way of doing things, which we made no concerted effort to overcome. The industry had been built up by the capitalist and planting had been carried on in the most casual way in early days—it was bristling with most interesting and intricate scientific problems and could not be neglected with safety, especially in view of the efforts that were being made to produce rubber artificially.

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[14] Comparing the two sets of four and five samples respectively, it may be noted that the "type" of the samples from any one of the areas is practically constant but differs distinctly from that of the samples from the other area. In this connection see footnote 13, p. 495.

Dr. H. P. Stevens said that the plantation rubber industry was perhaps an exception to the general rule which Professor Armstrong had laid down. Professor Armstrong suggested that there was not £5000 a year spent on it. His impression was that one of the research organisations alone spent this sum. For some six or seven years there had been research stations both in Ceylon and the Malaya, in which work had been carried on and for some time past, research work had been carried on at the Government Agricultural Department in Kuala Lumpur, F.M.S., also at the Imperial Institute and in private laboratories. His own firm had been acting for the Rubber Growers' Association for the last six or seven years, and had been carrying out a systematic series of tests during that period. The subject matter of Mr. Whitby's paper was one which had been covered already by their own researches on the subject, and he was glad to see many of his conclusions corroborated by those of other workers. The difficulty in making a comparison between native Brazilian prepared fine Para and similar rubber prepared on the plantation arose from our not knowing exactly how the Brazilian rubber was prepared. The smoking or curing process was purely a matter of skill, which no doubt could be acquired by anyone. Several attempts, however, had been made to imitate the Brazilian method experimentally in the Malayan Peninsula, and it was very doubtful whether the process had been carried out in a correct manner. His firm had had samples of rubber made in Malaya and Ceylon in the Brazilian fashion for examination. They had always found that the rubber on arrival differed in appearance and properties from the native Brazilian rubber. They had found that the amount of moisture left in the rubber affected the quality to some extent, and it was difficult to imitate the Brazilian method so as to retain the full amount of moisture. This also appeared to be the case with Mr. Whitby's samples, which contained less moisture than native Brazilian rubber. He also wished to point out that in his opinion there had not been sufficient research work of a fundamental nature carried out on the methods of testing plantation rubber. There was too great a tendency to limit tests to what was really a very theoretical mixing, consisting of rubber with perhaps 8% to 10% of sulphur added to it. Such a mixing was very seldom used in manufacturing work, and it was assumed without experimental proof that what applied to a theoretical mixing of this description also applied in the same manner and degree to the great variety of technical mixings which were used in a rubber factory.

Mr. Russell G. Pelly said he entirely confirmed what Dr. Stevens had said, especially with regard to research in Ceylon. About three years ago a number of Ceylon planters had come together and commenced a scheme of research for the purpose of bettering, if possible, the methods of preparation of plantation rubber. That scheme of research had been going on ever since. They had a chemist on one of the best known plantations in Ceylon preparing rubber by a large number of methods, in accordance with an entensive scheme of research. These specimens of rubber were sent back to England and tested at the Imperial Institute. He thought Professor Armstrong might acknowledge that he was at least wrong in that respect, viz., that little or no research was being carried out in the plantation rubber industry, and that the planters were not so foolish as people would make them out to be. In addition to two separate schemes of rubber research in Ceylon, there was a testing station in the Dutch East Indies, and also at Kuala Lumpur, in the Federated Malay States, and there was no doubt the plantation rubber industry was quite alive to the necessity and value of research.

Professor Armstrong said that Dr. Stevens was quite right in his criticism—the question was whether the Brazilian method of smoking had been successfully imitated; it might not have been, but the same material had been subjected to the different kinds of treatment and the comparison was valid to this extent. In his paper, the Author stated that he had made a comparison between the inner and the outer portions of the ball containing different proportions of water, and did not find any difference between these. Professor Armstrong said that he had visited the experiment station in Ceylon and had seen what was going on; admirable work was being done but the chemist was so occupied in controlling the technical side of the work that he had no time for research work proper. A botanist had joined the station a few days before he had visited it. In Malaya they had one chemist and one botanist, he believed, doing research work; a year ago the botanist was thought to be unnecessary and went home.

Mr. Pelly said it was possible Professor Armstrong was speaking of the wrong chemist; he had referred to the Rubber Growers' scheme.

Professor Armstrong said that in the sense in which he meant it, there was no research work going on. The men were just about able to keep the machine running and that was all; the staff was insufficient to run the industry and also do research work. A large and specially competent staff would be required for such work, to put the industry upon a safe basis.

Dr. H. P. Stevens wrote subsequently:—"This interesting paper covers a great deal more ground than would be apparent from the title. Great care has been exercised in the preparation of the samples and the importance of carrying out comparative tests on samples prepared from the same batch of latex is emphasised. I agree with Mr. Whitby that this is essential. The value of the paper lies chiefly in the results of the vulcanisation tests. It has now come to be recognised that only by vulcanising the rubber is it possible to arrive at an opinion on its merits. This view was expressed by myself many years ago (Chem. News), when other methods, such as viscosity determinations of the solution, were advocated. Much, however, depends on the details of the method of testing and arriving at results, and but few details are given in the paper. From Schidrowitz and Goldsbrough's preliminary paper little can be gleaned, nor are the results supported by duplicate tests. The only figures which enable a comparison to be made refer to the samples of rubber smoked respectively Brazilian fashion and plantation fashion. This difference in procedure results in a difference in cure of half an hour in the case of latex from young trees and of nil in the case of latex from old trees. Had the difference in the method of preparation produced a difference in the rate of cure in one case, one would have expected it to have produced a similar effect in the other.

" Mr. Whitby states that no ' keeping ' or ageing tests were made. This is unfortunate as these are of the greatest importance. A cure cannot be described as ' perfect ' unless the vulcanised product is lasting, and the degree of vulcanisation is the most important factor influencing the ageing or lasting qualities. It is in this sense that the rate of cure becomes of vital importance to manufacturers. There is no use in basing the rate of cure on some theoretical standard unless this standard corresponds to a condition of the maximum of stability in the vulcanised product. This may be illustrated by reference to the published results of Eaton and Grantham to which Mr. Whitby has referred. In this work they speak constantly of an ' optimum ' cure which Mr. Whitby states is obtained by an empirical and less exact method than that which he employs. It may be stated with confidence that the samples vulcanised by Eaton and Grantham at their ' optimum cure ' are much overcured. I hope shortly to lay before the Society a paper dealing with this matter.

" As regards the conclusions arrived at, I am able to confirm Mr. Whitby's results as to the comparison of Brazilian prepared rubber with plantation smoked sheet. I have also found but little difference between the results of tests on rubber from young and old trees, but I cannot agree with Mr. Whitby's conclusions as regards the smoking of sheet, which I have found to produce greater differences than he indicates."

THE FEDERATION OF THE INTERESTS OF APPLIED AND PURE CHEMISTRY IN AN IMPERIAL UNION OF BODIES REPRESENTING THE VARIOUS BRANCHES.

BY PROFESSOR H. E. ARMSTRONG, F.R.S.

(See this Journal, 1916, 400.)

Discussion.

Mr. A. **Chaston Chapman** said that they would all agree that much that Professor Armstrong had said was only too true. There was in the chemical profession an immense amount of overlapping, a very considerable waste of effort, and a very serious dissipation of energy. Looking at their Societies as instances, it was clear that no sharp lines of division were drawn, and it frequently happened that communications of the same character were dealt with quite indiscriminately by several Societies. Their publications overlapped very considerably, and above all, there was what he was almost inclined to call the scandal of abstracts. It really did seem disgraceful that at a time when there was so much to be done, half a dozen men should be engaged in abstracting the same paper for half a dozen journals, when one or possibly two abstracts would answer the purpose perfectly well. With regard to the general suggestion which he understood Professor Armstrong to have made, he supposed there could be very little difference of opinion as to its desirability. If the chemical profession could combine in any way, it would become to that extent the more vigorous, and would present a much stronger front to the enemy than if it continued in its present divided condition. The only difficulty was how far such federation was possible and by what means it could best be effected. It could not be overlooked that they differed in certain essentials from the medical profession, which Professor Armstrong had taken as his example of what might be done. It was a comparatively easy matter to weld the various medical societies into one harmonious whole, owing to the fact that their members were all trained professional men, differing only in the nature of their specialization. Up to a certain point they had all passed through the same academic curriculum, and consequently there was no insuperable difficulty in forming them into a compact body having common views and common aims. In the chemical profession, on the other hand, matters were very different. There were, it was true, a certain number of Societies whose members were almost exclusively professional men. There were, however, a number of technical Societies containing a very large percentage of members who could not be described as scientific men, except perhaps in the sense that they were anxious to apply the teachings of science, so far as they knew them. It would be a very difficult matter to obtain by the fusion of all these scientific and technical bodies, directly and indirectly concerned with chemistry, a compact and united body which would really be in any better position to forward the interests of chemistry than was the case with existing individual societies. The scientific element in such a composite body would be very largely swamped, the ratio of purely technical or industrial members to professional chemists being in some of the societies as high as five or six to one. He would not go so far as to say that that was necessarily an insuperable objection, but it was clearly one which would have to be faced in any scheme of federation, and it appeared to him to constitute the main difficulty. There were, however, other difficulties. Human nature was a governing factor which not even chemists could ignore, and a Society which had been working for a considerable number of years, which had done work of high quality and which had gained for itself an honourable reputation and an honoured name would, unless there were very strong grounds, object to losing its individuality by becoming a part of a large composite and heterogeneous body. These and other difficulties would be encountered at the outset by anybody making a serious attempt to bring about federation, but he was sure that every one who had the best interests of chemistry at heart would do what he could to further the movement so far as it might seem desirable. In June last the Chemical Society had appointed a General Committee, consisting of two members of each of the chemical and allied societies. One of the objects of this Committee was " To consider and discuss all questions of general policy, not only those arising from the war, but those matters on which it is desirable to have the opinion of a body thoroughly representative of every department of chemical science." He would ask Professor Armstrong whether it might not be possible to bring before that Committee as representing the various allied societies the suggestion he had made in his paper. That might at any rate be a convenient way of bringing the matter simultaneously and without delay before the great majority of the societies concerned.

Dr. L. T. **Thorne** said that he was absolutely and cordially in sympathy with the proposal of Professor Armstrong. They were at a very critical time in respect to the chemical industries of this country, and some sort of federation, or some bridging over of the gulf between the pure science and technical Societies was essential, if they were to make a really successful fight to regain their position in the chemical world. Individualising had grown to such a marked degree that the separation between the pure scientist and the technologist had become very grave indeed, and had certainly been harmful to the work of both. In many cases the pure scientist looked upon the technologist as an inferior being, and the technologist upon the pure scientist as a faddist who would not consider anything of a practical character, and who would like to fly away in the clouds where ordinary humanity could not follow. There should be no separation between pure chemistry and technical chemistry. They were both chemistry, and ought to work hand in hand, and not look upon one another as passing acquaintances, but rather as brother and sister. The closer communion existing in Germany between the pure chemist and the technical chemist had been largely the cause of the great advance in the German Chemical Industries, and was mutually helpful. This was a time of crisis, and it was high time for them to carry forward some system of federation such as Professor Armstrong had foreshadowed. If they did not do it now the probability, if not almost the possibility, would have passed, and could not be recalled, and both pure science and technological science would suffer. Our Society was one that could very well make a great effort, and he believed there was now more tendency to a feeling of brotherhood on both sides than there had hitherto been, and than there would be in the future if the present opportunity were not seized. He therefore sincerely hoped that the Society of Chemical Industry would attempt to move, and that they would get the co-operation of the Chemical Society as representing the other side. If they could move in sympathy, he believed that most of the other chemical and allied Societies would come in. As Professor Armstrong had pointed out, they did not need to lose their individuality, but they did need to work much more in co-operation and intimate fellowship than they had done.

Dr. J. T. **Dunn** sympathised cordially with the views that Professor Armstrong had put forth. No doubt there would be very great obstacles in the way of carrying out such a fundamental change, but he thought the unanimity with which the desirability of it must be regarded by everybody concerned would in itself go a long way towards overcoming those obstacles. One or two of the points on which Professor Armstrong had touched in themselves seemed to carry them so far on the road. There was first of all the question of the publication of the journals and the co-ordination of abstracts. A great deal of money was spent—to say wasted was perhaps using a strong word—by all the Chemical Societies at the present time in publishing abstracts which not only had to be made, but also to be read, in duplicate or triplicate. In all probability, if there were a proper co-ordination, the money saved by the various societies might go a very long way towards covering the expenses of the new society; so hat a man who was a member of three or four of hose societies would be able to be a member of the new society without any increase in his subscrip-ion. Another point which had been mentioned y Professor Armstrong was the necessity of stablishing some kind of chemical club. To rovincials who occasionally came up to London, it was a very great pleasure to be able to meet hemical colleagues; but short of going personally o visit them, or of meeting them as on the present ccasion of a meeting happening to occur at the me of the visit, there were no means of doing o. He certainly hoped, whether through the edium of the Joint Committee, of which Mr. haston Chapman had spoken, or other means, eps would very shortly be taken to try to achieve at result.

Dr. **Charles Carpenter** said that some time o Professor Armstrong had brought under his tice the proposals which were set out in the per, and as a result he had paid a visit to the Royal College of Medicine. The ideal was a fascinating one, and in ordinary times he did not think there would be any difficulty in persuading those interested in chemistry, whether from the professorial or academic standpoint, or those whose interest in one sense of the word was even deeper, namely manufacturers, as to the desirability of bringing together all those concerned in the chemical industry into one common centre. He personally had no doubt as to its desirability. His only difficulty was that at a time when money was so short, and there was every possibility of its getting shorter, whether there was any likelihood of the present being considered in any way a favourable opportunity of bringing about the result. The merit of the proposal had been brought home to him by the visit he had paid to the College. The various branches of medical and surgical science met under one roof. They had suitable rooms, both for scientific and social purposes, and an extremely valuable and well-arranged library; indeed, they had everything that the chemist wanted in theirs; and if it had been possible for the medical profession, he did not see why it should not be carried out equally well in their own case, though he was not sure whether the present time was opportune.

He thought that if the chemical industry were going to develop in Great Britain, as it had in other countries, it would be desirable and advantageous to have some central organisation for the common good in the same way in which it had been successfully done in the case of the medical profession.

Professor J. C. **Philip** thought the general condemnation, which most of the speakers had applied to the existing state of matters, was a little misconceived. He considered the division of their science into various branches to be a normal feature of its development. The process might have gone too far, and in that he would perhaps agree; but a certain amount of subdivision was only natural, and he was afraid that the forced junction of those various separate branches might lead to congestion. He agreed at the same time that much might be done from the practical standpoint, for instance, in connection with the pooling of abstracts. Some years ago a serious attempt had been made in that direction between the Chemical Society and the American Chemical Society, but came to nothing. An arrangement which was an instance of the same thing on a very much smaller scale, and was actually now in operation, was one between the Chemical Society and the physiologists whereby the latter utilised the physiological abstracts of the Chemical Society. It was a small instance of what could be done in that direction, and he hoped it would be extended. The objection which many people had raised to the pooling of abstracts still stood, namely, that technologists wanted a different abstract of a given paper from that which the chemists wanted. There were many cases in which the interests to be served by the abstracts were not identical, and in those cases there was very serious difficulty to be faced.

He agreed with Mr. Chaston Chapman that Professor Armstrong's analogy of the case of the Medical Societies was hardly in point, because there was a much greater uniformity of preparation and training in the case of men who were members of medical societies than there was in the case of members of the different chemical societies. He thought the most practical aspect of the question was also raised by Mr. Chaston Chapman in his suggestion that the Joint Committee which had been formed by the Chemical Society might be made a common meeting ground in the first place to discuss some of the questions which Professor Armstrong had raised.

Mr. GARDNER recalled the fact that in the discussion on the question of suggesting to the Board of Trade that it should form a Chemical Intelligence Branch for the consideration of chemical questions, he had urged that before they approached a Government Department with a proposition of that kind, it was necessary that they themselves should set their house in order and speak with one voice. It was therefore particularly gratifying to him to hear what Professor Armstrong had suggested; he asked Professor Armstrong not to put the matter before the Committee as suggested by Mr. Chaston Chapman, or, if it went before the Committee first of all even, it should be put afterwards to the individual members of the Society, because there were enormous difficulties in the way, and it was probable that the Councils of those societies would see those difficulties rather than the advantages which were to be obtained from mutual co-operation. They as individual members were not so much concerned with the difficulties which the various Councils were going to have in making the thing work, as with the desirability of the thing working. He therefore suggested it should be put to the individual members if possible. Chemists ought to do something between now and the end of the war, or at the end of the war, to prevent the state of things which existed before the war, when the Woolwich Arsenal could advertise and obtain really competent analytical chemists for the sum of two pounds and sixpence per week. The bulk of the important people in the chemical world were not concerned with whether a man was getting a decent living wage comparable with the training which he had had. But to the junior it made a lot of difference; he had known a number of first-rate men who had wasted four or five years of their lives at Woolwich at that paltry pittance. Professor Armstrong had not mentioned two societies, namely, the Institute of Chemistry and the Institute of Chemical Technologists. He thought they should take into their view every society which either did or pretended to take care of the interests of chemistry. It seemed to him it was not so much a question of whether this was advisable or possible now, or whether they, as chemists, were going to take advantage of their industrial birthright when the war was over. There was undoubtedly going to be some measure of fiscal protection for chemistry, because the Government for the first time in its existence was beginning to realise that chemists were needed and were doing useful work. But unless they as chemists were prepared to do their share, they could not expect the Government to legislate for them. The chemical industry in this country ought to be in a very healthy and happy state, and it was for them as chemists to see that they had their share, and in the first place to look after their junior brethren, and in the second place to see that their industry and co-operation was a real and flourishing one.

Mr. W. J. A. BUTTERFIELD said that the analogy to the chemists should have been from the engineering rather than from the medical profession, the members of which had a bond of union—which neither chemists nor engineers possessed—in the privileges and protection granted them by the State. In the engineering profession there were a number of societies each looking after a special branch of engineering work; in fact, the tendency was rather towards sub-division. He could foresee that just as there were these various institutions of engineers, so in the chemical profession they would have a Society of Organic Chemists, A Society of Technical Chemists, and a Society of Analysts; in fact, they were already divided in effect on such a basis. As to a headquarters for the chemical profession, he thought the Institute of Chemistry had now a building which was larger than was required for its immediate purposes; and if that Institute would in some way open its doors to the members of the profession at large, that building might well afford a good rendezvous for all chemists. He was somewhat doubtful of any success attending an attempt to bring chemists together under the ægis of the societies which were quartered in Burlington House. He thought technical chemists would look to the Society of Chemical Industry and the Institute of Chemistry to bring them together.

Mr. J. W. HINCHLEY suggested that chemists were suffering not from lack of organisation, but from lack of emulation. Instead of following Mr. Butterfield's advice and going to the engineers for an example, he would be inclined to go to the Salvation Army. He thought that the Salvation Army ran their concern infinitely better than the engineers. He suggested that most chemists joined the Societies for what they could get out of them, and not in any sense for the Association. He had never yet come across a member of the Chemical Society who felt that he was a part of that body. He had never felt the emulation which the Germans felt when they sang "Deutschland ueber Alles." The reason was that the people who ran those Societies thought they should run them on the opposite principle to the Salvation Army. When the Salvation Army got a member, they gave him something to do; but the Societies did not do so. They did their best to hedge around all the activities of the members, and prevent them taking any part. The country was ran on so-called democratic lines. The Scientific Societies were run on exactly the opposite, and he suggested that the success of the country depended on the democracy and not on the autocracy. No matter how great the men on the Committees were, they could not move the mass of the members of the industry, because they did not know its feelings and its views. His own feeling was that the Societies had enough organisation, but not of the right sort. They wanted organisation to produce emulation, and to make every member feel that he had a stake in the Society, and in the country of which the Society was a part. He suggested that they should run their Societies more on democratic lines than in the past. They should endeavour to make every member feel that he was contributing to make the chemical industry a great success, and contributing to its progress. He was afraid that that would not follow from a federation of the Societies unless they started from the bottom, and tried to produce in the ranks of the Societies emulation rather than merely trying to produce by organisation what was absent.

Mr. W. E. OAKDEN asked whether the aim of Prof. Armstrong was the promotion and development of the chemical industries, or to obtain political recognition by the Government in some shape or form for chemistry and its allied branches, or whether it was really to raise the status of th professional chemist himself? Was it propose that the new society to be established should b in the nature of a scientific institution, or more o less of a social institution where chemists coul meet and discuss social matters appertaining t their profession, or was its principal object th advancement of pure and applied chemica science?

Mr. F. H. CARR said that one of the many grea advantages of the scheme was that it opened th way for greater subdivision of chemistry, and th was a great need of chemical organisation. H did not know how many societies there we already; but if they carried the process to i logical conclusion, they needed to form ma more. At present one had to attend a lar number of meetings to listen to the comparative few papers of particular interest to oneself, wi consequent loss of time. A system of complete subdivision in one central home would be a very great advantage to all, and he thought this was the ultimate factor which would make it essential, that, in their generation, or in that which followed, they would have to adopt the very simple commonsense suggestion which it seemed to him was so commonsense, that they were all going out of their way to try to find the difficulties on the way. The objection which had been raised with regard to the false analogy with the medical or engineering profession was mere hair-splitting. The underlying principle was identical with their own, namely, a long training in common.

Mr. Maben, speaking as a member of the Royal Society of Medicine, said that he was quite sure that that Society would be delighted to entertain the Society of Chemical Industry at their house in Wimpole Street, if they were to apply to their able Secretary, Mr. Macalister. If their scheme was to be carried through they would need a man to do it—such as the Royal Society of Medicine had in Mr. Macalister. Whether in this time of necessity there would be sufficient enthusiasm to carry through a programme of that kind without very long delay, was a question. The Royal Society of Medicine had started about five or six years ago with 13 societies, and since then had added at least another five sub-divisions and different sections of societies. In that way they were contributing to the very idea that Mr. Carr had brought forward.

Mr. Hodgetts alluded to the case of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the other engineering societies which had been alluded to by Mr. Butterfield. At one time Sir William Siemens had proposed to devote a very large sum of money towards the housing of all these societies together, and in that way give them considerable importance; but there was not the democratic pushing worker, as at the Royal Society of Medicine, in the person of Mr. Macalister. On the contrary, there were a great many people who were directly interested in preventing the different coaches from moving to the same point; and that was the difficulty they would have to face. They would have to find a man who would take that burden on his shoulders, and would succeed in uniting the different societies; because, while they had an Institute of Chemistry, it was a purely professional institute, and of which hey could not become members without passing very stiff examination. They had a Chemical ociety, which was an academic society, and they ad a Society of Chemical Industry, which was either academic nor professional, but a little of oth. They would have to see how those ifferent societies would compromise and meet ach other.

The Chairman said that they were all in agreeent with Professor Armstrong's suggestion, if it ould be carried out. He himself thought it could e carried out; at any rate they ought to try it, nd this was the time to try. He agreed that if hey missed the present opportunity, it would not cur. It was on account of the specialisation of eir chemical work that they needed to be brought gether. Many of them in certain branches of emistry had not the slightest idea of what other ranches were doing. They must not stay away om the Chemical Society because they did not derstand the paper. It was more congenial attend a meeting of the Society when there was me matter for discussion upon one's own branch chemistry: but, on the other hand, the other anches of chemistry could teach them something. ne of the chief reasons that had been mentioned y the scheme was not carried out was because their adhesion to certain societies. It had ways seemed to him, although he was very much attached to the Society of Chemical Industry and many others, that they ran the Societies for the Societies' sake, instead of running them for their objective, the development of science.

Professor Armstrong, in reply, said that he had brought this problem of federation before their notice with the greatest diffidence, because he felt that he was raising a question that was full of difficulties; the discussion, however, had been most encouraging. With regard to the difficulty referred to, of bringing together people who had such different interests, he pointed out that they were practically all trebly distilled Pooh-Bah's: not only both Private Secretaries and Chancellors of the Exchequer but this, that and the other kind of chemist—if they were chemists at all; they, therefore, ought not to have such great difficulty in associating and bringing themselves together in one place more often than they did.

He had been asked what his object was: his object was to make chemistry a live agency in this country. At the present time, it was not. Unless chemists were very careful, if they went on in the way they were going at the present time, throughout the country, at the end of the war they would have no position left. During the last 15 months, he had been about a great deal and had come much into contact with the industrial element; he could see that their reputation was going down steadily; they were looked upon as a set of unpractical people; unless, therefore, chemists could improve their status, by organising themselves and demanding the rank which was rightly theirs, they would lose their position altogether.

If, as had been suggested, the matter were put into the hands of various Past-Presidents of the 10 or 11 societies mentioned, the scheme would be condemned forthwith, he feared. It must be taken up by the younger members of the Society and be put through as a democratic movement, if dealt with at all. The only practical way he could see, was for their President to convene a meeting, at as early a date as possible, preferably in the rooms of the Royal Society of Medicine, so that all the parties concerned could discuss the question openly. To refer the problem to any committee of elderly gentlemen like himself would be an absolute waste of time; he had been trying for years and years to move such people and had found that they could not be moved. If the younger chemists would come forward and have a little courage, something might be done, people like himself could only bring forward ideas. It would be very difficult to make any progress, unless support were forthcoming from the body generally; he therefore urged the younger men to take action; if there were anything in his propositions, they would be able to realise what the advantages were and if such help were secured, it might be possible to move the senior conservative element.

Mr. Walter C. Hancock wrote: "There is a feeling abroad that societies enough exist already, and that members have not time to devote to new ones. In fact it is doubtful whether proper attention is paid to those already existing, and much of the lack of clear action and definite policy, apparent during the present crisis, may be due to members not utilising the societies to the full extent. More of the democratic spirit, mentioned by Mr. Hinchley, is needed, so that the dicta of societies on particular points can be recognised as representing the opinion and wishes of the bulk of the members. That can only be attained by members recognising their responsibilities and exercising their rights. It is useless to complain that councils and committees of "elderly gentlemen" do nothing; most people appreciate that the officers do all they can to promote the general welfare. Mr. Butterfield's suggestion that the resources of the Institute of Chemistry might be utilised to achieve the objects suggested is worthy of the strongest support. The Institute already embraces so many prominent academic and technical chemists, that an extension of its sphere of action on the lines suggested would not only co-ordinate the interests of British chemists, but would place the scheme on a high and well-recognised footing. Could not some arrangement be worked out by which a sort of combined membership of the Chemical Society, the Society of Chemical Industry, and the Society of Public Analysts could be effected, and a joint committee of the three societies apportion papers among the publications so as to avoid overlapping? This is certainly the time to move, and not to wait until the war is over; by then, chemists must be at work, not thinking what there is to be done."

Meeting held at Burlington House on Monday, May 1st, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

THE EVAPORATION OF NAPHTHALENE IN DRY AND IN MOIST COAL-GAS.

BY J. S. G. THOMAS.

A knowledge of the vapour pressure of naphthalene in coal-gas is of extreme importance to gas-engineers and those concerned with the distribution of coal-gas. The amount of naphthalene required to saturate any given volume of gas can be at once calculated from a knowledge of the vapour pressure of naphthalene in the gas (Ostwald-Luther, Physico-Chemical Measurements, p. 114). The method of evaporation for the determination of the vapour pressure of naphthalene presents numerous advantages over the barometric method. This method has been previously employed by R. W. Allen,[*] by E. Schlumberger,[†] and by Perman and Davies.[‡] The method in theory is extremely simple. It consists merely in passing a known volume of air or other gas over a weighed amount of naphthalene and determining by difference the amount of naphthalene which evaporates. It is necessary to ensure that the gas passes sufficiently slowly to become saturated. Allen and Schlumberger both employed the evaporation method, and the former obtained confirmatory values by the barometric method. Schlumberger (*loc. cit.*) labours under a misapprehension when he states that Allen's values at lower temperatures are extrapolated from the values at higher temperatures. Allen determined the vapour pressure at 15°, 30°, 45°, 60°, and 75° C., by the evaporation method, and at 0°, 39°, 46·8°, 80·4°, 100°, 116°, and 130° C., by the barometric method.

Schlumberger confined his experiments to the region of temperature 0° C. to 50° C. The results obtained by Schlumberger, between 0° and 30° differ appreciably from those obtained by Allen over the same range. Above 30° C., the values obtained by both observers agree within the limits of experimental error. At 0° C., Schlumberger obtained the value 0·006 mm. as the vapour pressure of naphthalene, while Allen's value is 0·022 mm. Although neither pressure can be regarded as large, the difference in the amounts of naphthalene carried by the quantity of gas manufactured per day by one of our large gas companies, as calculated from the respective results at 0° C., is very considerable. The difference will be appreciated by those concerned with the distribution of coal-gas, Allen's value at 0° C. being practically identical with that found by Schlumberger at 10° C. Owing to the differences existing between the experimental results of these observers, it was an essential preliminary to the investigation of the evaporation of naphthalene in various vapours, which investigation the author undertook, at the suggestion of Dr. Charles Carpenter, to redetermine the vapour pressure of naphthalene in coal-gas and air, either of which is to be used in subsequent experimental work with various vapours. Both Allen and Schlumberger confined their attention to the evaporation of naphthalene in dry gas.

Preparation of the naphthalene.

This was prepared from what was described as pure naphthalene. The sample was alternately digested with sulphuric acid and caustic potash several times, being washed with water between each digestion. The purified sample was three times distilled in steam, drained free from water, "sublimed," powdered, and set to dry *in vacuo* over concentrated sulphuric acid for about six weeks. The melting point of the sample was 80·2° C., and when boiled with concentrated sulphuric acid it gave a very slight coloration.

Apparatus and method of experiment.

The experimental details for the case of moist gas do not differ very essentially from those employed in the case of the dry gas. The apparatus for the experiments with dry gas is herewith described in detail.

A rectangular bath of tinned copper, 2 ft. 9 in. long by 10 in. deep by 6 in. wide, was constructed. The water in the bath was heated by luminous burners, the temperature being regulated by a gas regulator of the type described and used by Perman.[*] The regulator was found very efficient over the range of temperatures employed. The temperature rarely varied more than 0·01° C. during an experiment, and I believe the maximum temperature error in any experiment does not exceed 0·03° C.[†] The temperature of the water in the bath was indicated by the thermometer, T (see Fig. 1), which was standardised, under the conditions of use, at the National Physical Laboratory. The stem of the thermometer was surrounded by water sucked up from the bath into the tube. L, the tube itself being wrapped with a thick layer of cotton wool. Readings of temperature were taken by means of "reader," and all temperatures were reduced t the hydrogen scale. The thermometer was no standardised until the experiments with the dr gas were completed, and it was therefore no possible to adjust the temperature of the bat exactly to any desired temperature, the necessar correction being unknown at the time of th experiment. This will account for the differen temperatures employed in the case of the dry ga and moist gas respectively.

The water in the bath was thoroughly stirre by two stirrers, S_1 and S_2, connected to pulley P_1 and P_2, the pulleys being driven by a small ho air engine. The stirring was very efficient, an no difference of temperature could be detect when the thermometer was placed at various par of the bath. No difference of temperature, lik wise, could be detected when the water in the tu L was renewed. The gas employed (air or co gas) entered through the wash bottle, A, containing concentrated sulphuric acid. B is a mercury gauge inserted to measure the pressure of the gas and to ascertain that the pressure was not appreciably different from atmospheric. The gas was further dried by passage up the tower, C, filled with pumice moistened with sulphuric acid, and over calcium chloride contained in the U-tube, D. Dust was filtered out of the gas by the plug of cotton wool contained in E. The gas then passed through a length of 10 feet of glass tubing—represented diagrammatically at F—so that the gas attained the temperature of the bath. G was a vessel of tinned copper 10 in. by 6 in. by 1 in., which was closed down with a lid of tinned copper. This lid was fastened down water-tight by means of screws, a layer of rubber 8 in. thick being placed between the lid and the top of the vessel. This vessel contained the tube, H, filled with calcium chloride kept in place by plugs of cotton wool. In G were likewise contained the U-tubes, J and K, filled with naphthalene. The gas passed successively through H, J, and K. It is evident that the amount of naphthalene absorbed by the gas—up to complete turation—at any given temperature depends pon the time the gas is in contact with the naphhalene. This time can be lengthened by employg more tubes containing naphthalene arranged ther in parallel or in series, or by aspirating the s more slowly. In preliminary experiments it as found that employing three tubes containing naphthalene, the absorption occurring in the third tube at 20°, 30°, and 50° C., was invariably less than could be detected by a balance sensitive to 0·1 mgrm. when a rate of flow of gas of about 3 litres per hour was maintained. The third U-tube was therefore abandoned, and two tubes, J and K, alone were employed. The gas, after passing through K, was passed into the wash bottle, M, containing sulphuric acid, where the naphthalene was re-absorbed. The gas then passed into the aspirator. The pressure in the aspirator was measured by a small mercury gauge. The aspirator had a cubical capacity of 36 litres. In most of the experiments a volume of 24 litres of gas was aspirated through the apparatus, a larger volume being aspirated at the lower temperatures. Thus at 5° C. the volume aspirated was 83 litres. Air at 65° C. was aspirated through the apparatus for 3 hours before commencing the series of tests. Any change of weight occurring in the empty tubes after the aspiration of air at 30° C. was found to be less than 0·1 mgrm. The volume of gas employed was corrected for (1) Temperature—all volumes were calculated at a temperature of 15° C., and all temperatures reduced to the hydrogen scale; (2) Humidity—the pressure of water vapour was taken from Kaye and Laby's Tables, and the partial pressure of the gas obtained by subtraction from the total pressure; (3) Pressure—all volumes were calculated at a pressure of 670 mm. of mercury.

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[*] Allen, Chem. Soc. Trans., 1900, pp. 400—412.

[†] Schlumberger, Journal für Gasbeleuchtung, 1912, pp. 1257—1259.

[‡] Perman and Davies, Chem. Soc. Trans., 1907, pp. 1114—1116.

[*] Perman, "The Evaporation of Water in a Current of A Proc. Roy. Soc., 1903, **72**, 74.

[†] An exception must be made of the case of the measurem at 12·98° C. The bath in this case was kept filled by a current tap water. The thermostat was not used, and a maximum variat of about 0·3° C. occurred during the course of the experiment.

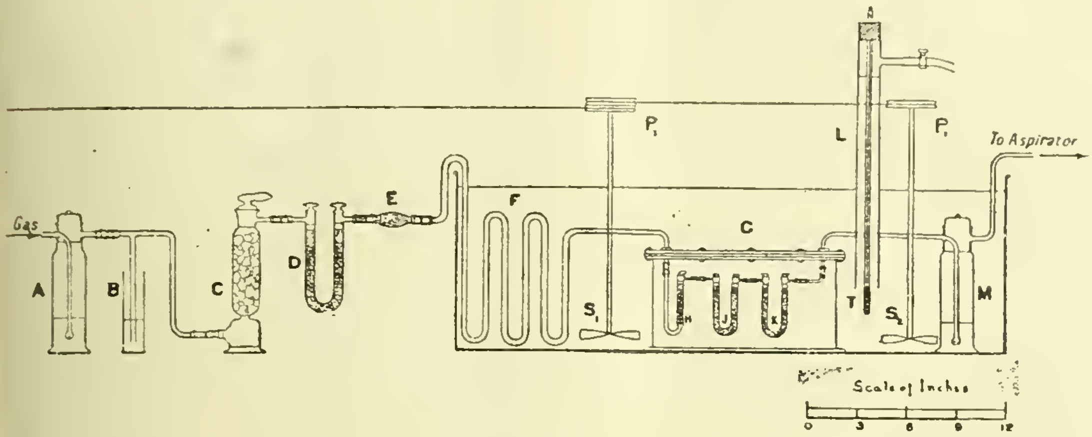

FIG. 1.

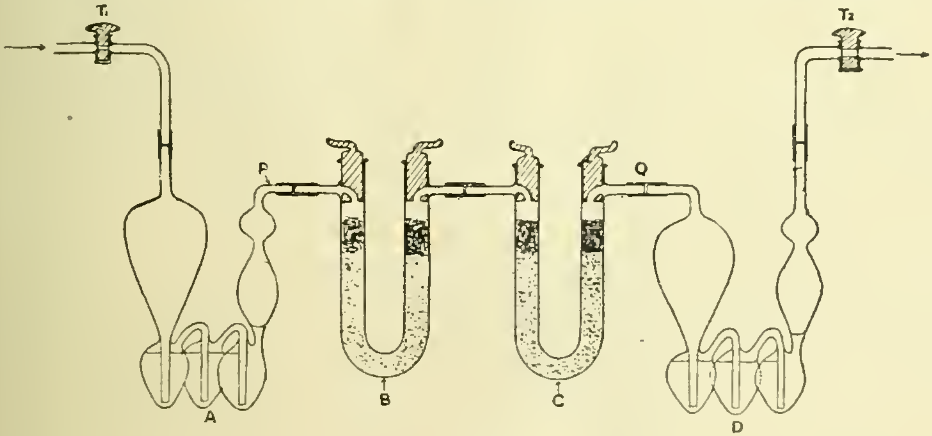

FIG. 2.

Modification of apparatus for experiments with moist gas.

The apparatus employed for drying the gas remains exactly as before, the only alteration in the apparatus being made in the arrangement of apparatus in the water-tight vessel, G. After passing through the glass tube, F, the gas entered the wash-bottle, A (see Fig. 2), containing carefully distilled water. Precaution was taken that no spray was carried over by the gas. This spraying is very largely prevented by the form of the wash-bottle, and in some of the experiments a plug of cotton wool was inserted at P. This precaution, however, was in the majority of cases found quite unnecessary, and was chiefly employed in preliminary experiments when the rate at which the gas should be passed through the apparatus was being determined. It was not, in general, desired to completely saturate the gas with water vapour, and in the experiments various degrees of saturation, ranging from 87 % up to complete saturation, were employed. This variation in the degree of saturation was obtained either by bubbling the gas at a quicker or slower rate through the water or by bye-passing a portion of the gas.

The gas after passage through the distilled water contained in A, passed through the U-tubes, B and C, containing finely-powdered purified naphthalene, plugs of cotton-wool, as shown, serving to keep the naphthalene in position. It was found by preliminary experiments that complete saturation of the gas with naphthalene was obtained when the rate of flow of gas was about 2700 c.c. per hour. With this rate of flow, no decrease of weight at 20° C. could be detected by a balance sensitive to one-tenth milligram, in a third U-tube containing purified naphthalene. The gas was largely deprived of its water vapour and naphthalene content by passage of the gas through the wash-bottle, D, containing concentrated sulphuric acid, thus deposition of water vapour and naphthalene was prevented in parts of the apparatus outside the bath.

Any fall of temperature of the gas by passage through the water contained in the wash-bottle, A, due to evaporation of the water will, under the conditions of these experiments, be extremely small,[*] and the gas during its passage through the naphthalene will certainly be at the temperature of the bath. For purposes of calculating the actual volume of the gas and vapour after leaving the U-tubes, it is necessary to know the pressure at Q (Fig. 2). A small mercury manometer was connected to Q, and it was found that the pressure at Q never differed from atmospheric by more than 1·5 cm. As the pressure term only enters into the calculation as a small correcting factor, the use of this manometer was discarded, it being well within the limit of experimental error to assume the pressure at Q as atmospheric.

Different volumes of gas were aspirated through the apparatus, the volumes at the lower temperatures being very much larger than the volumes at the higher temperatures. Thus at 5° C. (the lowest temperature employed) a volume of 67 litres (uncorrected) was aspirated through the apparatus, while at 60° C. a volume of 10 litres was aspirated. At 5° C. air was aspirated in place of coal-gas, as it was found impossible to obtain consistent results with the use of coal-gas owing to the deposition of some of the contents of the gas, although the gas was previously cooled by passage through a tube immersed in a freezing mixture. The experiment at 0° C. (employing air and saturating a portion only of the gas with water vapour at a temperature a little above 0° C.), was found to be exceedingly tedious, and the weight of naphthalene evaporated was such that an accuracy of about 10 % was all that could be obtained by the method. The saturation naphthalene content of moist coal-gas at 0°C. has therefore been obtained by extrapolation from the results obtained at the higher temperatures.

At 5° C. and 10° C. the temperature of the bath was regulated by hand. Ice-cold water was siphoned from a vessel containing ice and water into the bath when the temperature varied, the water entering at one end of the bath. This method was found more satisfactory, though more tedious, than the use of a Foote regulator. A maximum variation of about 0·3° C. occurred at these two temperatures, and in each case the experiment was concluded after the temperature had remained constant for at least half an hour at the appropriate temperature. In these latter cases a difference of about 0·2° C. existed for a short time between extreme ends of the bath when cold water was being added to the bath.

A necessary precaution in carrying out an experiment is that the gas must be aspirated through the apparatus for a considerable number of hours before the initial weight of the tubes, B and C, with the naphthalene contained in them is taken. The necessity for this precaution is particularly marked at the lower temperatures, and its significance will be pointed out in the sequel.

In drawing an experiment to a close, the outlet tap of the aspirator was first of all closed, and then the tap, T_1, shown in Fig. 1, tap T_2 being likewise closed before the tubes were disconnected from the rest of the apparatus. The taps of the U-tubes were closed, if for any reason the flow of gas through the apparatus was discontinued for any length of time, and also at the close of an experiment prior to their weights being determined.

Results obtained. (A) *Using dry gas.*

In the case of dry gas, air was used in most of the experiments, experiments with coal gas being limited to three temperatures. The vapour pressure is calculated from the experimental results by the formula

$$p=\frac{6230\ g\ T^*}{mV}.$$

where p = pressure of the vapour in cms. of mercury.
g = number of grms. of naphthalene evaporated.
T = absolute temperature of the gas.
m = molecular weight of the naphthalene.
V = volume of gas aspirated.

Table 1. gives the results obtained, temperatures being corrected to the hydrogen scale.

TABLE 1.

Temperatures.	Vapour pressure of naphthalene.	
	In air.	In coal-gas.
°C.	Millimetre of mercury.	Millimetre of mercury.
0	0·00538	
12·98	0·0233	
19·86	0·0500	
24·80	0·0845	0·0837
29·62	0·128	
34·60	0·218	0·217
39·70	0·320	
44·86	0·526	0·534
49·94	0·801	
59·76	1·780	

The values obtained using coal-gas are seen to agree with those obtained when the naphthalene evaporates into air. The experimental results are plotted graphically in Fig. 2. The results obtained by Allen and Schlumberger are also shown upon the same diagram.

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[*] See Perman, Proc. Roy. Soc., 1903, **72**, 77.

[*] Ostwald, Physico-Chemical Measurements, p. 114.

The results obtained for dry gas can be represented by a formula of the Kirchhoff-Rankine-Dupré type as follows :—

$$\log p = 11{\cdot}7797 - \frac{3812{\cdot}34}{\theta} - 0{\cdot}02593 \log \theta \; \ldots . \; (1)$$

θ being the temperature on the absolute scale. The coefficients in the formula are determined from the observations by the method of least squares. The accuracy with which the results are represented by the formula is shown in Table II.

TABLE II.

Temperature.	Vapour pressure (millimetre of mercury).		Difference. Experimental —Calculated.
	Experimental.	Calculated.	
°C.	mm.	mm.	mm.
0	0·0054	0·0056	—0·0002
12·98	0·0233	0·0243	—0·0010
19·86	0·0500	0·0499	+0·0001
24·80	0·0845	0·0820	+0·0025
29·62	0·128	0·131	—0·003
34·60	0·218	0·209	+0·009
39·70	0·320	0·334	—0·014
44·86	0·526	0·527	—0·001
49·94	0·801	0·812	—0·011
59·76	1·78	1·81	—0·03

The above expression for log p is employed to letermine the vapour pressure at intervals of ;° C. for purposes of comparison with the results btained with moist gas (see later).

(B) *Using moist gas.*

llustrative example of the method of calculation employed.

As an illustrative example of the results obtained nd the general method of calculation employed, erewith is given an extract from the laboratory ·cord :—

	Tube (1). H_2O.	Tube (2). $C_{10}H_8$.	Tube (3). $C_{10}H_8$.	Tube (4). H_2SO_4.
	Grms.	Grms.	Grms.	Grms.
itial weight ..	31·3631	21·3091	22·4348	43·7691
al weight .—	30·4460	21·2855	22·4341	44·7541
Difference	0·9171	0·0236	0·0007	0·9850

Total weight of naphthalene evaporated =)243 grm.

me.	Baro-meter	Bath tem-pera-ture by thermo-meter.	Water col-lected.	Total.	Tem-pera-ture of aspira-tor.	Remarks.
m.		°C.	c.c.	c.c.	°C.	
0	30·50″	30·38	0	0	14·0	Coal-gas aspirated
1 5	—	30·39	1,646	1,646	14·0	
1 5	—	30·38	1,605	3,251	14·5	
1 0	—	30·38	1,602	4,853	14·8	
1.						
1 0	—	30·39	1,611	6,464	14·9	
1: 0	—	30·38	1,760	8,224	15·0	
5	—	30·38	1,810	10,034	15·5	
	—	30·38	1,835	11,869	15·6	
)	—	30·39	1,622	13,491	15·8	
	30·30″	30·38	825	14,316	16·0	
)	—	30·37	1,635	15,951	16·0	
4	—	30·38	1,635	17,586	16·4	
5	—	30.38	1,770	19,356	16·6	
5	—	30·39	1,632	20,988	16·4	
6	—	30·38	1,622	22,610	16·1	
6	—	30·37	1,616	24,226	15·7	
7	—	30·38	1,607	25,833	15·7	Defect of pressure in aspirator = 23·7mm.
	—	30·39	1,621	27,454	15·7	
8	30·29″	30·38	1,618	29,072	15·4	
e	30·36″	30·38	—	—	15·5	

Correction to temperature of bath as indicated by thermometer = −0·38° C.

Hence temperature of bath (reduced to hydrogen scale) = 30·00° C.

Mean barometric pressure during experiment = 30·36″ of mercury = 771·1 mm.

Defect of pressure from atmospheric in aspirator = 23·7 mm.

Pressue of saturated water vapour at 15·4° C. (calculated from Kaye and Laby's Tables, p. 40) = 13·1 mm.

∴ Partial pressure of coal-gas in aspirator = (771·1—23·7—13·1) mm. = 734·3 mm.

∴ Corrected volume of *dry* coal-gas aspirated at 30° C. and 760 mm. pressure =

$$29{,}072 \times \frac{734{\cdot}3}{760{\cdot}0} \times \frac{303{\cdot}0}{288{\cdot}5} = 29{,}490 \text{ c.c.}$$

Now for saturation with water vapour, assuming vapour pressure of water in coal-gas to be the same as saturation vapour pressure of water in air or "vacuo" * we find that to saturate 1 litre of *dry* coal-gas with water vapour at 30° C. and 760 mm. pressure requires

$$0{\cdot}03004 \times \frac{760{\cdot}0}{760{\cdot}0 — 31{\cdot}71} = 0{\cdot}03134 \text{ grm. of water.}†$$

In the present experiment water vapour carried per litre of *dry* coal-gas at 30° C. and 760 mm.

$$\text{pressure} = \frac{0{\cdot}9171}{29{\cdot}49} \text{ grm.} = 0{\cdot}03109 \text{ grm.}$$

Hence fraction of saturation with water vapour =

$$\frac{0{\cdot}03109}{0{\cdot}03134} = 0{\cdot}9920.$$

∴ Pressure of water vapour present at 30° C. = 31·71 × 0·9920 = 31·46 mm.

∴ Under conditions of present experiment we find that 1 litre of *dry* gas at 30° C. and 760 mm. pressure has a volume of

$$1 \times \frac{760{\cdot}0}{760{\cdot}0 — 31{\cdot}46} = 1{\cdot}043 \text{ litre}$$

when wet at 30° C. and under a total pressure of 760 mm. of mercury.

We have, then, naphthalene carried per litre of *wet* gas measured at 30° C. and under *total* pressure of 760 mm.

$$= \frac{0{\cdot}0243}{29{\cdot}49 \times 1{\cdot}043} = 0{\cdot}0007902 \text{ grm.}$$

Hence grains of naphthalene carried per 100 cubic feet of *wet* gas measured at 30° C. and under *total* pressure of 760 mm. = 0·0007902 × 43,680 = 34·5 grains.

The corrected volume of moist gas can also be calculated by the formula,

$$V + 6230 \frac{g_w t}{m_w p}$$

V being the volume of the dry gas employed, T the absolute temperature, g_w the number of grams of water evaporated, m_w the molecular weight of water, and P the pressure in cms. of mercury. The correction to V on account of the volume of the naphthalene vapour is negligible.

Results obtained using moist gas.

The vapour pressure of naphthalene in moist gas at any temperature is given by the formula

$$p = \frac{6230\, gT}{m\left(V - 6230 \frac{g_w t}{m_w p}\right)}$$

the suffix w referring to water vapour.

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* See Perman, *loc. cit.*

† Kaye and Laby's Tables, pp. 39—40, or can be calculated direct from Regnault's results.

In this manner the results contained in Table III. have been calculated, the corresponding values for dry gas being calculated at the corresponding temperatures by the formula (1). Table III. also gives the number of grains of naphthalene to saturate 100 cub. ft. of dry and moist coal gas respectively, the temperature being that of the experiment.

TABLE III.

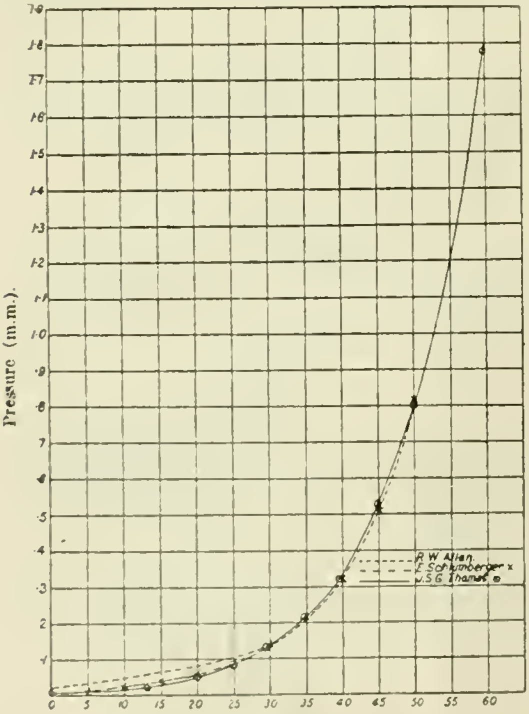
Temperature. °C.	Percentage of saturation with water vapour.	Vapour pressure of naphthalene (mm. of mercury).		Grams. of naphthalene to saturate 1 litre of gas at temperature of experiment and under 760 mm. total pressure.		Number of grains of naphthalene carried per 100 cb. ft. of coal gas measured at temperature of experiment and under total pressure of 760 mm.	
		Dry coal-gas.	Moist coal-gas.	Dry coal-gas.	Moist coal-gas.	Dry gas.	Moist gas.
0	—	0·0056	0·0017	0·0000421	0·0000126	1·85	0·55*
5	88·5	0·0101	0·0034	0·0000746	0·0000254	3·26	1·11
10	96·0	0·0176	0·0062	0·000128	000 00453	5·59	1·98
15	97·7	0·0301	0·0129	0·000215	0·0000920	9·39	4·02
20	98·2	0·0506	0·0260	0·000355	0·000182	15·5	7·93
25	92·4	0·0836	0·0471	0·000577	0·000325	25·2	14·2
30	99·2	0·136	0·116	0·000922	0·000780	40·3	34·5
35	95·9	0·218	0·222	0·00146	0·00148	63·6	64·7
40	91·9	0·343	0·355	0·00225	0·00233	98·5	101·9
45	87·4	0·533	0·532	0·00344	0·00343	150	150
50	99·0	0·816	0·907	0·00519	0·00577	227	252
55	98·3	1·23	1·35	0·00769	0·00847	336	370
60	100·0	1·84	2·04	0·0114	0·0126	497	552

* Extrapolated from curve.

The results given in the 7th and 8th columns above are represented diagrammatically in Fig. 4.

Discussion of results.

A consideration of Fig. 3 indicates that at temperatures above 30° C., the observations of Allen, Schlumberger, and the author of the present work are in practical agreement, what little differences exist being probably due to experimental error, as may be gathered from the fact that at 45° C. the value obtained by Schlumberger is less than the value obtained by the present author, the reverse being the case at 50° C.



Temperature (° C.).

FIG. 3.

Allen's values, however, are uniformly lower—though very little lower—than the values obtained in the present experiments between 30° C. and 50° C. The important parts of the curves relate to observations made at temperatures below 30° C. Here it will be seen that the values obtained by Allen are very considerably in excess of the values obtained by Schlumberger and myself, the values obtained by the two latter being in practical agreement. The difference between Allen's values and the values obtained by me cannot be ascribed entirely to experimental error. An examination of Allen's results shows a consistency of about 2% amongst individual results at any individual temperature. In seeking an explanation of the discrepancy three possible causes present themselves :—

(1) The possible presence in the naphthalene used by Allen of an impurity more volatile than naphthalene below 30° C. In the series of experiments by the present author, precaution was taken to remove any more volatile impurity by the prior aspiration of air at 65° C. for some hours over the naphthalene.

(2) The possibility that at temperatures below 30°C. the gas employed did not attain the temperature of the bath. Allen did not heat the gas t the temperature of the bath prior to its enterin the naphthalene tube. In Schlumberger's an the present author's experiments this precautio was taken. To see how far this might influenc the results obtained with the present apparatus experiments were performed at a temperature o about 15° C., the gas being in the one case pr heated and in the other not; the air temperatur was 21·7°C. A difference of, roughly, 2% wa obtained, the preheated gas giving the high result. The possibility of the atmospheric temperature in Auckland, N.Z., being higher than i London was taken into consideration by heatin the gas to 35° C. by means of a water jack prior to its entering the naphthalene tube, whic was at about 15° C. In this case, likewise, th difference found was within 2%. A knowled of the dimensions of Allen's apparatus would h one to realise more exactly the experiment conditions of his work. It is possible that le time was allowed the gas to attain the temperatu

of the bath than was the case in the experiments here cited.

(3) A third explanation may consist in the possible polymorphism of the naphthalene at temperatures below 30° C. This explanation was suggested to the author by Professor H. E. Armstrong.

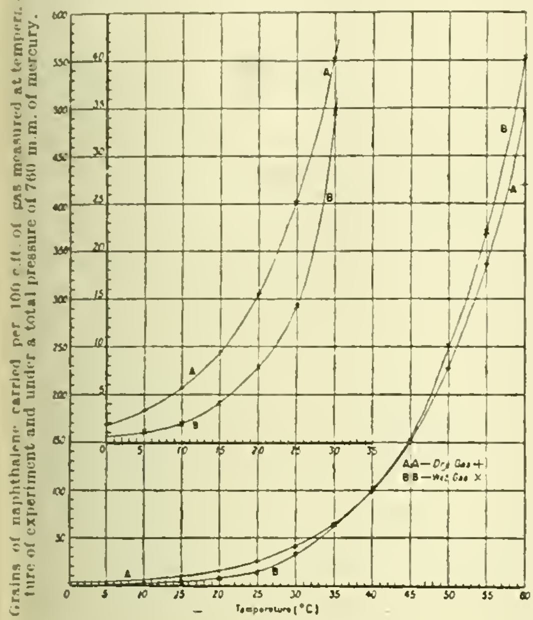


FIG. 4.

Passing to the results exhibited graphically in Fig. 4, it will be seen that over the range from 0° C. to 35° C. the saturation naphthalene content of moist coal-gas is less than the saturation naphthalene content of dry coal-gas, while above 35° C. the reverse is the case. Over the range from 0° C. to 35° C. it will be observed that with ascending temperature the ratio of the saturation naphthalene content of moist coal-gas to the saturation naphthalene content of dry coal-gas approaches continuously more nearly to a ratio of equality.

The important range of temperature from the point of view of gas distribution in connection with the present matter is that from 0° to 30° C. It must be remembered that in the present experiments the moist coal-gas passes over finely-powdered naphthalene. The interstices between the various small particles of naphthalene are substantially fine capillary tubes. Under these conditions, condensation of water vapour on the naphthalene can occur although the gas is not saturated with water vapour. This is an immediate deduction from a result first given by Lord Kelvin showing that the vapour pressure in equilibrium with a concave liquid surface is smaller than that on the plane surface. If we have n exceedingly fine capillary tube of radius 0^{-6} mm., then the equilibrium vapour pressure n such a tube for water vapour is about half that at a plane surface. It is quite possible that the fine lamination of the naphthalene may produce series of fine interstices producing condensation of water vapour upon the naphthalene. A further possible cause of deposition of water vapour afforded by the phenomenon of adsorption. t is hoped to return to this matter in a later treatment of the subject of the evaporation of naphthalene in different media. The possibility this condensation of water vapour upon the naphthalene renders it imperative that the naphthalene in the quantitative investigation of its evaporation has reached a steady state so far as its "wetness" is concerned before a weighing is made. Carrying out the experiment in this manner, the total decrease in weight of the tubes containing naphthalene may be larger than the decrease due to evaporation of naphthalene alone, owing to the possible removal of some of the deposited film of moisture. At the higher temperature employed in this research, results obtained without previous passage of the moist gas agreed within limits of experimental error with results obtained when moist gas was aspirated prior to the initial weight of tube being determined. Over the range from 5 to 30° C., consistent results could not be obtained without prior aspiration of moist gas. It must be remembered that the total quantity of moisture deposited is probably very small. A film of the order of 10^{-8} cm. in thickness would be sufficient for the purposes of the present argument. Any possible removal of moisture along with the naphthalene would under these circumstances be less than the experimental error of the method. In one experiment carried out at 17·3° C. it was found that starting with dry naphthalene an *increase* of weight amounting to 0·0009 grm. was obtained after the passage of 1016 c.c. of coal-gas.

So far as experimental evidence is available in the present case, there is reason to believe that this deposition effect is the more prominent the lower the temperature. Apart from any such possible evidence, however, theoretical considerations indicate that the deposition effect should *increase* with *decrease* of temperature.

One can easily establish, as was first shown by Lord Kelvin, that the vapour pressure ρ' at the liquid surface in the capillary is very approximately related to the vapour pressure p at the plane surface by the following equation :—

$$(p-p'=\frac{2\sigma}{a}\,\frac{\rho'}{\rho-\rho'}\ldots\ldots\ldots\ldots\ldots\ (1)$$

where σ is the surface tension of the liquid, a the radius of the capillary, and is positive in the present case, ρ' the density of the vapour, and ρ that of the liquid.

Neglecting ρ' compared with ρ, we can express this difference of vapour pressure by the approximate relation :—

$$P=\frac{2\sigma}{a}\,\frac{\rho'}{\rho}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The variation of this difference of pressure P with temperatures is given by

$$\frac{dP}{d\theta}=P\left\{\frac{1}{\rho'}\frac{d\rho'}{d\theta}+\frac{1}{\sigma}\frac{d\sigma}{d\theta}-\frac{1}{\rho}\frac{d\rho}{d\theta}-\frac{1}{a}\frac{da}{d\theta}\right\}\ldots(3)$$

An examination of the terms on the right hand side, bearing in mind that ρ' is small compared with ρ, that $\frac{d\rho'}{d\theta}$ is large compared with $\frac{d\rho}{d\theta}$ shows that the expression $\frac{1}{\rho}\frac{d\rho}{d\theta}$ is negligible, and we may write :—

$$\frac{dP}{d\theta}=P\left\{\frac{1}{\rho'}\frac{d\rho'}{d\theta}+\frac{1}{\sigma}\frac{d\sigma}{d\theta}-\frac{1}{a}\frac{da}{d\theta}\right\}\ \ldots.\ (4)$$

Compared with $\frac{1}{\rho'}\frac{d\rho'}{d\theta}$, $\frac{1}{\sigma}\frac{d\sigma}{d\theta}$ and $\frac{1}{a}\frac{da}{d\theta}$ are negligible, but the terms can be retained for our present purposes. Their neglect in no way invalidates the present argument.

Of the terms on the right hand side of equation (4), $\frac{d\rho'}{d\theta}$ and $\frac{d\sigma}{d\theta}$ are negative, while $\frac{da}{d\theta}$ is positive. It follows immediately, therefore, that $\frac{dP}{d\theta}$ is negative, *i.e.*, that the difference between the pressure at the plane surface and the pressure at the curved surface in the capillary diminishes with increase of temperature, *i.e.*, condensation to a smaller and smaller amount will occur with increase of temperature.

Apart from this consideration, assuming that an equal amount of condensation occurs at all temperatures below 30° C., we then have the particles of naphthalene surrounded by a "skin" of water of constant amount. Before evaporation of the naphthalene molecules into the gas can occur, the molecules must pass through this "skin" of water or other liquid. The velocities of all the naphthalene molecules at any given temperature are by no means equal, but various velocities are distributed "at random" amongst the molecules, the distribution being determined approximately according to the law of errors. The average velocity of the naphthalene molecules diminishes with decrease of temperature, and it is evident that with decrease of temperature, more and more molecules of naphthalene must therefore fail to pass through the protecting layer of water. The inhibiting effect of water will, therefore, be more pronounced with decrease in temperature on this account, and the effect will be increased on account of the considerations advanced above, where it is shown that the condensation of water vapour increases with decrease of temperature.

The necessity for allowing the gas to pass over the naphthalene for some considerable while before taking the initial weighing should now, I think, be evident. Provided condensation of water vapour upon the naphthalene has reached its steady value—and this, in general, is not attained until the expiration of some hours—then, within the limit of experimental error, the quantity of naphthalene evaporating into a definite volume of gas at a fixed temperature should be found, by calculation from the experimental data, to be independent of the volume of gas aspirated. This provides a method of determining whether "steady" conditions so far as condensation of water vapour have been attained, the time necessary for the actual determination of the saturation value being thereby lengthened, particularly at the lower temperatures.

Sufficient has now been brought forward to explain why between 0° C. and 35° C. the saturation naphthalene content of moist coal-gas is found to be less than that of the dry gas. The theory developed above indicates that the inhibiting influence of the water diminishes progressively with rise of temperature. If one makes the assumption that in the absence of this inhibiting effect of the condensed water—it is difficult to realise experimental conditions enabling us to test this assumption—the saturation naphthalene content of moist coal-gas is actually larger than that of the dry gas, then, I think, one can explain the form of the curve for moist gas throughout the range from 0° C. to 60° C. The inhibiting effect of the condensed water becomes paramount below 35° C, and the assumed greater evaporation is thereby changed into an actual deficit.

In conclusion, it should be mentioned that the results contained in the present paper must be applied with caution in any possible physical application for the removal of naphthalene from coal-gas. Theoretically, removal of the water vapour from moist coal-gas at 15° C., say, should leave the gas unsaturated, and one would expect about 5 grains of naphthalene per 100 cb. ft. of gas to evaporate to produce saturation of the dry gas. The drying of the gas would leave any deposit of naphthalene already existent in any of the mains, etc., still with its "skin" of water, and this being removable—if at all—only with extreme difficulty would prevent any very considerable further evaporation of naphthalene. Again, there are experimental results indicating that the process of adsorption is an essentially irreversible one. If, then, adsorption plays any considerable part in the phenomena of the evaporation and condensation of naphthalene from moist gas, results obtained by evaporation methods are inapplicable to the case of condensation. The problem of naphthalene condensation requires separate investigation.

The above experiments were carried out at the Physical Laboratory of the South Metropolitan Gas Company, and the author desires to express his thanks for the provision of facilities for carrying out the work, and to Dr. Carpenter for his continued interest in the investigation.

APPENDIX I.

Table giving experimental data for the calculation of results given in Table III. (moist gas).

Temperature of bath (corrected).	Water evaporated.	Naphthalene evaporated.	Volume of gas aspirated (moist) and uncorrected.	Mean temperature of aspirator.	Final temperature of aspirator.	Atmospheric pressure.	Defect of pressure in aspirator.	Remarks.
°C.	Grm.	Grm.	c.c.	°C.	°C.	Ins.	mm.	
5·00	0·4089	0·0017	16,321 16,350 17,184 17,773 6,420	15·7 16·1 15·9 15·8 16·2	16·0 17·0 16·7 16·2 16·8	29·99 29·73 29·62 29·96 29·37	32·2 33·5 33·5 44·1 46·0	Air
10·00	0·6314	0·0032	13·432 15·025 16,119 17,074 13,493	16·1 17·2 16·4 18·2 16·0	17·2 17·8 17·2 19·0 16·0	30·50 30·13 30·10 29·52 29·22	23·0 24·2 24·2 24·5 25·4	Coal-gas
15·00	0·7178	0·0054	14·281 16,030 16,363 14,578	15·7 16·8 17·0 18·5	16·0 17·0 18·7 18·4	29·94 29·97 30·00 30·13	24·5 25·2 24·0 24·0	Coal-gas
20·00	0·6849	0·0074	13,486 16,436 11,478	18·3 18·2 18·0	18·7 18·9 18·0	30·30 30·19 29·82	23·5 19·5 22·5	Coal-gas
25·00	0·6886	0·0106	16,704 15,908	17·9 19·2	19·0 20·6	30·29 30·08	24·0 20·6	Coal-gas
30·00	0·9171	0·0236	29,072	15·5	15·4	30·36	23·7	Coal-gas
35·00	1·1746	0·0462	14,165 15,206	17·1 17·2	17·2 17·0	29·87 29·64	20·0 22·5	Coal-gas
40·00	1·5452	0·0704	13,268 13,819	15·6 14·7	15·5 14·6	30·21 29·98	24·5 23·2	Coal-gas
45·00	1·4782	0·0883	13·231 9,889	18·3 19·0	19·2 19·6	29·82 29·32	24·5 23·0	Coal-gas
50·00	1·1530	0·0814	11,629	17·8	18·5	30·37	24·8	Coal-gas
55·00	1·4387	0·1193	11,039	17·0	17·8	30·28	21·2	Coal-gas
60·00	1·8766	0·1828	10,852	17·8	18·4	30·30	24·1	Coal-gas

Discussion.

Dr. **Charles Carpenter** said that the suppliers of town gas had two bugbears to contend with—one being the sulphur impurity, and the other the naphthalene impurity, which caused trouble, especially in winter, by crystallising in the service pipes. As an example of the empirical way of doing things, at one time the gas engineer encouraged the hope of carrying the naphthalene vapour in the gas. He was led to that idea by the light-giving value of naphthalene in the form of "candles," used in the albo-carbon light. The curious thing was that the calorific value and light-giving value calculated from an amount of naphthalene sufficient to produce a bad stoppage in a service pipe, would be found negligible. The paper dealt with the bases on which they had hitherto been relying in the experimental work of Allen. From the 5th Table it would be seen that the figure given by Allen was something like double the figure given by Schlumberger and confirmed by the author. When he was considering the question of naphthalene removal, he came to the conclusion, basing his belief on the figures of Allen, that if the naphthalene content could be reduced to something like 10 grains per 100 cubic feet, they would be immune from trouble in the distribution of gas. The naphthalene had been kept below that; but the trouble did not diminish. One of the gas-making works was connected with a gasholder by a main about two miles long, and during a whole year the gas entering the main was free from naphthalene, while the average content of naphthalene leaving the main was something like 7 or 8 grains. This went on for a second year and was absolutely inexplicable on Allen's figures. If the naphthalene content were 10 grains at 14° to 15° C., they would not have a horizontal line, but a falling one as the naphthalene in the main was gradually absorbed. It seemed, therefore, as if the explanation of their difficulties was that Allen's figures were too high. The author had by his most valuable and interesting experiments, proved that the amount of naphthalene carried was something like one half the amount that they were led to expect. He thought it was an excellent example of the importance of scientific research in getting at the bottom of industrial difficulties, and the practical result of Mr. Thomas's work was that they had to take as their standard not the figure of 10 or 12 grains, but something like 2 or 3, in order to be safe.

Mr. **W. J. A. Butterfield** asked whether, when 100 cubic feet of moist gas was spoken of, it meant 100 cubic feet of dry gas plus one or two per cent. of water vapour, or 100 cubic feet of gas including water vapour.

Mr. **Thomas**, in reply, said that 100 cubic feet of moist gas meant that the total volume of gas and its water vapour content was 100 cubic feet. The tables in the paper should be interpreted in this manner so far as the expression "100 cubic feet of moist gas" is concerned.

New York Section.

Meeting held at Rumford Hall, Chemists' Building, on Friday, March 24th, 1916.

DR. W. M. GROSVENOR IN THE CHAIR.

THE DEVELOPMENT OF LOW EXPANSION GLASSES.

BY E. C. SULLIVAN.

A low thermal expansion coefficient in glass is useful mainly because it carries with it the property of withstanding sudden heating and cooling without fracture. The expansion is one of six factors which determine the ability of the glass to resist such treatment.[*] The coefficient of thermal endurance is proportional directly to the tensile strength and to the square root of the heat conductivity, and inversely to the expansion coefficient and to the modulus of elasticity and to the square roots of the specific gravity and of the specific heat. Thanks to the pioneer work of Otto Schott, of Jena, we know that the expansion can be varied over a very wide range. Disregarding quartz glass and speaking only of glasses which can be melted and worked by the usual methods, the expansion of glass now can be varied in the ratio of six or seven or more to one. There is no reason to think that any such range is possible with respect to the other properties mentioned.

Ordinary lead glass has a linear expansion coefficient of 0·0000092, while lime glass is somewhat higher. Glasses are made without difficulty having expansion as high as 0·000013 or 0·000014, copper by way of comparison being 0·0000175, iron 0·000013. Going down the scale from lead glass we find the Jena "Normal" thermometer glass 16‴ at 0·0000085, and Jena borosilicate thermometer glass 59‴ at 0·0000064. The well-known brands of laboratory ware are made of glass having expansion from 0·0000055 to 0·0000075. A glass recently developed in America, which is finding some application for laboratory ware and for culinary utensils, although the bulk of it goes into battery jars and lantern globes for railroad purposes, has expansion 0·0000032.[†] This expansion is practically the same as that of the best porcelain, and the glass makes a satisfactory permanent seal with porcelain. Quartz glass has expansion 0·0000006 to 0·0000007.

The glass maker who endeavours to reduce the expansion of his glass soon encounters the serious difficulty that as expansion decreases, fluidity is likely to decrease also. The glass of low expansion tends to become very stiff at the ordinary glass-melting temperature. This is obviated to some extent by the use of boric oxide, but this has its limitations not only because the expansion of the glass passes through a minimum and begins to increase again as the amount of boric oxide is increased, but also because boric oxide, used in large quantities, affects the stability of the glass very seriously. One successful low expansion glass containing an unusual percentage of boric oxide was slowly but completely soluble in water. Jars of this glass ⅛ in. thick filled with water went to pieces in two or three months, while acid ate through them in a few days. And yet the glass was perfectly satisfactory for certain service and hundreds of tons of it were used.

Two glasses of equally low expansion will not, however, in general have precisely equal viscosities, and it is by taking advantage of slight differences in viscosity when the expansions are alike that the most favourable relation between expansion and fusibility is worked out step by step.

The expansion is measured by the method of Holborn and Day in a water-jacketed electric furnace consisting of a horizontal porcelain tube wound with resistance wire. Within the tube is supported horizontally a rod of the glass to be measured, about 3 mm. diameter and 25 cm. long and pointed at each end. Directly beneath the pointed ends of the rod are vertical openings in the bottom of the furnace through which, by means of totally-reflecting prisms, small telescopes can be sighted on the points. Cross hairs and a micrometer screw on each telescope fix the position of the extremities of the rod and so its length.

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[*] Winkelmann and Schott, Ann. Phys. Chem., 1894, 51, 730.

[†] Sullivan and Taylor, Jour. Ind. Eng. Chem., 1915, 7, 1064.

The temperature of the furnace when cold is determined by means of a thermometer thrust into the end of the pocelain tube, and when hot by means of platinum-platinum rhodium thermocouples which extend half the length of the tube. The temperature is carried usually to 350° or 400° C. and the expansion coefficient as determined is accurate to a few tenths per cent., which is adequate for the purpose.

A more direct comparison of coefficients of thermal endurance, which requires less time than the expansion measurement, is made by heating eight or ten pieces of glass rod in a vertical electric furnace to a definite temperature and then dropping the rods all at once into water by removal of the supporting asbestos slide. The temperature at which 50% of the rods fracture is a figure which, for purposes of comparison, represents the coefficient of thermal endurance of the glass in question.

The softening temperature is measured by a method similar to that described by Dr. Schaller of the Jena laboratory.* A thread of glass approximately 1 mm. in diameter and 23 cm. long is suspended vertically through a small electric furnace in such a way that the thread is heated through the upper 9 cm. of its length. The temperature is raised and noted at short intervals, and as the thread elongates by its own weight the movement of the lower end is read off on a scale and plotted against the time. The moment at which the thread was elongating at the rate of 1 mm. per minute is read from the curve at a glance and the temperature of the upper part of the thread at that moment is taken as the softening point of the glass. This is, of course, an arbitrary point. This method gives the viscosity at low temperatures and is useful in determining the sealing qualities of a glass. It does not, however, give so much information as one would like regarding the viscosity at high temperatures, which goes far towards determining the ease of melting. Behavior when worked in a hot flame gives some indication on this point.

The "workability" of a glass depends on its freedom from tendency to crystallise, on its viscosity curve, and on its surface tension. The glasses which are most satisfactory in the hands of the glassworker are those which remain pasty through an extended range of temperature. It is this possession of a viscosity curve which is low at comparatively low temperatures and yet does not decrease rapidly as the temperature rises, which gives lead glass its advantage in the construction of electric incandescence lamps and other apparatus. The lead glass, after being sealed to wire or other glass, as it cools remains soft to a low temperature and thus can yield to stresses caused by uneven cooling or unequal expansions and can cool without strain.

Lime glass is more like a crystalline substance which remains rigid until a definite temperature (its melting point) is reached, when it at once becomes very fluid. The viscosity curves of such glasses cross, and the lead glass, which is softer, that is, less viscous than the lime glass at low temperatures, is harder or more viscous at high temperatures. This is easily shown in the pull test, which is a simple method used by the glassworker for comparing the working qualities of glasses. The two glasses in cane or tube of the same diameter are sealed together and heated as nearly alike as possible, and are then removed from the flame and slowly pulled out a few inches, the joint being first slightly blown up in the case of tube. The harder glass will have greater diameter at the joint than the softer after pulling out. This is a sensitive and very useful method for checking up the uniformity of different lots of glass. In this test, as already indicated, the result in the case of glasses which differ widely in composition may depend on the temperature of pulling. A lead glass which appears softer than a lime glass at low temperatures, may prove to be harder than the same lime glass if the test is made quickly when the glasses are very hot.

Tensile strength and elasticity are measured by ordinary methods.

The tendency to crystallise is determined by a method described by Schaller.* A number of small crucibles containing the glass under investigation are maintained for a definite time at a low temperature favourable to crystallisation, and the proportion of cases in which crystallisation begins is taken as a measure of the tendency of the glass to devitrify.

Resistance to attack by reagents is most accurately measured by forming beakers of the glass and subjecting them to the solvent action of distilled water on the steam-bath. The temperature thus attained is about 80° C and the usual time is 48 hours. The solution is evaporated in a small platinum dish and the residue weighed. Non-volatile matter in the water used is determined and allowed for. Titration of the alkali dissolved instead of weighing is sometimes permissible, but should be employed only for the comparison of similar glasses, as the assumption is not always warranted that the alkali found is proportional to the total amount dissolved.

On the other hand, neither the alkali nor the total solids dissolved from the glass will in all cases answer as index to the serviceability, for the reason that some glasses leave a more opaque residue on dissolving than others do. The glass which is less soluble may become more cloudy when attacked by reagents than that which is more soluble. For comparison in this respect we find a steam digester useful with pressure at about 100 lb.

A rapid method which has been very satisfactory consists in enclosing a short length of glass rod with 10 c.c. of distilled water in a steel tube provided with screw cap and maintaining at a temperature of 180° C. for two hours. The alkali in the water is then titrated. Eight or ten of these tubes are run at one time.

An unexpected result when the glass baking dishes were put into service was the fact that baking took place more rapidly in them than in dishes of the ordinary materials. Investigation developed a sufficient reason for the phenomenon, but the fact was nevertheless very surprising. Metal reflects, according to various authorities, from 83 to 99% of the radiant heat which strikes it, while glass reflects only 3 to 14%. That radiation and not convection or conduction is the preponderant factor in baking was established by the following experiment.

The reflectivity of a glass baking dish was changed in part from that of glass to that of metal by silvering in a thin film on the outer surface in alternate quarters. A cake was baked in it in an ordinary kitchen oven heated by a gas flame. Where the cake had been protected by the metal coating the bottom after baking was light-coloured, sticky, and imperfectly baked, while in the other quarters it was brown and well-done. As the cake was turned out bottom up the quartering was plainly visible on it.

That bread bakes faster in glass was shown by baking equal quantities of dough in two glass bread pans and two tinned iron pans of the same internal dimensions. The metal pans had been in service for some time and their outer surfaces were somewhat tarnished. The pans were placed in the oven of a gas stove, the two glass pans diagonally opposite each other and the metal pans diagonally opposite each other. All four were left in the oven the same length of time. When taken out of the oven the crust in contact with the glass was browner than the corresponding portions of the crust in the metal pans. The bread in the glass had risen higher than that in the metal. On cutting the loaves the bread in the glass pans was found to be more thoroughly baked than that in the metal pans. This experiment was repeated with the same result.

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* Abegg, Handb. d. anorg. Chem., 3 Bd., 2 Abt., p. 373 (1909).

* *Loc. cit.*

A more accurate comparison of the rates of heating in various materials was obtained by placing the dishes containing one litre of water on the shelf in the oven for a definite time and noting the temperatures reached by the water. The determinations are given in Table 1.

TABLE 1.

Rates of heating water in various materials.

Test No.	Thin glass.	Alu-minum.	Tin.	Enamelled earthen-ware.	Thick glass.
1	90° 91°	78°	—	—	—
2	88 86	—	73 °	—	86°
3	89 89·5	—	73°	83	—
4	89 89	—	—	—	—
5	94 —	78°	74°	81	86
6	88 —	—	—	—	—
Average .	89·4	78°	73·3°	82	86

The resistance of the glassware to fracture by blow was compared with that of crockery (" china ") and enamelled earthenware by dropping a 350-grm. weight from increasing heights on the bottoms of inverted dishes of approximately the same shape.

TABLE II.

Resistance to fracture by blow.

Dishes tested.	Thickness of bottom.	Result.
Glass :		
2-quart	4·8 mm.	Cracked at 22 in.
2-quart	5·8 mm.	Not broken in 34 in.
1-quart	4·9 mm.	Cracked at 26 in.
1-quart	4·3 mm.	Cracked at 22 in.
Enamelled earthenware :		
German, 2-quart	5·4 mm.	Cracked at 6 in.
Domestic, 2-quart	8·1 mm.	Crazed at 8 in. Shattered at 18in.
German, 1-quart	5·6 mm.	Cracked at 14 in.
Crockery :		
New Jersey	6·20 mm.	Broke at 16 in.
Domestic ..	4·27 mm.	Broke at 10 in.
English	5·62 mm.	Broke at 12 in.
German	2·76 mm.	Broke at 4 in.

THE AMERICAN PRESSED AND BLOWN GLASS TABLEWARE INDUSTRY.

BY SAMUEL R. SCHOLES, PH.D.

One of the highest applications of the art of glass making is found in the production of the finer grades of tableware. Among all the varied uses to which glass is put there is none requiring so much care in the selection of materials, control of colour, lustre and uniformity in the glass itself, nor involving so much skill in the designing and producing of shapes and decorations. It may be truthfully said that the art of glass making has far outrun the science, and in many cases facts long ago discovered by the glassblower are still awaiting a suitable scientific explanation; many of the difficulties encountered in the various processes involved have not been successfully met by the application of engineering or chemical knowledge.

Historically, the manufacture of flint glass, as it was then designated, was located at an early date in Western Pennsylvania. The first experimental factory west of the Alleghenies was a window-glass furnace built in 1800. The glass industry of Pittsburgh dates from 1808. The first lead furnace in the United States was built by Deming Jarvis, of the New England Glass Works at East Cambridge, in 1818, and was devoted to the manufacture of lead oxides for glass. Owing to the abundance of fuel, especially natural gas, Western Pennsylvania, West Virginia, Ohio, and Indiana are the leading States in glass manufacture. In 1815 the manufacture of hollow ware of various sorts was begun at Wellsburgh, West Virginia, and in 1831 at Wheeling. The use of a press with a mould and plunger, worked by a lever, is due to American ingenuity, as is also the development of automatic machinery of various sorts, culminating in the truly remarkable Owens machine for bottles and jars. The present paper deals only with hand work, which is necessary for the production of the better grades of tableware.

Technology of the industry.

The pots in which the glass is melted are built by hand from carefully selected clays. The clay body is composed of approximately two-fifths raw clay and three-fifths burnt clay and material from old pots which has been ground to small particles. This mixture is built up, layer by layer, into a pot which is left to dry for several weeks and is then brought to the glass factory in the raw state. The pot is first placed in an oven called a pot arch, where it is slowly raised to a bright red heat during about three days. The pot is then set, while hot, in its place in the furnace, replacing one which it has been necessary to remove for any cause. This cause may be breaking or the prolonged effect of corrosion by the glass and glass batch. The furnaces generally used are of the ordinary type, round or oval, and contain usually about fourteen pots. The temperature attained in the furnace itself lies between 1300° and 1500° C., and in the pot rather lower, depending on conditions, whether it is filled with batch that is being melted, is being worked out, or is standing empty and ready to be refilled. Thus, the pots are not only subject to an extreme heat, but also to expansion and contraction, due to changes of temperature. The problem of a suitable glass pot is therefore a difficult one, and one which may be said to have met with only an approximate solution.

The materials for making the glass, of which more will be said later, are weighed out with considerable accuracy in batches, based usually on 1000 lb. of sand. The batch is then carefully mixed to as great uniformity as possible, either in a machine like a concrete mixer or in boxes by means of hoes in the hands of workmen. Upon being brought to the furnace floor, the batch, together with a quantity of cullet or refuse glass left over from making ware, is charged into the pot, which is then tightly stoppered. After about 12 hours, the loose batch is fused down, leaving a considerable space in the pot, so that it is usually topped, that is, more batch and cullet are added; thus the pot may be completely filled when the melt is finished. This requires from 12 to 24 hours longer, depending on the nature of the glass and the temperature of the furnace. When it is found that the glass is clear and ready to work, the pot is opened, the glass cools to about 800°—1000° C., the upper surface is skimmed off to remove undissolved impurities, and it is ready for the workmen.

Pressed ware.

In making a piece of pressed ware, the glass is gathered on the end of an iron rod, somewhat as one would gather honey on a fork, the ball of glass is swung out over the mould and allowed to drop into it, cut off by a pair of shears and the plunger brought down, squeezing the glass into all parts of the mould. Great accuracy is shown here by the presser, who cuts off the glass and is able to regulate the weight of glass cut off within a very small quantity. The gatherer, meanwhile, cuts off, on an iron plate with a sharp flange, the glass remaining on his gathering rod, or punty, dropping it into water, so that it disintegrates, ready to be mixed with the batch in another melt.

While the pressed article is still hot, it is placed beneath a blast burner and fire-polished. This invention* is owned by the H. C. Fry Glass Company and is decidedly advantageous, especially in the production of blanks for cutting. The older methods of making cut glass necessitated plain blanks, which have a fire-polished surface on the inside. It was almost impossible to polish the inside of pressed ware by the use of fine abrasives, but this invention produces a perfect polish without further treatment. The pressed piece of ware is turned out of the mould, examined for imperfections, and, if found satisfactory, is carried at once to the annealing lehr, through which it rides, gradually cooling for about 12 hours from a temperature of 300° to 400° C., to ordinary room temperature at the far end.

The annealing lehr consists of a long oven about 5 feet wide, high enough to accommodate the tallest pieces of ware, and about 60 feet in length. This oven is fired from beneath at the furnace end, and the stack is placed about one-third the way down the lehr. From this point the temperature of the lehr falls continuously and gradually, so that the glass is held at a temperature sufficient to relieve strains for several hours. On its removal from the lehr, the ware is carefully examined, piece by piece, for defects. These may be small bubbles in the glass, which are called "seeds" or "blisters," according to their size; pieces of unmelted material, arising either from the pot or the batch, known as "stones" and "cords," veins or streaks, which are similar to those observed when strong hydrochloric acid is poured into water, and indicating imperfect mixture of silicates, especially those of alumina. Other faults arise in the workmanship, such as imperfect shapes and weights, cracks and other minor defects, due to faulty handling. The faulty pieces are thrown out to be broken up as cullet and remelted, and the selected ware, usually about 90% of that leaving the workmen's hands, is ready for further treatment. In the case of blanks for cutting, another annealing is necessary, since the cutting process is very apt to cause breakage where there are strains remaining in the glass. The ware is, therefore, placed in kilns, usually about 10 ft. long by 5 ft. wide by 8 ft. high. These are supplied with iron shelves, so that they can be more or less completely filled with ware. The kilns are fired from beneath, and the fuel gases are carefully excluded from the interior to avoid what is commonly referred to as "sulphuring" or "smoking," amounting to a reduction of lead on the surface of the ware, giving it a yellow or gray appearance. The kilns are brought to their full temperature, which, in the case of lead glass, is usually about 350° C., in about six hours. They are held at this temperature for a short time, depending usually upon the strength of colour remaining to be removed, and are then allowed to cool for about twelve hours longer. By this time, the ware is tempered or annealed, so that it will not fly when subjected to the cutting wheel.

Cutting and polishing. Most cut glass is now manufactured from pressed figured blanks; that is, the figure which finally appears in the ware is stamped into the glass by the mould. When the ware reaches the cutting shop, the glass cutter has only to follow the design as it is marked in the piece, deepening the cuts and sharpening the edges. If, however, the cutter is working upon a blown blank, or what is known as a plain pressed blank, the design is sketched on the ware by means of a narrow brush dipped in ordinary red lead paint, and the first operation, known as roughing, marks out the deep, first cuts on the piece. The first cutting, or roughing, as it is called, is done by means of a steel wheel with a bevelled rim revolving at a moderate speed. A small hopper, full of sand and water, hangs over the wheel and a slow drip of this wet sand on the surface of the steel supplies the necessary abrasive. Following this roughing or, in the case of the figured blank, as a first operation, a stone wheel is employed. This smooths the cuts in the glass, sharpens the edges of the latter, and needs to be followed only by a felt wheel, coated with wet whiting, as the third operation. Originally, all the cut glass was completely finished on the felt wheel or buffer. Now, however, it has been found possible to take the ware as it leaves the finisher's stone, protect the fire-polished interior with resisting waxes, and dip the piece in a mixture of hydrofluoric and sulphuric acids. This dissolves a very fine layer from the surface of the glass, especially where the grinding has taken place, and leaves a smooth polished surface. In the manufacture of the finest cut ware, we still find it necessary to follow this acid dip with further buffing, to make a more perfect surface. There is, again, a careful examination and selection of the ware, and any defects in the cutting or polishing are indicated by suitable marks, the pieces being then returned to the shop for final treatment. The cut glass is finally finished, ready for sale.

Blown ware.

A thinner and lighter variety of tableware, which lends itself very readily to decoration by means of acid etching, is formed by blowing the glass in what are known as paste moulds. In this work, a shop, or group of workmen, usually consists of a gathering boy, a blower, a cracking-off boy, and a carrying-in boy. The pipes used are about 4 feet in length, one end being tapered to a suitable mouth-piece, the other made from $\frac{3}{4}$ inch to 2 inches in diameter, depending upon the size of the article to be blown. The hole through the pipe is about $\frac{5}{16}$ inch in diameter. A number of these pipes are used by a shop in rotation, so that the one in the hands of the gathering boy may be sufficiently hot to cling to the surface of the glass and yet not so hot that the cracking-off boy has difficulty in cleaning the pipe or that it becomes too hot to handle.

The gathering boy thrusts the pipe lightly into the surface of the glass in the pot, turns it rather rapidly a few times and quickly withdraws it, bringing out a small ball of pasty glass. He then blows a small bubble into this ball, and shapes the glass in a wooden block carrying a hemispherical depression and lying submerged in water; this treatment smooths the surface and aids in the even distribution of the glass. The gathering boy next rolls the glass into a conical shape on an iron plate, then blows the ball somewhat larger and passes the pipe to the blower, who stands on a platform, known as a dummy, mounted on a small tank of water. By shifting his position on the dummy, the blower can cause to rise out of the water an iron mould which is lined with what is known as paste. This paste is a mixture of pitch, waxes, charcoal, and sawdust, painted on the inside of the mould while in a melted state, and then baked so as to carbonise the entire lining. The blower deftly hangs the ball of glass in the open mould ; then, by stepping on a small lever, closes the two halves of the mould tightly and blows gently at first, turning the pipe between his hands, so as to avoid showing the marks from the mould. Gradually the glass is blown up to fill the mould completely and the lever is then released, the mould opens, and the bottle on the end of the pipe is swung out and passed to the cracking-off boy. The mould is then allowed to sink into the water to be cooled, ready for the next bottle. The cracking-off boy makes a scratch on the neck of the bottle and gives the pipe a slight jar, cracking off the piece of ware, which he then picks up with iron tongs on a small stick and places in an iron box, arranged to be kept hot until perhaps fifty pieces have been laid in it, when it is carried to the lehr.

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* U.S. Patent.

When a piece of stem-ware is being made, the blower, if he is making a pull-out stem, is provided with the familiar bench of the off-hand glass worker. This is like a broad-seated armchair with its arms shod with iron, upon which the pipe can be rolled with the left hand, while the blower manipulates the glass with tongs held in his right. This acts in effect like a lathe. The gathering boy has left a rather thick bottom on the ball of glass ; by seizing this with his forceps and pulling gently as he rotates the pipe, the blower is able to pull out a solid stem at the end of the blown ball. When this has reached the proper dimensions, he stands up on the dummy and the piece is blown as in the case of the tumbler.

The next process is that of foot-setting. For this work, another gathering boy is employed, who gathers a small ball of glass on a punty, and the pipe holding the goblet is passed to a foot-setter, who stands the pipe on end, mouthpiece down, and, seizing the gathering boy's punty in a pair of shears, sets the ball of glass carefully on the stem of the goblet, turns it up and cuts off the excess glass. Then, by means of wooden paddles and a tool, called a clapper, similar to the covers of a book, from one of which a piece has been cut to admit the stem of the goblet, he turns a circular foot on the goblet, rotating the pipe on the arm of the work bench. The pipe is next passed to a foot finisher, who, with a smaller tool, completes the shaping and flattening of the foot. He then wets the glass slightly near the end of the pipe and cracks the piece off, placing it by means of tongs in a fork to be placed in the ehr.

Many shapes that were formerly made off-hand —that is, were blown and shaped by the workman with no other guide than his eye and a pair of alipers—are now blown in these paste moulds. This includes jugs and vases, and even the larger izes.

The operation of putting handles on jugs and ishes of various sorts is a very interesting one. After a jug, for example, has been blown, a hot unty is stuck in the bottom of the jug, and, by udiciously wetting the glass near his pipe, the lower is enabled to crack it off and leave the jug tached to the punty in the hands of his helper. The helper then carries the jug to a glory hole, here he " warms " it in to heat the top sufficiently permit its shearing and finishing. The glory ole may be easily recognised from its name. is a circular furnace in which a blast of gas, with small excess of air to avoid a reducing flame, blown from the bottom against a refractory own, and finally issues through holes about or 8 inches in diameter at intervals around e side walls. After being heated in the glory le, the jug is carried to a finisher, who, with a ir of large shears, trims the glass from the top, and then, after further reheating, shapes the top with a wooden paddle, finally drawing the lip of the jug with a round stick. The paddles and sticks used in the shaping of glass are made of applewood, which is carbonised on the surface by rubbing with hot glass ; between operations these tools are kept in water. Much care is necessary to prevent water dripping on the cooler portions of the ware : but when at red heat, the glass seems able to withstand the shock of the wet tool without injury. Meanwhile, a gathering boy has taken out some glass for the handle, rolling it on an iron table known as a marver and carrying it to the finisher, who, seizing the punty in his shears, sets the glass carefully against the surface of the jug and presses it down firmly where it makes a perfect weld. He then draws the glass out a suitable length, cuts it off, and, by very skilful manipulation, turns the curved handle and attaches it again at its upper end. This is undoubtedly one of the cleverest operations of glass working, next to the off-hand blowing of vases and goblets.

Finishing blown tableware. The piece of blown tableware, as it comes to the selector at the end of the lehr, is in the form of a bottle. The ware is examined for defects as in the case of pressed ware ; and, owing to the thin and polished character of the ware, these defects are much more noticeable than in the heavier process pieces with their duller surfaces. About 90 % of the ware is usually passed to the finishing room.

The first operation is called cracking off. The bottle is circumscribed at the proper height by means of a diamond set in a steel fork. It is then placed on a small revolving table, and a short, flat flame plays on the glass at the scratch mark. After a few revolutions, the top cracks loose and can be picked off ; the tumbler or goblet then goes to the grinding machine. Here it is held end-wise against a rapidly revolving grindstone in a stream of water and the top is thus ground smooth and parallel to the base. The ware is then wiped clean and dry and goes to the melting machine. These machines are of various forms, the main feature being the action of a very hot, oxidising flame playing across the top of the piece as it is carried on a sort of " merry-go-round " about a circular burner. Considerable care is necessary to prevent over-melting while at the same time producing a smooth, fire-polished edge. After cooling on a large wooden table, the ware is ready to be wrapped and sold.

Etching.

Many pieces of tableware are now decorated with various patterns by means of treatment with hydrofluoric acid and fluorides. The general process consists, as might be expected, in first covering the glass with a resisting wax through which the design is traced by a needle, or in the application of the wax from transfer-paper. The two processes are therefore known as needle and plate etching. The needle etching is a comparatively simple process, but plate etching deserves a more extended description.

The design is produced on a steel plate by acid etching, in relief, while the other portions of the plate are depressed. The plate is then coated with a preparation known as ink, a mixture of pitch and waxes, scraped off smoothly with a knife so as to leave the design exposed and fill the depressions with ink, and a piece of thin paper is then laid over the plate and pressed down firmly with a roller. Upon lifting the paper, the ink adheres to it and the paper is then wrapped around a piece of ware which is set in a warm place until the ink adheres to the glass. The paper is then removed, leaving the ink on the glass covering a portion of the surface, and exposing the design. The remaining surface of the glass is then coated with melted resist by means of a brush, leaving the design exposed, and, after cooling, the piece is ready for dipping into the acid.

In the case of two-process etching, which brings out very pretty effects, still another coating of resist and treatment with acid is necessary. In this process, the ware, having the design etched into it in outline, is painted with resist, leaving exposed portions of the design, such as flower petals, that are intended to be brought out as a "matt" or satin surface. Upon this surface is now painted a mixture of hydrofluoric acid and ammonium fluoride stirred into a paste with barium sulphate. This remains a few moments and is rinsed off, leaving a surface resembling ground glass. The etching process adds much to the beauty, and of course, to the value of the ware.

Chemistry involved in making glass tableware.

The batch, or mixture, for making the glass for tableware is comparatively simple to devise. The raw materials, as every one knows, are chiefly sand, sodium and potassium carbonates, red lead, calcium carbonate, and sodium and potassium nitrates. The proportions to be used depend entirely upon the nature of the glass required. Density, high refractive index, and ease of cutting are increased with the increase in oxide of lead. The working properties and resistance to attack by weathering are conferred by lime; while the percentage of alkalis in the glass governs the softness, that is, ease of melting and low viscosity at the working temperature. Within rather wide limits, the glass maker can vary the percentages of sand, alkalis and other bases to produce the glass desired. The most difficult part of glass making is the control of colour, and it is this point that I shall dwell upon at some length.

It is the usual American practice to decolorise glass with manganese dioxide, which imparts, in the case of potash glasses, a violet colour, and in the case of glasses in which soda is the principal alkali, a reddish violet. In addition to manganese, a little cobalt oxide, introduced in a dilute form as "powder blue," which is a glass containing approximately 5 % of cobalt oxide, is also used. With soda glasses more cobalt is necessary. It will be readily seen that the violet colour, imparted by manganese, being complementary to the green shade caused by the presence of iron, serves to decolorise the glass by masking the green colour, that is, by causing a more uniform absorption of all the wave-lengths of the spectrum. Since manganese alone fails to absorb sufficient yellow, the blue of cobalt is required to complete the decolorisation.

The difference in colour produced by manganese, depending upon the alkali in the glass, is an interesting fact, which so far seems to have received no satisfactory explanation. The fact remains merely that the double silicate of potassium and manganese has a much richer colour and more of a violet shade, while the sodium-manganese silicate seems to have a fainter colour and to incline more toward the red. However, this is not the only difference. The phenomenon known as burning out of the colour, that is the disappearance, as a result of the annealing process, of the slight pink shade present in the glass as it leaves the workmen's hands, is more strongly marked in the case of soda glasses, so that the ware as it is placed in the annealing lehr must be given a decided pink in the case of soda glass, if it is to appear colourless at the other end of the lehr. This fugitive character of the manganese colour is a sourse of great annoyance and difficulty attending the use of manganese, and it is only by exercising great care and judgment that the proper balance of colour between violet and green in the finished ware can be maintained.

Another variation occurs according to the temperature of the pot when it is filled. If the pot has been kept closed for some time after being worked out, so that it has again reached a very high temperature, and is then filled, the colour of the glass is likely to be lower, that is, less pink, than when the pot is filled at a lower temperature. Also, where elliptical regenerative furnaces are used, the end pots are less strongly heated than the side pots and it is always found that the side pots in such a furnace require more manganese dioxide in each batch. This effect is probably due to the action of heat on the free oxide of manganese. It is known[1] that manganese dioxide decomposes upon heating to about 550° C., yielding oxygen and the sesquioxide, Mn_2O_3. This in turn loses oxygen at 940° C., and above that temperature the stable oxide is Mn_3O_4. Thus, one-third of the manganese has passed to a state forming a colourless silicate, if it has been heated rapidly to a high temperature, for the writer has shown,[2] and it has been usually assumed to be true, that trivalent manganese is the form in which the manganese goes into combination in the glass to produce a coloured silicate. It seems probable that, where the batch is relatively cooler, fusion of the alkalis takes place with attack upon the silica and consequent solution of the oxides of manganese before a very high temperature is reached, thus preventing further loss of oxygen.

Judging from the colouring power of manganese, as indicated by the small quantities necessary to change perceptibly the shade of colour in a pot of glass, comparatively little of the manganese originally added is really effective in producing colour in the glass. That is, in the case of potash glasses, it is easy to recognise the difference in colour where the quantity of manganese differs by only ¼ oz. in 1400 lb. of glass. In the whole batch, perhaps 10 oz. of manganese had been used. If no manganese at all were put in, with the purity of materials now obtainable, the glass would have had only a pale green shade, so that it may be roughly estimated that not more than one ounce or 10 % of the total, was finally effective in colouring the glass, the rest having lost its colouring power or passed into other forms of combination. It i well known that manganiferous glass become pink or violet on exposure to sunlight or othe light containing much ultra-violet, such as an arc in the presence of atmospheric oxygen and wate vapour. The colour so developed is very intens indicating that, if manganese could be so employe as to give its maximum coloration, a very sma quantity would suffice for decolorising.

The burning out of colour seems to take pla only slowly at high temperatures after the gla has become plain; that is, after the last bubbl have risen from the molten glass and the pot ready to open and work. The rate of burning o of the colour is quite rapid, however, at t annealing temperature, which is just below t softening temperature of the ware. As the me proceeds, proofs are usually taken. These a small samples removed on the end of an iron ro in a shape similar to the finger of a glove. Th serve to show the number of bubbles still remaini in the glass, and thus to indicate the probable ti necessary to complete the plaining. The fi proofs taken off are always of very high colo and this colour diminishes as the plaining procee until finally, just before the pot is ready to op the glass has practically the colour which it v have when it is worked, whether that be withi few hours or possibly twenty-four hours late that is, the fugitive nature of the manga colour is not rapidly manifest at a temperature say, 1000° C.

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[1] Meyer and Rottgers, Z. anorg. Ch., 1908, **57**, 104.

[2] J. Ind. Eng. Chem., 1915, **7**, 1037.

The theory sometimes advanced for the burning out of colour during the annealing process has been that a reaction takes place between some higher oxide of manganese and ferrous iron, whereby the iron is oxidised to the ferric condition and the manganese reduced to a colourless silicate. Representing the elements in the form of oxides, the equation has been written as follows :—

$$Mn_2O_3 + 2FeO = Fe_2O_3 + 2MnO.$$

This explanation seems to me entirely erroneous. In the first place, the actual melt has been carried on under strongly oxidising conditions ; nitrates are present, serving to furnish an atmosphere of oxygen in the pot—not to mention the oxygen given off by red lead and manganese dioxide, and the oxygen contained in the air occluded in the loose batch as it is charged—hence, it would appear that any iron present must already be in the ferric condition when the melt is complete and the glass is plain.

Another theory proposed for the disappearance of the manganese colour is that manganese sesquioxide, when it imparts a colour to the glass, is in the colloidal condition, and that this colloid returns to the crystalloid or ordinary state at certain temperatures. Analogies are to be found in the case of certain ruby glasses, which lose their colour upon being reheated. But, in the case of ruby glasses, it is usually possible to bring about the reverse change, and to restore the ruby colour by proper heat treatment. In the case of manganese, it is apparently impossible to restore the colour by any heat treatment ; the change is a permanent one. Moreover, sudden cooling from the molten state, which ought to have a maximum effect in causing the change from the colloid state, operates to maintain the manganese colour, and it always requires slow cooling through the change indicated, or one prolonged heating at a moderate temperature, to burn out the manganese colour.

I wish to propose another explanation for the phenomenon, for which as yet I have only incomplete, but nevertheless convincing evidence. It seems possible that a rearrangement takes place when glass coloured by trivalent manganese is exposed to the annealing temperature, say, 350° to 400°C. Such a reaction might be the formation of compounds in which the manganese plays an acidic rôle. Manganese dioxide, fused with an alkali in air or with nitrates, produces a green manganate. Suppose we assume then—neglecting or the moment the silica and other bases—that manganese trioxide behaves somewhat as nitric oxide does when dissolved in water ; that is, part of it is oxidised and part reduced. In this case, we should have manganous oxide, MnO, and some acidic manganese oxide, say, MnO_3. Manganous xide, since it forms a colourless silicate, can be eglected, but the manganese trioxide may produce a green manganate with soda, potash, or ther bases present. If this explanation of the oss of colour is a true one, it ought to be a fact hat the more basic glasses suffer a greater loss of olour, and this is borne out in practice. The fect, for example, of reducing the quantity of ead oxide in a heavy lead glass is always to make ossible the use of less manganese in the batch· he reduction of manganese is greater in proporon than the reduction of lead oxide, and, morever, the lead oxide, as now furnished to glass akers, is so nearly free from iron that no mananese as such ought to be necessary, because of he presence of lead oxide. By increasing the asic character of the glass, however, a great roportion of lead might, according to the above eory, increase the rate of burning out of the lour, and this is what does take place.

Another consequence of this theory would be at glasses containing manganese, if held at the nealing temperature for a sufficiently long time, would become actually green, and a more pronounced shade of green than if no manganese at all were present, since the green colour of the manganate would be added to the green produced by the iron impurity. This has also been repeatedly noted in practice. My conclusion is therefore on this point that a rearrangement takes place, perhaps somewhat according to the following equation :—

$$2Mn_2O_3 + R_2O = 3MnO + R_2MnO_4.$$

It also seems that the influence of temperature on the speed of this reaction reaches a maximum probably somewhere near the softening point of the glass—that is, at about 100° to 500° C. The silica is probably a stronger acid at higher temperatures, and retards the formation of manganates. As stated above, this burning-out of colour does take place, but more slowly, at higher temperatures, say 1000° C., so that, if the pot full of glass is left standing in the furnace indefinitely, the pink colour entirely disappears, and it is common knowledge that glass so left in the pots becomes a very pronounced green. It is also true that ware that is treated for a long time in the annealing process in a kiln may be made to take on a stronger green colour than the glass made of the same materials, with the exception of the manganese, would show.

I have already spoken of the comparatively rapid change in the colour during the melting process. In terms of this theory, this change of colour may be explained as follows :—While the glass is melting, the first compound formed is probably the alkaline silicate, produced by the interaction of sand and an alkali carbonate or nitrate. This silicate then begins to dissolve the remaining silica, but it must be well toward the end of the plaining process, before the glass assumes anything like homogeneity. Therefore, there will be present local areas of highly alkaline glass, and in these areas we would expect the formation of manganate to take place very readily. When the glass is plain and all the silica dissolved, and a more homogeneous liquid formed, the entire mass may be said to be distinctly acid in character, and the change in the form of combination of the manganese takes place much more slowly.

Certain lines of experiment are indicated which may serve to show whether this theory of manganate formation is correct or not. These have not yet been completed. For instance, if manganese dioxide is fused with soda and nitre, it forms a green manganate ; if this material is introduced into a glass batch, it should be possible to produce a green glass, especially if the proportion of silica to bases is not too high. Such a glass has been prepared. It is easy to see how manganates may form during the melting process, and partly melted batch has been taken from the pots, exhibiting this green material. Perhaps this manganate dissolves to some extent unchanged, and to that extent neutralises the colour of the trivalent manganese. I might suggest here that it is barely possible that the trivalent manganese gives up oxygen, which is retained in the glass under tremendous pressure, so that actual bubbles of the gas do not appear. While this is within the range of possibility, it seems unlikely for obvious reasons. Moreover, it would not explain the tendency of glasses containing manganese to become actually green upon continued heat treatment. From the facts at hand, therefore, I believe that the theory of manganate formation seems reasonable, and I am endeavouring to find still more evidence which will tend to prove or disprove it.

Other decolorising agents, which offer possibilities, are nickel and selenium. Nickel has the advantage of being unchanged by heat treatment, but the disadvantage of a general absorption of the light waves, which is only partially selective. We are indebted to Zsigmondy [*] for the best work on the absorption of light waves by various bases in glass. This lays the foundation for scientific work on decolorisation. It is obvious that, in order to decolorise glass, the bases introduced must be of a nature and amount to absorb all wave lengths equally. In order to do so where nickel is used, cobalt must also be added, and the total absorption is apparently greater than when manganese and cobalt are used. The result is a darkening of the glass, that is, less light is transmitted. However, work is being done on the problem of using nickel, especially in soda glasses (which is again a less favourable condition), and it is possible that, by a proper combination of elements, this darkening effect may be minimised.

Selenium as a decoloriser is almost prohibited by the fact that the development of the red colour necessitates reducing conditions, and these are difficult to control. Kraze [†] has worked out very thoroughly the behaviour of selenium, and, although this element is successfully employed in the production of ruby glasses, it is very difficult to control in any glass, and it is improbable that it will come into general use as a decoloriser.

The problem of a decoloriser seems to resolve itself into :—

(1) A development of a nickel-cobalt combination, which will absorb sufficient green without darkening the glass to a great extent ;

(2) A means of introducing manganese in some combination which will be more stable than the oxide under the conditions of the melt. The phenomenon of burning-out of colour, however, will probably persist whenever manganese is used, and this makes the matter of colour adjustment a very delicate operation. It is rarely that one finds a piece of tableware that is truly colourless ; most of them show either a pink or a green tint. The development of a perfect decolorising mixture is one of the greatest needs of present-day glass making.

Discussion.

Mr. E. C. Sullivan, calling attention to certain peculiarities connected with manganese colour in glass, said that the "topping-proof" taken seven to eight hours after filling, when much sand remained undissolved, was of a deep, opaque purple colour which entirely disappeared when the glass was fully melted. In the ware the faint purple colour due to manganese sometimes resided almost wholly in a thin film on the outer surface of the glass. Glass blown in an iron mould was lower, *i.e.*, greener in colour than the same glass blown in a paste mould.

WINDOW GLASS.

BY G. OSGOOD ANDREWS.

(Abstract.)

Window glass is made by two methods—by "machine" or by "hand." The difference is in the blowing process, both producing the cylinder from which all window glass is evolved. The same general treatment of the cylinder, to produce flat sheet glass, is followed in both machine or human blown material, and both produce equally standard quality. To make the cylinder the molten glass or "metal" is brought to proper consistency by extreme heat, and the glass in the human-blown process is "gathered" upon the end of a tube (or blow-pipe) from the furnace and blown into a huge cylinder by repeated heatings and blowings, until the material is all evenly distributed. From a globular mass about the size of a man's head, the blower swings the pipe into an alley or opening in the floor, blowing as he swings until the full-sized cylinder is formed. This requires skill of the highest degree the blower, by regulating the amount of material entering the cylinder, makes single strength or double strength or heavier glass, as desired.

The blowing machine accomplishes the same result by a purely mechanical process—the intricate working of the mechanism, the supply of molten glass, the air pressure, rapidity of action, making single or double thickness, being controlled by a single operator. The cylinder is decapitated at both ends by an ingenious method of spinning a string of hot glass at the proper place, or by the use of a wire wrapped around the glass and electrically heated which causes the cap and crown to break off clean. The cylinder is then split length-wise, placed in the flattening oven on a large circular stone, and as the heat is increased and the glass begins to wilt it is quickly smoothed out to the shape of the flat stone, upon which it rests. Cylinder glass cannot be perfectly flattened, and the waviness and bow or slight curve will always occur in this product.

Polished plate glass is made from the same ingredients as window glass, but after it has been melted to the proper degree, the pot or crucible in which it is melted is lifted from the oven and cast upon a steel table by the use of a crane. It is carefully skimmed to remove surface impurities, and then carried overhead by an electric tramway to the aforementioned casting table, which is a large, massive, flat table of iron, having as an attachment, a heavy iron roller, which covers the full width, and arranged so as to roll the entire length of the table. The sides of the table are fitted with adjustable strips which gauge the production of plates of different thickness. The pasty, or half fluid glass metal is now poured upon the table from the pot, and the roller quickly passes over it, leaving a layer of uniform thickness. The heavy roller is now moved out of the way, and then by means of a stowing tool the red hot plate is pushed into an annealing oven or lehr. The plates remain for some time in the lehrs, where the temperature is gradually reduced. When the plate is taken from the annealing ovens it has a rough, opaque, almost undulating appearance on the surfaces. After inspection, it goes to the cutter, who takes off the rough edges and squares it into the right dimensions, and thence to the grinding room.

The grinding table is a large, flat, revolving platform made of iron 25 ft. or more in diameter. This table is prepared by being flooded with plaster of Paris and water ; then the glass is carefull lowered and men mount upon the plate and tramp it into place until it is set. After this greater securit is obtained by pegging with prepared woode blocks, and the table is set in motion. Th grinding is done by revolving runners. Sharp san is fed upon the table, and a stream of water constantly flows over it. After the first cutting b the sand, emery is used in a similar manner. Th plates are inspected after leaving the grinding roo and if scratches or defects are found they ar marked.

There are also, not infrequently, nicks an ractures found at this stage ; and in such cas the plate must again be cut and squared, or if the defects are too great, the plate is broken up for cullet. The polishing is done on another special table by means of reciprocating machinery, using rouge (iron peroxide), applied with water, and rubbing the glass with blocks of felt so arranged that every part of the plate is brought underneath the rubbing surface. The grinding and polishing has reduced the original plate half of its thickness, sometimes more. The material washed away is lost and fully half the original weight of lime and soda has vanished, and even at the completion, the inspectors very carefully scrutinise the glass for excessive defects and reject that which is not up to quality.

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[*] Ann. d. Phys., 1901, **4**, 60.

[†] Sprechsaal, 1912, **45**, 214.

Polished plate glass is made in thicknesses ranging from ⅛ inch to over 1 inch. The latter is used for shelves, port holes in steamers, and for other purposes where very heavy glass is required. For mirror purposes ¼ in. polished plate glass is utilized and the same thickness is used in the store fronts of important buildings.

There are other kinds of glass which enter into building construction, of almost equal importance to the window and plate glass, namely, wire glass and rolled figured glass. Wire glass is formed by casting a sheet of glass in the same way as plate glass is made, and pressing a network of wire into the glass while the metal is still soft.

Rolled figured glass, which is translucent but not transparent, is made by a similar process to plate glass, with the exception that it does not go through the process of grinding and polishing. The roller which passes over the glass after it has been cast upon the table is engraved to the design required. This glass is made in thicknesses from ⅛ in. to ¼ in.

Yorkshire Section.

Meeting held at Leeds on Monday, April 10th, 1916.

MR. F. W. RICHARDSON IN THE CHAIR.

NOTE ON THE PRESENCE OF POTASH IN BANANA SKINS.

BY R. H. ELLIS, F.I.C.

Since reading my paper on the presence of potash in banana stalks (see this J., 1916, 456), I have made an examination of banana skins in order to ascertain whether they are equally rich in potash, with the following results:—

	%
Moisture in banana skins	88·2
Dried matter in banana skins	11·8
Ash in banana skins	1·77
Potash in banana skins	1·05
Ash on dried matter	15·00
Potash on dried matter	9·03
Potash on ash	57·16

The average number of bunches of bananas imported into this country per annum is 9,000,000; each stalk contains an average of 180 bananas, the skins of which weigh 15 lb. or 60,271 tons, containing 11·8% dried matter, *i.e.*, 7112 tons dried matter containing 9% potash. In the same way there are 9,000,000 stalks weighing when stripped 4 lb., or 16,071 tons in all; or 1350 tons of dried matter containing 13·7% potash, this being as rich as Kainit in potash.

DISCUSSION

The CHAIRMAN said that the Bradford Corporation dealt with about 1800 tons of refuse annually, of which probably at least 1000 tons was wet vegetable refuse. If this was washed and the potash extracted it would give about 5 tons of the hydroxide.

Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

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I.—GENERAL; PLANT; MACHINERY.

PATENTS.

Introducing gases into intimate contact with liquids; Apparatus for ——. G. W. Mottram, Sheffield. Eng. Pat. 4240, Mar. 18, 1915.

THE gas is passed into a pipe of porous material or a conduit formed of porous tiles or blocks immersed in the liquid. The porous tubes, tiles, or blocks are formed of coarse materials, and are provided with a surface facing of much finer material, so that while the gas passes easily through the coarser layers it is very finely divided by the finer material before it comes in contact with the liquid.—W. H. C.

Drying machines. R., F. R., and W. G. Simon, Nottingham. Eng. Pat. 4486, Mar. 22, 1915.

THE material is dried in a chamber heated by a revolving drum formed of tubes through which steam, hot air, or the like is passed. The hot vapour passes from one end of the drying chamber, through another chamber immediately below it, to an exhaust fan or chimney. The air supplied to the drying chamber is preheated in tubes which pass through the lower chamber and thus receive heat from the hot vapour.—W. F. F.

Drying substances containing water; Methods for ——. C. A. R. Steenstrup, Frederiksberg, Denmark. Eng. Pat. 12,046, Aug. 20, 1915. Under Int. Conv., Aug. 20, 1914.

IN drying plastic articles, surface-hardening is avoided by packing the articles during drying in sand or similar porous material, which allows the moisture to escape but does not form a hard surface.—W. H. C.

Drying or desiccating liquids; Process of and apparatus for ——. L. P. Mick and G. Weiss, Chicago, Ill. U.S. Pat. 1,176,078, Mar. 21, 1916. Date of appl., May 24, 1915.

THE liquid is sprayed against the lateral surfaces of a number of parallel rotating discs in a casing, heated by hot gases directed against the discs, and the dry powder is removed by scrapers between the discs.—W. F. F.

Drying drum. Schmidt und Blecher, Hamburg. Ger. Pat. 288,896, Apr. 28, 1914.

THE drum is divided into compartments by longitudinal partitions arranged tangentially to a tube passing through the centre of the drum. The central tube is provided with slots affording communication with the outer compartments.

The angle of inclination of the partitions may be varied to suit the particular material to be dried by using a larger or smaller central tube.—A. S.

Drying and heating drum. F. Haas Ges. m. b. H., Lennep. Ger. Pat. 289,179, Dec. 2, 1913.

THE inner surface of the drum, at the discharge end, is provided, for a certain distance, with one or more helical grooves, so that by altering the direction of rotation of the drum, the material may be forced backwards towards the feed end if desired.—A. S.

Crushers and grinders: Gyratory or other ——. R. A. Hadfield, Westminster, and W. T. W. Miller, Sheffield. Eng. Pat. 9109, June 21, 1915.

IN a crusher head of the type in which a conical mantle of hard metal is mounted on a conical sleeve carried by the shaft, when the mantle is forced on to the sleeve, inclined surfaces at its smaller end engage with similar surfaces on a washer. The washer is kept in position by a nut screwed on the shaft and having a spherical bearing surface, and is also provided with lugs engaging with recesses in the central sleeve to prevent relative rotation.—W. F. F.

Grinding-mill. H. L. Doherty, New York. U.S. Pat. 1,176,040, Mar. 21, 1916. Date of appl., Oct. 29, 1909.

THE inner surface of a horizontal rotary grinding drum is divided into a number of parallel circular corrugations or grooves, each of which is provided with its own spherical grinding body. The material to be ground is fed in at one end through a shoot into the first corrugation and is moved forward from corrugation to corrugation by conveyors which are supported from and operated by a central shaft.—W. H. C.

Crushing, grinding, and pulverising machines. W. H. Coward, Kelston, Somerset. Eng. Pat. 735, Jan. 16, 1915.

A DRUM with internal semi-circular teeth is mounted in a casing on balls or rollers kept apart by links or pipes, and is driven by worm or spur gearing. A smaller pinion or edge-runner with external teeth placed inside the drum is pressed by springs into contact with the rotating drum and driven by it. The material is fed in at one side of the drum, and drawn off through a rotating perforated plate at the other side by a suction fan into a collecting chamber. Light material such as bran, which collects on the face of the perforated plate, is swept off by a fixed brush and removed by a worm conveyor in the bottom of the casing.—W. F. F.

Muffles. J. T. Perks, Bilston. Eng. Pat. 2755, Feb. 20, 1915.

THE walls and roof of the muffle are constructed of bricks which are hollowed out and divided into a number of cells open towards the central heating chamber. Some of the bricks have their central cells shallower, and a dovetailed recess is formed on the other side to receive the end of a connecting brick which spans the annular surrounding space for the furnace gases. Some of the springers supporting the roof are similarly constructed. —W. F. F.

Furnaces; Oil fuel ——. C. M. Shaw, Yoker, Scotland. Eng. Pat. 2804, Feb. 22, 1915.

THE combustion chamber is semi-circular in vertical section and open at the top to the furnace. The oil jets are directed horizontally across the chamber from one side, meeting the air for combustion, which enters at the opposite side. The burning mixture then circulates round the periphery of the chamber and passes across the entering jets of oil on rising into the furnace.—W. F. F.

Furnace dust collectors. U. Wedge, Ardmore, Pa., U.S.A. Eng. Pat. 16,617, Nov. 24, 1915.

THE apparatus is of the type in which the furnace gases pass through a casing containing transversely inclined dust-retaining plates. The plates are supported by vertical rods, their upper ends resting on collars on the central rod, and their lower ends on hooks projecting from side rods. The plates may be jarred to detach dust by striking the upper ends of the supporting rods. Partitions for directing the flow of the gases are also supported by the rods.—W. F. F.

Calcining-furnaces [; Utilising waste heat of ——]. G. Moore, Joplin, Mo. U.S. Pat. 1,174,086, Mar. 7, 1916. Date of appl., Mar. 16, 1914.

HYDRATED waste solids are delivered through a perforated pipe extending along and above the furnace in such quantity as to require only the waste heat of the furnace for drying.—W. F. F.

Filter-manufacturing press. F. W. Mangelsdorff, Milwaukee, Wis. U.S. Pat. 1,175,001, Mar. 14, 1916. Date of appl., Apr. 8, 1912.

THE press-plate is concentrically corrugated to increase the surface area of the filter mass which is compressed, and provided with water-discharge ducts. The plate is provided with a set of depending adjustable stop-rods which may rest on a projecting flange of the casing, and is operated by a hydraulic press through the medium of spring buffers.—W. F. F.

Filter. Seitz-Werke T. und G. Seitz, Kreuznach. Ger. Pat. 290,425, Mar. 25, 1914.

THE filter-elements or plates are assembled in a frame which can be moved into and out of the filtering vessel, and are connected with a common collecting pipe. When the frame is introduced into the filtering vessel, the collecting pipe is connected with a discharge pipe outside the vessel. Two sets of filter plates are used, one set being taken out of the frame, cleaned, and replaced whilst the other set is being used in the filter.—A. S.

Separator; Centrifugal ——. D. B. Weston, Sharon, Mass. U.S. Pat. 1,176,412, Mar. 21, 1916. Date of appl., May 2, 1913.

THE interior of the basket is divided into a number of pockets by perforated radial partitions, which extend a certain distance inwards from the periphery of the basket. The upper ends of the radial partitions are connected with an annular baffle-plate. The liquid which collects on the interior surface of the cake is discharged through horizontal pipes which extend to the outside of the peripheral wall of the basket.—W. H. C.

Leaching process. G. Hanning, Hamburg. Ger. Pat. 289,026, Feb. 5, 1914.

THE crushed material mixed with a certain quantity of the leaching liquid (water or a volatile hydrocarbon) is heated, directly or indirectly, with steam, and circulated several times through a bar disintegrator, "Excelsior" mill, or analogous apparatus. The hot mixture is then filter-pressed, and the solution passed into a crystallising vessel or otherwise treated.—A. S.

Lixiviating apparatus; Rotary double-walled ——. O. Wilhelm, Stralsund. Ger. Pat. 289,959, Jan. 1, 1913.

THE rotary lixiviating chamber is provided inside with a number of removable tubes which serve for mixing the contents and for filtering the solution before it is discharged.—A. S.

Gases; Absorption of —— by liquids, under pressure, with subsequent regeneration of the absorbent by relieving the pressure. Ges. für Lindes Eismaschinen A.-G., Höllriegelskreuth. Ger. Pat. 289,106, Mar. 29, 1914.

Absorption is effected under as high a pressure as possible and the absorbed gas is subsequently released by producing a partial vacuum in the absorption vessel and simultaneously passing through it a current of gas in which the concentration of the absorbed gas, if this be present, is lower than corresponds to its partial pressure in the gas above the solution. It is stated that by this process the absorption of carbon monoxide in cuprous chloride solution, which hitherto has proved impracticable, may be usod with good results, *e.g.*, for the production of hydrogen free from carbon monoxide.—A. S.

Separating a mixture of two liquids into its components; Apparatus for ——. K. Knbierschky, Eisenach. Ger. Pat. 289,126, May 14, 1913.

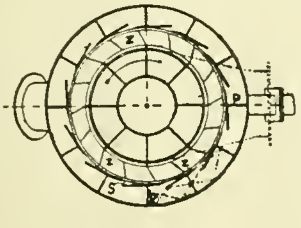
The apparatus consists of three columns connected with each other in a closed circuit. In one column the mixture is treated with an immiscible solvent for one of the components, and the solutions flowing from this column are fractionally distilled in the other two columns to recover the solvent. For example, benzene may be used as a solvent to recover aniline from an aqueous solution (see Borrmann, this J., 1915, 1232).—A. S.

Vacua; Process of producing and maintaining high ——. E. Rohlf, Kiel. Ger. Pat. 289,161, Mar. 24, 1914.

Lycopodium which has been heated by means of a current of heated inert gas and dried *in vacuo*, is introduced into the partially exhausted vessel in which a vacuum is to be produced or into an auxiliary vessel connected with it. Any residual gas is rapidly absorbed by the lycopodium.—A.S.

Suspended solid and liquid particles; Separation of —— from gases and vapours by centrifugal action. V. Aicher, Linz. Ger. Pat. 289,569, Nov. 8, 1913.

The gas passes through the apparatus in an axial direction, and helical guide plates are provided at the inlet and outlet. The peripheral portion of the centrifugal device (see fig.; plan) is divided into compartments, Z, open in the radial direction, and of such size and shape that the suspended particles are shielded therein from the action of the current of gas flowing through the apparatus, and are subjected for several seconds to centrifugal action only, whereby they are forced through the slits, S, into a collecting chamber or chambers. The baffle-plates, P, provided in the collecting chamber to facilitate deposition of the suspended matter, are so arranged that particles rebounding from them do not re-enter the slits, S.—A. S.



Lubricant [: Molasses as a ——]. H. Steffens, Zarkau. Ger. Pat. 290,750, Apr. 11, 1915.

The use of partially or completely desaccharified molasses as a lubricant is claimed. It does not resinify or become solid during use, and if its consistence or viscosity alters owing to evaporation, its original character can be readily restored whilst it is in use.—A. S.

Separating suspended bodies from electrically insulating fluids, especially gaseous fluids; Process for electrically ——. E. Möller, Brackwede, Germany. Eng. Pat. 17,175, July 20, 1914. Under Int. Conv., July 22, 1913.

See Ger. Pat. 282,737 of 1913; this J., 1915, 703.

Filters. E. C. R. Marks, London. From W. F. Warden, Cuyahoga Falls, Ohio, U.S.A. Eng. Pat. 5270, Apr. 7, 1915.

See U.S. Pats. 1,140,726 and 1,140,727 of 1915; this J., 1915, 785.

Roasting-kiln having superposed vaulted hearths. J. Lütjens and W. Ludewig, Hanover. U.S. Pat. 1,176,070, Mar. 21, 1916. Date of appl., Oct. 26, 1912.

See Fr. Pat. 449,144 of 1912; this J., 1913, 475.

Fluids; Device for measuring and for regulating the flow of liquid or gaseous ——. H. M. Liese, Hamburg, Germany. U.S. Pat. 1,177,193, Mar. 28, 1916. Date of appl., Dec. 8, 1911.

See Eng. Pat. 27,467 of 1911; this J., 1912, 761.

Vacuum drying and impregnating device. Eng. Pat. 10,803. *See* XI.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Fuel economists. W. J. A. Butterfield. J. Gas Lighting, 1916, **134**, 578—579, 627—628, and 679.

From a consideration of the practical and commercial aspects of fuel economy, based on the papers of Armstrong and of Bone (this J., 1916, 220, 389), it is concluded that the proposal to forbid the use of raw coal as a domestic fuel is impracticable. In the author's opinion, domestic fuel economy will be best effected by extending the use of gas, substituting gas coke and coke briquettes for raw coal as far as possible, and enforcing the adoption of economical grates and ranges when raw coal must be retained; and power fuel economy by improving the large gas engine and, indirectly, by encouraging the use of coal gas so that a liberal supply of gas coke at a moderate price will be provided for use as a boiler fuel either with or without preliminary gasification. For boiler firing in large power stations, the use of raw coal is more economical than direct gasification or carbonisation of the latter at low temperatures. The theoretical economy of producer or similar gas over raw coal is often small, especially when the coal is burnt in the form of dust in large modern furnaces; and if expensive plant for gasifying raw coal is to be installed it must be capable of giving an adequate return. Special grades of coal, not ordinarily employed for domestic or power purposes, may be advantageously utilised by low-temperature carbonisation, or in Mond or Kerpely producers, etc., and in this field there is ample room for development in the interests of fuel economy. In view of the fundamental importance of coal, it is imperative that only the most economical machinery, labour, and administration be employed in coal mining and transportation.—W. E. F. P.

Coke breeze; Utilisation of ——. V. Schön. Z. Ver. Gas- u. Wasserfachm. in Oester. u. Ung., 1915, **55**, 327—329, 347—353. Z. angew. Chem., 1916, **29**, Ref., 29—30.

At the Obuda gas-works satisfactory results have been obtained by burning lignite mixed with 25—30% of coke breeze on chain grates. In modern boiler installations, with the Wilton system of firing, it is possible to burn coke breeze alone, but the flues need frequent cleaning, and sometimes large quantities of fuel are lost in the ash-pit. When added to lignite for use as fuel in gas producers, coke breeze very soon causes stoppages, but a mixture of breeze with coke of hazel-nut or pea size may be added without untoward results. A better method of utilisation consists in briquetting the breeze with lignite tar. Roller presses give better results than stamp presses. If pitch is used as binding medium, it should be mixed with the breeze in the form of dry powder, and the mixture heated to 60° C. before briquetting.—A.S.

Carbon monoxide; Direct determination of —— in mixtures containing unsaturated hydrocarbons. A. Piva. Annali Chim. Appl., 1916, **5**, 82—93.

The method is based on the fact that carbon monoxide is rapidly and completely absorbed by soda-lime at 200°—240° C., and that secondary reactions occur only at higher temperatures. The soda-lime is coarsely ground to a mixture of small granules and powder, and about 30 grms. is packed into a U-tube of 10 mm. internal diam. and 15 cm. high, the distance between the limbs being 10 cm. The U-tube is placed in a copper cylinder covered with a disc of asbestos having holes for the limbs of the tube and for a thermometer. The U-tube is connected on the one hand with a Hempel pipette containing alkaline pyrogallate or hydrosulphite, and on the other with a Hempel burette containing water. The gas is first treated repeatedly with the reagent in the pipette to remove carbon dioxide and oxygen, and then the copper air-bath is heated to 230° C. and the gas passed repeatedly over the soda-lime until its volume remains constant. The maximum time required is 15 mins., and satisfactory results have been obtained with illuminating gas, producer gas, and test mixtures of carbon monoxide with nitrogen, ethylene, and acetylene respectively.—A. S.

Acetylene; Action of [crude] —— upon metals. H. Reckleben and J. Scheiber. Chem.-Zeit., 1916, **40**, 325.

In consequence of a communication from Wa. Ostwald regarding observations which contradicted the results of the authors (this J., 1915, 214) and suggested the possibility of the formation of an acetylide by the action of acetylene on metallic copper, the experiments have been repeated and extended. Crude acetylene containing polymerisation products, hydrogen sulphide, ammonia, etc., was passed over copper foil and the layer produced on the surface examined; it did not exhibit explosive properties on heating, and on boiling another sample with dilute hydrochloric acid, no acetylene could be detected after removal of the hydrogen sulphide from the gaseous products. Prolonged digestion with 15—20 % hydrochloric acid resulted in the solution of the copper sulphide in the layer, and eventually the liberation of acetylene, which must therefore have been present in the combined state. The authors were unable to decide by analysis whether the non-explosibility of the product was due to the distribution of the cupro-acetylide in the sulphide, phosphide, oxide, and other copper compounds, or to the presence of the more stable cupri-acetylide. It is considered remarkable that an acetylide should be produced in presence of hydrogen sulphide, as copper acetylides are readily converted into sulphide by an irreversible reaction with the liberation of acetylene. Whereas pure acetylene is without action on copper, it is concluded that crude acetylene, particularly if it contains ammonia, gives small amounts of an acetylide.—F. W. A.

Acetylene; Decarburisation of —— by means of carbon dioxide. U. Alvisi. Rass. Min., Met. e Chim., 1916, **45**, 1—3. Annali Chim. Appl., 1916, **5**, 118—119.

In the utilisation of acetylene for heating and lighting, the consumption of the gas may be considerably reduced and the character of the flame modified by introducing carbon dioxide at the point of ignition, when the following reactions occur: $2CO_2+2C_2H_2=C_2H_4+4CO$;
$C_2H_4+CO_2=CH_4+2CO$.—A. S.

Water-gas tar; Burning and distilling ——. C. Otten, jun. New England Assoc. Gas Eng., Feb. 16, 1916. J. Gas Lighting, 1916, **134**, 140—141.

Since Sept. 13, 1914, the boilers at the Haverhill (Mass., U.S.A.) Gaslight Co.'s works have been fired entirely with water-gas tar. There are two horizontal return tubular boilers (72 in. diam. by 19 ft. 6 in. long, with 92 tubes, and 78 in. diam. by 21 ft. 6 in. long, with 120 tubes, respectively), and each is fired by means of a "Best's No. 2" burner inserted through the centre of the front wall of the boiler setting, the fire-doors being bricked up and chequer-bricks placed on the grate, but spaces being left to allow sufficient air to be drawn in. The bridge wall is cut down to about the level of the chequer-bricks on the grate. A gas burner is provided to ignite the tar when necessary. In two trials 39,300 and 40,200 lb. of water were evaporated from and at 212°F. (100° C.) by 3075 and 3092 lb. of tar respectively. One boiler has been fired with oil for 314 days and the other for 186 days; the brickwork of the boiler setting has required no repairs except a little pointing-up at intervals, and no noticeable wear of the boiler tubes or shell has occurred.

By distilling water-gas tar with steam at 40—60 lb. pressure, 6—10 % of light oil (15—20 % distilling up to 135° C., calorific value 17,800 B.Th.U. per lb.) has been recovered.—A. S.

Natural-gas industry, its progress and importance. J. A. L. Henderson. Inst. Petrol. Techn., Mar., 1916. [Advance proof.] (See also this J., 1915, 131.)

The value of the natural gas produced in the United States increased from £3,143,000 in 1898 to £19,336,000 in 1914 (44 % of the value of the petroleum output), the latter figure representing a production of about 591,867 million cub. ft., or about 13,211,300 long tons. Canada produced gas to the value of £750,259 in 1914, and the total production in the United States and Canada up to the end of 1914 exceeded £217,000,000 and £4,423,000, respectively, in value. In 1914 the average price was 8d. per 1000 cub. ft. for all purposes and 1s. 2d. for purely domestic uses; on a thermal basis the latter represents only one-quarter the price paid for London gas (2s. 4d. per 1000 cub. ft.). The extent of the gas fields in the United States has been estimated by the Geological Survey at 9365 sq. miles, but 10,600,000 acres (about 16,560 sq. miles) were under the control of various natural-gas undertakings in 1914. Enormous wastage of gas, from preventable and hitherto unpreventable causes, has been a prominent feature of the industry from its inception. Attempts are now being made in California to store superfluous gas in dry or exhausted sands in neighbouring wells. Reference is made to the possibilities of the Triassic-Jurassic artesian basin of Australia, in which 15 bore-holes—yielding flows of inflammable gas up to 1,000,000 cub. ft. per day in association with mineralised artesian water and occasional small quantities of petroleum—have been sunk in Queensland and New South Wales. At Kissarmas, Transylvania, initial flows amounting to over 82,000,000 cub. ft. per day from 19 shallow wells have been developed during recent years. There is a relatively small output in Russia; the production of Italy amounted to 212,330,000 cub. ft. in 1913. Statistics of the natural-gas gasoline industry show an almost six-fold increase in production and value from 1911 to 1914, the production for the latter year being 42,652,632 U.S. galls. and the value £638,200; the average prices in 1913 and 1911 were 5d. and 3⅜d. per U.S. gall., respectively. Three methods are in use for extracting gasoline (from "wet" or "casing-head" gas), namely: compression accompanied by cooling—by which method nearly the whole output is produced; cooling by means of a refrigerant at low pressures; and absorption in heavy oil, under pressure.—W. E. F. P.

Hydrocarbons produced by cracking petroleum; Equilibrium relations among aromatic ——. W. F. Rittman and T. J. Twomey. J. Ind. Eng. Chem., 1916, 8, 20—22.

Definite relations exist between the percentages of various aromatic compounds present in the oil obtained when petroleum is cracked, the proportions depending on the degree of cracking. The following results (percentages by weight) were obtained in a series of experiments:—

Furnace conditions.			Cracked oil.						
Pressure, lb. per sq. in.	Temp. °C.	Feed, galls. per hour.	Yield, %	Sp. gr.	Benzene.	Toluene.	Xylene.	Naphthalene.	Anthracene.
200	(600)	14	30·0	1·018	19·1	10·4	3·1	14·1	9·6
200	700	14	20·0	1·000	20·7	11·2	4·6	8·1	3·8
250	650	15	23·5	0·992	20·3	12·2	4·4	7·0	0·0
250	700	15	22·5	0·978	20·2	12·4	5·0	2·0	0·0
250	650	15	23·5	0·954	16·5	17·8	10·8	0·0	0·0
200	625	14	30·0	0·938	12·3	13·4	7·0	0·0	0·0
250	600	15	31·2	0·900	7·9	12·0	7·1	0·0	0·0
200	550	14	55·0	0·837	0·0	4·0	2·8	0·0	0·0

Toluene and xylene show the same variations in percentage formation; both are at a maximum in a recovered oil of sp.gr. about 0·95. Benzene formation requires a more vigorous cracking than is needed for the production of toluene and xylene. Naphthalene begins to form at about the point where the toluene-xylene content passes its maximum, indicating that naphthalene is a product of the decomposition of the monocyclic hydrocarbons; the same applies to the formation of anthracene. The quantities of benzene, toluene, and xylene in the primary fraction of the redistilled oil (up to 175° C.) may be determined by a method described by Rittman, Twomey, and Egloff (this J., 1915, 1080; see also this J., 1916, 105, 169, and 296).—W. P. S.

Liquid-fuel engines; Composition of the exhaust from ——. R. W. Fenning. Inst. Mech. Eng., Mar. 17, 1916. Engineering, 1916, 101, 288—292, 336—338.

Mixtures of air and vaporised fuel in known proportions were exploded in the small (50—100 c.c.) explosion vessel of a Macfarlane and Caldwell gas-analysis apparatus, and successive determinations made of carbon dioxide and oxygen, heavy hydrocarbons, carbon monoxide, and hydrogen in the products of combustion. Hexane and benzene were used as standards, and petrol (Bowley's Special) and benzol as commercial fuels. For purposes of comparison samples were also taken from the exhaust of a single-cylinder sleeve-valve engine (102 mm. diam. by 129 mm. stroke, running at 800 revs. per min.), in which petrol-air and benzol-air mixtures were used, the proportions of fuel and air in these being measured separately by Watson's method, in which the gas or vapour is drawn through a standard aperture in a thin metal plate and the difference of pressure between the two sides of the plate noted. A series of "exhaust-gas charts" is given by means of which the ratio of air to fuel in the mixture supplied to an engine may be determined from the proportions of carbon dioxide, carbon monoxide, and oxygen in the exhaust gases. Each chart consists of a set of curves obtained by plotting on a "strength of mixture" base the percentages of the above constituents in the exhaust gases, the strength of mixture being expressed as the ratio of air to fuel by weight. The composition of the products resulting from the explosion of volatile fuels with air is practically the same whether explosion be effected in a small vessel or an engine cylinder, so that an exhaust gas chart prepared from explosion-vessel tests of the fuel employed can be used to determine with considerable accuracy the strength of mixture supplied to an engine. Engine-exhaust gases contain little, if any, unsaturated or saturated hydrocarbons, and the proportion of hydrogen in exhausts increases rapidly with the strength of the fuel-air mixture used. Watson and others having already shown that the thermal efficiency of an explosion engine is affected considerably by the strength of the fuel-air mixture employed, the author urges the adoption of the exhaust-gas chart method for setting carburettors so as to lessen carbonisation and promote fuel economy.—W. E. F. P.

Asphalt; Examination of ——. M. Gary. Mitt. K. Materialprüf., 1916, 33, 210—220.

A description is given of Richardson's "penetrometer," which measures the degree of penetration of a needle point, and of the "ductilometer," which measures the length to which a prepared slab of the material can be drawn without breaking. Tests made with typical samples of asphalts of different kinds showed that the differences in the degrees of softness increased with rise of temperature from 15° to 25° C., the increase being more rapid in the case of the softer materials. The softness is therefore most suitably determined at 25° C. The materials examined could be classified into three well-defined groups, *viz.* (*a*) hard, 1·9 to 4·1; (*b*) semi-soft, 10·1 to 15·9; and (*c*) soft, 29·4 to 42·9 degrees of softness as measured in the penetrometer (each degree indicates a penetration of 0·1 mm.). All materials with a softness of less than 5 should be described as having ductility = 0, since they cannot be tested in the machine. At the other extreme are asphalts with a ductility of over 100 cm., which also cannot be tested directly. Softness and ductility do not show parallel results. For instance, certain substances of moderate softness (*e.g.*, some distillation residues) may show very pronounced ductility. The effects of diluting asphalts and bitumens with paraffin oil to approximately the same degree of softness before testing the ductility, indicated that softness and ductility are influenced in a different way by dilution with oil. When the constituents which influence the ductility, have been removed by heating, the original ductility cannot be restored even when the material is brought to its original degree of softness. To avoid changes and loss of volatile constituents as far as possible, only as much of the material should be melted as is required to fill the moulds of the apparatus. Results are given showing the effect of the temperature and length of heating when melting on the results of the penetration test.

Asphalts and asphaltic material containing less than 96% of bitumen cannot be directly tested for ductility. In such cases the bitumen should be extracted in a Soxhlet apparatus with chloroform, the solvent evaporated, and the residue dried at 130° C. until no odour of chloroform is perceptible. Bitumens thus prepared from (1) Trinidad asphalt, (2) Bermuda asphalt, and (3) asphalt mastic with natural asphalt gave the following results:—(1) Softness 12, ductility 0; (2) softness 42, ductility over 100; (3) softness 44, ductility 3·5. After the addition of 12% of paraffin oil (sp. gr. 0·920) to (1) the softness was 45 degrees, while the addition of 3% of oil to (3) raised the softness to 67 degrees. Hence, in judging of the value of asphalts and mixtures, tests of the extracted bitumen and of the behaviour of the sample in admixture with oil are indispensable.—C. A. M.

Bituminous materials; New penetration needle for use in testing ——. C. S. Reeve and F. P. Pritchard. J. Agric. Res., 1916, **5**, 1121—1126.

A STANDARD needle is made from a 2 in. length of 0·011 in. annealed steel drill rod. This is placed in the chuck of a lathe at high speed and pointed with a file, so that it tapers from a point ¼ in. from the end to a point. The needle is then tempered, ground to a sharp needle-point, smoothed and polished with emery dust, crocus cloth and rouge, and finished on a buffing wheel. The needle above the tapered portion must be exactly 0·04 in. in diameter, and the point must be smooth and sharp enough to penetrate ordinary writing paper without sticking.—C. A. M.

Naphthenic acids. G. von Kozicki and S. von Pilat. Petroleum, 1916, **11**, 310—316. Z. angew. Chem., 1916, **29**, Ref., 175.

THE crude naphthenic acids (sp. gr. 0·9403 at 15° C.) isolated from a Galician petroleum distillate of sp. gr. 0·8127 and flash point 33° C., were purified by conversion into potassium salts and extraction with petroleum spirit, and were then methylated and the methyl esters subjected to fractional distillation. By saponification of the various fractions the naphthenic acids from $C_7H_{13}CO_2H$ up to $C_{14}H_{27}CO_2H$ were isolated. The calcium, manganese, cobalt, and magnesium salts, the dinitrophenyl ester, the amide, and the nitrile of the dodecanaphthenecarboxylic acid were prepared, and the nitrile was converted into the corresponding amine, which was characterised by means of its acetyl derivative and oxalate. The results of the experiments afford conclusive proof that the naphthenic acids are carboxylic acids. —A. S.

Means for dealing with arsenical sulphuric acid in the manufacture of ammonium sulphate. Parrish. *See* VII.

New accurate method of gas analysis. Krone. *See* XXIII.

Reagents for use in gas analysis. II. Chromous chloride. Anderson and Riffle. *See* XXIII.

Reagents for use in gas analysis. III. Specific absorption of alkaline pyrogallol in various pipettes. Pipettes especially adapted for use with alkaline pyrogallol. IV. Phosphorus in solution. Anderson. *See* XXIII.

PATENTS.

Lignite, brown coal, peat, wood, and the like raw fuel materials; Process for the treatment of ——. Bogwood G.m.b.H., Munich, Assignees of C. Melhardt, Starnberg, Germany. Eng. Pat. 24,299, Dec. 18, 1914. Under Int. Conv., Dec. 5, 1913.

THE material is dried at a temperature rising from 25° to 70° C., and then heated to 180°—250° C. in a closed chamber at atmospheric pressure till all water vapour, carbon monoxide and dioxide, and nitrogen have been driven off. The ash may be removed by washing in water or dilute salt solution in the usual manner. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 2831 of 1870, 22,381 of 1902 and 27,397 of 1904; see Fr. Pats. 326,326 and 349,139, this J., 1903, 791; 1905, 612).—W. F. F.

Coal wash water and the like; Apparatus for treating ——. W. Hargreaves, Rothwell, M. Charlton, Whitwood, Yorks., R. Wilson, Bishop Auckland, Durham, and W. M. Mackey, Leeds. Eng. Pat. 8587, June 10, 1915.

THE wash water is delivered to a tank of inverted conical form through perforations at the bottom of the side walls. The water flows upwards at a gradually decreasing rate whereby the fine coal is carried over into a discharge gutter and the dirt tends to settle.—W. F. F.

Fuel containing spent fullers' earth. N. Sulzberger, New York. U.S. Pat. 1,174,199, Mar. 7, 1916. Date of appl., Nov. 16, 1915.

A MIXTURE of finely divided coal and spent fullers' earth which has been used in treating fatty material, is made into briquettes.—W. F. F.

Briquetting process for coal, fodder, and the like, using rice starch as binding medium. R. Richter, Dresden. Ger. Pat. 290,528, June 27, 1915.

RICE waste containing oil in addition to starch is used as binding medium.—A. S.

Briquettes; Apparatus for the continuous coking of the binding medium in ——. Maschinenbau-Anstalt Humboldt, Cöln-Kalk. Ger. Pat. 290,707, Nov. 24, 1914.

THE briquettes pass downwards by gravity through the coking chamber, meeting an upward current of hot air by which the coking is effected. In the lower part of the chamber supports are provided which take part of the weight of the briquettes and these are then discharged through openings in a rotary discharge plate, whilst at the same time cold air is drawn in through the openings to cool the briquettes.—A. S.

Firing with dust; Method of ——. L. Robert, Hamburg, and A. J. Irinyi, Altrahlstedt. Ger. Pat. 290,708, June 7, 1914.

THE use of pitch dust as fuel is claimed. Much higher temperatures can be obtained than with coal dust.—A. S.

Coal and other material; Process for treating ——. L. P. Burrows, Ottawa, Canada. Eng. Pat. 1206, Jan. 25, 1915.

COAL is heated and agitated in a revolving drum and subjected to the action of steam which has been expanded, freed from moisture, and then highly superheated. The resulting gaseous product may be partly used in heating the coal, and the steam is generated and superheated by the heat of the combustion chamber. The liquid distillation products are separated and consist of hydrocarbons suitable for use as paint, lubricating, or illuminating oil, and also a low-boiling product similar to gasoline. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 3714 of 1903.)—W. F. F.

Coking plants ; Process and means for controlling combustion in ——. H. Koppers, Essen, Germany, Assignor to H. Koppers Co. U.S. Pats. 1,176,066 and 1,176,067, Mar. 21, 1916. Dates of appl., June 8 and June 9, 1914.

The combustion chambers are supplied either with producer gas poor in hydrogen or with coke-oven gas rich in hydrogen. In the first case the gas is preheated by passing through regenerators, and in the second case the fuel gas is diluted with a neutral gas, *e.g.*, flue-gases, so as to increase the size of the flame to give the same uniformity of heating as in the first case. The air for combustion in both cases is preheated by passing through regenerators.—W. F. F.

Coke-oven. Gebr. Hinselmann, Essen. Ger. Pat. 289,082, Nov. 29, 1913.

The oven is heated from below with either rich gas or low-grade gas, and air heaters are arranged laterally alongside the battery of ovens. The low-grade gas is preheated in small heat recuperators interposed between the blocks carrying the burner nozzles for the rich gas, *i.e.*, one below each heating wall but above the main sole-flue. Behind each of these heat recuperators, in the waste gas flue, is a regulating device, accessible from the main sole-flue. The blocks carrying the burner nozzles are mounted so that they can be swung round on a vertical axis to allow of heating the oven with either rich gas or low-grade gas as desired.—A. S.

[Gas] retort structures ; Method of constructing and heating ——. H. A. Carpenter, Sewickley, Pa., Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,174,390, Mar. 7, 1916. Date of appl., June 18, 1915.

Retorts for making coal gas are built of blocks of refractory material which expand and contract as units. By the expansion of the blocks the structure is brought to a condition suitable for the distillation of coal by the time it reaches the working temperature.—W. F. F.

Coal-gas apparatus. C. S. Chrisman, West Chester, Assignor to The United Gas Improvement Co., Philadelphia, Pa. U.S. Pat. 1,176,432, Mar. 21, 1916. Date of appl., Sept. 11, 1913.

An installation for the manufacture of coal gas includes a gas producer, a combustion chamber communicating with the producer, and a number of vertical retorts, one of which communicates at the bottom with the producer and supplies it uniformly with coke. Means are provided for adjusting the pressure at the base of this retort, in order to exclude producer gas.—J. B. C. K.

Benzol in gas ; Process of and apparatus for determining [detecting] ——. C. L. O. Graul, Chicago, Ill., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat. 1,163,654, Dec. 14, 1915. Date of appl., Feb. 2, 1915.

After passing through a benzol absorber, the gas is passed through picric acid to absorb naphthalene and then divided into two parts. One part passes through a pressure regulator direct to an Argand burner, while the other part passes through an oil bath to remove any residual benzol and through a pressure regulator to a similar Argand burner. The luminosities of the two gas flames are compared photometrically, the presence of benzol in the untreated gas being indicated by a higher luminosity.—W. F. F.

Producer gas plants, particularly suction gas plants. K. I. Crossley and F. Fielden, Manchester. Eng. Pat. 14,830, Oct. 20, 1915.

The gas-outlet pipe of the producer is designed with its mouth pointing upwards, and is provided, for clearing purposes, with scrapers capable of being worked in straight lines along the pipe without interfering with the production of gas. —J. B. C. K.

Producer-gas ; Process of generating and utilising ——. G. M. S. Tait, Montclair, N.J., Assignor to Tait Producer Co., New York. U.S. Pat. 1,175,191, Mar. 14, 1916. Date of appl., Jan. 11, 1910.

Air is supplied to a bed of fuel at a pressure above atmospheric which can be regulated by the exhaust pressure of a gas engine, and the gas is withdrawn from an intermediate point of the bed by the suction of the engine. The hydrocarbon gas evolved from the fresh fuel, or liquid hydrocarbon, is supplied to a moderately heated zone and the resulting gas is drawn off with the producer gas.—W. F. F.

Coke and gas ; Process of producing —— from fluid hydrocarbon. L. P. Lowe, San Francisco, Cal. U.S. Pat. 1,174,511, Mar. 7, 1916. Date of appl., Apr. 29, 1914.

Finely divided liquid hydrocarbon is passed into a bed of incandescent solid fuel, hydrogen being liberated and carbon deposited. Sufficient air is admitted partly to burn the carbon, and the cycle is repeated.—W. F. F.

Gas ; Apparatus for making —— from liquid hydrocarbons. Process of making gas. W. C. Dayton, Assignor to G. H. Smith, Buffalo, N.Y. U.S. Pats. (A) 1,174,970 and (B) 1,174,971, Mar. 14, 1916. Dates of appl., Apr. 29, 1914 and Jan. 25, 1915.

(A) Air and hydrocarbon are forced by separate pumps into a mixing device in predetermined proportions, which are maintained constant while the air pressure may vary. The mixture passes to a heated retort where it is partly burnt, and the products of combustion are delivered to a gasometer, means being provided to keep the volume constant notwithstanding a variable demand. (B) Air is delivered to a mixing device at a pressure varying with the required rate of delivery of gas. Oil from an adjacent supply, at a constant but negligible head to avoid frictional and inertia variations of flow, is also delivered to the mixer by an injector so that its ratio to the air remains constant, the quantity of air being sufficient for partial combustion. The pressure of the oil is the difference between the initial air pressure and its pressure after partial expansion in the mixer. The mixture passes to a heated zone for combustion, from which the resulting gas of substantially constant composition and calorific value is withdrawn.—W. F. F.

[Hydrogen from other] gases ; Apparatus for separating ——. W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,174,631, Mar. 7, 1916. Date of appl., Sept. 17, 1914.

A sheet of platinum about 0·001 inch thick is mounted on or between porous supports and heated, when it becomes permeable to hydrogen. The gas mixture is brought into contact with one side of the platinum.—W. F. F.

Lighting and heating gases ; Purification of —— from hydrogen sulphide and ammonia. L. Bergfeld, Durlach. Ger. Pat. 290,509, Sept. 3, 1912.

The gas is washed with a solution of ammonium bisulphite containing excess of sulphur dioxide, which absorbs both the ammonia and the hydrogen sulphide. The gas is then treated further with a sulphite solution which has been rendered slightly alkaline by spraying it through the crude gas, and the circulation of this solution is so controlled by means of a Bergfeld "neutral holder" that the gas leaves the second washer completely free from acid and alkaline constituents. The main wash-liquor from the first washer flows direct to a settling tank or filter, and part of the separated sulphur is burnt to sulphur dioxide, which is used to regenerate the wash-liquor for use again, thus rendering the process continuous. Easily soluble ammonium polythionates gradually accumulate in the wash-liquor, and to recover the ammonia, the solution is heated first by means of the hot regenerated wash-liquor after the latter has been saturated with sulphur dioxide, and further by the heat of combustion of the sulphur to sulphur dioxide (see above). In this way the polythionates are decomposed with formation of ammonium sulphate, sulphur, and sulphur dioxide.—A. S.

Hydrocarbon oils; Apparatus for treating —— for the production of bodies suitable for use in lieu of gasoline or naphtha. H. J. C. Forrester, London. From New Process Oil Co., St. Louis, Mo., U.S.A. Eng. Pat. 4856, Mar. 29, 1915.

Hydrocarbon oil and water are fed from separate reservoirs under pressure to a retort kept at 600°—800° F. (315°—430° C.) for petroleum gas oil, or 1200°—1400° F. (650°—760° C.) for kerosene. The gaseous products pass through a hand-operated valve to a condenser connected to a closed receiver, so that a pressure of 3—10 atmospheres is maintained in the retort and a similar or lower pressure in the condenser.—W. F. F.

Lubricating oils; Process of purifying used ——. C. J. Skidmore and P. F. Conerty, New York. Eng. Pat. 14,781, Oct. 19, 1915. Under Int. Conv., Oct. 24, 1914.

The oil, *e.g.*, lubricating oil from internal combustion engines, is agitated with an aqueous solution of an alkaline phosphate, *e.g.*, trisodium phosphate, by passing air through the mixture for 1 hour, the liquid being heated to about 130° F. (55° C.). The mixture is allowed to settle for about 24 hours, when it separates into three layers, the purified oil at the top, the impurities in the middle, and the aqueous solution at the bottom.—W. F. F.

Paraffin; Method of refining ——. Allgem. Ges. f. Chem. Ind. m. b. H., Berlin. Ger. Pat. 289,879, Feb. 4, 1914. Addition to Ger. Pat. 276,994 of 1913 (this J., 1914, 1149).

Solid paraffin, obtained, for example, as described in the principal patent, is treated with liquefied sulphur dioxide, at a temperature at which the purified paraffin is liquid. Impurities are thus removed in solution.—F. Sodn.

Hydrocarbons such as petroleum or the like; Desulphurisation of ——. F. Bergius, Hanover, and A.-G. für Petroleumind., Nuremberg. Ger. Pat. 290,563, Nov. 30, 1913.

Petroleum and its products, other mineral oils, bitumen, and similar substances are desulphurised by mixing them with metallic oxides or hydroxides and heating them to above 200° C. under such a gaseous pressure that they remain in the liquid state. The pressure is preferably produced by means of hydrogen.—A. S.

Sulphuric acid from the waste acid of petroleum factories; Process of recovering ——. V. C. C. van Voorhout, The Hague, Holland. Eng. Pat. 12,363, Aug. 27, 1915.

The waste acid after dilution with water to about 52° B. (sp. gr. 1·563) is placed in a lead-lined, steam-jacketed autoclave, and carbon dioxide is forced in until the pressure reaches 7 atmospheres. Steam is then passed through the jacket until the pressure within the autoclave has risen to 10 atmospheres. The heating is maintained for two hours, when the acid will have separated from the tar without any formation of sulphur dioxide or anhydrous sulphuric acid. The acid and tar are then blown out of the autoclave separately. The carbon dioxide is washed and used again.—W. H. C.

Recovering hydrocarbons from absorbing oils; Apparatus for ——. F. Püning, Chicago, Ill., Assignor to H. Koppers Co. U.S. Pat. 1,176,094, Mar. 21, 1916. Date of appl., Oct. 20, 1913.

The absorbing oil is passed first through a heat exchanger, where it is heated by the vapours coming from the still, then through a second heat exchanger where it is heated by the hot exhausted absorbing oil coming from the still, and finally through a third heat exchanger where it is heated by steam. The heated oil, with any vapour given off, is then delivered to the still, and the vapours from the still, after passing through the first heat exchanger, are conveyed along with any condensed liquid into a water-cooled condenser. The heat exchangers are of the horizontal tubular type, and spare vessels are provided to allow cleaning or repairs to be effected without stopping the process.—W. H. C.

Apparatus for feeding pulverised or finely divided fuel or other material. Quigley Furnace and Foundry Co., Springfield, Mass., and A. D. Heyl, New York. Eng. Pat. 9680, July 2, 1915. Under Int. Conv., Jan 23, 1915.

Means for supplying comminuted fuel to furnaces. J. R. Magarvey, W. Dalton, and C. L. Heisler, Schenectady, N.Y. U.S. Pat. 1,177,045, Mar. 28, 1916. Date of appl., June 8, 1914.

Burners for liquid fuel. A. F. Drössel, Mannheim. Eng. Pat. 12,740, Sept. 6, 1915.

Peat; Apparatus for the conversion of —— into coal. O. A. Ford and J. C. Long, Everett, Mass., Assignors to United States Fuel Co., Boston, Mass. U.S. Pat. 1,175,944, Mar. 21, 1916. Date of appl., Jan. 21, 1914.

See Eng. Pat. 7593 of 1914; this J., 1915, 482.

Distillation retorts; Charging means for ——. E. Heiderich, Zeebrugge, Belgium. U.S. Pat. 1,171,979, Mar. 14, 1916. Date of appl., Mar. 30, 1914.

See Fr. Pat. 470,216 of 1914; this J., 1915, 166.

Gas producer. B. Versen, Dortmund, Germany. U.S. Pat. 1,175,844, Mar. 14, 1916. Date of appl., Nov. 3, 1913. Renewed Oct. 26, 1915.

See Eng. Pat. 24,329 of 1913; this J., 1915, 825.

[Mineral] lubricating oils and [petroleum] distillates from which such oils are formed; Treatment of ——. Allgem. Ges. f. Chem. Ind., Berlin. Eng. Pat. 7309, Mar. 23, 1914. Under Int. Conv., Mar. 27, 1913.

See Ger. Pat. 287,309 of 1913; this J., 1916, 169. (Reference is directed to Eng. Pat. 11,140 of 1908; this J., 1908, 974.)

Production of hydrogen. Ger. Pat. 289,207. *See* VII.

Plant for the production of hydrogen. Ger. Pat 289,208. *See* VII.

Process for purifying liquids. Eng. Pat. 6735 *See* XIXb.

Gas analysing apparatus. U.S. Pat. 1,176,199. *See* XXIII.

Apparatus for measuring automatically the composition of gases or gaseous mixtures by means of a Wheatstone bridge. Ger. Pat. 290,581. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Lignite; Results of the dry distillation of —— at various temperatures. A. Naumann. Z. Elektrochem., 1916, 22, 109—112.

The lignite was obtained from the Ludwigshoffnung mine, Wölfersheim, Wetterau; it was partly in pieces and partly in the form of an earthy powder. The pieces retained their shape during the distillation, and the coke did not cake or swell. The air-dried material showed on analysis C 21·70%, H 2·22%, O 9·17%, S 0·81%, N 0·17%, water 57·60%, and ash 8·33%. When dried in a toluol bath at 110° C. it lost all its water. The air-dried material had a calorific power of 5252 grm.-cals. 140 grms. of the air-dry material was distilled in an iron retort 30 cm. long and 5·7 cm. inside diameter, heated in an electric furnace, the temperatures being measured with a thermo-electric pyrometer. The tar was condensed in a water-cooled worm and the ammonia fixed in 30% sulphuric acid, the gas then passing into a gasometer. The following results, calculated on 100 grms. of the completely dried lignite, were obtained:—

Temperature of distillation. °C.	Gas, litres,	Tar, grms.	Ammonium sulphate, grms.	Coke, grms.
450	3·77	11·93	0·038	62·74
600	9·21	12·39	0·184	56·55
750	16·02	14·88	0·208	52·91
960	17·43	19·28	0·419	51·12
1100	24·32	19·36	0·467	46·47

The gas obtained at 750° C. and above, contained 80% by volume of combustible gases and had a calorific power of 3900 grm.-cals. per litre. The gas contains undesirable sulphur compounds which can be removed if necessary. The calorific power of the tar varied from 9000 to 10,765 grm.-cals. The tar contained a considerable proportion of paraffins of both low and high boiling point, and should be a welcome substitute for certain petroleum products. It has long been used for the manufacture of oils for Diesel engines. The presence of water increased the yield of ammonia, and a still larger yield could be obtained by gasifying the lignite in a producer. The calorific power of the coke was higher at the higher temperatures, averaging just over 5000 grm.-cals. The percentage composition of the coke was C 56·86, H 1·68, N 0·24, O 1·83, S 0·49, and ash 38·90%.—A. B. S.

Patents.

Ammonia; Furnace for the production of —— by destructive distillation of bituminous substances at a relatively low temperature. Torfentgasung Stauber Ges. m. b. H., Berlin. Ger. Pat. 290,577, June 11, 1914.

The interior of the furnace is divided into two compartments by a tubular partition, and a framework of vertical rods is arranged on either side of the partition in order to accelerate carbonisation.—A. S.

[Arc light] electrodes; Manufacture of ——. Gebr. Siemens und Co., Berlin-Lichtenberg. Ger. Pat. 289,645, Oct. 5, 1913.

The electrode material is moulded with the aid of a binding material which sets at a relatively low temperature, *e.g.*, with a solution of not more than 3% (of the total mass) of bakelite, and the electrodes are made ready for use by drying or moderate heating. A flaming arc light electrode, for example, is made from a mixture of 60% of graphite, 38% of suitable luminescent materials, and 2% of bakelite.—A. S.

Gaseous fuel combustion apparatus for heating purposes. E. Turner, Manchester. Eng. Pat. 1357, Jan. 27, 1915.

Process and apparatus for making denatured spirit. Denatured spirit. U.S. Pats. 1,176,150 and 1,176,462. *See* XVIII.

III.—TAR AND TAR PRODUCTS.

Toluene; Photobromination of ——. K. Andrich and M. Le Blanc. Z. wiss. Phot., 1915, **15**, 148, 183, 197. Z. angew. Chem., 1916, **29**, Ref., 147.

The yield of benzyl bromide and bromotoluene in the bromination of toluene under the influence of light is practically constant over the whole range of the spectrum between 579 and 325 $\mu\mu$, but it increases with the oxygen content of the reaction mixture. The consumption of oxygen in the reaction is due to the oxidation of hydrobromic acid with liberation of bromine, which again produces a substitution reaction; it is also due to the formation of peroxides and phenolic compounds. Addition of water to the mixture of toluene and bromine reduces the reaction velocity slightly in the air and markedly in an atmosphere of oxygen. The bromination of toluene dissolved in ethyl acetate is not sensitive to light, owing to the pronounced association of the bromine with the ethyl acetate. The differences observed in the absorption spectrum of bromine dissolved in different solvents is attributed to differences in the degree of association of the bromine and the solvent. For example in hexane and carbon tetrachloride there is little or no association, and in toluene much less than in ethyl acetate.—A. S.

β-Orcinol; Preparation of ——. A. Sonn. Ber., 1916, **49**, 621—623.

m-Dinitro-*p*-xylene (m.pt. 124° C.) is obtained by the dinitration of acetyl-*p*-xylidine and subsequent elimination of the acetyl group and replacement of the amino-group by hydrogen. Reduction followed by diazotisation of the *m*-nitro-amino-*p*-xylene leads to the production of *p*-xylorcinol (2.4-dihydroxy-*p*-xylene).—F. W. A.

Sulphurylindoxyl. Heterocyclic sulphones. III. M. Claass. Ber., 1916, **49**, 614—621.

On heating with ammonia under pressure, the α-carbon atom of sulphazone is eliminated as formic acid, and an indoxyl, $C_6H_4{<}\substack{NH\\SO_2}{>}CH_2$, is produced in which the CO group is replaced by SO_2 and to which the name sulphurylindoxyl is given. It has m.pt. 85°—86° C., b.pt. 336° C., and its methylene group is less reactive than that of the oxygen and sulphur isologues, β-coumaranone and oxythionaphthene, on account of the absence of the adjacent carbonyl group. The mono- and di-bromo derivatives (m.pt. 138°, 139° C.) are extremely stable and the nitro-compound fairly stable, as compared with the relative instability of the corresponding isologues. The behaviour of sulphurylindoxyl towards nitrous acid is quite different from that of its isologues. which give oximes readily with the exception of coumaranone whereas a nitrile compound and nitrated compounds are produced from sulphurylindoxyl. It was not found possible to bring about interaction between nitrosodimethylaniline and sulphurylindoxyl by known methods.—F. W. A.

Burning and distilling water-gas tar. Otten, jun. *See* IIa.

Equilibrium relations among aromatic hydrocarbons produced by cracking petroleum. Rittman and Twomey. *See* IIa.

Examination of asphalt. Gary. *See* IIa.

New penetration needle for use in testing bituminous materials. Reeve and Pritchard. *See* IIa.

Patents.

Creosote-oil ; Process of preparing ——. G. A. Cook, Kansas City, Mo. U.S. Pat. 1,176,315, Mar. 21, 1916. Date of appl., Aug. 5, 1915.

Approximately equal volumes of fuel oil and coal tar are mixed together and the mixture is allowed to settle. The upper clear layer, consisting of a solution of creosote oil, is then removed.—W. H. C.

Naphthalene : Method of purifying crude ——. Ges. f. Teerverwertung m. b. H., Duisburg-Meiderich. Ger. Pat. 289,945, May 15, 1915.

Crude naphthalene is treated with air at a temperature above 100° C., and the resulting product distilled. The impurities remain in an altered form in the distillation residue. Treatment with sulphuric acid is rendered unnecessary.—F. Sodn.

Isatin and resorcinol ; Preparation of a condensation product from ——. Farbw. vorm. Meister, Lucius.u.Brüning. Ger.Pat.290,599,Sept.22,1914.

Isatin is allowed to act upon an aqueous solution of resorcinol in the presence of an alkaline condensing agent, until its colour is discharged. A colourless. infusible substance is obtained, insoluble in the ordinary solvents, and apparently of high molecular weight, which can be used for the preparation of dyestuffs and of pharmaceutical compounds.—B. V. S.

[Hydr]oxytriarylmethanecarboxylic acids ; Preparation of ——. Farbenfabr. vorm. F. Bayer u. Co. Ger. Pat. 290,601, Nov. 24, 1914. Addition to Ger. Pat. 286,433 (this J., 1915, 1135).

In place of an aromatic aldehyde as in the chief patent, the corresponding benzal halide or a nucleus-substitution product may be used.—B. V. S.

Coal pitch ; Method of manufacturing finely-divided carbon and by-products from ——. A. C. Evans, Hampton Wick, and P. J. Mitchell, London. U.S. Pat. 1,175,732, Mar. 14, 1916. Date of appl., Dec. 22, 1915.

See Eng. Pats. 24,314 of 1914 and 8901 of 1915; this J., 1916, 170.

Process and apparatus for determining benzol in gas. U.S. Pat. 1,163,651. *See* IIa.

Apparatus for recovering hydrocarbons from absorbing oils. U.S. Pat. 1,176,094. *See* IIa.

Production of tar-macadam road surfaces. Ger. Pat. 290,839. *See* IX.

IV.—COLOURING MATTERS AND DYES.

Indigotins ; Simple method of preparing substituted ——. F. Bodinus. Chem.-Zeit., 1916, **40**, 326.

Substituted *o*-nitrochloroacetophenones are converted into the corresponding substituted indigotins by boiling with zinc and 30 % acetic acid. *Example.* 50 grms. of *p*-acet-toluide dissolved in 500 grms. of glacial acetic acid is chlorinated by a rapid current of dry chlorine mixed with dry carbon dioxide : after about 1½ hrs. the solution suddenly solidifies ; the solid is rapidly sucked dry, dissolved in the smallest possible amount of methyl alcohol, water added until the solution becomes opalescent, and the *m*-chloro-*p*-acet-toluido (m.pt. 116° C.) allowed to crystallise. By treatment with chloroacetyl chloride, this compound is readily converted by the Friedel-Crafts reaction into acetamino-*p*-methyl-*o*-chloro-*m*-*ω*-chloroacetophenone (m.pt. 129° C.), which is soluble in alcohol, ether, benzene, and chloroform. Careful introduction of this ketone into cooled fuming nitric acid and rapid addition of the reddish-brown solution to iced water gives a substituted *o*-nitrochloroacetophenone which crystallises in yellow needles (m.pt. 198°—199° C.). A solution of this substance in 30 % acetic acid gives on boiling with granulated zinc a blue flocculent precipitate of 4.4′-dimethyl-6.6′-dichloro-7.7′-diacetaminoindigotin. This compound is soluble in aniline, and slightly soluble in chloroform and glacial acetic acid ; on treatment with concentrated sulphuric acid the acetyl group is eliminated and a sulphonic acid group is introduced. The preparation of 4.4′.6.6′-tetramethyl-7.7′-diphthalaminoindigotin is also described. —F. W. A.

Natural and synthetic [coal-tar] dyestuffs ; Distinction between —— *based on electrical conductivity.* G. W. Chlopin and P. J. Wassiljewa. Z. Unters. Nahr. Genussm., **25**, 596. Monit. Scient., 1916, **83**, 54—55.

A method has been devised to distinguish between coal-tar colours and colouring matters of vegetable or animal origin, based on the fact that coal-tar dyestuffs (Auramine, Azoflavine, Chrysoidine, picric acid, and Naphthol Yellow) have a much higher conductivity than natural colouring matters (Cochineal, Catechu, Saffron, Quercitron, and Curcumin) in aqueous, and particularly in alcohol, solutions.—F. W. A.

Selenazine dyestuffs. P. Karrer. Ber., 1916, **49**, 597—603.

Selenodiphenylamine, prepared by the method of Cornelius (J. prakt. Chem., [2], **88**, 395), condenses readily with amines in a similar manner to the corresponding sulphur compound, the resulting selenium dyestuffs being very similar in chemical properties to the analogous sulphur dyestuffs, and having about the same toxicity. 3.6-Diaminoselenazine (Cornelius, *loc. cit.*), corresponding to thionine. is a stable substance undecomposed by boiling with fairly concentrated hydrochloric acid. The compound described by A. v. Wassermann and E. Wassermann (Ger. Pat. 261,793 ; this J., 1913, 783) as tetramethyldiaminoselenazine, seleno-Methylene Blue, is easily decomposed, and the author considers it doubtful whether seleno-Methylene Blue has yet been prepared. Selenazines containing a highly toxophoric group have been prepared from selenodiphenylamine and amino-substitution products of phenylarsinic acid. (Compare Bauer. this J., 1914, 1688.)—F. W. A.

Diglycines ; Aromatic ——. S. Fränkel and F. Bruckner. Ber., 1916, **49**, 485—488.

Phenyldiglycines have been prepared with the object of synthesising complex indigoid dye-stuffs.

The glycines of *o*-, *m*-, and *p*-phenylenediamine are readily obtained by the action of monochloroacetic acid on the diamine in presence of an excess of caustic soda ; the reaction temperature must be maintained between 80° C. and 120° C., as lower temperatures lead to the production of aminophenylglycines, whereas higher temperatures cause the formation of methylaminophenylglycines and anhydrides of the diglycines. The three diglycines are readily soluble in alkali hydroxides and carbonates and in dilute mineral acids, but less soluble in water and in hot glacial acetic acid. The *o*- and *m*-compounds are also soluble in acetone-alcohol. Fuming nitric acid and sulphuric acid exert a vigorous action on the compounds. Freshly precipitated copper hydroxide yields non-crystalline, green copper salts ; a saturated aqueous solution of picric acid gives the yellow picrates of the diglycines. Acid solutions give intense colorations with ferric chloride, ferricyanide, hydrogen peroxide, and other weak oxidising agents. Condensation by means of alkaline fusion, sodium amide, soda-lime, potassium cyanide, etc.. gives small amounts of a blue dyestuff, the nature of which has not been ascertained.—F. W. A.

Pyridine derivatives ; Synthesis of ——. L. Gattermann and A. Skita. Ber., 1916, **49**, 494—501.

The ketonic form of 2.6-dihydroxydinicotinic acid ester is obtained by the condensation of sodiomalonic ester with the so-called hydrocyanic acid sesquihydrochloride, dichloromethylformamidine hydrochloride, $NH:CH.NH.CHCl_2.HCl$, and subsequent elimination of alcohol. The potassium salt of the acid from this compound forms 2.6-dihydroxypyridine (m.pt. 202°—203° C.) on warming with dilute hydrochloric acid. On heating with phthalic anhydride and zinc chloride, dihydroxypyridine gives more highly fluorescent dyestuffs than resorcinol. The nitro- and nitroso-compounds have been prepared and a new series of azo dyestuffs produced by the action of diazotised amines.—F. W. A.

Patents.

Disazo dyestuffs ; Manufacture of chromable green secondary ——. Chem. Fabr. vorm. Sandoz, Basle, Switzerland. Eng. Pat. 17,607, Dec. 16, 1915. Under Int. Conv., June 9, 1915.

Monoazo dyestuffs obtained from *o*-diazophenols and 1.8-aminonaphthol-3.6-disulphonic acid are diazotised and combined with pyrazolones containing an unoccupied 4-position. The chromed green dyeings of the new dyestuffs are of excellent fastness to light, to milling, and to potting, the last-named constituting an advantage over the dyestuffs claimed in Eng. Pat. 14,768 of 1903 (this J., 1904, 782).—F. W. A.

[*Dis*]*azo dyestuffs.* O. Günther, Leverkusen, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,150,675, Aug. 17, 1915. Date of appl., Feb. 16, 1914.

1-Amino-2-naphtholethers with a free 4-position are combined with a diazo-compound, and the product diazotised and combined with a derivative of a 2-aminonaphthol sulphonic acid, *e.g.*, 2-amino-5-naphthol-7-sulphonic acid or 2-amino-8-naphthol-6-sulphonic acid, containing a diazotisable amino-group in a heteronuclear side chain. The alkali salts dye cotton blue to greenish-blue shades, converted into fast greenish shades by diazotisation on the fibre and development with phenylmethylpyrazolone, acetoacetanilide, phenol, or resorcinol, or by development with diazotised *p*-nitraniline. The dyestuff from 2.5-dichloroaniline-4-sulphonic acid using 1-amino-2-naphtholethylether-6-sulphonic acid as middle component and *p*-aminobenzoyl-2-amino-5-naphthol-7-sulphonic acid as end component is specially claimed.
—F. W. A.

Azo dyestuff ; Blue-violet ——. M. Latten, Leverkusen, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,169,329, Jan. 25, 1916. Date of appl., Mar. 23, 1915.

Tetrazo - 1.5 - naphthylenediamine-3.7-disulphonic acid is combined with 2 mols. of cresidine, and the resulting disazo-dyestuff is tetrazotised and combined with 2 mols. of resorcinol. The product gives violet shades on cotton rendered fast to washing by after-treatment with formaldehyde.
—F. W. A.

Disazo dyestuff ; Blue ——. W. Neelmeier , H. Jordan, and K. Heusner, Leverkusen, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1.169,344, Jan. 25, 1916. Date of appl., Jan. 29, 1915.

The diazo-compound of an *ortho*-disubstituted acyl-*p*-phenylenediamine, *e.g.*, 5-amino-4-chloro-2-acetamino-1-phenolmethyl ether, is coupled with a 1-amino-2-naphtholether-6-sulphonic acid, the product diazotised and combined with 1-naphthol-4-sulphonic acid. The products generally dye cotton blue shades which can be converted by diazotisation on the fibre and after-treatment with suitable developers, *e.g.*, β-naphthol, into bright greenish-blue shades, fast to washing, and discharged to a pure white by hydrosulphite.
—F. W. A.

Sulphur colours. M. Buff, Elberfeld, and A. Thauss, Deutz, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,175,230, Mar. 14, 1916. Date of appl., Nov. 13, 1914.

By sulphurising indophenols derived from a *p*-aminophenol and an α-aminotetrahydronaphthalene, *e.g.*, the leucoindophenol 1-amino-4-[*p*-hydroxyphenylamino]-5.6.7.8-tetrahydronaphthalene, sulphur dyestuffs are obtained which dye unmordanted cotton from a sulphide or hydrosulphite vat pure blue shades fast to boiling.
—F. W. A.

Mordant dyestuffs ; Preparation of acridone ——. L. Cassella und Co. Ger. Pat. 290,064, June 13, 1914.

β-Naphthoquinone-3-carboxylic acid is condensed with primary or secondary amines of the benzene or naphthalene series containing a free *ortho*-position to the amino-group, and the products treated with acid condensing agents to split off water. The dyestuffs obtained are quite different from those of Ger. Pat. 280,712 (this J., 1915, 545), being fast mordant dyestuffs for wool, giving brown, blue to black shades from an acid bath ; the dyeings may be deepened by treatment with suitable mordants and are absolutely fast to milling and to potting. Amines of the benzene series generally give brown to brownish-black dyestuffs. Valuable products are obtained from α-naphthylamine, its N-alkyl and N-aryl derivatives and ring-substituted products ; the dyeings obtained are blue to blue-black, and full deep black shades of good fastness to milling and to potting are obtained by after-chroming.—F. W. A.

Triarylmethane dyestuffs fast to light ; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 290,065, July 18, 1914.

4-Halogen-4′-aminobenzophenones, their N-substitution products and homologues, are condensed with α-indoles, the dyestuffs obtained treated with aromatic amines, and the products sulphonated. Violet acid dyestuffs of good fastness to light are obtained.—F. W. A.

Polyazo dyestuffs ; Preparation of substantive ——. Farbw. vorm. Meister, Lucius. und Brüning. Ger. Pat. 290,398, Apr. 24, 1914.

The disazo dyestuffs, prepared according to Ger.

Pat. 205,661 (this J., 1909, 198) by diazotising and coupling with aminoarylacidyl derivatives of 2-amino-5-hydroxynaphthalene-7-sulphonic acid the monoazo dyestuffs obtained by coupling 2.4-aminobenzoylamino-5-hydroxynaphthalene-7-sulphonic acid with a diazo compound, are diazotised and coupled with resorcinol or *m*-aminophenol. The red dyestuffs obtained give yellowish-red to bluish-red dyeings on cotton very fast to washing after treatment with formaldehyde.—F. W. A.

Finely divided dyestuffs of 'the N-dihydro-1.2.1′.2′-*anthraquinoneazine [Indanthrene] series ; Production of* ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 290,521, Sept. 7, 1913.

The dyestuffs are treated in presence of water with organic liquids, such as pyridine, phenol, cresol, etc., and are thus obtained in an extremely fine state of division suitable for application as pigment and printing colours.—F. W. A.

Monoazo dyestuffs ; Preparation of mordant ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290 078, May 19, 1914. Addition to Ger. Pat. 263,192.

2-Diazophenolsulphonic acids or their ring-substituted products are combined with 1-arylsulphamino-7-naphthols instead of with the carboxylic acids claimed in the main patent. The dyeings are of greener shade and are faster to milling.—F. W. A.

Anthracene [vat] dyestuffs ; Preparation of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 290,079, Sept. 8, 1914.

Benzanthrone, its derivatives or analogues, are treated with caustic alkalis in presence of indifferent solvents of high boiling-point, *e.g.*, aromatic amines. Pure dyestuffs are readily obtained in this manner.—F. W. A.

Phthalein dyestuffs ; Preparation of ——. Anilinfarben- u. Extraktfabr. vorm. J. R. Geigy. Ger. Pat. 290,508, June 12, 1915.

Equimolecular amounts of α-hydroxynaphthoyl-*o*-benzoic acid or its substitution products, and of resorcinol or a ring substitution product containing a *para*-position to one of the hydroxy groups free, *e.g.* pyrogallol, are condensed at a high temperature by means of concentrated sulphuric acid or zinc chloride, and if required the products are halogenated. In case pyrogallol is used green chrome mordant dyestuffs are produced.—F. W. A.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Wood flour. F. W. Kressmann. Met. and Chem. Eng., 1916, **14**, 372—374.

Wood flour is used in the manufacture of dynamite, linoleum, and plastic and flooring materials, and as an inert absorbent in other industries. The species of wood employed are limited, by considerations of colour and weight, to the white non-resinous conifers and broad-leaved woods ; spruce, white pine, and poplar are those most often used. The wood, stripped of bark, is reduced to chips and then ground in stone mills or in steel burr roller mills, the former being used almost exclusively in Europe, particularly Scandinavia, where water power turbines are employed. The mills are enclosed and sufficient water or steam is added to the charge to prevent firing and dusting, the fine material being drawn or blown through iron pipes to the screening apparatus in which bronze wire or silk bolting cloth is used, and the screened product either sacked with automatic sacking and weighing machinery or compressed into bales for export. Before the war, Norwegian wood flour was delivered to the U.S. Atlantic ports for $12.50—$15 (£2 12s.—£3 2s. 6d.) per ton and there sold in competition with the domestic product. In the manufacture of dynamite, wood flour is the absorbent most commonly used at the present time, typical dynamites containing 15 or 18·5% of this constituent with 40 or 61 of nitroglycerin, 41 or 19 of sodium or potassium nitrate, and 1 or 1·5 of calcium carbonate (to neutralise acidity caused by storage). A good wood flour should be capable of making dynamite containing 60 or 70% of nitroglycerin without permitting any of the latter to exude ; the absorptive qualities may be improved by boiling wood flour with water and drying. In 1900, over 9,934,000 lb. of wood flour was used in the manufacture of dynamite in the United States, the amount similarly consumed in 1909 being probably about 20,000,000 lb. Wood flour is used exclusively in the manufacture of inlaid linoleum, cork not being permissible by reason of its dark colour. Wood flour weighs about 50—100% more than the cork used in the same industry. In 1909 about 4,460,000 sq. yds. of inlaid linoleum, weighing 8—12 lb. per sq. yd. (excluding the painted backing) and containing 40—50% of wood flour, was produced in the United States.—W. E. F. P.

Patents.

Zirconium compounds ; Process of impregnating fibrous materials with —— *[e.g., in fireproofing textiles and weighting silk].* A. Mond, London. From E. Rietz, San Paulo, Brazil. Eng. Pat. 4457, Mar. 22, 1915.

In fixing zirconium compounds in textile fibres, *e.g.*, for fireproofing or for weighting silk, a uniform impregnation with a hydrogel of zirconium hydroxide is produced by steeping the material in a solution of a zirconium salt, *e.g.*, 20 grms. of zirconium acetonitrate (obtained by evaporating zirconium nitrate with acetic acid) and a neutral salt, *e.g.*, 200 grms. of magnesium sulphate, in 1 litre of water, draining, heating at 60°—70° C. for ¾ hour, and washing. For fireproofing, the impregnated material may be treated with dilute phosphoric acid to form an adsorption compound with the hydrogel of zirconium hydroxide. Another method consists in dissolving precipitated zirconium phosphate in a concentrated solution of oxalic acid, agitating it in presence of excess of the solid acid, impregnating the material with the solution, with or without a subsequent treatment in a solution of a neutral salt, *e.g.*, magnesium chloride, and heating in a drying chamber at 70°C. —J. F. B.

Wool and other textile fibres and textile and othe materials ; Machines for washing ——. F. B Petrie, Rochdale. Eng. Pat. 100,145, Dec. 10 1914. (Appl. No. 1503 of 1916.)

In a washing machine of the type described i Eng. Pat. 23,837 of 1914 (this J., 1916, 172 means other than a screw-conveyor are provide for moving the foreign matters accumulated a the bottom of the bowl towards the outlet valv A conveyor of the endless-band type is specified —J. F. B.

Saturating [tyre] fabric : Apparatus for —— F. W. Kremer, Carlstadt, N.J. U.S. Pat 1,174,995, Mar. 14, 1916. Date of appl., May 16, 191

The fabric passes vertically downwards throug squeezing rollers immersed in the impregnatin liquid contained in a tank ; the rollers expel t air from the fabric, and means are provided f removing air-laden fluid from both sides of the rollers. By means of a guide roller the fabric is made to pass horizontally across the tank and then vertically upwards out of the liquid and between squeezing rollers. Means are provided for adjusting the pressure on the first pair of squeezing rollers, which are journaled in a vertically sliding frame which may be removed from the tank with the rollers. A baffle plate serves to confine air bubbles expelled from the fabric to the portion of the fluid adjacent to the first pair of squeezing rollers.—F. W. A.

Artificial silk ; Machines for spinning ——. H. de Chardonnet, Paris. Eng. Pat. 10.857, July 27, 1915. Under Int. Conv., Aug. 1, 1914.

The nozzles producing each group of threads are grouped together on a separate feed-table, which is supplied with collodion by a two-barrel feed pump with differential plungers passing right through their respective barrels, the movement of each plunger in forcing the collodion through the spinning nozzles being slower than the suction movement of the same in filling the barrel, so that one plunger continues to feed the collodion while the distribution-cock of the other barrel is turning at the end of every stroke, avoiding interruption of the flow at the dead point, while slight variations are compensated by a spring pressure regulator or accumulator on each feed-table. Two series of pump plungers are connected to two vertically sliding beams actuated by rollers travelling in the grooved paths of rotating cam pulleys, the count of the thread being determined by the ratio of the speed of rotation of the cam pulleys to that of the bobbins. Studs sliding in circular and oblique grooves in the rims of the cam pulleys actuate through sliding bars a series of three-way distribution cocks in the respective pump barrels. As the collodion enters the pump barrels from the supply pipe under pressure, its tendency to raise the plunger system is counteracted to the extent of the minimum pressure reached in spinning, by attaching counterweights to the plungers, so that the force required to move the plunger downwards against the resistance of the collodion corresponds only to the difference between the maximum and minimum pressures reached in spinning.—J. F. B.

Cellulose for the preparation of spinning solutions ; Manufacture of ——. Ver. f. Chem. Ind. in Mainz, Frankfort. Ger. Pat. 290,131, May 31, 1913.

Cotton is treated with small quantities of acid or acid salts, *e.g.*, with 0·01 to 0·2 % of sulphuric acid, and dried at a low temperature. Its strength is thus increased by 10 to 30 %, and not more than traces of oxy- or hydrocellulose are formed. It behaves like mercerised cotton in giving viscose solutions of improved solubility, and the fibres from such solutions show considerable strength. It is also possible by means of this process to obtain solutions of approximately uniform viscosity.—F. Sp.

Acid magnesium sulphite solution ; Process for the production of —— and its application for the extraction of cellulose from fibrous vegetable materials. J. L. Jardine, Penecuik, and T. A. Nelson, Edinburgh. Eng. Pat. 2509, Feb. 17,1915.

In the preparation of an acid magnesium sulphite solution by the addition of sulphur dioxide to magnesium oxide suspended in water, the proportion of base to acid in the solution increases as the temperature at which the solution is prepared is raised. A solution prepared at or above 110° F. (43° C.), when 2·4 % of total sulphur dioxide has been absorbed, will show, by the ordinary analysis, 1·6 % of combined and 0·8 % of "free" acid. Such a relatively basic bisulphite solution is suitable for the digestion of materials, *e.g.*, bamboo, which contain relatively large proportions of pectin and small proportions of lignin. In the digestion process described in Eng. Pat. 18,371 of 1913 (this J., 1914, 1006), it is necessary with ordinary liquor at a high degree of acidity to blow off the excess of acid gas in order to avoid its deleterious action, but when employing a liquor of the above character, the absorption of the "free" sulphur dioxide is completed in the digester itself.—J. F. B.

Pulp ; Process of compacting and drying ——. J. H. Rivers, St. Louis, Mo., Assignor to Universal Fibre Co., New York. U.S. Pat. 1,174,447, Mar. 7, 1916. Date of appl., July 26, 1909.

Pulp-composition suspended in water is introduced into a perforated "former" contained in a casing, so as to cause the perforated surface to be submerged while a relatively thin primary layer is deposited. The remainder of the pulp is then deposited against the primary layer by the introduction of superheated steam under gradually increasing pressure, and the action of the steam is continued after the completion of the deposit until the pulp has become sufficiently compact and dry. —J. F. B.

Pulp boilers ; Apparatus for heating liquor for ——. E. Morterud, Torderöd, Norway. Ger. Pat. 289,538, July 1, 1913.

The lower portion of a vertical cylindrical heater is divided by horizontal diaphragms into three compartments. From the upper compartment, a tube closed at the upper end passes vertically upwards inside the heater. Inside this is a slightly narrower tube, open at the upper end, and communicating with the middle compartment at the lower end. Steam is led into the middle compartment, passes upwards to the open end of the narrow tube, and then down the space between the two tubes into the upper compartment, where condensed water is drawn off. Any air which collects in the widest tube can be drawn off by means of a third tube, inside the other two, and open at each end, which leads from the bottom compartment almost to the top of the widest tube. Each heating unit thus consists of three concentric tubes, attached to the upper, middle, and lower diaphragm respectively, and a number of these units is provided to each heater.—F. Sp.

Sizing composition [for paper] and process of making same. J. A. De Cew, Montreal. U.S. Pat. 1,174,697, Mar. 7, 1916. Date of appl., Aug. 13, 1914.

A non-separating waterproof sizing composition is made by permanently emulsifying rosin in combination with over 15 % of its weight of a mineral wax or one not readily saponifiable.—J.F.B.

Paper ; Process for removing ink or colouring matter from ——. J. Welsh, Green Bay, Wis. U.S. Pat. 1,175,853, Mar. 14, 1916. Date of appl., Mar. 31, 1915.

Waste paper is reduced to a pulp which is treated with "spent digester liquids," the material is drained, washed in fresh water, and the clean pulp fibres are separated from the impurities.—J. F. B.

(A) *Sulphite waste liquors ; Method of treating* ——. (B) *Method of treating waste sulphite liquor, and product produced thereby.* (C) *Insulating composition.* (D) *Plastic composition and method of making same.* (E) *Cement composition.* W. K. Freeman, Oscawana, N.Y., Assignor to Hydrolose Process Corporation, New York. U.S. Pats. 1,175,422—1,175,426, Mar. 14, 1916. Date of appl., Nov. 25, 1913.

(A) Sulphite waste liquor is concentrated, treated with hydrochloric acid, agitated and boiled,

partially cooled, treated with ammonia, agitated by heating so as to precipitate the sulphur-calcium compounds in an inert form, allowed to settle, and the product evaporated. (B) Partially evaporated sulphite liquor is treated with an alkali chloride, agitated while hot, partially cooled, and treated with barium chloride so as to precipitate the sulphur-calcium compounds. (C) The product of sulphite liquor treated to precipitate the sulphur and calcium compounds, dried with the precipitate therein and ground, is mixed with an oxide and chloride capable of reacting to form an oxychloride binding agent, a suitable inert substance of high insulating properties, and a small percentage of gum. (D) The product of sulphite liquor, treated as above, separated from the precipitates, evaporated, dried, and powdered, is mixed with a small quantity of gum camphor, with or without powdered indurated vegetable fibre, and then with a mixture of powdered metallic oxide and chloride adapted, when wet, to form an oxychloride binding agent. (E) The product of sulphite liquor treated as above, dried without removing the precipitate and powdered, is mixed with the powdered components of an oxychloride binding agent and with finely disintegrated wood which has previously been treated with an oxychloride cement, allowed to set, and then disintegrated.
—J. F. B.

Plastic composition [from sulphite waste liquor], article made from same, and process of making. W. K. Freeman, Oscawana, N.Y., Assignor to Hydrolose Process Corporation, New York. U.S. Pat. 1,175,427, Mar. 14, 1916. Date of appl., Nov. 25, 1913.

Composition articles are made by mixing powdered "xylium" with powdered magnesium oxide and disintegrated fibrous material, moistening the mass with a solution containing magnesium chloride to form a plastic mass, the chloride being in sufficient quantity to form an oxychloride bond, and bringing the mass in contact with hot surfaces to remove excess moisture and press it into form.—J. F. B.

Ethers of carbohydrates, $nC_6H_{10}O_5$, and their derivatives; Manufacture of ——. L. Lilienfeld, Vienna. Eng. Pat. 3370, Feb. 9, 1914. Under Int. Conv., Feb. 14, 1913.

See Fr. Pat. 468,162 of 1914; this J., 1914, 958.

Plastic composition [from acetylcellulose]; Process of obtaining a ——. F. Meyer, Aachen, Assignor to A. Eichengrün, Berlin, Germany. U.S. Pat. 1,175,791, Mar. 14, 1916. Date of appl., Aug. 21, 1908.

See Fr. Pat. 393,963 of 1908; this J., 1909, 257.

Cork; Manufacture of homogeneous, elastic and light objects resembling ——. F. Raschig, Ludwigshafen, and Suberit-Fabr. Ges., Mannheim-Rheinau, Germany. Eng. Pat. 5359, Apr. 9, 1915.

See U.S. Pat. 1,170,102 of 1916; this J., 1916, 356.

Manufacture of a building and insulating material and of articles of all kinds from wood pulp and wood pulp compositions. Ger. Pat. 288,320. *See* IX.

Method of producing balata impregnated textile driving belts impervious to moisture. Eng. Pat. 4494. *See* XIV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Faded wool; The affinity of —— for certain dyestuffs. M. Fort. J. Soc. Dyers and Col., 1916, 32, 109—111. (See also Whittaker, this J., 1916, 11.)

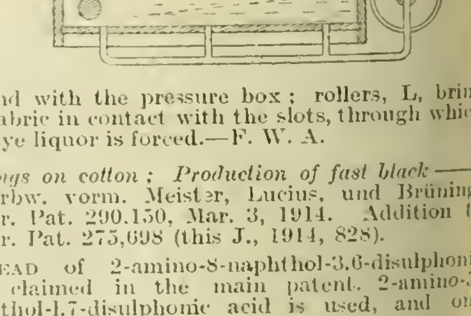
The affinity of faded wool for various classes of dyestuffs is somewhat erratic; generally there is increased affinity for basic dyestuffs, but opinions differ in the case of acid dyestuffs, mainly because the behaviour of wool faded by exposure for a short time may be totally different from its behaviour after prolonged exposure. A parallel case of this order is that of steaming; prolonged steaming reverses the initial effect of the treatment in relation to certain dyestuffs. Faded wool is extremely sensitive to the solvent action of alkalis; this fact and the increased affinity for basic dyestuffs point to an increased development of acidic groups. A close parallel may be drawn between the modification effected by fading by exposure and that produced by boiling wool with dilute caustic alkali. The similarity of the affinity for dyestuffs of the modified wools is very close and apparently the only differences may be explained by the fact that fading is a dry process, in which the acidic products remain *in situ*, whereas by the alkali treatment they are decomposed and removed. The acidification of wool by fading does not, however, preclude the increased development of amino groups at the same time, since wool is amphoteric in character, and the modification in the basic direction is manifested by the reaction with α-naphthoquinone sulphonate and the affinity for certain acid dyestuffs. Partially faded fabrics may be equalised towards basic dyestuffs by sulphur-mordanting, *i.e.*, steep-containing 4 % of sulphuric acid. With acid dyestuffs a more level result may be obtained by preliminary treatment with ammonium persulphate, which has the advantage of leaving the wool in combination with sulphuric acid and ready for direct dyeing. A trace of catalyst, *e.g.*, silver nitrate, stimulates the action of the persulphate.
—J. F. B.

Dyeing, etc.; Apparatus for ——. J. J. Tracy, Cleveland, Ohio. U.S. Pat. 1,174,912, Mar. 7, 1916. Date of appl., Mar. 12, 1914.

A number of vats are arranged side by side, and in each of them is a removable container. Each container is provided with a slotted arm projecting on either side and fitting over pins on a pair of parallel bars placed on either side of the row of vats. The bars are reciprocated in opposite directions, whereby the containers are oscillated about a vertical axis.—F. W. A.

Dyeing [or impregnating] machine. L. J. Matos, East Orange, N.J. U.S. Pat. 1,175,538, Mar. 14, 1916. Date of appl., Nov. 24, 1913.

The dyeing or impregnating machine consists of a pressure box, B, provided with slots, *b*, and a circulating pump, D, connected with the dye vat, A, and with the pressure box; rollers, L, brin the fabric in contact with the slots, through whic the dye liquor is forced.—F. W. A.



Dyeings on cotton; Production of fast black ——. Farbw. vorm. Meister, Lucius, und Brüning Ger. Pat. 290,150, Mar. 3, 1914. Addition t Ger. Pat. 275,698 (this J., 1914, 828).

Instead of 2-amino-8-naphthol-3.6-disulphoni acid claimed in the main patent, 2-amino- naphthol-1.7-disulphonic acid is used, and on or both molecules of resorcinol are replaced by *m*-aminophenol. The trisazo dyestuffs so obtained give shades having a reddish instead of a greenish tinge, and the dyeings on after-treatment with formaldehyde possess better fastness to washing and to light.—F. W. A.

Bleaching by electrolysis; Apparatus for ——. J. F. Webb, London, and W. W. Williams, Enham. U.S. Pat. 1,175,572, Mar. 14, 1916. Date of appl., Feb. 25, 1915.

See Eng. Pat. 20,714 of 1914; this J., 1915, 1139.

Textile materials: Apparatus for the fluid treatment of ——. J., T., and E. Brandwood, Bury. U.S. Pat. 1,174,662, Mar. 7, 1916. Date of appl., Feb. 12, 1913.

See Eng. Pat. 551 of 1913; this J., 1914, 133.

Dyeing pelts, hairs, feathers, and the like: Process for ——. F. Merkel, Offenbach, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,175,539, Mar. 14, 1916. Date of appl., Apr. 22, 1915.

See Eng. Pat. 5447 of 1915; this J., 1915, 831.

Vat-dyestuff compounds suited for dyeing and printing. M. Iljinsky, Assignor to Wedekind und Co., Uerdingen, Germany. U.S. Pat. 1,175,634, Mar. 14, 1916. Date of appl., Dec. 13, 1912.

See Fr. Pat. 453427 of 1913; this J., 1913, 746.

Quinone vat dyestuffs; Preparations from ——. A. Schmidt, Assignor to Farbw. vorm. Meister, Lucius u. Brüning, Höchst, Germany. U.S. Pat. 1,175,997, Mar. 21, 1916. Date of appl., Sep. 2, 1914.

See Eng. Pat. 19,272 of 1914; this J., 1915, 955.

Colorations on fibre; Process of producing ——. F. Günther, Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,176,363, Mar. 21, 1916. Date of appl., Sep. 5, 1913.

See Eng. Pat. 6796 of 1913; this J., 1913, 1154.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

ulphur in pyrites cinder; Rapid method for the determination of ——. H. C. Moore. J. Ind. Eng. Chem., 1916, 8, 26—28.

BOUT 1 grm. of the cinder, ground to pass a 100-iesh sieve, is mixed in a wrought iron or nickel rucible with 7 grms. of sodium peroxide, the ixture is covered with a thin layer of the per-xide, and heated to fusion for some minutes. After oling, the crucible is placed in a beaker containing bout 50 c.c. of water and, when the fused mass as dissolved, the crucible is removed, rinsed, and e solution treated with hydrochloric acid to dis- lve the iron residue, but avoiding excess. he solution is transferred to a 500 c.c. flask, eated with about 0·5 grm. of aluminium powder, iled until nearly all of the aluminium has ssolved, then cooled, diluted to the mark, d filtered. Two hundred c.c. of the filtrate diluted to 450 c.c., 1 c.c. of hydrochloric id is added, and the sulphuric acid precipitated treating the cold solution with barium chloride lution. The precipitate is collected after 1 hour, shed with cold water, dried, ignited, and weighed. e presence of a considerable quantity of barium lphate or silica in the cinder has no appreciable luence on the results obtained.—W. P. S.

icial acetic acid; Preparation of —— from aqueous acetic acid. E. Gahtzenstein. Z. angew. Chem., 1916, 29, 148.

ACIAL acetic acid may be prepared from dilute aqueous acetic acid by extracting it with low-boiling solvents immiscible with water, *e.g.*, chloroform, symmetrical dichloroethylene, benzene, or petroleum ether, and distilling off the solvent (cf. Ger. Pat. 28,064). An apparatus for conducting the process is described, consisting of a vessel provided with stirring gear, in which the extraction takes place. The non-aqueous layer is run by gravity into a still; the solvent is vaporised, rises through a rectifying column where it is freed from acetic acid, and is then condensed and returned to the extraction vessel. The process is stopped when the solvent extracts practically no more acetic acid. *Examples.* (1) 156 kilos. of calcium acetate, decomposed with its equivalent of concentrated hydrochloric acid, and extracted with 250 litres of chloroform, yielded 90% of the theoretical amount of 99·6% acetic acid. (2) 300 kilos. of a solution of acetic acid in sulphuric acid, obtained electrolytically, containing 70% of acetic acid and 7% of sulphuric acid, extracted with 250 litres of dichloroethylene, yielded 90% of the theoretical amount of absolute acetic acid.—F. Sp.

Ammonium sulphate; Methods for dealing with arsenical sulphuric acid in the manufacture of ——. P. Parrish. J. Gas Lighting, 1916, 134, 134—137.

It has become necessary, recently, for many manufacturers of ammonium sulphate to use arsenical sulphuric acid, with the result that arsenic sulphide is precipitated in the saturator and the sulphate is discoloured. Three methods are available for overcoming this difficulty:—(1) The method used by shale distillers in Scotland, which consists in working with an oil film, *e.g.*, of anthracene, on the surface of the acid in the saturator. Once or twice each day the bath is diluted, heated to boiling, and then allowed to stand, whereupon the oil settles to the bottom, carrying with it tarry impurities, etc., and the precipitated arsenic sulphide, and is drawn off. (2) By using a closed saturator with an automatic scumming device: the arsenic sulphide is discharged continuously with the tarry matter, and the use of an oil film is not necessary. (3). By precipitating the arsenic from the acid by means of the waste gases from the saturator. The acid, diluted to 65% strength to avoid precipitation of sulphur, flows by gravity from a lead-lined feed tank through two closed dearsenicating tanks of cast iron, preferably lined with lead, though this is not essential, as weak acid saturated with hydrogen sulphide has little or no corrosive action on cast iron. The waste gases from the saturator, after leaving the coolers, are passed through the dearsenicating tanks in the opposite direction to the acid, the gas-inlet pipe in each tank terminating in a perforated horse-shoe cracker pipe of hard lead, below the level of the acid. The acid flows from the dearsenicating tanks to settlers of sufficient capacity to allow of settling for 24 hours, and then passes through siphons to lead-lined filter-tanks each having a false bottom of porous tiles. The concentration of the acid is reduced by 5°—6° Tw. (0·025—0·03 sp.gr. units) by the process of dearsenication. The mud in the settling tanks must be washed periodically with water to recover the acid.

Attention is drawn to the great waste which occurs owing to the failure to treat coke-oven gas for the recovery of sulphur. It is estimated that at least 80% of the gas produced in coke-ovens in Great Britain is untreated so far as recovery of hydrogen sulphide is concerned and that an additional 51,600 tons of spent oxide of 50% S content might be made available from this source. It is recommended that the Ministry of Munitions should take steps to ensure recovery of this sulphur, should forbid elimination of hydrogen sulphide by means of lime, and should enforce the removal of sulphur compounds other than hydrogen sulphide by the process of Carpenter and Evans (see this J., 1914, 737; 1915, 9) in order that the sulphur may be recovered in a useful form.—A. S.

Carbon dioxide; Rapid method for the determination of ——. W. H. Waggaman. J. Ind. Eng. Chem., 1916, 8, 41.

The carbonate or other substance is decomposed in a 300 c.c. conical flask the upper part of which is surrounded by a cooling coil; the delivery tube of the flask is connected with a short condenser, inclined upwards, and this in turn is connected with the following series of absorption vessels:—A U-tube containing silver sulphate solution (to remove hydrochloric acid), a sulphuric acid bulb, a potash bulb, a calcium chloride tube, a second sulphuric acid bulb, and a tube containing barium hydroxide solution. The latter indicates any loss of carbon dioxide due to too rapid passage of gas through the apparatus; it also shows when the potash bulb has become exhausted. Air is drawn through the apparatus after having first been passed through potassium hydroxide solution contained in a flask; the stopper of this flask also carries an Ostwald gas-regulator which controls the supply of gas to the burner under the decomposition flask. The apparatus is useful for the estimation of carbon dioxide in carbonates as well as in soils and organic compounds.—W. P. S.

Zinc salts: Study of the action of alkali on certain —— *by means of the hydrogen electrode.* J. H. Hildebrand and W. G. Bowers. J. Amer. Chem. Soc., 1916, 38, 785—788.

Solutions of zinc chloride, bromide, and iodide, each containing an excess of the corresponding acid, were titrated with sodium hydroxide and the course of the reaction followed by means of the hydrogen electrode. The results indicate that in such solutions there is present a weak acid of the type $HZnCl_3$, and that zinc hydroxide acts towards alkali essentially as a monobasic acid. —B. N.

Zinc peroxide. E. H. Riesenfeld and W. Nottebohm. Z. anorg. Chem., 1915, 90, 150—152. Chem. Zeit., 1916, 40, Rep., 122.

Solutions of zinc salts in concentrated hydrogen peroxide give with alkalis and ammonia, in the cold a precipitate containing equivalent amounts of Zn and O_2 but yielding less water than would correspond with $ZnO.H_2O_2$; it is considered to be a hydrated peroxide, $ZnO_2,\frac{1}{2}H_2O$, but it has not been possible to decide whether the water is combined chemically or not. The composition of the precipitate was not altered by continued stirring with 30% hydrogen peroxide.—F. W. A.

Iron; The oxides of ——. *I. Solid solution in the system Fe_2O_3–Fe_3O_4.* R. B. Sosman and J. C. Hostetter. J. Amer. Chem. Soc., 1916, 38, 807—833.

Measurements of the dissociation pressures of the iron oxides were made in a vacuum furnace with a heating tube of platinum-rhodium, with a view to the study of iron-bearing silicates at high temperatures. It was found that reproducible oxygen pressures can be obtained at a given temperature, equilibrium being produced in a few minutes at high temperatures, although certain disturbing reactions go on slowly, such as the reduction of the oxide by the platinum, forming an iron-platinum alloy. With minor exceptions, ferric oxides from various sources yielded practically identical pressures, either with rising or falling temperatures, and the oxidation of magnetite gave pressures identical with those produced by the dissociation of pure ferric oxide. The pressure-composition isotherm for the system Fe_2O_3—Fe_3O_4 at 1200° C., confirmed also by the one at 1100° C., indicated a continuous series of solid solutions from Fe_2O_3 to a point very near Fe_3O_4, if not over the entire range to Fe_3O_4, but an optical demonstration of the existence of solid solution is prevented in the products containing more than 18% of FeO owing to their opacity. The greater portion of the oxygen pressure curve of the system at 1200° C. lies between the limits 4 mm. and 1 mm., the pressure dropping rapidly near Fe_3O_4 and rising rapidly near Fe_2O_3, as shown in the table, which gives representative values of oxygen pressure in equilibrium with solid solutions between Fe_2O_3 and Fe_3O_4.

Percentage of FeO.	Percentage of iron which is ferrous.	Pressure at 1100° C.	Pressure at 1200° C.
0·90	1·0	0·37	5·0
1·80	2·0	0·22	3·6
2·71	3·0	0·17	3·0
4·52	5·0	0·13	2·6
9·09	10·0	0·10	2·15
13·70	15·0	0·092	1·80
18·37	20·0	0·085	1·55
23·07	25·0	0·069	1·27
27·83	30·0	0·052	0·85
31·03	33·33	$<$ 0·005	$<$ 0·04

Since the dissociation of Fe_2O_3 results in the formation of a solid solution, the pressure of oxygen and the composition of the solid phase will depend upon the relation of the weight of the charg to the volume of the space into which the oxygen formed by dissociation, passes, which account for the variety and uncertainty of results previousl obtained in experiments on the dissociatio pressure of Fe_2O_3.—B. N.

Iron, manganese, lead, and the metals of Group II. (periodic law); Compounds of ——. S. U Pickering. Chem. Soc. Trans., 1916, 109, 235—250

In a previous communication (this J., 1915, 868 it was shown that metallo-compounds of cobal and nickel are formed analogous to those of coppe The work has now been extended to manganes iron, lead, zinc, cadmium, mercury, magnesium barium, strontium, and calcium, over forty pair of such compounds having been obtained wit five different organic acids, and the colou phenomena of copper salts leave no doubt tha similar compounds exist in the case of all organ acids. When first formed, the metallo-compoun appears to contain the elements of water in additio to the formula MR, but in many cases it can b dehydrated without losing its distinctive propertie and in this condition it is strictly isomeric wit the normal salt, from which however it diffe in physical properties and constitution, for electr lysis shows it to contain the metal in the anio The explanation given of the existence of th copper metallo-salts applies equally to those the other metals, and all the metals appear to capable of acting as tetrads.—B. N.

Carbon monoxide; The periodic evolution of —— J. S. Morgan. Chem. Soc. Trans., 1916, 10 271—283.

When certain fractions obtained by distillati of formic acid are treated with concentrat sulphuric acid, the evolution of carbon monoxi is periodic, but the pure acid does not show periodicity. The higher fractions were ve active, and the addition of a small quantity any of these, or traces of other impurities, an inactive acid induced periodicity. The acti is considered to be a supersaturation phe menon; the decomposition proceeds smooth but the evolution of gas is retarded until the solution attains such a concentration that spontaneous evolution ensues in accordance with Ostwald's theory. As soon as the requisite quantity of gas has been formed, the absorbed gas escapes with a violent rush, and is followed by a further quantity of gas which escapes at the pressure that would be normal if the reaction were proceeding smoothly. It is suggested that the influence on the limits of supersaturation attained, and on the quantity of gas liberated over and above that which has been absorbed, may be due largely to small quantities of impurities.—B. N.

Adsorption of strong electrolytes [*by blood charcoal*]. Y. Osaka. Mem. Coll. Sci., Kyoto Imp. Univ., 1915, 1, 257—268.

The adsorption of strong electrolytes by blood charcoal was studied, and by recognising the necessity of determining and allowing for the adsorption of the solvent, which is comparatively so great as to reverse in some cases the effect of adsorpt on on the electrolyte and cause an apparent negative adsorption, consistent results were obtained which may be summarised as follows:—The higher the concentration the greater the adsorption; sodium and potassium nitrates, and potassium bromide and iodide are positively adsorbed; sodium and potassium sulphates and sodium chloride are apparently negatively adsorbed owing to the adsorption of the water being for its molecular concentration greater than that of the dissolved salt. After calculating the actual adsorption of the salts themselves per grm. of charcoal it becomes evident that for the same molecular concentrations the degrees of adsorption of salts of the same base are in the order $I > NO_3 > Br > Cl > SO_4$, and further that sodium salts are less adsorbed than potassium salts of the same acid. This series is in the same order as that in which the salts influence the surface tension of water, the precipitation of a sol, and other similar physico-chemical phenomena.—G. F. M.

PATENTS.

Nitric acid; Process for making highly concentrated ——. O. Imray, London. From Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. Eng. Pat. 4345, Mar. 19, 1915.

On adding liquid nitrogen peroxide to dilute nitric acid, and allowing the mixture to stand, two separate liquid layers are formed, of which the upper consists of very concentrated acid mixed with peroxide (which can be removed by distillation), and the lower contains weak acid and peroxide. The lower layer is treated with oxygen to oxidise the peroxide, and then with liquid peroxide as above. A mixture of water, or of dilute nitric acid and liquid nitrogen peroxide, with or without oxygen treatment, can be used for preparing concentrated acid of any desired strength, *e.g.*, 15 parts by weight of 81% nitric acid is mixed and shaken with 30 parts of liquefied peroxide; after settling the upper layer contains acid of 98—99%, and the lower layer acid of 75% strength. The liquids should be well agitated, and a reflux apparatus should be used to avoid loss of nitrogen peroxide. The process may also be worked under pressure.—E. H. T.

Volatile acids [*nitric acid*]; *Apparatus for the manufacture of* —— *from their salts.* H. Frischer, Cologne, Germany. Eng. Pat. 7099, May 11, 1915.

Retorts for the distillation of volatile acids, *e.g.*, nitric acid, are provided with a number of pipes at different points for carrying off the acid vapours. These pipes are connected singly or in pairs to separate condensers which unite towards the end f the cooling system. A more rapid, uniform and economical distillation results, and larger retorts can be used, *e.g.*, 5000 kilos. of saltpetre can be treated in 6—8 hours.—F. Sp.

Glover, Gay-Lussac, and like towers. The Accrington Brick and Tile Co., Ltd., and S. Middleton, Accrington. Eng. Pat. 8152, June 2, 1915.

The tower is furnished with channelled packing blocks arranged so as to produce long, narrow, inclined passages. The earthenware blocks are easy to make and comparatively few are required; each may be used in an upright or in an inverted and reversed position. If the blocks are placed end to end, and alternate blocks of each layer are reversed, or if they are laid one on top of another, with the alternate blocks reversed, a wall-like tier is produced through which runs a series of continuous, zig-zag channels. The tower can be completely filled with these tiers in such a way that they are independent of one another.
—E. H. T.

Sulphuric acid: Process for concentrating —— *and apparatus therefor.* Soc. Anon. La Fabrique de Soie Artificielle de Tubize, Brussels. Eng. Pat. 10,386, July 16, 1915. Under Int. Conv., July 16, 1914.

The acid is concentrated in a series of closed, intercommunicating vessels arranged in step-like formation. The acid flows downwards from one vessel to another, and the evolved vapours are led off at the top of each vessel into the acid contained in the vessel immediately above it.—E. H. T.

Table salt; Process and apparatus for making —— *from rock salt.* Gewerkschaft "Einigkeit I." Ehmen, Germany. Eng. Pat. 12,911, Sept. 9, 1915. Under Int. Conv., Sept. 11, 1914.

Ground rock salt that has been moistened with water, with or without the addition of a binding material, or with other liquid of a binding nature, is granulated and dried by heating it in a metallic shaking trough. The latter is divided longitudinally into narrow channels by means of low partitions, and for about two-thirds of its length it is provided with transverse corrugations. The trough is heated by steam, hot air, or fuel. Before entering the trough, the salt is passed through sieves or sifting floors, and after treatment it is bleached in a drum with chlorine and then aerated in a second drum.—E. H. T.

Metal oxides and hydroxides; Recovery of ——. A. O. Blickle, Assignor to Metallbank und Metallurgische Ges. A.-G., Frankfort, Germany. U.S. Pat. 1,175,587, Mar. 14, 1916. Date of appl., Sept. 24, 1913.

Solutions of metallic salts, *e.g.*, metallic chlorides, are treated with basic substances in amount just sufficient to precipitate one or more of the metals as basic salt. The precipitate is then heated with more basic substance in amount equivalent to the particular metal or metals to be separated, the temperature being below the boiling point of the salt. The metal is converted into oxide or hydroxide, which is then removed by lixiviation.
—E. H. T.

Lixiviation of minerals or the like. O. Brünler, Brussels. Ger. Pats. (A) 286,742, Nov. 30, 1913, and (B) 289,365, Jan. 27, 1914.

(A) A mixture of combustion gases and steam, produced by a flame burning under water in a closed vessel, is passed through a mass of the mineral under treatment, immersed in water. The mineral may be packed around a tube through which the mixture of steam and combustion gases passes first, before coming in contact with the mineral. The process may be used for the extraction of sodium nitrate from caliche. (B) A mixture of combustion gases and steam carrying particles of water in suspension, is passed through a vessel containing the mineral.—A. S.

Crystallisation of hot salt solutions. W. Häberlein, Berlin-Grunewald. Ger. Pats. (A) 288,817, June 13, 1913, and (B) 288,901, Aug. 14, 1914. Additions to Ger. Pat. 271,102 (this J., 1914, 409).

(A) INSTEAD of using a vessel divided into compartments as in the chief patent, a series of troughs is used, connected with each other by bridge-pieces, so that the solution can overflow from one trough to the next, but otherwise completely independent. In this way transmission of heat from one cooling zone to the next is hindered, and the number of cooling stages and the time required are reduced. The bridge-pieces, exposed to the air above and below, are of such width that the thin film of solution flowing over them is cooled appreciably, and are inclined so that any crystals which separate are carried forward by the liquid into the next trough. (B) Each trough is provided with a separate supply conduit for the cooling water, and the cooling water leaving the troughs flows into reservoirs, from which the supply conduits are fed with progressively smaller quantities of water from one end of the system to the other.—A. S.

Magnesia; Process for obtaining products rich in —— from mixtures of magnesium carbonate and calcium carbonate. Harburger Chem. Werke Schön u. Co., Harburg. Ger. Pat. 289,710, Feb. 2, 1915.

A MIXTURE of magnesium and calcium oxides produced by burning the mixed carbonates is slaked with water, the quantity of which is sufficient to convert only the calcium oxide into hydroxide. The amount of water required is determined by test. The magnesia product may be freed still further from calcium hydroxide by treatment with solutions of magnesium salts, such as magnesium chloride.—W. C. H.

Potassium salts; Apparatus for the continuous separation of liquid from granular material, especially ——. B. Schilde Maschinenbau und Apparatebau Ges. Ger. Pat. 289,774, Jan. 28, 1914.

THE apparatus consists of a trough divided into an upper and a lower compartment by a pair of longitudinal perforated partitions. The material, contained in the upper compartment, is moved forwards by a series of scrapers which travel to and fro and are pivoted in such a way that they swing freely whilst moving in one direction, but are prevented from swinging whilst moving in the other. The lower ends of the scrapers are a short distance above the upper perforated partition and are so curved that they exert a downward pressure on the material, thus expelling the liquid, which flows through the partitions into the lower compartment in which a partial vacuum is maintained.—A. S.

Nitrogen and oxygen; Method of producing compounds of —— especially nitrogen oxides from free nitrogen. W. Lachmann, Dresden. Ger. Pat. 289,844, July 26, 1913.

IN the production of nitrogen oxides the heating and reaction periods are kept separate. For example a gaseous mixture containing free nitrogen and free oxygen is passed over an auxiliary substance (such as magnesia) which has been previously heated to a high temperature by direct contact with combustion gases (produced, preferably, with gas rich in oxygen, instead of with air). During the production and utilisation of the heating gas, the temperature may be controlled by circulating part of the hot waste combustion gases near the furnace walls. The furnace described is divided by radial walls into contiguous units.—F. SODN.

Barium oxide; Manufacture of ——. W. Lampe, Hameln. Ger. Pat. 290,445, Nov. 22, 1913.

IN the production of barium oxide by calcining, a furnace fired by flameless surface-combustion is used. The bed of refractory material forming the surface-combustion burner acts as the roof of the calcining chamber and can be raised or lowered in order to control the temperature.—A. S.

Nitrogen and carbon dioxide; Manufacture of ——. R. H. Brownlee and R. H. Uhlinger, Pittsburgh, U.S.A. Eng. Pat. 5097, Apr. 1, 1915.

SEE U.S. Pat. 1,154,172 of 1915; this J., 1915, 1141. Other carbonaceous substances than fuel gas may be added to the mixture of combustion products and air, *e.g.*, a volatilisable oil, fuel oil, powdered coal, or the like.

Hydrogen and other gases; Apparatus for carrying out reactions between ——. H. Wade, London. From M. Pier, Zehlendorf, Germany. Eng. Pats. (A) 9661, Apr. 18, 1914, and (B) 100,216, Apr. 18, 1914. (Appl. No. 148 of 1916.)

(A) SEE U.S. Pat. 1,090,874 of 1914; this J., 1914, 485. The inner vessel is formed of glass, silica, or glazed porcelain, and the outer vessel of iron or steel, or, for temperatures above 550° C., of nickel-steel or nickel-chrome-steel, which has been previously heated to a temperature suitable for hardening, quenched in oil, heated slowly to a temperature exceeding the normal range at which the apparatus is to be worked, and then allowed to cool slowly. The space between the inner and outer vessels is filled with an inert gas, *e.g.*, nitrogen. (B) See U.S. Pat. 1,159,865 of 1915; this J., 1915, 1250. The inner vessel is formed of iron, and the outer vessel of iron or steel, or, for temperatures above 550° C., of specially treated steel (see above). The inner space and the space between the inner and outer vessels communicate by a special tube or by apertures in the wall of the inner vessel above the level of the molten metal in the intermediate space.

Hydrogen; Production of ——. W. Näher and M. Nöding, Pforzheim. Ger. Pat. 289,207, Jan. 24, 1915.

IN the production of hydrogen by the action of steam upon iron, the latter is used in the form of shavings obtained from cast iron by the action of a steel tool, the edge of which meets the piece of cast iron at an obtuse angle. Shavings obtained in this way, when packed into a retort, resemble a piece of massive but perfectly porous iron and expose a much greater surface to the steam than iron prepared in any other way. Shavings of a similar character cannot be prepared from wrought iron or steel.—A. S.

Hydrogen; Plant for the production of ——. K. Schaffer, Charlottenburg. Ger. Pat. 289,208, Apr. 1, 1914.

IN an installation for the production of hydrogen by the treatment of iron alternately with steam and with a reducing gas previously cooled and purified, the capacity of the apparatus in which the reducing gas is produced, and of the cooler and purifier connected therewith, is so adjusted that the gas may be supplied direct to the hydrogen-producing apparatus, the working pressure being regulated according to the varying back pressur in the section of the plant in which hydrogen i generated and purified. One or more elastic gas holders, placed underground, are interposed betwee the hydrogen generator and the compressin apparatus to receive excess of hydrogen an supply it to the compressing apparatus when the output of the hydrogen generator is curtailed.—A.S.

Silicates ; Manufacture of soluble ——. J. W. Spensley and J. W. Battersby, Manchester. U.S. Pat. 1,176,613, Mar. 21, 1916. Date of appl., May 1, 1915.

See Eng. Pat. 11,959 of 1914 ; this J., 1915, 834.

Nitrous vapours or gases ; Process of absorbing —— in burnt lime. A. T. Schloesing, Paris, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. U.S. Pat. 1,177,359, Mar. 28, 1916. Date of appl., Sept. 24, 1913.

See Fr. Pat. 460,328 of 1912 ; this J., 1914, 23.

Kelp and similar aquatic plants ; Utilisation of ——. T. Boberg and N. Testrup, Assignors to Techno-Chemical Laboratories, Ltd., London. U.S. Pat. 1,177,375, Mar. 28, 1916. Date of appl., Dec. 28, 1914.

See Eng. Pat. 1766 of 1914 ; this J., 1915, 227.

Process of recovering sulphuric acid from the waste acid of petroleum factories. Eng. Pat. 12,363. *See* IIa.

Purification of heating and lighting gases from hydrogen sulphide and ammonia. Ger. Pat. 290,509. *See* IIa.

Furnace for the production of ammonia by destructive distillation of bituminous substances at a relatively low temperature. Ger. Pat. 290,577. *See* IIb.

VIII.—GLASS ; CERAMICS.

Silver on glass ; Yellow coloration of burnished ——. L. Springer. Keram.-Runds., 1915, **23**, 159—160, 177—178, 190, 207—208. Z. angew. Chem., 1915, **28**, Ref., 630—631.

Silver decoration on glass, after burning, requently appears more or less yellow on the side n contact with the glass, whilst quite white and apable of taking a high polish on the other side. This yellow coloration depends upon the burning emperature. For example, in cases where no discoloration occurred at a temperature corresponding to Seger cone 022, a yellow colour appeared on burning at cone 019 to 017 ; and when a faint discoloration appeared at the lower temperature t was intensified on burning at a higher temperature. The silver should not be applied with other colours or enamels which require a high temperature ; burning should be effected at as low a temperature s possible (not above cone 022, dark red heat). and the glass should be left in the muffle for as hort a time as possible. The composition of the ilver preparation also has some influence. Silver arbonate and fine grey silver powder, probably morphous, gave good results, whereas silver owder of bright lustrous character, probably rystalline, and silver powder containing copper roved unsatisfactory.—A. S.

Porcelain ; Notes on hard or felspathic ——. J. W. Mellor. Trans. Eng. Ceram. Soc., 1914-15, **14**, 176—192.

The author considers it useless to attempt to upplant German hard porcelain by imitations made with other kinds of ware, as these cannot ossess the requisite technical properties, but the manufacture of hard porcelain in England should ffer no insuperable difficulties. The typical erman hard porcelain is composed of clay subance 50, felspar 25, and quartz 25%. For sisting sudden changes in temperature a mixture clay substance 57, felspar or equivalent 23, nd flint 20 is preferable, but for domestic china the body should be rich in silica as it will then require less firing. A suggested mixture (composed of British materials) consists of china clay 38, ball clay 15, purple Cornish stone 40, flint 7% ; this closely resembles an ordinary earthenware body. It is considered essential to the commercial success of the manufacture of hard porcelain in England that no foreign materials should be used ; it may be difficult to find a suitable clay to replace the ball clay and a stone free from the disadvantages of the Cornish stone suggested above. The glazes are similar to the materials composing Seger cones 4 to 11 and are equivalent in composition to (0·1 to 0·3 K_2O, 0 to 0·3 MgO, 0 to 0·3 BaO, 0·4 to 0·7 CaO), (0·4 to 1·2 Al_2O_3), (3·5 to 11·0 SiO_2). Lead and boric oxides, which are used in English porcelain glazes, are absent from the German ones. The chief differences between the methods of manufacture in Germany and England are that German manufacturers (*a*) temper the materials in an edge-runner mill instead of pugging them, (*b*) age the paste for a considerable time before using it, (*c*) cast more efficiently and with greater skill, (*d*) fire the biscuit ware at a much lower temperature, (*e*) fire the glazed ware at a much higher temperature (cone 12 to 16), (*f*) make exceptionally large allowances in the moulds for deformation of the ware in the kiln, and (*g*) keep a reducing atmosphere in the kiln throughout the burning. The German saggers, in which the ware is burned, are made largely of grog (burned clay) which has been freed from dust and separated into two grades—coarse and fine—the particles ranging from 1 to 7 mm. diameter. The usual proportions are fine grog 2 parts, coarse grog 8 parts, plastic clay 7 to 10 parts. The saggers are made in a similar manner to those in England but are shallower. The decoration is mostly on the glaze, as underglaze colours are nearly all destroyed at the high temperatures used in glazing. The on-glaze colours do not weld well with the glaze and their effect is less pleasing than in English china ware. Marquardt porcelain has a body containing 30 to 35% silica and 60 to 65% alumina, some of the latter being apparently in the free state. The pyrometer tubes made of this material are extruded from a machine and are apparently fired in a vertical position.—A. B. S.

Earthenware bodies ; A study of ——. (I). L. J. Truss and P. Stanway. Trans. Eng. Ceram. Soc., 1914-15, **14**, 173—175.

Thirty-three bodies were compounded according to their "rational" analyses from ball clay, china clay, quartz, and felspar, half the "clay substance" being introduced as ball clay and the other half as china clay. The dried materials were made into slips, sifted, dried on plaster to a suitable consistency, and moulded into slabs which were then dried. The shrinkage on drying was measured, the slabs were fired in an ordinary earthenware biscuit oven (cone 2a), and the kiln-shrinkage measured. The slabs were then glazed with an ordinary earthenware glaze and fired in an earthenware glost oven (cone 02a). The results, shown on a triangular diagram, indicate that the best mixtures are those in the centre of the diagram ; mixtures very rich in clay or felspar tend to craze badly, whilst those rich in quartz tend to peel.—A. B. S.

Tunnel oven ; Development of the Dressler —— since 1911. C. Dressler. Trans. Eng. Ceram. Soc., 1914-15, **14**, 41—61.

In the earlier ovens (Eng. Pats. 18,114 and 28,617 of 1910 ; this J., 1911, 1254) the goods were carried on a plain car, the products of combustion of the fuel passing through two horizontal pipes, one on each side of the car and known as "combustion chambers." In this arrangement the upper goods were heated more strongly than the lower ones. By making the two combustion chambers triangular in cross-section and placing the goods on a high car well above them (see Eng. Pat. 8228 of 1912; this J., 1913, 792), much greater uniformity of heating was obtained, but the goods were too hot when taken out of the kiln, the output was too low, and the temperature reached was insufficient for general use. By placing two cooling pipes, similar to the "combustion chambers," in the cooling section of the kiln and drawing air through these pipes (see Eng. Pat. 23,863 of 1912; this J., 1913, 1094), it is possible to withdraw the goods at any desired temperature: the hot air produced may be used for drying other goods. By using "combustion chambers" of quadrilateral cross section and inserting another pipe inside each, they could be made to withstand any desired temperature, as the air passing through the inside pipe kept them from softening and collapsing. In the kiln last erected (see Eng. Pat. 18,821 of 1913; this J., 1915, 81), the combustion chambers reach almost to the top of the tunnel, a low car is used and is piled high with the goods, the three chief drawbacks in the earlier kilns being now obviated.—A. B. S.

Ovens; Distribution of heat in ceramic ——. A. Bigot. Trans. Eng. Ceram. Soc., 1914-15, **14**, 96—129.

The heat produced by the combustion of fuel in an oven or kiln is expended in heating (*a*) the goods, (*b*) the air required for combustion, (*c*) the excess of air purposely present to secure good colour, etc., (*d*) the air leaking into the kiln, (*e*) the foundations, (*f*) the atmosphere surrounding the kiln, and (*g*) the walls, and also (*h*) in radiation from the walls, and (*i*) heat escaping up the chimney. The author considers the following results as typical:—

	Dressler's tunnel kiln.	Hoffmann's continuous kiln.	Intermittent down-draugh oven.
Temperature attained	1000° C.	1000° C.	1000 °C.
Heat supplied by fuel	4·80%	7·00%	21·00%
" " " hot air or gases ...	1·53%	3·12%	—
" " " fired ware.	3·27%	3·00%	—
	9·60%	13·12%	21·00
Heat expended:—			
To evaporate combined water in the goods ...	0·56%	0·50%	0·50%
To raise goods to 1000° C.	3·27%	3·00%	3·00%
To heat supports, walls, etc.	1·26%	3·30%	4·02%
To heat excess of air ...	—	4·52%	2·26%
Loss by chimney	0·55%	0·90%	9·42%
Loss by radiation, etc. ..	0·36%	0·90%	1·80%
Loss owing to goods leaving kiln whilst hot	0·60%	—	—
	6·60%	13·12%	21·00%
Heat recoverable for drying, etc.	3·00 %		
	9·60%		
Relative costs for fuel per ton of goods burned	6d.	8½d.	2s. 3d.

The percentages given are the proportion of fuel per 100 parts of goods burned. The author considers that, allowing for unavoidable losses by radiation, etc., raw goods should require the following proportions of fuel:—3·5% at 1000° C., 4·1% at 1200° C., 4·38% at 1300° C., and 4·70% at 1400° C. When temperatures above 1000° C. are to be reached, some form of insulation should be employed. Two methods are suggested: (*a*) building the kiln of highly porous bricks made largely of kieselguhr and reducing the thickness of the walls to one-half, and thereby reducing the loss through the walls from 4·02% to 0·75% and saving half the fuel; (*b*) by surrounding the oven with a ferro-concrete casing and building it on a ferro-concrete table so as to isolate it below and on each side.—A. B. S.

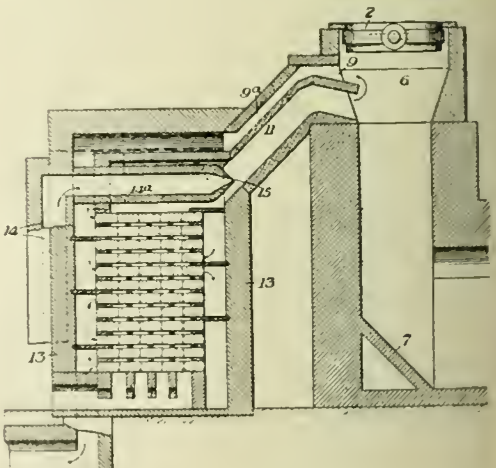
Colours [*for pottery*]; *Cobalt and nickel* ——. A. D. Hollinshead, J. Turner, and J. W. Mellor. Trans. Eng. Ceram. Soc., 1914-15, **14**, 167—172.

Ternary mixtures of either cobalt or nickel oxide with zinc oxide and aluminium hydroxide (the last calculated to oxide) were made to correspond to the points of intersection of a triangular diagram representing 20% variations of each ingredient. The mixtures were calcined in a china biscuit oven (cone 10), wet-ground, sifted, dried, and printed on standard earthenware slabs. The colours were "hardened on" at a dull red heat and dipped in (*a*) leadless glaze, (*b*) raw lead glaze, or (*c*) low solubility glaze and then fired in a glost oven (cone 01a). Coloure ddiagrams are given showing the various shades of blue and brown obtained. The equilibrium tint for the cobalt mixtures is a violet-blue. A matt blue (Thenard's) is obtained with aluminous glazes low in lead, but is very sensitive to the composition of the glaze. Anything which favours action of the silica on the body or glaze increases the tendency to form the equilibrium tint. The nickel colours were all unsatisfactory, being unstable and liable to variations in tint.—A. B. S.

Patents.

Regenerative [*glass*] *furnaces*. H. Wade, London. From Empire Machine Co., Pittsburgh, U.S.A. Eng. Pat. 10,157, July 12, 1915.

A glass-drawing furnace containing a reversible glass-pot, 2, mounted on trunnions in a well, 6, is combined with a recuperator, 13, which provides a supply of hot air for the combustion of the gas used for heating the furnace. The gas enters through the flue 14, and as it passes along the flue, 14*a*, it is heated by the air circulating around the latter and is burned at the jet, 15, and in the combustion chamber, 11, the products of combustion passing around the pot, 2, and through the flues, 9, 9*a*, into the recuperator, which is thereby heated. The furnace works with natura draught, and it is claimed that the deposition o carbon on the glass-pot is thereby prevented The use of a reversible pot enables the refuse glass to be melted out of the inverted portion and



collected at the base, 7, of the well, 6, providing a clean pot whenever one is required.—A. B. S.

Glass; Method of manufacturing ——. R. G. Kann, Pittsburgh, U.S.A. Eng. Pat. 10,446, July 19, 1915.

The customary method of mixing the ingredients of glass in bulk and taking portions of the mixture as required is stated to give irregular results. To avoid this, the ingredients are mixed in small quantities, made into briquettes, and a suitable number of the briquettes supplied to the furnace. The plant used consists of a series of bins to hold the raw materials, each bin being fitted with an automatic measuring device which delivers a suitable quantity of each ingredient on to a horizontal conveyor-belt. The materials, together with a suitable binder, are delivered to a mixer and the mixture is passed through a briquetting machine, the briquettes being stored in an elevated bin from which they are discharged, as required, into a ladle mounted on a small wagon and taken to the furnace.—A. B. S.

[Ceramic] kilns. W. A. Norman and E. Evans, Ruabon, Wales. Eng. Pat. 5341, Apr. 9, 1915.

In a ceramic kiln having a lower floor below the floor supporting the material, the draught openings in the former are surrounded by short vertical pipes provided with detachable hoods to prevent obstruction by broken material. Plugs may be provided for stopping the pipes when a modification of the draught is desired.—W. F. F.

Ceramic ware; Process of and apparatus for burning ——. H. L. Doherty, New York. U.S. Pats. (a) 1,175,246 and (b) 1,175,247, Mar. 14, 1916. Dates of appl., (a) Oct. 29, 1909, renewed Feb. 7, 1916; (b) Sept. 30, 1910.

The ware is passed progressively downwards through a tall shaft kiln. In the upper part of the kiln it is dried and preheated by the combustion gases from the zone below; in the intermediate or heating zone the ware is burned by gas from a producer, the air for combustion being heated by drawing it through the cooling ware in the lower part of the kiln. The producer consists of an annular chamber in the walls of the kiln, and the gas is formed by withdrawing some of the combustion gases from the firing zone and passing them through a comparatively deep bed of fuel at such a velocity that sufficient carbon dioxide is reduced to carbon monoxide to give the desired flame-temperature at the burners. As the ware passes downwards, it travels in the opposite direction to the hot air, flame and combustion gases, efficient heating being secured by this counter-current effect. The charge in the kiln is carried by bars in the cooling zone, but when it is desired to withdraw part of the burned and cooled ware a vertically movable platform, forming the bottom of the kiln, is raised by hydraulic power until it supports the whole weight of the contents of the kiln. The bars are then withdrawn, the platform lowered, and the bars re-inserted; when the platform reaches its lowest point, the section of goods below the bars is removed through an opening in the side of the kiln.—A. B. S.

Salt-glazed stoneware pipes, gullies, traps and the like; Method of making —— *to prevent blisters rising after such are made.* J. Brewin, Woodville. Eng. Pat. 10,643, July 22, 1915.

To prevent blisters rising during drying, some dry clay dust is mixed with the prepared pugged clay before using the latter.—W. C. H.

Highly refractory ceramic objects; Process of manufacture of —— *with a coating of the most refractory rare earths.* H. Herzfeld, Berlin. Ger. Pat. 289,992, Feb. 8, 1914.

The parts of the objects to be coated are covered with a thin layer of a mixture of the body material and the rare earth and then with the pure earth (zirconia, thoria) itself and the whole fired. The layers of rare earths may be deposited by electro-osmosis, in which case the refractory articles are rendered conductive by first coating them with a thin layer of graphite. They are then introduced into a bath containing strongly dehydrated hydroxides of the earths in the finest state of suspension. The earths are deposited on the articles by an E.M.F. of about 200 volts till a layer of several millimetres thickness is formed. By endosmose the particles are arranged according to fineness, so that the coating is dense and uniform.—W. C. H.

Enamel glaze; Manufacture of ——. Westf. Stanz. und Emaillierwerke A.-G. vorm. J. and H. Kerkmann, Ahlen. Ger. Pat. 290,054, Nov. 4, 1913. Addition to Ger. Pat. 289,103 (this J., 1916, 424).

In place of metal powder, soluble metallic compounds are employed which are decomposed at the temperature required for enamelling and yield the metal in a fine state of division.—W. C. H.

Potters' ovens; Charging and drawing of ——. M. P. Ferneyhough, Stoke-on-Trent. Eng. Pat. 13,387, Sept. 20, 1915.

IX.—BUILDING MATERIALS.

Portland cement mortars; Behaviour of —— *in different salt solutions.* V. Rodt. Mitt. k. Materialprüf., 1915, **33**, 229—240.

Test pieces made up of 1 part of cement and 3 parts of normal sand, and of 1 part of cement and 6 parts of sand, were immersed for 6 months in 0·1% to 10% solutions in tap water of sodium chloride, sodium sulphate, magnesium sulphate, magnesium chloride, and calcium chloride, in saturated and 1/10 saturated solutions of calcium sulphate, and in the tap water itself. The actions of the solutions were observed by inspection, and the lime content and alkalinity of the solutions at the conclusion of the tests were determined. The 1 : 3 briquettes were cut in halves, and each half, weighing about 80 grms., used for different tests. The 1 : 6 briquettes were used whole and weighed each about 136 grms. The volumes of the solutions used varied from 400 c.c. to 5 litres. None of the 1 : 3 briquettes was destroyed, but indications of destructive action were observed with the calcium sulphate solutions. With the 1 : 6 mortar only the solutions of the sulphates acted destructively, but in these cases, the action was considerable. Surface markings appeared to be formed in an arbitrary manner, and were merely local. Calcium chloride and magnesium chloride led to considerable extraction of lime from the cement, especially with the more concentrated solutions and the 1 : 6 mortar.—T. St.

Examination of asphalt. Gary. *See* IIa.

Patents.

Artificial stone; Manufacture of ——. A. Ford, and P. Ford and Sons, Ltd., Uttoxeter. Eng. Pat. 4246, Mar. 18, 1915.

Stone resembling granite, amygdaloid, or other natural stone is made by mixing crushed natural stone with cementing material and water, casting the whole in a mould, grinding, and polishing. The cementing material is made to have the same hardness and coefficient of expansion as the natural stone and to be translucent, through the crystallisation of the cementing constituents, by adding to a mixture of Portland cement and calcium sulphate two or more of the following: soluble aluminous salts (alum), alkali silicate, or boric acid.—W. C. H.

Artificial stones containing hydraulic binding materials; Process of treating freshly made —— in tunnels with gases charged with steam. A. P. Bock, Vienna. Ger. Pat. 289,494, Mar. 5, 1913.

The stones are exposed in the front part of the tunnel (the setting chamber), under special admission of steam, to a current of warm air continuously passing from back to front, and in the back part of the tunnel (the drying chamber) to a current of warmer dry air continuously passing from back to front. Part of the fumes developed in the drying chamber is removed independently from the air current in the setting chamber. Above or at the side of the drying chamber are arrangements for generating steam and preheating the air. A boiler supplies steam to a heater for warming the drying medium entering the back part of the drying chamber. Circulation of warm air is maintained by a fan, adjoining a heater above the setting chamber. The steam passes through the two heaters in succession, and then to discharge openings in the base of the setting chamber. The separating wall between the return air pipe and the setting chamber is provided at intervals with openings controlled by dampers.—W. C. H.

Fibrous materials [wood], etc.; Weather and flame resistant composition for ——. S. R. Church, Brooklyn, Assignor to Barrett Manufacturing Co., New York. U.S. Pat. 1,162,453, Nov. 30, 1915. Date of appl., June 16, 1915.

An intermediate product for use in proofing fibrous materials, such as wood, etc., is prepared by mixing a non-combustible waxy body, *e.g.*, a polychloronaphthalene, with a combustible waxy body, *e.g.*, the semi-solid product of the destructive distillation of petroleum tar, known as "wax tailings," the latter body acting as a non-volatile solvent of the former. Example: 1000 lb. of hexachloronaphthalene is melted with 350 lb. of "wax tailings" at 120°—150° C., and the melt is subsequently digested at 80°—90° C. with a solvent mixture containing 320 lb. of heavy coal tar naphtha and 135 lb. of carbon tetrachloride under a reflux condenser. The presence of the wax tailings increases the solubility of the hexachloronaphthalene in the volatile solvent and improves the physical properties of the residue after application.—J. F. B.

Wood; Process of preserving ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 289,990, Apr. 3, 1913.

Wood is treated with mixtures of mercury salts and soluble silicates. Mercury is not separated from such mixtures by contact with iron, so that iron tanks may be used. The silicate acts as a fire-proofing material, and the mercury salts in wood thus treated are not in a volatile form. The wood can be used in enclosed spaces. By the action of atmospheric carbon dioxide part of the alkali is removed from the silicate, which is converted into a more or less insoluble form, poor in alkali, which fills the pores of the wood and diminishes the absorption of moisture.—W. C. H.

Wood; Process for preserving ——. F. Bub, Falkenberg. Ger. Pat. 290,186, Feb. 21, 1914.

The wood is treated with a solution of fluorides and a solution of mercuric chloride, separately or simultaneously. Silico-fluorides may be added to the fluorides. In admixture with fluorides mercuric chloride does not coagulate albumin even on continued boiling.—F. W. A.

Porous blocks; Method of treating ——. C. E. Fuller, Kansas City, Mo. U.S. Pat. 1,176,284, Mar. 21, 1916. Date of appl., Oct. 9, 1915.

Porous blocks are saturated with a substance, such as bitumen or asphalt, having a greater coefficient of expansion than the blocks, the substance being solid when cold but readily melted. The blocks are heated, treated with liquid bitumen under pressure, and cooled slowly under atmospheric pressure.—A. B. S.

Masonry; Process of caulking —— by partial water pressure. G. Schall, Schönau. Ger. Pat. 289,799, Feb. 1, 1913.

Dry cement mortar mixtures are moistened with benzine, benzol, or other liquid hydrocarbons, together with a little water, by a small water pressure, or by a stronger pressure without any water, and the mass is forced into the joints, etc., to be caulked. Cement sets quicker and more completely with benzine than with alcohol, and after the setting the benzine evaporates as completely as alcohol.—W. C. H.

Building and insulating material and articles of all kinds from wood pulp and wood pulp compositions; Manufacture of ——. B. Jirotka, Berlin. Ger. Pat. 288,320, Nov. 12, 1914.

The wet wood pulp composition is charged into moulds and partially dehydrated by centrifugal force, and the product is then completely dried either in the mould, *e.g.*, by the introduction of hot air, or after removal from the mould. The dried material may also be impregnated, whilst still in the mould, with the aid of centrifugal force. An apparatus for carrying out the process consists of a drum mounted to rotate around a hollow axis and divided into compartments by radial partitions. The perforated periphery of the drum forms the outer walls of the moulds, the inner walls of which are formed by fixed or movable plates arranged between the radial partitions.
—A. S.

Tar-macadam road surfaces; Production of ——. K. Dammann, Essen, Germany. Ger. Pat. 290,839, Mar. 18, 1913.

The road is covered with a layer, 5 cm. thick, of pieces of slag of uniform size (1—3 cm. diameter), and after tarring and rolling, hollow spaces are filled and a smooth surface formed by applying a mixture of sand, or slag or stone dust, and fused pitch and bitumen heated to 90°—100° C. The road surface thus prepared resembles an asphalt surface, but is considerably cheaper than this, and also than tar-macadam surfaces prepared by other methods.—A. S.

Asphalt; Process of manufacturing ——. R. Wallbaum, Berlin. U.S. Pat. 1,176,006, Mar. 21, 1916. Date of appl., Nov. 12, 1913.

See Fr. Pat. 462,658 of 1913; this J., 1914, 315.

Waterproofing and weatherproofing composition [for porous stone, etc.]. H. Von der Heide, Unna-Königsborn, Germany. U.S. Pat. 1,177,156, Mar. 28, 1916. Date of appl., June 18, 1914.

See Eng. Pat. 10,491 of 1914; this J., 1914, 961.

Method of treating waste sulphite liquor, and production of plastic and cement compositions. U.S. Pats. 1,175,422, 1,175,423, 1,175,425, and 1,175,426. *See* V.

Treating mineral substances [blast-furnace slag]. U.S. Pat. 1,169,506. *See* X.

Process for utilising the slime which separates after the sand in beetroot washing. Ger. Pat. 289,981. *See* XVII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steel; High sulphur in open-hearth ——. J. S. Unger. Eng. News, Feb. 24, 1916. Eng. and Min. J., 1916, **101**, 595—597.

Ingots of basic open-hearth steel having sulphur contents up to 0·25 % were prepared by the addition of powdered sulphur, during pouring, to normal steels containing 0·09, 0·32, and 0·51 % C, respectively, and used for the manufacture of rivets, chains, sheets, wire, tubes, pipes, drop forgings, channels, plates, axles, rails, and wire rope by the usual processes. Except in the case of the 0·09 % C ingots highest in sulphur, which cracked badly during rolling and were discarded, no difficulty was experienced in normal working, the tendency to cracking and crumbling exhibited, during welding, by the low-carbon steels containing 0·14 % S and above being obviated by lowering the welding temperature by about 100° C. As shown by comparative tests, the mechanical properties of the high-sulphur steels were generally not inferior to those of similar, low-sulphur ones, from which it is concluded that, contrary to the belief implied by present specifications, steel containing up to 0·1 % S is not necessarily of poor mechanical quality.—W. E. F. P.

Alloy steels; Action of sulphuric acid on ——. L. Aitchison. Chem. Soc. Trans., 1916, **109**, 288—298. (See also this J., 1916, 50.)

Experiments on vanadium, chromium, tungsten, nickel, cobalt, and manganese steels, have shown that in most cases, and particularly in steels containing the higher percentages of the third element, the carbides are not attacked by a 10 % solution of sulphuric acid. The carbides of these alloy steels have probably a much greater chemical stability than the pure iron carbide present in plain carbon steels. It is therefore inferred that they are unlikely to be attacked by milder reagents such as tap water and brine, and this is in accordance with a microscopic examination of the steels before and after corrosion. Hence the problem of the production of a non-corrodible steel becomes one of producing a practically non-corrodible alloy of iron with another metal which forms a solid solution with it. If corrosion is due to galvanic action, the carbides must be acting as cathodes to the anodes of the solid solution, and, as the carbides are likely to be of very similar electrical potential, whatever their composition, the action will depend very largely on the potential of the solid solution, which should be as low as possible to diminish the corrosion.—B. N.

Gold bullion [cyanide]; Segregation in ——. J. H. Hance. Bull. Amer. Inst. Min. Eng., Feb., 1916. Min. and Eng. World, 1916, **44**, 601.

In an investigation made on gold (cyanide) bullion practically free from silver but containing base metals other than copper, drillings from near the edges of the bars were found to be extremely variable and generally to contain more gold than dip samples, whilst the latter were usually richer in gold than drillings from the middle portions of the bars. In most cases, drillings and dip samples from the tops were richer in gold than those from the bottoms of the bars, and the points of maximum and minimum richness occurred as often near the middle portions as near the ends. Less segregation occurred when the bullion contained a little silver, bars containing 9 or 10 % of the latter being practically homogeneous throughout. Segregation in bullion of this type being probably due to the non-solvent properties of gold towards lead, zinc, and other impurities, the addition of 9 or 10 % of silver to cyanide bullion in bulk is suggested as a means of surmounting assaying difficulties without impairing the alloy for subsequent refining.—W. E. F. P.

Tungsten-molybdenum alloys as substitutes for platinum. F. A. Fahrenwald. Amer. Inst. Min. Eng., Feb., 1916. Min. and Eng. World, 1916, **44**, 606.

As substitutes for the softer forms of platinum, the gold and silver alloys of palladium—although less resistant chemically—fulfil all requirements when conditions are not too rigid. Pure ductile tungsten, and to a smaller degree molybdenum, are also highly satisfactory substitutes, but must be coated with a precious metal or alloy to prevent oxidation and facilitate soldering; this material is now replacing platinum-iridium alloys and permits of uses impossible with the materials hitherto available. Wrought alloys of the tungsten-molybdenum series can be produced by a process entirely under metallographic control, and the application of similar methods to the production of iridium, tantalum, rhodium, osmium, etc., in combination with each other or with tungsten and molybdenum, is suggested.—W. E. F. P.

Zinc; Proposed quick analytical method for determining —— *in retort residues or electric zinc furnace slags.* W. McA. Johnson. Met. and Chem. Eng., 1916, **14**, 395.

A mixture of the finely powdered residue or slag with 4 or more times its weight of coke (4—10 mesh) is heated to about 1600° C. in a special graphite vessel through which an upward stream of coal gas is maintained, the object being to volatilise the zinc which, together with the bulk of the lead, is condensed in an asbestos bag attached to the mouth of the apparatus. The vessel is heated between the two horizontal electrodes of an electric furnace open at the top, and consists of a block of Acheson graphite having a central, conical cavity or crucible to the upper part of which is attached a short graphite pipe, the latter extending through the furnace cover and being closed at the top by the asbestos bag; from the bottom of the crucible cavity a bent gas duct extends through the block to a point, near the crucible mouth, where a gas-supply pipe is provided. When all the zinc has been expelled from the charge (say after 15 mins. heating) and the crucible allowed to cool, the asbestos bag is removed and treated with very dilute acid to dissolve the zinc, which is then determined by any of the usual methods.—W. E. F. P.

Aluminium-zinc alloys. O. Bauer and O. Vogel. Mitt. k. Materialprüf., 1915, **33**, 146—198.

The equilibrium diagram obtained by the authors is in good agreement with that determined by Rosenhain and Archbutt (this J., 1911, 1166), the chief differences being that the line running from the eutectic point to the pure zinc point is shown as slightly curved, the extensions of the horizontals at 443° C. and at 256° C. are omitted, as also is that of the eutectic horizontal at 380° C., and the extremity of the horizontal at 256° C. is considered to lie between 70 % and 80 % Al. The microscopic structure of a series of alloys extending over the complete range is described in detail, and photomicrographs are given. Each alloy was subjected to three different heat treatments. The microscopic observations were in complete agreement with the thermal results. Ball-hardness tests (Martens and Heyn) on annealed alloys gave the following results:—The hardness of each of the pure metals is nearly the same. With increasing zinc the hardness of the solid solution of zinc in aluminium (γ-solid solution) rises, reaching a maximum with 30 % Zn. The hardness then diminishes gradually, as the aluminium falls off to about 20 %, and then more quickly to 10 % Al. The eutectic alloy (5 % Al) is almost exactly as hard as the alloy with 10 % Al. From the eutectic point the hardness sinks slowly to 0·5 % Al, and then quickly falls to that of pure zinc, the influence of 0·5 % Al being quite considerable. Hardness tests made on quenched specimens gave the following results:—The hardness of quenched aluminium is the same as that of the annealed metal, but in the case of zinc, quenching produces a distinct though not considerable increase in hardness. From the aluminium side the hardness increases with increasing zinc, attaining a maximum with 50 % Zn. Between 50 % and 20 % Al it falls rapidly, the hardness at 20 % Al being less than that of the annealed alloy, showing that the Al_2Zn_3 crystals are softer than the decomposition product ($\alpha + \gamma$). Between 20 % and 5 % Al the hardness rises again, reaching a second well-defined maximum at the eutectic composition. From 5 % Al it sinks rapidly but always exceeds that of the corresponding annealed alloy. In tensile tests made on a sample of cold-rolled commercial aluminium sheet (Al 99·0, Fe 0·46, Si 0·46, Cu 0·03 %) as received and after annealing at different temperatures, the effects of the cold work were entirely removed by annealing at 300°—400° C. In the case of an aluminium-zinc angle-bar containing 8·73 % Zn, the best tensile results were obtained after annealing at 300—400 C., and the worst after annealing at 200° C. To ascertain quickly whether an unknown material consisted of pure aluminium or of aluminium-zinc, the authors immersed a piece of the metal for 5 minutes in 5 % sodium hydroxide solution. The zinc-free aluminium remained white under this treatment, whilst the surface of aluminium-zinc alloys became deep-black. This black coating could not be removed by gentle rubbing under running water. Aluminium with 3 % Cu also gave a black coating but in this case the coating was easily rubbed off. Qualitative corrosion tests in tap-, distilled-, and sea-water, were made on aluminium and aluminium-zinc (7—10 % Zn), in the cold-worked state as received, and after annealing for two hours at 400° C. The specimens were wholly immersed and the water was changed weekly over a period of three months. Also, specimens suspended by aluminium wire were exposed to the action of the air for three months. In tap-water, swellings and exfoliations were produced on the cold-worked zinc-free aluminium samples, but the effect was considerably reduced by annealing. The alloys with 7—10 % Zn were much less attacked, and the difference between the cold-worked and annealed samples was insignificant. Distilled water had very little action on the aluminium samples; the samples in the cold-worked state appeared to be less attacked than after annealing. The samples containing zinc were considerably more attacked than the zinc-free samples. Sea-water attacked aluminium strongly, the effect being less with lower degrees of cold-working and with higher annealing temperatures. The zinc-containing alloys were also considerably affected; there was little difference between the cold-worked and annealed samples. Exposure to the air produced a thin grey skin on both the cold-worked and annealed samples of aluminium. The zinc-containing alloys were covered over the whole surface with minute white swellings. Quantitative corrosion tests made in tap water on samples as received and after annealing for two hours at 100°, 200°, 300°, and 400° C. respectively, showed that while swellings and exfoliations were not produced on the annealed aluminium samples, the total loss in weight was greater than on the cold-worked specimens; the most favourable annealing temperature appeared to be 400° C. With the sample containing 8·73 % Zn the greatest loss was given after annealing at 200° C., and the smallest after annealing at 400°—500° C. In no case were swellings or exfoliations produced. As a means of protection against the action of tap- and sea-water the following procedure was found to be very effective. The specimen was immersed for 2 to 4 hours in a solution, heated to 90—95° C., composed of distilled water 1000 c.c., potassium carbonate 25 grms., sodium bicarbonate 25 grms., potassium bichromate 10 grms., then washed with water, and dried. The dark-grey coating thus formed was not removed by bending or hammering, and the treatment did not affect the strength of the material. Comparative corrosion tests were made with treated and untreated samples of aluminium, and aluminium with 8·5 % Zn, in sea-water and tap-water. The treated samples were almost unaffected whilst the untreated samples were badly corroded. The protection of the aluminium-zinc alloy against atmospheric attack was however not complete. The protective coating was immediately attacked by dilute hydrochloric acid and, after some time, by dilute acetic acid. Photographs of the samples subjected to corrosion tests are given.—T. St.

Gallium-indium alloy. P. E. Browning and H. S. Uhler. Amer. J. Sci., 1916, 41, 351—354.

MERCURY-LIKE globules of a gallium-indium alloy were found on a residue obtained from the distillation of zinc (see Hillebrand and Scherrer, this J., 1916, 473). The alloy contained about 10 % of indium, small amounts of zinc and lead, and traces of copper and silver; in the residue were found 95·6 % lead, less than 1 % copper, about 3 % gallium, and about 1·2 % zinc. *Aqua regia* is th best solvent for the alloy. Gallium and indiu may be separated by depositing the forme electrolytically from an alkaline solution; thei separation by fractional crystallisation of thei ammonium alums is under investigation. B heating the alloy in a silica vessel *in vacuo* (0·000 mm.), using a flame of oxygen and illuminating gas zinc and some other elements were volatilised, an at a temperature when the silica was dazzlin white and began to soften, a small globule o gallium containing only copper and a trace o indium was left behind. It is concluded that th boiling-point of pure gallium is above 1600 C. and that it could be separated completely fro indium by prolonged heating at about 1800° C The gallium had a sp.gr. of 5·91 at 20° C.; it di not melt sharply but when melten could be supe cooled to 0° C. without solidification.—E. H. T.

Action of crude acetylene on metals. Reckiebe and Scheiber. *See* IIA.

Rapid determination of sulphur in pyrites cind Moore. *See* VII.

Oxides of iron. I. Solid solution in the syst Fe_2O_3—Fe_3O_4. Sosman and Hostetter. *See* VI

PATENTS.

Mild steel, steel, or copper; Deoxidation of ——. König, Düsseldorf. Ger. Pat. 290,309, Mar. 30, 191

THE molten metal whilst still in the convert open-hearth furnace, or electric furnace, is subjected to the action of a continuous electric current passing between a carbon anode dipping into the metal and a water-cooled cathode, also in contact with the molten metal, made of a material not attacked by the latter. Deoxidation is complete when formation of carbon monoxide, as indicated by a heaping up of the molten metal around the anode, can no longer be observed, and if the anode then be immediately withdrawn, no appreciable carburisation of the metal occurs.—A. S.

Manganese alloys; Production of ——. T. Goldschmidt A.-G., Essen, Germany. Eng. Pat. 4455, Mar. 22, 1915. Under Int. Conv., Mar. 20, 1914.

Alloys suitable as media for the introduction of manganese in the manufacture of brass, bronze, or nickel alloys containing manganese, are made by alloying phosphor-copper, or copper in presence of elementary phosphorus, with manganese, ferromanganese, manganese-copper, or other manganese alloys.—A. S.

Furnace; Metal melting ——. I. Hall, Birmingham. Eng. Pat. 5139, Apr. 3, 1915.

The melting pot has a central discharge opening controlled by a valve operated through a vertical spindle by an externally arranged screw thread and wheel. Suitable blades, shaped so as to elevate the metal from the lower to the upper part of the pot, are attached by a boss to the lower end of a sleeve which surrounds the valve spindle and extends through the top of the furnace. Suitable means for turning the stirring device, such as hand grips, are fastened to the upper end of the sleeve. An opening in the cover is provided to allow of the stirrer being easily disconnected and removed, thus rendering the inner part of the furnace readily accessible without removing the furnace top.—T. St.

Electrolytes for use in the electrolytic deposition of metals; Preparation of ——. P. Marino, London. Eng. Pat. 9957, July 8, 1915.

An electrolyte, for the electrodeposition of cobalt, nickel, copper, zinc, lead, antimony, iron, or tin, is prepared by treating a solution of a salt, or oxide of the metal, with a suitable reagent, and then completely dissolving the precipitate in a suitable solvent. Ammonium, sodium, or potassium salicylate and ammonia are then added to the solution thus prepared (see Eng. Pat. 28,953 of 1912: this J., 1914, 86). In the examples given cobalt solutions are precipitated by sodium hypochlorite or hypobromite, and the precipitate dissolved in potassium cyanide, or the precipitate produced by ammonium carbonate is dissolved in ammonium chloride solution, whilst the precipitants and solvents for the other metals are: nickel, sodium phosphate and phosphoric acid, or potassium bromate and potassium cyanide; copper, ammonium sulphide and potassium cyanide; zinc, sodium phosphate and alkalis or acids; lead, sulphuric acid and ammonium tartrate or acetate, or hydrochloric acid and sodium or ammonium acetate; antimony, water and an organic acid or potassium cyanide: iron, potassium ferrocyanide and oxalic acid with potassium or ammonium oxalate; tin, hydrogen sulphide and alkali sulphide or caustic potash, or potassium bromate and potassium cyanide.—B. N.

Copper; Electrodeposition of ——. S. C. Babcock, Hamburg, and E. W. Hagmaier, Lackawanna, N.Y. U.S. Pat. 1,174,466, Mar. 7, 1916. Date of appl., July 12, 1915.

Phenolsulphonic acid is added to the copper sulphate electrolyte, and current applied in the usual manner.—B. N.

Copper values; Concentrating ——. R. M. Atwater, jun., Scarsdale, N.Y. U.S. Pat. 1,175,331, Mar. 14, 1916. Date of appl., June 17, 1915.

Copper tailings, piled in heaps, are treated with sufficient sulphuric acid to dissolve a substantial portion of the copper, and then exposed to the action of the sun in a dry atmosphere. The values are brought to the surface by capillarity and converted into the solid state by evaporation, the concentrates produced being subsequently removed.—B. N.

Mineral substances [blast furnace slag]; Treating ——. S. W. Osgood, Chicago, Ill. U.S. Pat. 1,169,506, Jan. 25, 1916. Date of appl., June 22, 1914.

Blast-furnace slag is run into a solution of a fusible silicate to break it up into granules and simultaneously coat them. The particles may be further heated and treated with a hardening salt, such as aluminium, calcium, or magnesium silicate or sulphate in solution or suspension, with or without a colouring matter, or the hardening salt may be added to the fusible silicate solution. The product may be used for coating roofing paper and for various other purposes.
—B. N.

Solid bodies [tungsten metal] from powder or other loose material; Producing ——. J. A. Williams, Cleveland, Ohio. U.S. Pat. 1,174,646, Mar. 7, 1916. Date of appl., July 14, 1915.

Air is removed from the finely-divided tungsten in a vacuum, and the metal subjected to pressure, also in a vacuum, to form a bar.—B. N.

Ores; Method of treating [nodulising] ——. A. G. and J. T. Jones, Iron Mountain, Mich., Assignors to New Metals-Process Co., Chicago. U.S. Pat. 1,174,727, Mar. 7, 1916. Date of appl., July 21, 1913.

In a nodulising furnace consisting of a vertical shaft open at the bottom and supported above a conical base, a preheating chamber for the mixture of ore and fuel charged is formed at the top by a constriction at which the shaft is closed by a balanced cone; the conical base is surrounded by a water-trough in which the discharged product is received. A gas outlet is provided near the lower and an air-blast inlet near the upper end of the shaft; a portion of the waste gases is conducted to the preheating chamber through a pipe communicating with the shaft at a point opposite the gas outlet.—W. E. F. P.

Ore-reducing furnace. Metallising process. Ore reducing furnace. A. G. and J. T. Jones, Iron Mountain, Mich., Assignors to New Metals-Process Co., Chicago, Ill. U.S. Pats. (A) 1,174,728, (B) 1,174,729, and (C) 1,174,732, Mar. 7, 1916. Date of appl., Mar. 26, 1914; renewed (A and B) Jan. 20, (C) Jan. 26, 1916.

In a process for reducing ores of non-volatile metals without general fusion, a mixture of the ore with several times its volume of coke or charcoal in relatively large lumps is fed slowly into the upper end of a long, inclined preheating tube of relatively large diameter, the lower end of which communicates with the top of a closed reduction chamber. The upper end of the preheater communicates with a smoke stack through which the inclined stem of a funnel-shaped feeding device extends into the tube. Limited quantities of air are introduced into the upper part of the reduction chamber, through tuyères disposed just below the gas outlet, to maintain the necessary temperature and reducing atmosphere in the latter, the waste gases from which are drawn through the tube to the stack; and into the lower end of the preheater to effect combustion of the reducing gases. Provision is also made, in (c), for introducing fresh portions of solid fuel containing hydrocarbons into the upper part of the reduction chamber. The reduced material is periodically discharged from the lower part of the chamber, the unused fuel and adhering globules of metal being returned to the apparatus with a fresh charge.—W. E. F. P.

Metallising process and apparatus. Metal recovering process and apparatus. A. G. and J. T. Jones, Iron Mountain, Mich., Assignors to New Metals-Process Co., Chicago, Ill. U.S. Pats. (A) 1,174,730 and (B) 1,174,731, Mar. 7, 1916. Date of appl., Mar. 26, 1914; renewed Jan. 20, 1916.

In a non-fusion process for treating ores of metals having comparatively low volatilising points, a mixture of the ore with several times its volume of coke or charcoal, in relatively large pieces, is introduced into a deoxidising chamber, to the upper part of which sufficient air is admitted to maintain the necessary temperature and reducing atmosphere. The deoxidising chamber communicates (A) with a condenser in which the metal is recovered as such, or (B) with a combustion chamber from which the metal is recovered as oxide. Portions of the spent charge are periodically removed from the lower part of the chamber, the lumps of unconsumed fuel, with any adhering metal, being separated and re-charged with fresh ore-mixture.—W. E. F. P.

Hydrometallurgy [*of ores*]. E. R. Holden, Los Angeles, Cal. U.S. Pat. 1,175,867, Mar. 14, 1916. Date of appl., July 14, 1915.

The valuable constituents of an ore are dissolved and concentrated simultaneously by mixing the pulverised ore with a suitable solvent, and the mixture is rotated in a tank. The particles of ore are raised by the rotary motion of the liquid, forming various strata in conformity with their specific gravities and sizes, whilst the larger particles of metals and their compounds, not wholly dissolved in the liquid, remain at the bottom. The solution containing the dissolved metals and the gangue are withdrawn from the tank in successive steps downwards from the top, whilst the rotary motion is continued, the undissolved metals and compounds being left in the lowest stratum and subsequently recovered.—B. N.

Amalgams; Method of treating ——. J. W. Smith, Madison, Minn. U.S. Pat. 1,176,176, Mar. 21, 1916. Date of appl., Sept. 11, 1915.

The amalgam is cooled until the mercury becomes solid and is maintained in this condition until required for use, when it is heated to render it plastic and workable.—T. St.

Aluminium skimmings, screenings, slags, or analogous materials; Process of treating ——. P. R. Hersman, Milwaukee, Wis., Assignor to W. F. Jobbins, Aurora, Ill. U.S. Pat. 1,176,292, Mar. 21, 1916. Date of appl., Nov. 14, 1912.

The material is washed with water to remove soluble salts and then treated with dilute sulphuric acid to remove the bulk of the iron. The solid residue is dissolved in excess of strong sulphuric acid, and the excess of acid neutralised by the addition of an excess of skimmings partially purified from iron. Copper is removed by precipitation from the resulting solution, which is finally concentrated to cause aluminium sulphate to crystallise.—T. St.

Ores; Process of concentrating ——. E. Gayford and G. Crerar, Salt Lake City, Utah, Assignors to Metals Recovery Co., Augusta, Me. U.S. Pat. 1,176,441, Mar. 21, 1916. Date of appl., May 29, 1914.

The ore is ground in a ball mill with water and an oily frothing agent having a preferential affinity for metalliferous matter, and the mixture transferred to a flotation machine where it is aerated and the concentrates floated off. The process is repeated progressively in a series of alternate grinding mills and flotation machines, the tailings from each of the latter being further reduced in each succeeding grinding mill.—T. St.

Ores and the like; [*Stamp*] *mill for treating* ——. A. V. Park, S. Melbourne, Australia. Eng. Pat 5458, Apr. 10, 1915. Under Int. Conv., May 6, 1914.

Apparatus for use in the annealing of metal or in the manufacture of malleable cast iron. W. Slingsby, Keighley. Eng. Pat. 7564, May 20, 1915.

Lead and other soft metals; Means for forming or squirting ——. I. Hall, Birmingham. Eng. Pat. 9068, June 21, 1915.

Coating metals. British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 11,262, Aug. 4, 1915.

See U.S. Pat. 1,157,283 of 1915; this J., 1915, 1123.

Ore or fuel briquettes and process of making same. D. H. Bibb, New York. Eng. Pat. 13,376, Sept. 20, 1915.

See U.S. Pat. 1,158,363 of 1915; this J., 1915, 1199.

Aluminium alloys. W. N. Naylor, London, and S. P. Hutton, Beckenham. U.S. Pat. 1,175,655, Mar. 14, 1916. Date of appl., Nov. 22, 1912.

See Eng. Pats. 27,382 of 1911 and 15,689 of 1912; this J., 1912, 994.

Tungsten; Process of producing ——. C. Bosch and A. Mittasch, Assignors to Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,175,693, Mar. 14, 1916. Date of appl., Jan. 30, 1912.

See Fr. Pat. 439,261 of 1912; this J., 1912, 721.

Copper and copper alloys; Method of forming a layer protective against the corrosive action of sea water upon ——. G. Kurth, Assignor to C. G. Tietzen's Eidam, Bautzen, Germany. U.S Pat. 1,176,571, Mar. 21, 1916. Date of appl., May 22, 1915.

See Eng. Pat. 5774 of 1915; this J., 1916, 124.

Bearing [*metal*]. J. Riddel, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,176,603, Mar. 21, 1916. Date of appl., Oct. 20, 1913.

See Eng. Pat. 10,872 of 1914; this J., 1915, 621.

Electric furnaces for metallurgical and other purposes. Eng. Pat. 13,951. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Lead electrode; A study of the ——. F. H. Getman. J. Amer. Chem. Soc., 1916, **38**, 792—801.

Five different types of lead have been studied in the cell:

$$\mathrm{Pb—sat.\ sol.\ Pb(NO_3)_2} \,\|\, N/10\,\mathrm{KCl, HgCl—Hg},$$

and the only one which was constant and reproducible within 0·3 millivolt was the one in which lead deposited electrolytically on platinum was employed. Freshly cast sticks of lead in an acidified solution of lead nitrate formed a grey allotropic modification. Measurements of the electromotive force, developed at 0° and 25° C., with cells containing freshly cast lead and the grey modification as electrodes in $N/5$ lead nitrate as electrolyte, failed to give any indication of a transition point. The value of the normal electrode potential of lead was found to be 0·1318 volt at 25° C.—B. N.

Patents.

Drying and impregnating device ; Vacuum ——. more especially suitable for treatment of the coils of electrical machinery and apparatus. E. Haffely et Cie., Basle, Switzerland. Eng. Pat. 10,803, July 26, 1915. Under Int. Conv., July 24, 1914.

The central drying and heating receptacle, in which the material to be impregnated is placed, is connected to a number of comparatively small, narrow retorts in which the impregnating material is melted ; to minimise differences and fall of temperature, the retorts are adapted to be heated both externally and internally. The central chamber may be evacuated or connected with a source of compressed air, for the purpose of transferring the impregnating material to and from the central chamber.—B. N.

Furnaces for metallurgical or other purposes ; Electric ——. H. Nathusius, Friendenshütte, Germany, and Westdeutsche Thomasphosphat-Werke G. m. b. H., Berlin. Eng. Pat. 13,951, June 9, 1914.

Two or more sets of electrodes, embedded in the lining of the furnace, are arranged symmetrically with regard to the heating chamber, and terminate in large electrode plates, thus presenting operative surfaces in a number of zones around the heating chamber, and as far as possible along its whole length. Several pairs of electrodes may be arranged symmetrically round the chamber, so that the electrodes of each pair are diametrically opposite each other, and the current may be supplied from a polyphase system, each phase being connected to diametrically opposite electrodes. The voltage of the current supply must be arranged so that the distribution of energy by the current flowing between each of the pairs of electrodes is as uniform as possible. The heating is controlled during the operation of the furnace, by regulating means at the supply generator or transformer, as, *e.g.*, an alternating current induction potential regulator.—B. N.

Furnace ; Electric ——. F. T. Snyder, Oak Park, Ill. U.S. Pat. 1,167,026, Jan. 4, 1916. Date of appl., Jan. 19, 1914.

The furnace-electrode is supported by a crane, attached to the furnace by a double set of hinges, so that it is normally prevented from rotating, but may be swung clear of the furnace cover on the axis of one set of hinges when the hinge mechanism on the other axis is disconnected. The crane is composed of a pair of oppositely-disposed vertical channel bars, in which are mounted upper and lower slides, comprising loops approximately rectangular in shape with their ends fitted into the channels of the bars, and raised or lowered by a rack and pinion. A pair of vertical insulated conductor bars of U-shaped cross-section is secured to the slides, extending from the bottom to the top of the furnace, and horizontal conductor arms also U-shaped in cross-section, extend from the upper ends of the vertical bars over the top of the furnace, and are provided at their free ends with an electrode-clamp. Water is circulated through chambers in the electrode holder, by means of rigid water pipes located in the channels of the conductor bars, the ends of the pipes being attached to flexible hose pipes to allow both the furnace and supporting crane to be tilted.—B. N.

Furnace [; Electric ——]. T. F. Baily and F. T. Cope, Assignors to The Electric Furnace Co., Alliance, Ohio. U.S. Pat. 1,176,018, Mar. 21, 1916. Date of appl., Dec. 11, 1914.

The heating chamber of the furnace is provided with supporting walls carrying a hearth, and resistance elements are arranged upon the walls at each side of the hearth. The arched roof of the chamber reflects the heat rays passing upwards from both the resistance elements, whilst inclined walls, beneath the resistance elements and between the supporting walls, reflect upon the hearth the heat rays passing in a downward direction.—B. N.

Manganese dioxide depolariser ; Colloidal ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,169,943, Feb. 1, 1916. Date of appl., Oct. 23, 1915.

Colloidal manganese dioxide, prepared by the reducing action of an alkaline glucose solution on potassium permanganate solution, is employed for cementing together graphite and ordinary manganese dioxide, such as particles of pyrolusite, the colloidal and non-colloidal forms being in the proportion 1 : 10.—B. N.

Electrode ; Secondary battery ——. W. Morrison, Des Moines, Iowa. U.S. Pat. 1,175,370, Mar. 14, 1916. Date of appl., Sept. 11, 1914.

Lead electrodes for secondary batteries are subjected to the action of an electric current whilst in contact with a sulphuric acid electrolyte containing titanic acid in solution, so that the surface layer becomes permeated with a titanium compound.—B. N.

Electrodes ; Storage-battery ——. H. C. Hubbell, Newark, N.J. U.S. Pat. 1,175,954, Mar. 21, 1916. Date of appl., June 5, 1911.

Electro-deposited layers of different metals, *e.g.*, nickel and a more soluble metal such as copper, are arranged alternately to form bars, with the layers running lengthwise, and the bars are united into a plate with the layers disposed edgewise to the faces of the plate. The copper is dissolved away by using the plate as an anode in a solution of sodium and ammonium acetates containing free ammonia, at a current density sufficiently low to leave the nickel unattacked, and the nickel is finally oxidised by using it as anode in a dilute solution of phenol and fixed alkali, employing a "forming" current of low density.—B. N.

Electrolytic cell. Process of electrolysis. A. E. Gibbs, Assignor to Pennsylvania Salt Manufacturing Co., Philadelphia, Pa. U.S Pats. (A) 1,176,540 and (B) 1,176,541, Mar. 21, 1916. Dates of appl., (A) Mar. 24, and (B) Oct. 25, 1913.

(A) A cylindrical, permeable diaphragm is arranged in contact with an outer cathode, the latter having on its inner surface a number of vertical ribs or corrugations, forming passages for the flow of the products of electrolysis. The cell is provided with means for causing a flow of electrolyte from the anode compartment, independent of and additional to the permeation through the diaphragm, to the passages on the surface of the cathode for removal of the products of electrolysis. (B) The electrolyte is maintained under a constant pressure, and is continually fed into the anode compartment ; a portion is sent through a by-pass around the porous diaphragm, thus maintaining a constant flow across the electrolytic field in thin sheets between the diaphragm and the cathode, with a continuous discharge of the cathode liquor.—B. N.

Arcs ; Producing rotating electric ——. A. Foss, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,175,252, Mar. 14, 1916. Date of appl., Sep. 15, 1913.

A ROTATING arc, approximately cylindrical in shape, is formed between two opposite electrodes, and is supported throughout its length between an outer rotating gas current and a concentric longitudinal gas current, the latter being directed in the direction of the axis of the cylindrical arc.
—B. N.

Method of treating waste sulphite liquors, and production of an insulating composition. U.S. Pats. 1,175,122—1,175,124. *See* V.

Insulating enamel. U.S. Pat. 1,170,000. *See* XIII.

XII.—FATS ; OILS ; WAXES.

Chinese wood oil ; Polymerisation of ——. C. L. Schumann. J. Ind. Eng. Chem., 1916, **8**, 5—15.

POLYMERISATION of Chinese wood oil is due to the union of two molecules of the elæomargaric acid triglyceride with dissolution of one unsaturated linkage in each elæomargaric acid chain in the triglyceride (see Kametaka this J., 1903, 1138 ; 1908, 1120). This intermediate product or polymerised triglyceride, is formed whenever wood oil is heated alone or in the presence of a solvent, and does not vary with the temperature ; it forms molecular complexes under favourable conditions, giving an insoluble colloidal mass, not, however, accompanied by further loss of double linkages, as is shown by the iodine value remaining the same. It is soluble in all the ordinary organic solvents, with the exception of very low-boiling petroleum spirit. The percentage of polymerised triglyceride in gels of the same apparent consistence is not necessarily the same, and the formation of the gel is not entirely dependent upon the concentration of the polymer or upon the heat required for its production. A satisfactory method for the examination of wood oil is based on the property of elæomargaric acid of crystallising from dilute alcohol solution ; the fatty acids from the polymerised triglyceride of wood oil as well as those from other drying and semi-drying oils do not have this property. Five grms. of the raw or heated oil is saponified, the fatty acids are liberated (their weight is about 4·7 grms.) and dissolved in 40 c.c. of absolute alcohol. The solution is cooled to 0° C., from 14 to 14·5 c.c. of water is added, drop by drop, the solution then warmed to 5° C., allowed to cool slowly, and kept at 0° C. overnight. The crystals of elæomargaric acid are collected on an ice-cooled filter, the filtrate is evaporated under reduced pressure, the residue dried and weighed, and the elæomargaric acid computed by difference. A correction of 0·132 grm. is made for the quantity of elæomargaric acid which remains dissolved in the filtrate. Wood oil can be polymerised completely by heating it at 350° C. for 15 mins., but it will not gelatinise under this treatment. The rate of polymerisation of wood oil is considerably higher than for linseed oil at corresponding temperatures ; the wood oil is polymerised completely in 1 hour at 250° C., but only about 72 % is polymerised in 66 hours at 150° C. Wood oil oxidises to a considerable extent when heated in contact with air. Lime, litharge, and oxidation products act as catalysts in the polymerisation of elæomargaric acid triglyceride into the intermediate product but oxygen only acts indirectly through the oxidation products. A large number of metals act as catalysts at the higher temperatures. When the solid gel is dissolved in resin, or heated continuously above 250° C., the soluble intermediate products are re-formed ; decomposition also takes place during the heating. The pure polymerised product of wood oil dries very slowly ; this low rate of drying characterises such resin-wood oil varnishes as contain considerable amounts of polymerised triglyceride.—W. P. S.

Fats ; Completely hydrogenated ——. C. Mannich and E. Thiele. Ber. Deutschen Pharm. Ges., 1916, **26**, 36—48.

BY the addition of animal charcoal the absorption capacity of palladium for hydrogen is greatly increased, and the mixture absorbs much more gas than the total quantity absorbed by the separate constituents. A catalyst which rapidly effects the complete hydrogenation of fats is prepared by shaking powdered, ignited animal charcoal wth palladium chloride (preferably 2 %) solution and hydrogen until no more gas is absorbed. The powder is then washed and dried and can be kept unaltered. It can be used in conjunction with any solvent and after hydrogenation is completely separated by simple filtration, without leaving any trace of metal in the fat. In these respects it is superior to colloidal palladium preparations. An oil such as arachis oil can be hydrogenated by means of 1/60 of its weight of animal charcoal containing 0·2 % palladium (ratio of metal to oil = 1 : 30,000) into a tallow-like mass, with m.pt. 51° C. and iodine value 45·5. Even by the use of 1 part of palladium (distributed over animal charcoal) to 150,000 parts of arachis oil the hardening can be effected in one operation. The following table gives the characters of oils completely hydrogenated in this way :—

Hydrogenated oil.	M.pt.	Iodine value.	Saponif. value.	M.pt. of insoluble fatty acids.
	°C.			°C.
Olive…………	70	0·2	190·9	71
Almond ………	72	0·0	191·8	71
Arachis ………	64—64·5	0·0	191·6	67
Sesamé ………	68·5	0·7	190·6	69·5
Cacao butter….	63·5—64	0·0	193·9	65·5
Poppy seed …..	70·5	0·3	191·3	71
Linseed ………	68	0·2	189·6	70·5
Tallow ………	62	0·1	197·7	64
Lard …………	64	1·0	196·8	62
Cod liver ……	65	1·2	186·2	59

A chloroform solution of the hydrogenated cod-liver oil gave no coloration with sulphuric acid.
—C. A. M.

Hydrogenated fats ; Determination of the origin of ——. J. Prescher. Z. Unters. Nahr. Genussm., 1915, **30**, 357. Z. angew. Chem., 1916, **29**, Ref., 165.

HARDENED (hydrogenated) marine animal oils are indicated by the colour reactions of Tortelli and Jaffe (this J., 1914, 1061), together with positive results in Kreis and Roth's test for arachidic acid (this J., 1913, 201) and the cholesteryl acetate test. The presence of arachidic acid and a positive result in the phytosteryl acetate test indicate arachis or rape seed oils. Sesamé oil is detected by the Soltsien and Baudouin tests. An excessively low saponification value points to rape oil, while coconut and palm kernel oils are indicated by saponification values exceeding 230 and by the Reichert-Meissl and Polenske values. Hydrogenated castor oil has a high hydroxyl value, while hydrogenated cottonseed oil may be detected by Becchi's and Hauchecorne's tests. The ratio between the iodine value and refractive index is different in hydrogenated fats from the ratio in animal fats. Coconut oil is distinguished by its very low iodine value. Bellier's reaction is only applicable to a limited extent to the detection of hydrogenated vegetable oils. The dimethylglyoxime test for nickel may also be inconclusive, since many freshly-expressed oils give a red coloration in the test in the absence of nickel.—C. A. M.

Cholesterol and phytosterol; Effect of hydrogenation on ——. J. Marcusson and G. Meyerheim. Mitt. k. Materialprüf., 1916, 33, 221—225.

Cholesterol and phytosterol were separated from the unsaponifiable matter of natural and hydrogenated oils and fats by the digitonin method of Windaus (compare this J., 1915, 1152). The amounts in natural fats ranged from 0·03 (tallow) to 0·38 % (linseed oil). Calculated on the unsaponifiable matter the proportion ranged from 33 to 55 % in the case of the vegetable oils examined, and from 8 to 14 % in the case of the animal fats (codliver oil and tallow). In addition to phytosterol or cholesterol other alcohols are present in the unsaponifiable matter, which either neutralise the optical lævorotation (as in the case of cottonseed oil) or even produce dextrorotation (linseed, codliver, and especially sesamé oil). The presence of sesamol ($[\alpha]_D = +52°$) affords a means of detecting sesamé oil, when no colour reactions can be obtained. The unsaponifiable matter left after separation of cholesterol or phytosterol was a thick oil or semi-solid mass, consisting in the main of unsaturated dextrorotatory alcohols (lævorotatory in the case of ox tallow) and small quantities of hydrocarbons. Only in the unsaponifiable matter of dark codliver oil were considerable amounts of hydrocarbons found. The dextrorotatory power of the unsaponifiable matter of sesamé oil was greatly increased ($[\alpha]_D = +102°$) by the removal of the phytosterol. The iodine value (Hübl-Waller) of the residual unsaponifiable matter ranged from 56 to 78. As a rule hydrogenated fats contained less cholesterol or phytosterol than the corresponding natural fats, and the proportion decreased with the degree of hydrogenation. For example, the following results were obtained in the progressive hydrogenation of a marine animal oil :—

	Iodine value.	Solidif. pt.	Cholesterol.
		°C.	%
Original marine animal oil .	114	—	0·13
Talgol	67	31	0·10
Talgol extra	36	38	0·07
Candelite	20	42	0·05
Candelite extra	13	45	0·02

The unsaponifiable matter of hydrogenated fats after removal of the cholesterol or phytosterol was a yellow semi-solid mass, from which, in the case of talgol and candelite, a saturated alcohol, m. pt. 59·3° to 59·8° C., could be extracted with petroleum spirit. It had a refractive index of 1·4268 at 100° C. and appeared to be octodecyl alcohol. Transformation products of cholesterol were not obtained from talgol or candelite, but derivatives of phytosterol could be separated from hydrogenated vegetable oils. For example, repeated recrystallisation of the unsaponifiable matter of hydrogenated linseed oil from 96 % alcohol yielded an alcohol (m. pt. 75° C.) which did not give the characteristic phytosterol reactions.—C. A. M.

Soap; Researches on the detergent action of ——. S. A. Shorter. J. Soc. Dyers and Col., 1916, 32, 99—109. (See also this J., 1915, 289; 1916, 262.)

The observations in connection with these researches were carried out with the stalagmometer, an instrument of the type of a pipette, filled with benzene or other immiscible liquid, designed to deliver drops from its up-turned point when held below the surface of the solution to be tested. The number of drops formed in the discharge of a measured volume was counted, giving the "drop number," which is approximately inversely proportional to the surface tension; a large drop number corresponds to a large "surface activity." In a solution of soap consisting of free hydrolysis alkali and acid soap, the latter exercises no "surface activity"; this was proved by the stalagmometer filled with pure benzene immersed in soap solutions to which increasing quantities of hydrochloric acid were added. As the decomposition of the soap progressed the drop number fell until it became practically equal to that obtained with pure water. The influence of alkali in soap solutions was studied by adding oleic acid to the benzene and comparing the increased drop number with that of pure benzene; soap solutions containing various ratios of alkali to fatty acid were employed. In a "neutral" soap solution, with molecular ratio of acid : alkali = 1·0, the "surface activity" of the free hydrolysis alkali was only about one-fifth of that of the undecomposed potassium oleate; it was slightly more in a more alkaline soap and considerably less in one with higher acid : alkali ratio. The "surface activity ratio" increased only slightly with increase in concentration of the soap solution, because the degree of hydrolysis decreases in more concentrated solutions. Hence the detergent action of solutions of neutral or slightly alkaline soaps is due mainly to the undecomposed soap. The view that the detergent action of soap is due to its colloidal nature is supported by observations carried out on "Sapon," an alkaline detergent containing no fat, prepared by the action of strong alkalis on cereals. This colloidal detergent showed a "surface activity" in the stalagmometer comparable with that of soap solutions; this method, therefore, is capable of determining the value of a detergent containing "surface active" colloids other than salts of fatty acids. The addition of alkali to a soap solution increases the "surface activity" of the soap, even to pure benzene, and its detergent action is improved, probably by a modification in a favourable sense of its colloidal condition; the addition of saline electrolytes also increases the "surface activity," but in a minor degree. It is suggested that this action of alkali on the soap may be quite as important as its specific action on the fatty acids of the grease.

—J. F. B.

Patents.

Contact mass [for hydrogenating oils] and process for its manufacture. Bremen-Besigheimer Oelfabriken, Bremen, Germany. Eng. Pat. 4023, Mar. 13, 1915. Under Int. Conv., Mar. 14, 1914.

A catalytic material for the hydrogenation of fats and oils is prepared by calcining organic compounds of metals, alone or mixed with carbon or carbon-containing substances, until a pyrophorous mixture of metal, or metal oxides, and carbon is obtained, and introducing this at once into oil or other indifferent liquid, in which it can be kept indefinitely. For example, nickel benzoate is heated above 1000° C. until it is carbonised and the carbon has completely or partly reduced the nickel oxide formed; or, nickel carbonate or oxide, precipitated on fossil meal, is mixed with about the same quantity of fine carbon, and heated above 1000° C. until pyrophorous. Fat hardening with such catalysts can be carried out at 150°—200° C., and the presence of the carbon has a deodorising as well as a bleaching effect.—E. W. L.

Edible fat complex and process of making same. Catalytic material [for hydrogenating oils] and process of making same. Hydrogenation of fats and the like. C. Ellis, Montclair, N.J. U.S. Pats. (A) 1,151,002 and (B) 1,151,003, Aug. 24, 1915, and (C) 1,174,245, Mar. 7, 1916. Dates of appl., Apr. 19, 1913, May 4, 1915, Feb. 24, 1912.

(A) Fatty oils such as marine animal oils are polymerised by heating, *e.g.*, for about 18 hours at 250° C., and then mixed with hydrogenated oils; or polymerisable and non-polymerisable oils may be mixed prior to polymerisation and hydrogenation. (B) Finely divided electrolytic nickel is attached to a hydrogen-occluding material, such as powdered charcoal, graphite, or a metal such as nickel in a catalytically inactive form. If the electrolytically deposited nickel has become oxdised it may be reduced by means of hydrogen in an oily medium. The presence of a small amount of another metal, such as zinc, copper, or titanium, in the electrolytic nickel increases its absorptive capacity for hydrogen. (C) The oil is heated with hydrogen or a gas containing hydrogen under pressure in presence of an active non-metallic substance (charcoal), coated, but not impregnated, with a metallic catalyst (platinum), both metallic and non-metallic substances being free from occluded oxygen.—C. A. M.

Oils or fats; Process of hydrogenating ——. W. D. Richardson, Assignor to Swift and Co., Chicago, Ill. U.S. Pat. 1,175,905, Mar. 14, 1916. Date of appl., Nov. 11, 1912.

An electric arc is produced between electrodes of nickel or other metal immersed in a volatile solvent for fats, so that part of the metal is disintegrated in a fine state of division in the liquid. The mixture is then added to the fat, and, after hydrogenation of the latter, the solvent is evaporated.—C. A. M.

Sulphonated stearic products; Production and utilisation of ——. I. Levinstein, Assignor to Levinstein, Ltd., Manchester. U.S. Pat. 1,176,378, Mar. 21, 1916. Date of appl., Feb. 17, 1914.

See Eng. Pat. 16,577 of 1913; this J., 1914, 930.

Process of purifying used lubricating oils. Eng. Pat. 14,781. *See* IIa.

Fuel containing spent fullers' earth. U.S. Pat. 1,174,199. *See* IIa.

Insulating enamel. U.S. Pat. 1,170,000. *See* XIII.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Wood flour. Kressmann. *See* V.

Polymerisation of Chinese wood oil. Schumann. *See* XII.

Patents.

Paint. T. D. Kelly, Hove, Sussex. Eng. Pat. 9839, July 6, 1915.

Iron, wood, fabrics, paper, leather, and other similar materials, dry or wet, may be waterproofed by a mixture composed of limestone, Portland cement, or marl (1 part), finely-ground silicious material, such as magnesium silicate (1 part) oils containing resinous material, such as petroleum refuse (2 parts), and water (1 part).—B. N.

Pigment and process of making the same. H. A. Gardner, Washington, D.C. U.S. Pat. 1,169,253, Jan. 25, 1916. Date of appl., Mar. 9, 1915.

The pigment is composed of carbonates (normal or basic), sulphites, or sulphates of lead and barium, or mixtures of these, in predetermined, *e.g.*, molecular, proportions. It is produced by preparing a mixture of lead and barium compounds in the desired proportions, one at least being soluble in water, and then adding sodium carbonate, sulphite, or sulphate, or passing in sulphur dioxide or carbon dioxide.—B. N.

White lead chambers; Method of emptying ——. Farbwerke A.-G., Düsseldorf. Ger. Pat. 289,190, Oct. 8, 1914.

The floor of the chamber slopes at an angle of at least 20° to the outlet opening, which is provided with a grating or the like, and the white lead is removed from the unoxidised lead, and discharged, by means of jets of water, without it being necessary for the workman to enter the chamber or come in contact with the material.—A. S.

Insulating enamel. F. A. Robinson, Auburn, N.Y., Assignor to D. W. Armistead, Aurora, N.Y. U.S. Pat. 1,170,000, Feb. 1, 1916. Date of appl., Nov. 7, 1914.

The enamel is derived from walrus, whale, or similar oils by heating rapidly to about 900° F. (480° C.), thus forming a dense fluid residue which adheres to an electrical conductor in a thin film, and dries to a hard, elastic, flexible product, without carbonisation, at 1200° F. (650° C.).—B.N.

Colouring matter lakes; Manufacture of ——. J. Y. Johnson, London. From Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. Eng. Pat. 15,951, July 3, 1914.

See Fr. Pat. 474,706 of 1914; this J., 1915, 1085.

Carbon black and hydrogen; Manufacture of ——. R. H. Brownlee and R. H. Uhlinger, Pittsburgh, U.S.A. Eng. Pat. 5098, Apr. 1, 1915.

See U.S. Pat. 1,168,931 of 1916; this J., 1916, 309.

White lead pigment; Process for separating thallium and radioactive metals from lead ores and producing a ——. J. B. Hannay, Hamburg, Assignor to Deutsche Felsen-Oel-Ges. Franzen und Co., Berlin, Germany. U.S. Pat. 1,175,146, Mar. 14, 1916. Date of appl., July 30, 1913. Renewed Dec. 31, 1915.

See Ger. Pat. 264,526 of 1912; this J., 1913, 1078.

Oil and oil-paint; Process of manufacturing pellicles of ——. G. Müller-Naegeli, Assignor to Oel- und Farbfilm A.-G., Wadenswil, Switzerland. U.S. Pat. 1,175,169, Mar. 14, 1916. Date of appl., Aug. 21, 1914.

See Fr. Pat. 471,158 of 1914; this J., 1915, 180.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Vulcanised rubber; Relationship of mechanical to chemical properties of ——. P. Schidrowitz and H. A. Goldsbrough. India-Rubber J., 1916, 51, 505.

Eaton (Agric. Bull. Fed. Malay States, 1915, 3,

233) has raised the question as to the constancy of combined sulphur at "correct cure." The authors have carried out work in this connection with the results tabulated below; the mixing consisted of 100 parts rubber and 8 parts sulphur, and the cure was carried out at 286° F. (141° C.). "correct cure" being determined by the optimum curve method (this J., 1915, 842); "the slope of curve" (type) is represented by $2 \cdot 5\,T = E_1 - E$, where E is the elongation at 600 grms. load and E_1 that at 1040 grms. load per sq. mm. Insoluble matter was determined by difference, soluble matter by Caspari's method (this J., 1913, 1011), and combined sulphur was estimated in the rubber after exhaustive extraction with acetone.

Sample.	Correct cure, hrs.	Slope of curve (type).	T.S. lb. per sq. in.	Elongation (original = 1).	Insoluble. %	Soluble. %	Combined sulphur, %
Smoked sheet	2	38	2188	10·39	10·80	81·9	4·37
" "	2¼	33	2250	10·74	8·88	81·3	4·86
Plain sheet	2½	33	2100	10·6	7·52	28·8	2·88
" "	4	31	2450	11·0	6·64	80·55	2·03
Smoked sheet	1¾	36	2100	10·43	11·52	81·1	4·30
" "	2	37	2110	10·35	10·16	76·4	4·70
Film smoked	2¼	37	2528	10·56	7·52	94·85	4·21
" "	1¾	33	2289	10·78	17·20	81·75	4·70
Para	3	38	2093	10·43	—	—	3·62

The results do not suggest that combined sulphur at "correct cure" is more or less a constant.
—E. W. L.

Patents.

Balata impregnated textile driving belts impervious to moisture; Method of producing ——. W. Kohlschütter, G. Rothmund, and G. Rothmund und Co., Hamburg, Germany. Eng. Pat. 4494, Mar. 22, 1915.

Woven belt fabric of camel-hair, cotton, etc., is thoroughly impregnated, preferably while uniformly stretched, with a solution of varnish, rubber, caoutchouc, or oil residues, in benzol. The superfluous solution is drained off, and the fabric is dried superficially in the air and subsequently impregnated with balata to coat the exposed surfaces. It is claimed that this method of production prevents the unequal expansion and contraction of the inner and the outer layers of fabric due to variations of moisture content in the surrounding atmosphere.—E. W. L.

Vulcanisable composition of matter [*substitute for rubber and leather*], *and method of preparing same.* J. S. Campbell, London. U.S. Pat. 1,174,967, Mar. 14, 1916. Date of appl., Apr. 12, 1915.

See Eng. Pat. 9370 of 1914; this J., 1915, 624.

Apparatus for saturating [*tyre*] *fabric.* U.S. Pat. 1,174,995. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins; Detection and distinction of artificial tannins, alone and in admixture with vegetable ——. R. Lauffmann. Kunststoffe, 1915, 5, 205—207. Z. angew. Chem., 1916, 29, Ref., 156.

ARTIFICIAL tannins are detected by the flocculent precipitate given with aniline and hydrochloric acid, their presence being confirmed by the reaction ith cinchonine sulphate (Appelius, this J., 1915, 01). Neradol D is detected by means of diazotised -nitraniline solution, but methods have not been devised for the detection of Neradol N and cellulose extract. In absence of Neradol D the presence of vegetable tannins is readily detected, Stiasny's test with formaldehyde and hydrochloric acid (this J., 1911, 1192) being recommended; in case no precipitate is obtained, only pyrogallol and artificial tannins are present; Neradol D gives a slight white precipitate, but the filtrate does not give the violet coloration characteristic of certain vegetable tannins on addition of iron alum and sodium acetate.—F. W. A.

Purification of effluents from glue and artificial manure works. Batek. *See* XIXb.

Patents.

Leather and other materials; Composition for preserving ——. S. C. McNally, Glasgow. Eng. Pat. 9741, July 5, 1915.

A mixture of about twelve parts of grease such as yellow wagon grease, four parts of lard, one part of beeswax, and two parts of a decoction of comfrey roots (*Symphytum officinale*), acts as a preservative and waterproofing agent for leather, and will take a fair polish some hours after application.—F. C. T.

Glue: Process for manufacturing ——. R. Berliner, Moscow. U.S. Pat. 1,176,644, Mar. 21, 1916. Date of appl., May 26, 1914.

Bones are treated with sulphur dioxide; the fat is then extracted, and at the same time the sulphur dioxide is expelled, after which the glue is boiled out.—F. C. T.

Tanning of butts or hides and apparatus to be used therefor. E. Wilson, Bootle. U.S. Pat. 1,176,633, Mar. 21, 1916. Date of appl., Aug. 25, 1915.

See Eng. Pat. 3484 of 1915; this J., 1916, 60.

XVI.—SOILS; FERTILISERS.

Acid soils and the effect of acid phosphate [*superphosphate*] *and other fertilisers on them.* [*Determination of soluble acidity of soils.*] S. D. Conner. J. Ind. Eng. Chem., 1916, 8, 35—40.

The various acid constituents of soils show different degrees of reactivity with different bases and also with the same base when free or combined with different acids. The acidity developed when acid soils or silicates are treated with neutral salt solutions is more probably due to chemical exchange of bases than to physical selective adsorption: if aluminium silicates are treated with potassium hydroxide solution, heat is developed in the case of the acid silicates but not with the neutral silicates. The heat produced is proportional to the acidity, indicating a chemical rather than a physical reaction. The acidity of aluminium silicates is proportional to the ratio of Al_2O_3 to SiO_2, and also to the water of constitution;

when the water is expelled by heating, the acidity is decreased until, when all the water has been removed, the compound is neutral. Ignition of soils also destroys the acidity. Much of the injurious acidity of soils is due to the presence of toxic acid salts of aluminium and iron. The immediate effect of the addition of soluble salts of strong mineral acids (hydrochloric, sulphuric, and nitric) to acid soils is to increase the quantity of soluble acid salts of aluminium and iron. Field experiments showed that soils which had been treated for 20 years with superphosphate had a lower acidity than soils which had not been so treated; this was confirmed by laboratory experiments with acid soils and silicates. The reduction of soil acidity by superphosphate is probably due principally to a combination of the soluble phosphoric acid with the acid salts of aluminium and the consequent formation of insoluble non-acid compounds. A method of determining soil acidity is described in which the catalysis of ethyl acetate is taken as the measure of the soluble acidity of the soil. Ten grms. of the soil is mixed in a stoppered bottle with 100 c.c. of 5% aqueous ethyl acetate solution; the mixture is shaken at intervals for one day, allowed to settle overnight, and 10 c.c. of the clear liquid is then titrated with $N/20$ alkali solution, using phenolphthalein as indicator. By repeating the shaking and titration at definite intervals, the value of the velocity constant can be calculated, if desired, by using the formula for a monomolecular reaction represented by the equation $1/t \log_e a/a - x = K$. A control experiment without soil should be made at the same time, and the determinations carried out at a constant temperature.—W. P. S.

Limestone for agricultural purposes: Rapid method for the analysis of ——. A. S. Behrman. J. Ind. Eng. Chem., 1916, **8**, 42—45.

The quantities of calcium and magnesium carbonates may be determined as follows:—One grm. of the powdered limestone is heated at 86° C. for 30 mins. with 50 c.c. of $N/2$ hydrochloric acid and a few drops of hydrogen peroxide solution; the solution is then cooled, 5 grms. of ammonium chloride added and dissolved, a quantity of macerated filter-paper introduced, and 25 c.c. of $N/2$ ammonia added slowly. After 15 minutes, the mixture is filtered, the insoluble portion washed with neutral 10% ammonium nitrate solution until all the free ammonia is in the filtrate, and the contents of the filter are ignited and weighed. The percentage weight found (representing the insoluble matter plus aluminium and ferric hydroxides) is subtracted from 100 to obtain the combined weights of the calcium and magnesium carbonates. The filtrate is titrated with $N/2$ hydrochloric acid, using methyl orange as indicator, and from the result the quantity of hydrochloric acid required to decompose the two carbonates and, consequently, the total amount of carbon dioxide present, is calculated. Knowing the combined weight of the two carbonates and the quantity of carbon dioxide they contain, a simple calculation gives the actual amounts of the respective carbonates. The results found by the method are usually accurate within about 1%.—W. P. S.

Sludge; Fertiliser value of activated [*sewage*] ——. E. Bartow and W. D. Hatfield. J. Ind. Eng. Chem., 1916, **8**, 17—20.

Pot cultures with wheat and garden experiments with radishes and lettuce showed that activated sludge (see Ardern and Lockett, this J., 1914, 523, 1122; Bartow and Mohlman, *ibid.*, 1915, 508) gave better results as a fertiliser than did equivalent amounts of dried blood, sodium nitrate, ammonium sulphate, or gluten meal.—W. P. S.

Basic-slag: Determination of the citric-soluble phosphoric acid in —— *by the iron-citrate method.* M. Popp. Chem.-Zeit., 1916, **40**, 257—260. (See this J., 1912, 831, 911; 1913, 953; 1914, 704.)

To find out if the quality of the ferric chloride exerts any influence on the results obtained by this method, fourteen different samples were analysed, and although the percentage of $FeCl_3$ in them was found to vary between 58·86 and 99·64, the variations were without effect upon the amount of citric-soluble phosphoric acid found in a sample of slag. This result is in keeping with the conclusion previously drawn that so long as the ratio of the soluble silica to iron does not exceed 2 : 1, no silicic acid is precipitated during the determination. The stability of the hydrogen peroxide used in the determination is ensured by adding 1 c.c. of $N/2$ sulphuric acid or 5 c.c. of 96% alcohol to the litre. In a test experiment the presence of the latter completely inhibited the decomposition of a 3·35% aqueous solution of peroxide during 10 days. The introduction of acetanilide in alcoholic solution, as used in America, is unnecessary. The low results obtained for the phosphoric acid consequent on using an excess of hydrogen peroxide, are not due to the presence of manganese. Determinations by the Böttcher-Wagner method of the citric-soluble P_2O_5 in sodium phosphate, in an artificially prepared solution corresponding to that from a basic slag containing 40% CaO, and in a sample of basic slag, when varying amounts of peroxide and manganese were present, showed conclusively that the manganese exerted no influence. It is remarkable that whereas in the first two cases, excessive amounts of peroxide produced only an insignificant and irregular effect, with the sample of slag the results for phosphoric acid were very much reduced.—E. H. T.

Rapid determination of carbon dioxide. Waggaman. *See* VII.

Purification of effluents from glue and artificial manure works. Batek. *See* XIXb.

Patent.

Seeds; Treatment of —— [*before sowing*]. C. E. De Wolf, London, and H. E. Fry, Dorchester. Eng. Pat. 8994, June 18, 1915.

Prior to sowing, the seeds are steeped in water, or in a solution of an organic or chemical manure, or in natural waters, particularly such as are radioactive. The seeds are placed in rectangular wooden tanks (to within 3 inches of the top which are provided with well-fitting covers bored in two places to admit of the inlet of liquid and the outlet of air. The period of treatment varies with the kind of seed. Wheat requires 24 hours, but this time may be shortened to 3 hours by passing an electric current (about 0·5 amp per bushel of seed), using electrodes of ⅛ inch iro plate. If the water used is not naturally radio active, it is made so. The solutions recommende are 1·5 or 2% sodium chloride, or 0·5% magnesiu chloride. After treatment, the seeds should b sprinkled with petroleum or benzine; the may then be sown within a few hours.—E. H. T.

XVII.—SUGARS; STARCHES; GUMS.

Indian sugar industry. W. Sayer. Agric. J. India 1916, **11**, 42—64.

India is the largest producer of sugar in the worl mostly in the form of *gur*, which contains a hig proportion of reducing sugars, and is used for dire consumption. The annual production amounts to about 2,600,000 tons from cane, and nearly 500,000 tons from palm; but the consumption is over 3,750,000 tons, the difference being met by importation mostly from Java and Mauritius. The methods of cultivation in vogue are capable of very considerable improvement. In Northern India, for example, 8—14 tons of cane, and in Southern India, 25 tons is the average yield, whereas in Java a yield of 42 and occasionally of 60 tons per acre is obtained. Recently, however, improvements have been effected by the introduction of varieties such as Striped Mauritius, Barbados Seedling 208, and Java Seedling 33, which have supplanted inferior local canes. Special attention has also been given to the improvement of local canes by selection, and to the production of seedlings; while it has now been proved that sets from plant cane are superior to those from ratoons, and further that terminal sets produce a more vigorous growth than any other part of the stalk. Processes of milling and of manufacture also are in many places far from modern, but efforts are being made to foster the co-operative principle, and to employ modern mills which will extract 30 % more juice than does bullock power plant; a system of manufacturing jaggery, using small power-driven mills and avoiding excessive inversion and caramelisation, has also been elaborated. In Bihar and parts of the United Provinces new factories on up-to-date lines are increasing, the supply of cane being assured at a price which, while remunerative to the cultivator, will also enable the factory to work with financially successful results.—J. P. O.

[*Sugar solutions;*] *Velocity of saturation* [*of limed —— with carbon dioxide*]. Stanek. Z. Zuckerind. Böhm., 1916, **40**, 250. Chem.-Zeit., 1916, **40**, Rep., 110. (See also Andrlik and Stanek, this J., 1913, 247.)

In experiments on the action of carbon dioxide on limed sugar solutions, at 85° C., in small, specially constructed apparatus, precipitation of the lime was found to be facilitated by increase of the sugar-content (especially beyond 15 %) and lime content of the solutions and by the addition of dry lime instead of milk of lime; the rate of precipitation was greatest at the middle period of the reaction. Prolonged heating of the limed solutions before saturation retarded the carbonatation process, as also did addition of calcium chloride, invert-sugar, asparagine, alkali salts of aspartic or glutamic acids, or beet-pulp or its aqueous extracts. Sodium chloride, alkali acetates, and betaine had no influence on the process.—J. H. L.

Inulin; A coagulant of —— which accompanies it in vegetable tissues. J. Wolff. Comptes rend., 1916, **162**, 514—516.

The roots of chicory, *Cichorium intybus*, and the tubers of the dahlia, *Dahlia variabilis*, contain a substance, resembling diastase in many respects, which has the property of coagulating the expressed juices of those plants and precipitating pure inulin from its colloidal solutions; the name inulo-coagulase is therefore proposed for it. The enzyme is found in largest amount in the endodermis of the tubers, it functions purely as a coagulating enzyme, and its action is specific for inulin. Like diastase it is precipitated by alcohol from its aqueous solutions along with the salts which accompany it.—G. F. M.

Determination of moisture in syrups by the calcium carbide method. West. *See* XIXa.

Patents.

Beetroot washing; Process for utilising the slime which separates after the sand in ——. H. Mützel, Münsterberg. Ger. Pat. 289,984, June 30, 1914.

The slime after pressing and drying is formed into bricks which are burnt. About 4000 cb. m. of slime, from about 50,000 tons of beet, yields 2,000,000 bricks.—W. C. H.

Sugar juices and solutions; Method of rendering —— readily filtrable. A. Wijnberg, Assignor to Naaml. Vennootschap "Norit" Witsuiker Maatschappij (Norit White Sugar Co.), Amsterdam, Netherlands. U.S. Pat. 1,176,999, Mar. 28, 1916. Date of appl., Dec. 3, 1915.

See Eng. Pat. 3854 of 1915; this J., 1916, 432.

Molasses as a lubricant. Ger. Pat. 290,750. *See* I.

Manufacture of preparations of sugars and formaldehyde. Ger. Pat. 289,910. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

A coagulant of inulin which accompanies it in vegetable tissues. Wolff. *See* XVII.

Patents.

Denatured spirit; Process and apparatus for making ——. Denatured spirit. J. W. Kenevel, Philadelphia, Assignor to Distol Manufacturing Co., Wilmington, Del. U.S. Pats. (A) 1,176,150, and (B) 1,176,462, Mar. 21, 1916. Dates of appl., May 17 and Nov. 20, 1911.

(A) Carbonaceous organic material is submitted to destructive distillation, the gaseous products and those condensing above about 100° C. are eliminated, and the remaining vapours are mixed with alcohol vapour, and the mixture condensed and rectified in the usual manner. (B) Fermented vegetable matter is distilled, and the products mixed with the vapours obtained by the destructive distillation of wood. The spirit condensed from this mixture is unrefined, except by the elimination of the constituents boiling at temperatures substantially different from the boiling point of ethyl alcohol.—J. B. C. K.

Yeast; Manufacture of pressed ——. J. Effront and A. Boidin, Seclin, France. U.S. Pat. 1,176,528, Mar. 21, 1916. Date of appl., Oct. 14, 1911.

See Fr. Pat. 433,119 of 1911; this J., 1912, 146.

Mannitol from natural musts; Preparation of ——. G. P. Guignard, Melun, France. U.S. Pat. 1,175,747, Mar. 14, 1916. Date of appl., Mar. 5, 1913.

See Eng. Pat. 3261 of 1913; this J., 1913, 879.

XIXa.—FOODS.

Wheat flour; Method for the determination of the strength and baking qualities of ——. C. H. Bailey. J. Ind. Eng. Chem., 1916, 8, 53—57.

A dough was prepared from 450 grms. of flour, 5·5 grms. of yeast, 6·75 grms. of salt, 11·25 grms. of sugar, and a sufficient quantity of water. The salt and sugar were first dissolved in 200 c.c. of water, the yeast mixed with about twice its weight of water, and these were placed together with the flour in a mixing machine, additional water being added during the mixing until the dough attained the proper consistence. The quantity of water absorbed by the flour was noted. The dough was then transferred to an earthenware jar and placed in a thermostat at 28° C. The length of the fermentation period varied somewhat, being reduced by as much as 30 minutes in the case of doughs made from weak flours. Strong flour doughs were allowed to ferment for 150 mins. before being broken down, followed by successive light kneadings at the end of 60, 15, and 15 mins. The total time from kneading to moulding the loaf was thus 270 mins. The dough was then weighed, and divided into two portions, one representing 300 grms. of flour and the other 150 grms. The smaller portion was moulded and placed in a slightly greased glass cylinder 7 cm. in diameter at the bottom, widening to 9 cm. in diameter at a height of 8·2 cm. and continuing at this diameter to a total height of 23·8 cm. A disc, suspended from a cord passing over a pulley, was allowed to rest on a piece of paper placed on the surface of the dough, and the other end of the cord carried a counterpoise. The cylinder and its contents were placed in a thermostat at 32° C. and a pointer attached to the cord indicated the degree of expansion of the dough on a suitably graduated scale. The larger portion of the dough was placed in a baking pan and allowed to expand at 34° C. until the portion in the expansimeter cylinder occupied a volume of 710 c.c.; it was then baked for about 45 mins. at 200° C., and the volume of the loaf was determined. The colour and texture of the bread were also noted.—W. P. S.

Sucrose in condensed milk; Determination of ——. G. W. Knight and G. Formanek. J. Ind. Eng. Chem., 1916, 8, 28—31.

The tin of condensed milk is heated for a short time at 100° C., cooled, and its contents are washed into a 500 c.c. flask, shaken until all crystals of lactose and sucrose are dissolved, cooled, and diluted to the mark. Two portions of the solution, measuring 50 and 100 c.c. respectively, are placed in 200 c.c. flasks and for each 10 grms. of condensed milk there is added 1·7 c.c. of 5 % phosphotungstic acid followed by 2·1 c.c. of 25 % normal lead acetate solution. The two mixtures are now diluted to the mark, filtered, and to 100 c.c. of each of the filtrates is added powdered potassium oxalate in small quantities at a time until a curdy precipitate settles, leaving a clear supernatant liquid: about 0·5 grm. of oxalate is usually sufficient and a large excess should be avoided. The solutions are again filtered, using hardened filters containing about 5 grms. of fullers' earth in the apex, and the filtrates are polarised at 20° C. The direct polarisation (P) corrected for the volume of the precipitate is found by multiplying the reading of the dilute solution by 4 and subtracting the reading of the stronger solution from the product. Fifty c.c. of each of the filtrates is then placed in 100 c.c. flasks, 5 c.c. of 38·8 % hydrochloric acid is added to each, and the mixtures allowed to stand overnight between 20° and 25° C. Next morning a few drops of phenolphthalein solution are added, the mixtures neutralised with sodium hydroxide solution, diluted to the mark, and polarised at 20° C. The corrected invert polarisation (P') is obtained by subtracting the reading of the strong solution from 4 times the reading of the weaker solution and multiplying the result by 2. The percentage quantity of sucrose (S) in the sample is found from the equation:

$$S=\frac{26000(P-P')}{W(141\cdot7-t/2)},$$

where W is the weight of condensed milk and t the temperature of the polarisations.—W. P. S.

Moisture in syrups: Determination of —— by the calcium carbide method. R. M. West. J. Ind. Eng. Chem., 1916, 8, 31—35.

The calcium carbide method (see this J., 1913, 67) is particularly suitable for the determination of moisture in syrups. Ten grms. of the sample is introduced into a small flask provided with two side tubes, the neck of the flask being closed with a rubber stopper carrying a stirrer; one of the side tubes is connected with a bulb containing powdered calcium carbide and the other, through a calcium chloride tube, with the top of a gas measuring burette. The latter is filled with water previously saturated with acetylene and is connected at its lower end with a levelling tube and a second tube by means of which a fairly constant diminished pressure can be maintained in the burette throughout the determination. The calcium carbide is then shaken gradually into the flask and the mixture stirred, the flask being meanwhile cooled in a bath of cold water. When all the carbide has been added and the flask shaken so as to bring the carbide into contact with all parts of the stirrer, flask, etc., the flask is immersed in a bath containing saturated sodium sulphate solution and the latter heated to boiling; the heating is continued until the volumo of gas in the burette remains constant for 15 mins., the flask then cooled, and the volume of gas read at atmospheric pressure and temperature. It was found that 1 c.c. of acetylene corresponded with 0·001725 grm. of water. When the method was applied to fruit juices, the volume of the liberated acetylene had to be corrected for the acidity of the sample; the acids present reacted with the carbide, and acetylene was liberated in quantity proportional to the hydrogen ion concentration. The results obtained by the method are accurate within 0·3 or 0·4 %.—W. P. S.

Distinction between natural and synthetic [coal tar] dyestuffs based on electrical conductivity. Chlopin and Wassiljewa. *See* IV.

Patents.

Milk; Process for removing foreign odours from —— P. Müller, Leipzig. Ger. Pat. 290,616, Feb. 3, 1915

In the manufacture of milk powder, the milk i atomised in a chamber containing peat. Fo example the chamber may be lined with peat preferably with a thick layer of peat covered b a thinner easily removable layer.—A. S.

Coffee extract; Method of making highly-aromatic clearly-soluble, solid ——. Process for makin coffee extract. K. von Vietinghoff, Berlin U.S. Pats. (A) 1,175,091 and (B) 1,175,490 Mar. 14, 1916. Dates of appl., Aug. 4, 1914 and Jan. 14, 1915.

(A) Roasted coffee beans are lixiviated wit water, the solution evaporated to dryness, and th residue roasted at 225° C. for 10 mins. Fat, ex tracted from roasted coffee beans, is added to th product. (B) Roasted and powdered coffee berri are extracted with a fat solvent and then wit water, and the extracts are evaporated separatel The residue from the water extraction is roaste and then mixed with the dried extracted fat. —J. H. J.

Vegetable milk and its derivatives; Manufacture ——. W. J. Melhuish, Upper Parkstone. U. Pat. 1,175,467, Mar. 14, 1916. Date of app June 1, 1914.

See Eng. Pat. 21,572 of 1913; this J., 1915, 19

Beverage extract. J. L. Kellogg, Battle Creek, Mich. U.S. Pats. 1,177,037 and 1,177,038, Mar. 28,1916. Dates of appl.,Nov.27 and Dec.19, 1914.

See Eng. Pat. 2472 of 1915; this J., 1915, 1162.

Briquetting process for coal, fodder, and the like, using rice starch as binding medium. Ger. Pat. 290,528. *See* IIa.

Edible fat complex. U.S. Pat. 1,151,002. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Sewage: Purification of —— by aeration in the presence of activated sludge. E. Bartow and F. W. Mohlman. J. Ind. Eng. Chem., 1916, 8, 14—17. (See also Ardern and Lockett, this J., 1914, 523, 1122; 1915, 937; 1916, 153.)

Experiments on a larger scale than those recorded previously (this J., 1915, 508) have been made, the tanks used having an area of 10 sq. ft. and a depth of 8·5 ft. The process was applied to ordinary town sewage. Whilst the 3 a.m. sewage nearly always yielded a stable effluent, the strong morning sewage required a longer period of aeration than 4½ hours to obtain a good effluent. It was shown that, in order to keep the sludge in its most active state, complete nitrification of each sewage is necessary. The effluents were usually stable when 50% of the free ammonia had been removed and 2 to 3 parts per million of nitrogen as nitrates was present. The greatest efficiency in air consumption was attained when enough air was used to make the sewage non-putrescible and to keep the sludge activated. The operation of the plant during six months suggested the desirability of further studying other features of the process, such as the amount of sludge formed, the building up of nitrogen compounds in the sludge, and the composition of the effluent gases.—W. P. S.

Effluents from glue and artificial manure works; Purification of ——. A. Batek. Chem.-Zeit., 1916, 40, 313—315.

The treatment consists of a preliminary chemical purification with lime and aluminium sulphate, followed by continuous bacterial purification in open filter beds. The chemical treatment is carried out in four large tanks each of 55 cb. m. capacity, 13·3 kilos. of aluminium sulphate and 1·5 kilos. of lime being added to each 100 cb. m. of effluent. Each tank requires 10 to 11 hrs. to fill, and after adding the lime water and aluminium sulphate solution and thoroughly mixing, by means of steam agitators, the contents of the tanks are allowed 2 hrs. to settle, and the clear water then removed by means of a floating siphon, without disturbing the precipitated matter and mud. The clear effluent from these tanks is pumped to the open bacterial beds, which cover an area of 14 by 23 sq. m., and are surrounded by a wall 50 cm. in height. The depth of the beds is 3·1 m. The filter bed area is intersected with canals covered with porous cement plates, and the bacterial beds themselves are provided with numerous air canals which end in the enclosing wall. The advantages of having the bacterial bed of such large size and depth, are that in winter time he heat generated by the process is conserved by he large volume of liquid under treatment, and undue cooling or freezing of the beds is avoided. Even with the air temperature at −20° C. these large bacterial beds have worked quite satisfactorily. A large number of analyses of the drainage water before and after the treatment are given showing that a combination of hemical and bacterial methods of purification is applicable to the effluent from glue and artificial manure works. The method of purification described is both simple and economical, and this system of treatment can compete with more elaborate and expensive systems. —J. B. C. K.

Fertiliser value of activated [sewage] sludge. Bartow and Hatfield. *See* XVI.

Patents.

Liquids [trade wastes]; Process for purifying ——. T. W. Barber, Westminster. Eng. Pat. 6735, May 5, 1915.

A waste trade liquid, such as coke oven waste, is diluted 10—20 times with some of the effluent obtained by the previous operation of the process. The diluted liquid is mixed with 1—5% of domestic sewage sludge and 0·5—1% of clay and is passed to a filter bed, preferably to the bottom of an upward flow bed, which is in an active bacterial condition. The separated solids are washed out from the bottom of the bed daily. The effluent from the filter, except one-tenth or other proportion equal to the amount of fresh waste entering the plant, is pumped to a tank ready to be measured off again for diluting fresh waste. The one-tenth portion, or other proportion, flows away as the effluent from the plant. The process may be continuous or intermittent.—J. H. J.

Sewage; Process and apparatus for purifying ——. H. Desrumaux, Paris. Eng.Pat.9723,July 3,1915.

Sewage enters the first compartment of a septic tank and leaves by a pipe leading from about half the depth of the compartment and delivering on to the surface of the liquid in the second compartment. From here the sewage passes through an orifice near the bottom of the compartment into the third and fourth compartments and finally through a filter compartment. The filter delivers the liquid into the hollow axle of a long rotating cylinder which distributes it over filter beds. The cylinder is divided by longitudinal radial partitions into three sections which are filled successively from the axle, and when full, cause the drum to swing round so that the liquid is discharged. Each section of the cylinder delivers over a separate area of the filter beds.—J. H. J.

Ozone; Process for purifying and sterilising barrels, and the like with ——. Actienges. f. Anilinfabr. Ger. Pat. 290,204, Jan. 7, 1914.

Highly ozonised air or oxygen is first blown into the barrel, followed by a spray of ozonised air and water, the barrel meanwhile being closed by a spring valve set at a definite pressure. An apparatus for applying the process consists of a vertical ozone- and water-spraying jet, having on its neck a cone resting on a spring. The barrel is lowered on to the vertical jet, which passes through the bunghole into the interior of the barrel. By an arrangement of levers controlling the ozone and water supplies to the jet, the weight of the barrel first opens the ozone supply, then brings the edges of the bunghole tightly against the spring-supported cone on the neck of the jet (thus closing the barrel) and opens the water supply. An intimate mixture of water and ozone is thus sprayed into the barrel until the pressure exceeds the pressure of the spring which holds the cone against the bunghole. The latter then opens, and the barrel empties itself. When it is lifted off the jet, the levers close the ozone and water supplies again.—F. Sp.

Antiseptic jelly or compound; Water-soluble ——. S. Jamieson and W. R. Hart, London. Eng. Pat. 4415, Mar. 20, 1915.

About 9 parts of melted stearic acid is incor porated, at about 65° C., with about 200 parts of *Liquor cresoli saponatus* or a similar preparation, and the mixture is neutralised with about 5 parts of sodium carbonate.—J. H. L.

Sewage sludge and the like; Apparatus for drying ——. J. Bromet, F. Thorman, and H. C. Wood, Tadcaster. U.S. Pat. 1,176,813, Mar. 28, 1916. Date of appl., June 5, 1915.

See Eng. Pat. 11,615 of 1914; this J., 1915, 631.

Phenolic condensation products capable of acting as poisons to marine growths, bacteria, and the like: Production of ——. A. Heinemann, London. U.S. Pat. 1,176,056, Mar. 21, 1916. Date of appl., May 4, 1915.

See Eng. Pat. 11,394 of 1914; this J., 1915, 815.

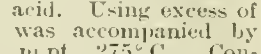
XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids: Hydrochloride method for the determination of ——. G. D. Beal and S. E. Brady. J. Ind. Eng. Chem., 1916, 8, 48.

The method consists in extracting the alkaloid with ether, treating the ethereal solution with dry hydrogen chloride, then evaporating the ether, and weighing the salt; the latter may be dissolved in water and the hydrochloric acid titrated with standard alkali solution, using phenolphthalein as indicator. The authors have determined coniine in conium seeds by the method. The ground seeds were extracted with a mixture of ether, alcohol, and ammonia, the separated ethereal solution was shaken with $N/1$ sulphuric acid to free the alkaloid from fat and colouring matter, and the acid solution, now containing the alkaloids, was rendered ammoniacal and extracted with ether. On treating this ethereal solution with dry hydrogen chloride, the hydrochloride of the alkaloids separated partly as a crystalline solid and partly as an oil. After the ether had been evaporated the residue was weighed and then titrated. The two results agreed with each other and also with that obtained by the U.S.P. method. Satisfactory results were also obtained on applying the method to colchicum root and tobacco.—W. P. S.

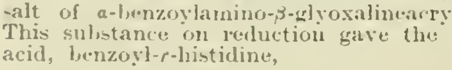
Glyoxaline-4(or 5)-formaldehyde and glyoxaline-4 (or 5)-carboxylic acid; Derivatives of ——. *A new synthesis of histidine.* F. L. Pyman. Chem. Soc. Trans., 1916, 109, 186—202.

Glyoxaline-4(or 5)-formaldehyde,



$$CHO{\cdot}\underset{\dot{N}=\!=\!=\dot{C}H}{C:CH{\cdot}NH}$$

was obtained by the oxidation of the corresponding hydroxymethylglyoxaline (Chem. Soc. Trans., 1912, **101**, 542) with nitric acid. Using excess of nitric acid the aldehyde was accompanied by glyoxalinecarboxylic acid, m.pt. 275° C. Condensation of the aldehyde with hippuric acid in presence of acetic anhydride gave about a 70% yield of 2-phenyl-4-[1-acetylglyoxaline-4(or 5)-methylidene]-oxazolone, which on hydrolysis with sodium carbonate was converted into the sodium salt of α-benzoylamino-β-glyoxalineacrylic acid. This substance on reduction gave the saturated acid, benzoyl-*r*-histidine,



$$CO_2H.CH\,(NH.COC_6H_5).CH_2.\underset{\dot{N}\text{———}\dot{C}H}{C:CH.NH}$$

hydrolysis of which resulted in the production of *r*-histidine. From the cyanohydrin of the aldehydoglyoxaline, β-hydroxy-β-glyoxaline-4 (or 5)-ethylamine was obtained by reduction. Its physiological activity was less than that of 4 (or 5)-β-aminoethylglyoxaline, one of the active principles of ergot.—G. F. M.

Lecithin: Nitrogenous constituents of brain ——. J. E. Darrah and C. G. MacArthur. J. Amer. Chem. Soc., 1916, 38, 922—930.

Six samples of lecithin were extracted from fresh sheep and ox brain, and were then purified and hydrolysed with dilute hydrochloric acid or potassium hydroxide. Amino-ethyl alcohol was extracted, in the form of picrolonate, from two samples, and found to be identical with that obtained artificially by passing the vapour of ethylene oxide into a saturated solution of ammonia in ethyl alcohol. The presence of this base was also demonstrated by isolating the gold double salt. From the analysis of the platinum salts it was shown that choline was also present in beef and sheep brain. The nitrogen of these two bases constitutes 85% of the total nitrogen in the lecithin; the remaining 15% is in the form of an unhydrolysable residue. Lecithin is probably not a homogeneous substance: if it is, it is a very complex one, and contains amino-ethyl alcohol and choline in equimolecular proportions.—E. H. T.

Oils of incense cedar; The leaf, twig, and bark ——. *Oils of the coniferæ.* V. A. W. Schorger. J. Ind. Eng. Chem., 1916, 8, 22—24. (See this J., 1915, 197, 499.)

The incense cedar (*Libocedrus decurrens*) is mainly restricted in its range to the state of California. The leaves (needles) and twigs of the tree yielded about 9·24% of greenish-yellow oil having sp. gr. 0·8655—0·8766 at 15° C.; n_D^{15} = 1·4754—1·4778; $[\alpha]_D^{20}$ = —3·20° to +38·68°; acid value, 0·18—1·30 ester value, 18·49—27·82; after acetylation, 28·64—46·24. The oil contained, approximately: *l*-α-pinene, 12—16; *d*-sylvestrene, *d*-limonene, and dipentene, 54—58; bornyl acetate, 8; free borneol, 4; "libocedrene" (a sesquiterpene), 6—7; "green oil," 2%. The bark yielded 0·14% of faint greenish-yellow oil which had sp. gr. 0·8621 at 15° C.; n_D^{15}=1·4716; $[\alpha]_D^{20}$ = +1·10°: acid value, 0·60; ester value, 3·22; after acetylation, 9·53. It contained: *l*-α-pinene, 73—85; dipentene, 5—6; bornyl acetate, 1; free borneol, 2; "green oil," 3%.—W. P. S.

Bismuth acetylsalicylate. L. Vanino and F. Mussgnug. Arch. Pharm., 1915, 253, 511—512. Z. angew. Chem., 1916, 29, Ref., 160.

Bismuth acetylsalicylate, $(C_9H_7O_4)_3Bi$, is formed as an insoluble precipitate when a bismuth-mannitol solution is added to a solution of sodium acetylsalicylate.—G. F. M.

Selenazine dyestuffs. Karrer. *See* IV.

Patents.

Acetaldehyde from acetylene; Manufacture of ——. Consortium f. Elektrochem. Ind., G. m. b. H., Nürnberg, Germany. Eng. Pat. 5132, Apr. 3, 1915. Under Int. Conv., Apr. 3, 1914.

The rapidity of the conversion of acetylene into acetaldehyde by combination with water in the presence of a mercury salt is greatly increased by carrying out the reaction in glacial acetic acid solution at 80°—90° C., adding water onl as it is required by the reaction. The acetic acid may be partly replaced by ethylidene diacetate. *Example:* Acetylene is led into a well stirred mixture of 1000 grms. of glacial acetic acid, 22·5 grms. of concentrated sulphuric acid and 100 grms. of mercuric oxide at 80°—85° C The excess of acetylene passes through a fractionating apparatus, a condenser cooled by a freezin mixture, an absorption vessel charged with wate (in which the acetaldehyde is absorbed) and then back to the reaction vessel. It is absorbed, at the rate of 100—200 litres per hour, and water is added at the same rate as it is used up. The reaction vessel may be made of iron, nickel, or any other metal not attacked by concentrated acetic acid. Mercury salts of strong acids other than sulphuric acid may be used as catalysts, and either the mercuric oxide or the acid may be in excess.—F. Sp.

Blood pressure ; Manufacture of agents for reducing ——. G. Zuelzer, Berlin. Eng. Pat. 14,365, June 15, 1914. Under Int. Conv., June 20, 1913.

Micro-organisms forming endotoxin, which have been rendered non-pathogenic, are charged with amboceptors (anti-substances), *e.g.*, by treatment with a serum containing the latter, and then mixed with gelatin.—J. H. L.

Pituitary gland ; Growth-controlling substance derived from the anterior lobe of the ——*. and process for producing the same.* T. B. Robertson, Berkeley, Cal., U.S.A. Eng. Pat. 15,683, Nov. 6, 1915.

The anterior lobes of the pituitary glands of oxen, sheep, etc., are reduced to a dry, finely-powdered state (preferably by mixing the minced material with anhydrous calcium and sodium sulphates, drying, and pulverising), and extracted with alcohol. The extract is concentrated, and precipitated by 1½ parts by volume of ether, and the precipitate is washed with an ether-alcohol mixture of the same composition as the mother-liquor, and dried in absence of moisture. The product is soluble in water, chloroform, alcohol, and ether, but insoluble in certain mixtures of the last two (see above). It contains about 1·4% of phosphorus and 4 atoms of nitrogen to 1 of phosphorus, and appears to yield inositol when hydrolysed with barium hydroxide and sulphuric acid. On treatment with sodium nitrite and acetic acid, nitrogen equivalent to half of that contained in the substance is evolved.—J. H. L.

Benzene-arsinic acid derivatives ; Substituted ——. W. P. Thompson, Liverpool. From Soc. Anon. les Etablissements Poulenc Frères, Paris. Eng. Pat. 22,522, Nov. 14, 1914.

4-N-Alkylnitrosaminophenyl-1-arsinic acids are produced by treating N-dialkyl-*p*-aminophenylarsinic acids with nitrous acid, according to the equation :—$R'R''N.C_6H_4.AsO(OH)_2+HNO_2=R'(NO)N.C_6H_4.AsO(OH)_2+R''OH$, where $R'=CH_3, C_2H_5, CH_2.COOH, CH_2.COO(Alkyl)$, etc., and $R''=CH_3$, C_2H_5, etc. The dialkylaminophenylarsinic acids are produced by condensing dialkylanilines with arsenic trichloride and oxidising the product with hydrogen peroxide. *Example.*—A solution of 15 grms. of sodium nitrite in 200 c.c. of 70% sulphuric acid at 0° C. is poured into 25 grms. of the amyl ester of 4-N-methylphenylglycinearsinic acid dissolved in 150 c.c. of 70% sulphuric acid at 0° C. When the temperature has risen to 25°—30° C., the product is poured on to ice and neutralised with sodium carbonate. The precipitate of 4-nitrosophenylglycinearsinic acid is filtered off and crystallised from dilute acetic acid. It is a colourless substance, decomposing at about 150° C., insoluble in water and acids, soluble in dilute alkalis, alcohol, and glacial acetic acid. 4-N-Methylnitrosaminophenyl-1-arsinic acid, decomposing at about 190° C., is prepared from 4-N-dimethylaminophenylarsinic acid. These substances yield the corresponding N-monoalkyl compounds when treated with strong hydrochloric acid, and may be used for the preparation of therapeutically valuable hydrazine derivatives. —F. Sp.

Sugars and formaldehyde ; Manufacture of preparations of ——. Bauer und Co., Berlin. Ger. Pat. 289,910, Jan. 15, 1914. Addition to Ger. Pat. 289,312.

The process described in the chief patent (this J., 1916, 439) is varied by treating the mixture of sugars with compounds producing formaldehyde, instead of with formaldehyde itself.—F. Sp.

Saponin and its decomposition products ; Preparation of brominated derivatives of ——. F. Hoffmann-La Roche und Co. Ger. Pat. 289,946, Mar. 19, 1914.

Solutions of saponin or its decomposition products are treated with bromine ; hydrogen bromide is evolved, and the products are isolated by precipitation or evaporation. The new compounds, some of which are soluble in water and some insoluble, do not possess the hæmolytic power of saponin, but those which dissolve in water possess foam-producing properties.—F. Sp.

Norcamphor ; Preparation of solutions of —— *suitable for injection.* Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 289,950, April 26, 1914.

Unlike camphor or borneol, norcamphor, $C_9H_{14}O$, dissolves in almost any proportion in solutions of salts of hydroxybenzoic acids, forming solutions, suitable for injection, which exert analeptic action on the heart and respiratory organs similar to that of camphor.—F. Sp.

Acidylsalicyl derivatives of theobromine ; Preparation of ——. E. Merck, Darmstadt. Ger. Pat. 290,205, Oct. 15, 1913.

Acidylsalicyl derivatives of theobromine, of the general formula $C_7H_7O_2N_4.CO.C_6H_4.OR$ (where R is an acid radicle, *e.g.*, acetyl, benzoyl, or carbomethoxyl) are obtained by treating metallic salts of theobromine with acidylsalicyl chlorides at not too high temperatures. The products are stable towards weak acids, and cause none of the unpleasant effects of free salicylic acid. In dilute alkalis, and therefore in the intestines, they are resolved into their components.—F. Sp.

Mercury compounds ; Preparation of soluble alkali salts of ——. Chem. Fabr. von Heyden. Ger. Pat. 290,210, Jan. 22, 1913. Addition to Ger. Pat. 216,267.

The process described in the chief patent (this J., 1909, 1327) is altered by the substitution of sulphonic acids of benzoic acid, either in the form of free acid, or acid or neutral alkali salts, for the corresponding hydroxybenzoic acid compounds. The new compounds, *e.g.*, sodium mercuri-*o*-sulphobenzoate and sodium mercuri-*m*-sulphobenzoate, are more stable, and the action of the mercury in the organism is more gradual. Tested in equimolecular proportions by the ammonium sulphide test, the former compound deposits mercuric sulphide in about 36 hours, and the latter in about 72 hours.—F. Sp.

Sulphurous acid ; Preparation of salts of an organic derivative of ——. J. D. Riedel Akt.-Ges. Ger. Pat. 290,426, Jan. 27, 1911.

Salts of the hitherto unknown aminocarbonylsulphurous acid are formed by the action of alkali isocyanates, such as potassium isocyanate, on alkali bisulphites. Like the alkali salts of aminomethanedisulphonic acid, the new compounds react with metallic oxides with the formation of non-ionised salts which are of value as starting materials for the preparation of therapeutic substances.—G. F. M.

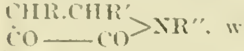
Alkamines; Preparation of esters of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,522. Mar. 29. 1914.

ALKAMINE esters are obtained by heating mono- or di-acidyl derivatives of urethanes with alkamines.—G. F. M.

Choline; Preparation of non-hygroscopic salts of ——. F. Hoffmann-La Roche und Co. Ger. Pat. 290,523. Aug. 12. 1913.

SOLUBLE non-hygroscopic salts of choline are prepared either by neutralising the free base with dihalogenhydroxybenzoic acids or by double decomposition between choline salts and salts of the dihalogenhydroxybenzoic acids.—G. F. M.

Diketopyrrolidine derivatives; Preparation of —— Chem. Fabr. auf Aktien vorm. E. Schering. Ger. Pat. 290,531. Aug. 23. 1911.

DIKETOPYRROLIDINES of the general formula  $\begin{matrix}\text{CHR.CHR}'\\ \text{CO}\text{——}\text{CO}\end{matrix}\!>\!\text{NR}''$, where R′ and R″ are any desired radicles, and R an acid residue, are treated with ammonia at high temperatures. The reaction proceeds by the elimination of water and the entry of an amino group into the pyrrolidine ring probably into the 4-position. Halogen derivatives of diketopyrrolidines may be treated in a similar manner. The products are intended for therapeutic use, especially for gout and rheumatism.—G. F. M.

Isopropenylacetylene; Preparation of ——. Farbenfabr. vorm. F. Bayer u. Co. Ger. Pat. 290,558. Jan. 29, 1914.

BY heating 2-methylbutinol, $(CH_3)_2{:}C(OH).C{:}CH$, with a dehydrating agent, isopropenylacetylene, $CH_2{:}C(CH_3).C{:}CH$, is obtained. The homologues and analogues of 2-methylbutinol give the same reaction, which was unexpected, as 3-methylbutinol breaks up into acetone and acetylene on heating, and compounds with triple bonds generally either decompose or polymerise on heating. The substances are used as the starting point for the preparation of therapeutically and technically valuable bodies.—B. V. S.

Purine derivatives; Preparation of salt-like, double compounds of ω-methylsulphonic acids of amines with ——. I. Abelin, E. Bürgi, and M. Perelstein, Berne, Switzerland. Ger. Pat. 290,600, Dec. 12, 1914. Addition to Ger. Pats. 285,579 and 287,801 (this J., 1915, 1167, and 1916, 198).

IN place of the ω-methylsulphonic acid of *p*-aminophenylsalicylate as prescribed in the earlier patents, is alkali salts of ω-methylsulphonic acids of other carbo- or hetero-cyclic amines, or the corresponding free ω-methylsulphonic acids and alkali compounds of basic purine derivatives are used. The salt-like compounds produced are easily soluble, many are of therapeutic value, and possess on the whole the same properties as the corresponding caffeine and theophylline compounds described in the chief patent.—G. F. M.

Papaverine series; Condensation products of the —— and process of making same. A. Pictet, Geneva, Assignor to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,176,597, Mar. 21, 1916. Date of appl., July 28 1914.

SEE Ger. Pat. 281,017 of 1913; this J., 1915, 636.

XXII.—EXPLOSIVES; MATCHES.

Explosives; Comparative effects of ——. A. Stettbacher. Z. ges. Schiess- u. Sprengstoffw., 1915, **10**, 193—195, 214—216, 229—232. Z. angew. Chem., 1915, **28**, Ref., 631.

COMPARATIVE experiments were made with explosives of various types which were exploded whilst unconfined, and the effect on the support observed. Under these conditions the explosion pressure and velocity of detonation of mercury fulminate was found to be less than that of nitro-explosives. Azides showed lower velocity of detonation and explosion pressure than mercury fulminate. The most effective explosives are those, such as nitroglycerin, in which the composition corresponds most closely to the equation of complete combustion. Nitroglycerin is inferior to aromatic nitro-compounds in penetrating power, but in consequence of its higher energy content, deforms tough iron to a far greater extent than, for example, trinitrotoluene. As a tamping agent for maintaining the pressure, water is more effective than sand. A mixture of 31·5 % of trinitrotoluene and 65·5 % of potassium chlorate produces a greater effect when exploded unconfined than does pure trinitrotoluene when confined.—A. S.

Wood flour. Kressmann. *See* V.

PATENTS.

Ethylenediamine perchlorate; Production of —— in a fibrous compressible form. A. Stähler, Berlin-Steglitz. Ger. Pat. 288,114, Jan. 17, 1915.

THE perchlorate is precipitated from a solution containing excess of the base by addition of a solvent in which it is soluble with difficulty, and the precipitate so obtained is compressed either dry or moistened with a liquid in which it is sparingly soluble. Ethylenediamine perchlorate, for example, is obtained in a fibrous form, which can be compressed into cakes, by adding ether gradually to an alcoholic solution.—A. S.

Nitrating apparatus; Means for fastening covers of ——. Vereinigte Eisenhütten und Maschinenbau-A.-G., Barmen. Ger. Pat. 288,362, Mar. 4, 1915.

THE cover is held in place by means of springs so that it is lifted in the event of undue pressure being developed in the nitrating vessel but returns to its normal position as soon as the pressure is relieved. An annular hood, attached to the cover and to the rim of the nitrating vessel, is arranged over the joint, so that in the event of an explosion in the nitrating vessel, any flame jets escaping are directed downwards.—A. S.

Nitrocellulose manufacture; Treatment of the wash water from ——. C. Claessen, Berlin. Ger. Pat. 288,459, Jan. 29, 1914.

THE wash water is used repeatedly to increase the concentration of acids therein, and is then treated for the recovery of the nitric and sulphuric acids. For example the nitric acid may be converted into nitric oxide by means of a reducing agent, such as ferrous sulphate in presence of sulphuric acid, and the nitric oxide converted into nitric acid by the methods used in making nitric acid from atmospheric nitrogen.—A. S.

XXIII.—ANALYSIS.

Vanadium; Determination of —— by "cupferron." W. A. Turner. Amer. J. Sci., 1916, **41**, 339—343. (See also this J., 1910, 115; 1911, 1090.)

VANADIUM in the form of vanadate and in slightl acid solution is readily detected by the formatio of a red precipitate or coloration when treate with ammonium nitrosophenylhydroxylamin ("cupferron"), the limit being 0·000001 grm vanadium per c.c. A solution of ammoniu metavanadate was standardised by evaporating weighed amount to dryness with extreme care igniting with a Meker flame, and weighing a vanadium pentoxide. The determination with cupferron was performed by diluting 25 c.c. of the metavanadate solution to 150—200 c.c. and then adding a slight excess of a 6% solution of the reagent. The precipitate was at once filtered off and washed with a cold solution containing about 10 c.c. of concentrated sulphuric acid and 1·5 grms. of cupferron per litre. After draining, the moist precipitate was transferred with the filter paper to a large platinum crucible which was first heated cautiously with a small flame, and finally ignited in an excess of air: the vanadium pentoxide was then weighed. The vanadium-cupferron precipitate is formed only in solutions containing a little free acid (hydrochloric or sulphuric). The results were very accurate.—E. H. T.

Nitrogen; Comparative study of aeration and heat-distillation in the Kjeldahl method of determining ——. K. G. Falk and K. Sugiura. J. Amer. Chem. Soc., 1916, **38**, 916—921.

The expulsion of the liberated ammonia by the passage of a current of air leads to inaccurate and unreliable results. In a series of test determinations on organic nitrogen compounds and on ammonium sulphate, the nitrogen content found was almost invariably too low (0·30—1·97%), and the deficiency could be recovered by subsequent distillation of the residues from the aeration method by using heat.—E. H. T.

Gas analysis: New accurate method of ——. O. A. Krone. J. Ind. Eng. Chem., 1916, **8**, 231—237.

An apparatus is described by means of which, it is claimed, a complete analysis can be made in 20 mins. Carbon dioxide is absorbed by 50% potash solution in a Hempel single pipette packed with iron turnings; unsaturated hydrocarbons, benzene, etc., by fuming sulphuric acid or saturated bromine water; oxygen when present in low oncentrations (up to 5%) by sticks of phosphorus n a Hempel single pipette, or, at higher con-entrations, and when carbon monoxide or dioxide s not present, by copper wire in an ammoniacal olution of ammonium chloride in a Hempel double ipette. The solution is prepared by saturating vith ammonium chloride a dilute ammonia solution 1 of ammonia solution of sp.gr. 0·9 to 4 of water by eight). Hydrogen, carbon monoxide, and aethane are determined by combustion. When thane is to be determined, the hydrogen is bsorbed by colloidal palladium or in a palladium ube, and then the carbon monoxide, methane, nd ethane determined by combustion.—A. S.

as analysis; Reagents for use in ——. *II. Chromous chloride.* R. P. Anderson and J. Riffe. J. Ind. Eng. Chem., 1916, **8**, 24—26. (See this J., 1915, 853.)

hromous chloride solution prepared by treating romous acetate with hydrochloric acid is not able and is useless as a reagent for absorbing ygen in gas analysis (see Berthelot, this J., 1898, 1). The authors have prepared a stable solution reducing violet chromic chloride with hydrogen d filtering through glass wool; the latter eration was essential, as the unfiltered solution ntained some insoluble matter (possibly metallic romium) and evolved hydrogen gradually. The sorption of oxygen by this reagent was rapid t always incomplete, and the reagent cannot, erefore, be recommended for use in gas analysis.
W. P. S.

s analysis; Reagents for use in ——. *III. pecific absorption of alkaline pyrogallol in various ipettes. Pipettes especially adapted for use with lkaline pyrogallol.* R. P. Anderson. J. Ind. Eng. Chem., 1916, **8**, 131—135.

the pipettes which have been devised for the rapid absorption of gases without shaking with the reagent, the Orsat pipette gives much better results than any of those which have been suggested as substitutes for it, when used with the modified alkaline pyrogallol reagent described previously (this J., 1915, 853). There is, however, considerable inconvenience in manipulation owing to the formation of a precipitate, and modified forms of the Orsat pipette have accordingly been constructed to overcome this defect. In both of the modified forms the portion connecting the upper end of the cylindrical vessel with the capillary tube is conical and tapers more gradually than in the ordinary form. The cylindrical portion is either 13 cm. long and 3·6 cm. diam., containing 27 thin-walled glass tubes resting on a perforated porcelain cone, or 7 cm. long and 5 cm. diam., with 33 glass tubes resting on a glass support, which, as also the tubes, can be removed through an opening at the bottom closed by a rubber stopper. With these modified pipettes the best results were obtained with a reagent containing 21·2 grms. of pyrogallol and 66·6 grms. of potassium hydroxide per 100 c.c., prepared by dissolving 25 grms. of pyrogallol in 100 c.c. of a solution of potassium hydroxide of sp.gr. 1·55. The specific absorption (*loc. cit.*) of this reagent for 1-minute contact at 20°—24° C. in either of the modified pipettes is about 36 with 100 c.c. samples of gas containing 20·9% of oxygen. The pipettes are not well adapted to the analysis of samples of nearly pure oxygen.
—A. S.

Gas analysis: Reagents for use in ——. *IV. Phosphorus in solution.* R. P. Anderson and W. Biederman. J. Ind. Eng. Chem., 1916, **8**, 135—136.

A solution of phosphorus in castor oil, recommended by Centnerszwer (this J., 1910, 722), was found to be unsuitable for the gas-analytical determination of oxygen; absorption was not complete even after contact for 9 mins. with the reagent in a Hempel pipette for solid and liquid reagents.—A. S.

Direct determination of carbon monoxide in mixtures containing unsaturated hydrocarbons. Piva. *See* IIa.

Examination of asphalt. Gary. *See* IIa.

New penetration needle for use in testing bituminous materials. Reeve and Pritchard. *See* IIa.

Distinction between natural and synthetic [coal tar] dyestuffs based on electrical conductivity. Chlopin and Wassiljewa. *See* IV.

Rapid determination of sulphur in pyrites cinder. Moore. *See* VII.

Rapid determination of carbon dioxide. Waggaman. *See* VII.

Proposed quick analytical method for determining zinc in retort residues or electric zinc furnace slags. Johnson. *See* X.

Determination of the origin of hydrogenated fats. Prescher. *See* XII.

Detection and distinction of artificial tannins alone and in admixture with vegetable tannins. Lauffmann. *See* XV.

Acid soils and the effect of superphosphate and other fertilisers on them. Determination of soluble acidity in soils. Conner. *See* XVI.

Rapid analysis of limestone for agricultural purposes. Behrman. *See* XVI.

Determination of the citric-soluble phosphoric acid in basic slag by the iron citrate method. Popp. *See* XVI.

Determination of the strength and baking qualities of wheat flour. Bailey. *See* XIXa.

Determination of sucrose in condensed milk. Knight and Formanek. *See* XIXa.

Determination of moisture in syrups by the calcium carbide method. West. *See* XIXa.

Phenol coefficient of germicides. Kilmer and others. *See* XIXb.

Hydrochloride method for the determination of alkaloids. Beal and Brady. *See* XX.

Patents.

Gas analysing apparatus. G. A. Burrell, Pittsburgh, Pa. U.S. Pat. 1,176,199. Mar. 21, 1916. Date of appl., Feb. 11, 1916. (Dedicated to the public.)

A U-tube (or two vertical tubes having a connection between their lower extremities) is provided with a liquid seal at the lowest part. The upper end of one of the tubes is closed by a valve, and is provided with a filament which can be heated electrically. A graduated scale is placed adjacent to the other limb of the U-tube.—J.B.C.K.

Gases or gaseous mixtures ; Apparatus for measuring automatically the composition of —— by means of a Wheatstone bridge. H. Heinicke, Seehof. Ger. Pat. 290,581, Jan. 9, 1914.

The gas to be tested is passed through a tube containing a platinum wire, heated electrically to incandescence, and mounted alongside a second wire forming part of one of the arms of a Wheatstone bridge, which is supplied with current from an independent source. If the composition of the gaseous mixture alters owing to addition of a combustible gas, the latter burns in contact with the incandescent wire and raises its temperature and hence also that of the bridge-wire, and the change of resistance thus caused is indicated by a deflection of the galvanometer-needle. Conversely if a non-combustible gas, such as nitrogen or carbon dioxide, be added, the temperature of the incandescent wire is reduced, and the galvanometer needle is deflected in the opposite direction.—A. S.

Books Received.

Catalysis. By E. Jobling. J. and A. Churchill, 7, Great Marlborough Street, London. 12 pages, 7½ × 5 in. Price 2s. 6d.

The subject of catalysis is now of such great interest and importance that the appearance of this little book should prove welcome. The first chapter is devoted to a general consideration of the subject in which the various forms of catalytic action are classified. The subsequent chapters are headed :—II. Sulphuric acid manufacture. III. Chlorine, salt cake and sulphur recovery. IV. Fixation of atmospheric nitrogen. V. Surface action. VI. Hydrogenation. VII. Dehydrogenation and oxidation. VIII. Dehydration, hydrolysis, etc. Under the heading " Hydrogenation " (Chap. VI.) is also included reduction (*i.e.*, of nitro groups, ketones, etc.). The book may be recommended as a useful introduction to the subject.

Richter's Organic Chemistry. Vol. I. Chemistry of the Aliphatic Series. Translated and Revised from the German by P. E. Spielmann. Kegan, Paul, Trench, Trübner and Co., Ltd., 68-74, Carter Lane, London, E.C. 719 pages, 9 × 6 in. Price 21s.

This volume forms part of the first English Edition of Victor von Richter's well-known work, the previous translation having been of American origin. Whilst the German text book has been closely followed, certain modifications have been made and statements corrected with a view to improvement. The work is so widely known as to render an extended comment unnecessary, but it may be mentioned that the index of the present volume is considerably more detailed than that in the last American Edition.

Manuals of Chemical Technology. V. Sulphuric Acid and Sulphur Products. By G. Martin and J. L. Foucar. VI. The Salt and Alkali Industry. By G. Martin, S. Smith, and F. Milson. Crosby, Lockwood and Son, 5, Stationers' Hall Court, London, E.C. Vol. V. 75 pages, Vol. VI. 100 pages, 10 × 6 in. Price 7s. 6d. each.

These volumes contain brief descriptions of the industries mentioned, with illustrations of the modern forms of plant used, and statistics. Vol. V. deals with the sulphur and sulphuric acid industries, the manufacture of sulphur dioxide and sulphites, and with carbon bisulphide, sodium thiosulphate and hyposulphite, and sulphuretted hydrogen. Vol. VI. contains, in addition to an account of the salt and alkali industry, notes on potassium salts and the Stassfurt industry.

Phosphate Rock and Methods Proposed for its Utilisation as a Fertiliser. By W. H. Waggaman and W. H. Fry. U.S. Dept. of Agriculture, Nov. 5, 1915. 37 pages. Price 5 c.*

A brief account of the phosphate deposits of the United States, and of the methods which have been proposed for conversion of rock phosphate into a form suitable for use as a fertiliser. The various U.S. Patents bearing on the subject are enumerated and classified.

Brief Course in Metallurgical Analysis. B H. Ziegel. Chemical Publishing Co., Easton, Pa. U.S.A. 72 + vi. pages. 10 × 6¾ in. Price $1.0

This book is intended for the use of students o metallurgy who have already had some trainin in elementary analysis, the object being to indicat a course of work which will cover the ordinar methods used in analytical laboratories. Alternat pages are ruled with blank tables for the insertio of results of analyses. It should prove useful t those students who prefer to have their analytic tables and laboratory note book bound in tl same cover.

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* A certain number is available for free distribution by tl Department of Agriculture. When this supply is exhauste copies can only be obtained, at the price mentioned, from t Superintendent of Documents, Government Printing Offi Washington, U.S.A.

Journal of the Society of Chemical Industry.

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Official Notice.

ANNUAL GENERAL MEETING, 1916.

In accordance with the provisions of By-law 64, notice is hereby given that the Annual General Meeting will be held at the University of Edinburgh at 10.30 a.m. on Wednesday, July 19th, 1916. A provisional programme of the proceedings was inserted in the last issue of the Journal.

Dr. Charles Carpenter has been nominated to the office of President under By-law 20; Profs. F. G. Donnan and Henry Louis have been nominated Vice-Presidents under By-law 21: Messrs. H. Hemingway and D. Lloyd Howard have been nominated Vice-Presidents under By-laws 21 and 32, and Mr. Thos. Tyrer and Dr. R. Messel, F.R.S., have been reappointed Hon. Treasurer and Hon. Foreign Secretary respectively.

Prof. J. W. Bain, Mr. D. B. Dott, Mr. E. V. Evans, Mr. E. Grant Hooper, Mr. W. J. Leonard, Mr. R. D. Pullar, Dr. Alfred Ree, and Mr. Edwin Thompson have been nominated under By-Law 25 to fill four vacancies among the Ordinary Members of Council. A ballot list will be found in this number of the Journal.

Association of British Chemical and Allied Manufacturers.

In the early part of this year a Joint Committee f the Chemical Society, the Society of Dyers and olourists, and the Society of Chemical Industry et at the suggestion of the first named to consider he best methods for promoting co-operation etween British chemical manufacturers, and a eport on the following lines was eventually drawn p.

The Committee recommended that, in view f the vital need for organisation among the comonent parts of the Chemical Industry, the three ocieties should invite representatives of the arious branches to meet in conference for the urpose of establishing such organisation.

In the opinion of the Committee it is desirable at British Firms engaged in Chemical Manucture and its allied industries should form themlves into an Association having the following jects :—

1. To promote closer co-operation between chemical manufacturers.
2. To form a medium for placing before Government and Government Officials its views upon matters affecting the British Chemical Industry.
3. The furtherance of better technical organisation and the promotion of industrial research.
4. To keep in touch with the progress made in chemical knowledge and practice and thereby to facilitate the development of new British industries and the extension of existing ones.
5. To promote closer co-operation between chemical manufacturers and the various Universities and Technical Colleges.

The Committee suggest that the adoption by t Association of the following methods would give ct to their recommendation :—

(A) The Association might finance and supervise researches undertaken in co-operation with teaching institutions in the interests of chemical industry as a whole, such researches to be made available to any member.

(B) It might advise its Members in regard to particular researches or investigations which they may wish to undertake or have undertaken in the laboratories of teaching institutions, as well as in regard to the most suitable institution or authority to whom to apply in cases of difficulty.

(C) It might obtain the services of a chemically trained administrator of wide knowledge and organising ability, who would be paid a substantial salary and debarred from undertaking private work. A special Committee of the Governing Body containing also representatives of the academical profession might be appointed to work in consultation with him. It might also appoint an Advisory Committee to promote systematic conferences between manufacturers and teachers.

(D) The Association might keep a record for the sole use of its members of all British-made chemical products and their makers. It might facilitate mutual help and action between firms pursuing similar aims, discourage unnecessary duplication in carrying out investigations on the same subjects, thereby avoiding loss of time, duplication of plant, etc.

(E) The necessary funds might be provided by an annual subscription plus a *pro rata* addition based as far as possible on the size of the subscribing undertaking.

An invitation was issued in due course to a number of chemical and allied manufacturers to attend a meeting at the rooms of the Chemical Society, Burlington House, London, on May 23rd. An excellent response was received, over 100 firms sending representatives to the meeting.

Dr. Alexander Scott, F.R.S. (President of the Chemical Society) heartily welcomed those present, and said that the Councils of the three Societies felt that, in order to recover much of a trade which had been allowed to slip from our hands and so organise it that it may be ours for all time to come, it was essential that an Association of Chemical Manufacturers should be formed—an Association which would be powerful enough to dictate to our legislators what must be done in the true interests of the chemical industries of this Country. He hoped therefore that manufacturers would bind themselves together to form such an Association and rapidly acquire the necessary power and authority, for such could not be achieved too soon. He gratefully acknowledged the efficient help which the Joint Committee had received from the clerical staffs of the three Societies.

Dr. Scott then asked Dr. Charles Carpenter, President of the Society of Chemical Industry, to take the chair.

Dr. Carpenter said he thought it must be clear to all engaged in chemical industry that something must be done to deal with this most pressing, urgent, and important problem. There was very good evidence that the day of individualism had passed and that now the need for organisation of the highest possible kind had become paramount. One of the most pressing problems, which appealed to all manufacturers, was the labour problem. Labour to a very great extent wielded the power it did because it acted through important trade organisations, which were able to speak with a united voice and compel the Government to give attention to their suggestions and demands.

One of the difficulties which chemical industry had in dealing with the Government was that the industry had no organisation, and was consequently unable to lay its claims and aims before the Government with a united and decided voice. The methods under which the chemical industry in this country must be carried on in the future would certainly differ from what had been done in the past. The only way to progress and make our chemical industry once more what it was in the past, was to pool our resources, using the word in the broadest sense, that was, our resources of men and money, of ability and brains, of everything necessary to build up an organisation of that kind.

Among the many practical problems which appealed to every manufacturer he mentioned those of technical training, labour, and tariffs—problems which could not be dealt with unless the industry were able to speak with a united voice. They must therefore set to work to bring about an organisation of the character outlined in the Report, and he invited the meeting to discuss those proposals.

Sir **William Pearce**, M.P., pointed out that no association of capitalists could hope to approach the power of the Trade Unions, which had the enormous power of a multitude of votes behind them. On the other hand, there were many ways in which Parliamentary action could be influenced, if not controlled, and it would be a great advantage if there were an Association which could represent the views of chemical manufacturers to the Government. For example, there were the questions of excess profits and the control of chemical manufacturers. Nearly the whole of the chemical industry had been controlled, without the knowledge of Parliament, so far as he understood, simply at the will of the Minister of Munitions. That had been done entirely without consulting the chemical industry. Again, with regard to excess profits, it must be obvious that to-day, when there was a national demand for the development of the chemical industries, the money being earned was being taken away without regard to the continuance of the industry.

We as a nation had failed to recognise the enormous importance of research work, neither had we made use of the scientific minds and intelligence in our Universities. From all those points of view it was quite evident to him that we required some new organisation whereby the whole of the interests of the industry could be promoted.

Dr. **Alfred Ree**, President of the Society of Dyers and Colourists, said he thought that the scheme for organising chemical industry should be started without delay, and that an essential to success was that they should all devote some time and energy to further the interests of the chemical industry as a whole. Such work, though involving the initial sacrifice of time and energy, and possibly some personal loss, must ultimately have a highly beneficial effect on the whole industry. If they joined together and stated their collective interests, then and only then could the Government really help them.

Sir **Edward Evans** urged that when the Association was formed it should associate itself with the Central Employers' Association, which represented something like 200 millions of capital. In that way they would have the whole force of the other industries of the country at their backs. The only way to obtain what they wanted was to show the Government that they had a right to be heard. Also they must have a Minister of Commerce who would understand such matters. But the main thing at present was to organise.

Mr. E. J. **Boake** thought that nothing but good could come from the formation of the Association, but it must be confined to the manufacturing interests and not get into the hands of professional chemists, because their interests and requirements were not exactly parallel. The question of tariffs was of the highest importance, and it was vital to industries to have some definite idea from the Government what to expect in the way of protection. Many were hesitating to-day whether to erect new plant or launch out into fresh manufactures, because they had no assurance that they would be supported. He cordially supported the suggestion that an Association of British Chemical Manufacturers should be formed, but he urged that it must be confined to British manufacturers in a very narrow sense.

Mr. R. H. **Clayton** thoroughly agreed with the formation of the Association, and said he believed that German progress had been due to their cooperation whilst our falling back had been due to our isolation. The whole success of the Association depended on the selection of a suitable Secretary.

Mr. J. F. L. **Brunner** moved the following resolution: "That in the opinion of this meeting it is desirable that British firms engaged in chemical manufacture and its allied industries should form themselves into an Association having the objects described under items 1 to 5 of the Report of the Joint Committee" (see above).

He thought that the most important item was No. 5, which was bound up with the promotion of technical education, which had been neglected in this country to a scandalous degree. Our chemical industries had done extraordinarily fine work in this war, but unfortunately the Government, by their lack of knowledge of chemistry, had kept them back in more ways than one. It should be their business to see that the Government thoroughly equipped the Imperial College at South Kensington.

Mr. R. G. **Perry**, in seconding Mr. Brunner's proposal, suggested that a representative committee should at once be formed to prepare a scheme which could be placed before another meeting in, say, a fortnight's time. If they were to do any good in the commercial war before them, they must come together and pool their brains, and make the best possible use of the material at the disposal of the country. He agreed with Mr. Brunner as to the importance of item No. 5 of the scheme, but he considered item No. 2 to be just as important.

The motion was then put to the meeting and carried unanimously.

The **Chairman** then invited consideration of the proposal to form a small Committee.

Dr. E. F. **Armstrong**, in supporting this proposal, said that he felt sincerely that they must combine very closely if they were to meet future competition. He was sure that they could help one another much more than they had done even though they were competing against one another. He urged on the meeting the necessity of getting six or eight men who were prepared to sacrifice a good deal of time and do a good deal of hard work, to form a Committee to carry out the proposals.

This proposal was unanimously agreed to, and Committee was appointed consisting of Sir William Pearce, Dr. Alfred Ree, Dr. E. F. Armstrong Dr. Charles Carpenter, Mr. R. G. Perry, and Mr C. A. Hill, with power to co-opt other members.

A very hearty vote of thanks to Dr. Scott an to the Chemical Society, proposed by Dr. Carpenter and seconded by Dr. Ree, was carried wit acclamation.

Canadian Section.

Meeting held at Montreal, on Friday, December 10th, 1915.

MR. T. H. WARDLEWORTH IN THE CHAIR.

THE UTILIZATION OF WASTE SULPHITE LYES.

BY JAMES BEVERIDGE.

(Abstract.)

Of the waste products of the chemical industry few have offered so many difficulties for their utilisation as the waste lye obtained in the manufacture of sulphite cellulose from wood, owing chiefly to the fact that the organic compounds contained in these lyes and derived from the wood vary greatly in character and are difficult to separate one from the other. According to Prof. Klason dry spruce wood, which forms the principal raw fibrous material for cellulose manufacture, contains substantially 53% of cellulose, 29% lignin, 14% of other carbohydrates, 3·3% resin and closely allied bodies, and 0·7% proteins. When therefore this wood is treated by the sulphite process 47% of its organic matter is rendered soluble and removed in these lyes, whilst 53% remains behind as cellulose.

The sulphite process as we know it to-day was invented by the late Mr. B. C. Tilghman, of Philadelphia, in 1866 and consists in digesting the wood at high temperatures in aqueous solutions of bisulphites, preferably those of the lime, magnesia, or soda. Either of these bases may be used, or a mixture of them employed in varying proportions. When soda is preferred as the base, it is best used alone. The greater part of the soluble constituents of the wood combine with the normal sulphites present and pass completely into solution. The chemical reactions aking place within the digester during the boiling peration have not yet been clearly defined, but nough is known at the present time from the nvestigations of Klein and others to indicate that ertain valuable products are formed which are orth recovering commercially.

There are two well-defined systems of manuacturing sulphite wood cellulose, alike in principle, ut differing as to the conditions under which the hemical action is carried out, namely the Mitscherch or "slow cook" system and the Ritterellner or "quick cook" system. In the Mitscherh system, the boiling is carried out at a temperare not exceeding 120° C. in order primarily to eserve the strength of the cellulose fibre. On e other hand, in the Ritter-Kellner or "quick ok" system the temperature of boiling may be high as 155° C., which hastens the chemical tion, but in so doing, the fibre is tendered or ndered soft. What influence the manufacturing nditions governing these two systems, have on the organic products formed has never so as I know been investigated, but one might sonably infer that temperature—other things ng equal—would affect the result. The freshly pared lyes from both systems possess a pungent newhat sweetish odour, due respectively to the sence of small quantities of sulphurous acid l saccharine matter or so-called sugars. That m the Mitcherlich system is generally clear and a bright yellow colour and contains sugars ying in amount from 0·47% to 1·56%, whilst t from the Ritter-Kellner system is usually bid and dark brown with sugar contents ying from 0·89 to 2·02% (Krause). One would r from these figures that the higher temperas promote the formation of sugars, but a further study of the most favourable conditions for their formation would prove of great value. These sugars are most important as they form the basis of the manufacture of alcohol from sulphite lyes.

According to the analysis of Wichelhaus these lyes obtained from spruce and bisulphite of lime have the following composition: Dry residue 82·835 grms. per litre (organic matter 68·344, inorganic 14·491) containing SO_3 3·434 grms., SO_2 combined 5·842, SO_2 free 2·560, Cl 0·024, SiO_2 0·0024, Fe_2O_3 and Al_2O_3 0·0102, CaO 7·176, MgO 0·004, alkalis 0·0192 grms. per litre. The sp.gr. is 1·0390.

Practically all the lime present in these liquors combines either with the sulphuric acid or with the organic matter. The same holds good whether the base be soda or other alkali, or magnesia. Of the organic compounds the most important are those that form insoluble compounds with gelatin or hide and can in consequence be used for tanning, and the fermentable sugars which may be converted into alcohol. Beyond these two, the nature and amount of the others offers a somewhat limited field at the moment for exploitation as commercial products.

The following suggestions have been made for the disposal of the lye by itself, that is, without subjecting it to chemical treatment beyond that of neutralising the free sulphur dioxide. Its use has been suggested for laying the dust on roads; as a cementing or binding material with or without such agents as calcium sulphate, in the manufacture of briquettes from sawdust and coal; for the preservation of timber, mixed with other materials such as zinc chloride; as an artificial manure when mixed with finely ground Thomas-slag; as a source of wood pitch when evaporated to a high density and finally dried on a steam drum; as a binding material for the sand in foundries, and as a mordant in dyeing certain textile fabrics. In the early days of the manufacture it was applied as a cheap sizing material for jute and such coarse fabrics, but failed in this and in other directions on account of its strong odour and of the fact that it is slightly hygroscopic. When exposed to moist air it is apt to undergo decomposition with unpleasant results, sulphuretted hydrogen being evolved.

As regards chemical treatment, V. B. Drewsen was the first to suggest the regeneration of the lye for re-use. He treated the lye with lime in closed vessels and then treated the precipitate with sulphurous acid. The bisulphites formed were removed from the organic matter by filtration. Mitscherlich, who was the first to recognise the commercial importance of the tannins in the lyes, precipitated the tannins with gelatin prepared from horn, preferably in weak acid solution. The gelatin may with advantage be mixed with resin, and both dissolved in caustic or carbonated alkalis. The precipitated gelatinous mass obtained was recommended as a sizing material in the manufacture of paper, but owing to its very dark colour its application was limited. C. D. Ekman, seeking a somewhat similar result, added zinc carbonate or oxide, or produced these in the lye itself by precipitation of a zinc salt. Later he prepared a compound which he called "dextrone" by treating the lyes obtained by his own process (involving the use of magnesium bisulphite) with either the sulphates of magnesia, soda, or potash or the corresponding chlorides, whereby a gelatinous mass separates which, when mixed with gelatin and finally dissolved in sodium bisulphite, yields a size and mordant suitable for certain branches of the textile trade. Opl obtains a product distinguished for great adhesive properties by adding 3 to 5% of a 40% formaldehyde solution to the lye previous to evaporating it. Goldschmidt treats the lye with 1% of benzoyl chloride in a weak alkaline solution. The carbohydrates, tannins, and other bodies separate out and by washing and subsequent drying can be obtained as a white powder which it is said is an excellent food for poultry. The lye has also been recommended for use in indigo dyeing and printing owing to its reducing properties, and Phelps has prepared by a nitration process a yellow organic colouring matter which is said to be fast towards sunlight and other atmospheric influences. More recently its application to the preparation of organic dyestuffs has been confirmed by American chemists, but it remains to be seen whether or not these dyes will take their place as permanent factors in the dyeing industry.

Whatever may be thought of these chemical methods they have not been adopted to any extent, and the bulk of them have not gone beyond the experimental stage. Many of them are too costly to be of commercial value. Besides, any process or combination of processes that does not provide for the disposal of the lye as a whole is unsatisfactory. This aspect of the problem is one that appeals most to pulp manufacturers, and anyone desiring to take commercial advantage of the valuable constituents in these lyes will require to confine their attention to the recovery of one or two of the more important organic compounds, *e.g.*, the tannins and fermentable sugars, and to the recovery, for use again, of the sulphur and base, particularly when this base is soda. The problem thus stated is somewhat narrowed down but is not an easy one as the operations involved are complicated, necessitating the erection of a chemical factory alongside the pulp mill.

When the lye is neutralised with lime and the clear liquor evaporated down in specially constructed pans, it can be sold as a tanning agent and as such is known in the American market as "spruce liquor." The following analysis fairly represents the composition of this commodity, and for purposes of comparison the analysis of an extract made from hemlock wood by the sulphite process and one from hemlock bark are also given.

Analyses of extracts.

	Spruce. Sulphite process. %	Hemlock wood. Sulphite process. %	Hemlock bark. Extracted by water only. %
Moisture	41·34	47·93	54·24
Total solids	58·68	52·07	45·76
Soluble do.	58·61	51·93	41·93
Insolubles	·07	·14	3·83
Non-tannins	39·36	24·84	16·63
Tannins	19·25	27·09	25·30
Sp.gr.	1·290	1·269	1·215

If we calculate the amount of tannin on 100 parts of total solids in these analyses we get respectively (in the order given) 32·80, 52·02, and 55·29%. One-third of the total organic matter in the "spruce liquor" has therefore the property of combining with gelatin and hence this "spruce liquor," in conjunction with other tanning materials such as quebracho, valonia, hemlock, &c., is being used for the preparation of certain kinds of leather, and notwithstanding a prejudice attending its use its consumption seems to be increasing. The fact that this tannin is associated with other organic compounds in combination with lime and sulphurous acid and that these have a tendency to foul the tan liquors in the pits, and perhaps enter into the composition of the leather itself, have operated against its extended use. Mitscherlich succeeded in separating these tans for the most part from the other organic matter by osmose, without having resort to precipitation methods. Opl, on the other hand, separated them by precipitation with aluminium sulphate or alum, whilst Kempe used the sulphates of the heavy metals. Kumpfmüller's process is stated to be more important. The lye is heated to precipitate calcium sulphite, whilst the remainder of the combined lime is removed by addition of an organic acid (lactic acid). The lactic acid is harmless in the tan pits. A modification of this process consists in heating the lye under vacuum to remove free sulphur dioxide and to precipitate calcium sulphite, then oxidising with ozone, and finally precipitating with freshly prepared barium carbonate.

The separation of the tannins in a commercial way from the other organic bodies, more particularly the fermentable sugars, still remains unsolved. Obviously if this can be accomplished, either by precipitation or otherwise and the sugars left untouched, the most valuable organic constituents of the lye can be utilised. The sugars can be converted by fermentation into alcohol and recovered. This process is one of the most interesting that has been introduced to manufacturers in recent years, and although simple in principle, yet it is attended with difficulties of a technical character requiring a high state of scientific knowledge for their solution. The names of Wallin and Ekström are intimately connected with the origin and development of this process. The hot lyes from the pulp digester ar deprived of the free sulphur dioxide by addition o lime or by boiling *in vacuo* or otherwise, th resulting calcium sulphite or sulphur dioxid being recovered and sent back to the aci plant of the sulphite pulp mill. The ly are then cooled by aeration or by means of a hea economiser, the last traces of acid being remove by an alkali, preferably ammonia. It is said tha the neutralisation of the last traces of acid b ammonia appreciably increases the yield of alcohol The prepared lyes are then subjected to fermentation by the aid of a specially cultivated yeas acclimatised to its particular environment in th vats. Finally the alcohol is distilled off. This i brief outline is the alcohol process as it is carrie out to-day in Scandinavia.

Passing now to a consideration of the recover of the inorganic constituents of these lyes, viz the sulphur and lime or magnesia, so long as the alkaline earths are used as the base in the prepara tion of the bisulphite liquor, there seems little ho of any process of recovery being commercial successful. If, however, the lime or magnesia replaced by soda the possibilities in this directi are greatly increased, for by simple evaporati of the lye, and calcination of the residue eith with or without lime, sodium sulphide can obtained, which in its turn may be converted in carbonate. Sodium bisulphite offers certa advantages to the pulp maker. The "cooking operation is carried out with greater ease, and t highest quality of cellulose is obtained. The was lye moreover contains substantially no lime a hence no trouble can arise from lime precipitat

L. J. Dorenfeldt was the first to suggest t recovery of the sulphur and soda in such lyes, using the well known reactions of the Le Bla soda process. The lyes were evaporated to d ness, mixed with limestone or lime, and calci to obtain ball soda. This when lixiviated yiel sodium carbonate more or less mixed with caus soda and sulphide, and calcium sulphide as residue. After the alkaline liquors have be freed from sodium sulphide, they are sent to acid plant of the pulp mill for conversion bisulphite, whilst the calcium sulphide may decomposed, as in Chance's process, by carb dioxide into calcium carbonate and free hydro sulphide which is oxidised. This process however, complicated and involves the use of extra fuel and lime in the preparation of the ball soda, and has not been adopted. Several modifications of the Le Blanc process may be suggested. The ball soda may be heated under pressure in presence of water, to obtain sodium sulphide and calcium carbonate, as in Weldon's process for the preparation of sodium sulphide. The sodium sulphide obtained may then be decomposed by carbon dioxide.

A simpler method is to add a quantity of sulphuric acid equivalent to the combined sulphur dioxide, boil, and finally evaporate to dryness, either with or without the separation of the precipitated organic matter by filtration, and calcine the mass in specially constructed furnaces to obtain sodium sulphide, which can then be decomposed with carbon dioxide. In this system the sulphuric acid decomposes the organic bodies that are combined with normal sodium sulphite, liberating sulphur dioxide, which is recovered with precipitation of organic matter (chiefly lignin). The organic matter in the dried residue evolves sufficient heat on burning to satisfy the requirements of the chemical reaction taking place within the furnace, this reaction being endothermic, and also sufficient heat to evaporate the liquors to dryness when refined systems of evaporation are employed. The decomposition of the sodium sulphide in aqueous solution by carbon dioxide presents some difficulties owing to the soda separating to a great extent as bicarbonate, but these difficulties are not insurmountable.

It will be seen that in such systems of recovery there is nothing in the reactions themselves necessitating the addition of any compound other than those required to make up the chemical and mechanical losses inevitable in such operations. The carbon dioxide, sulphur, and soda are all circulating quantities.

There is yet an alternative method that has been formulated for the recovery of the soda (and sulphur if need be) by the aid of alumina, but this necessitates the manufacture of an additional product, namely, aluminium sulphate. This process consists in calcining the dried residue from the waste lye with lime and bauxite in slight excess of equivalent proportions according to the equation:— $3Na_2S + 3CaO + Al_2(OH)_6 = Al_2(ONa)_6 + 3CaS + 3H_2O$. The calcined mass is lixiviated with water, sodium aluminate passing into solution, whilst the calcium sulphide remains behind as an insoluble residue and contains all the iron originally present in the bauxite. If desired this residue may be treated for recovery of the sulphur. By passing sulphur dioxide into the hot solution of sodium aluminate, the alumina separates out as a dense granular precipitate in the form of hydroxide, sodium sulphite being at the same time formed. The aluminium hydroxide is separated in a filter press, washed to remove sodium sulphite, and finally dissolved in sulphuric acid. The aluminium sulphate thus obtained is entirely free from iron and can command the highest price in the market for such salts. The sodium sulphite is passed over to the pulp mill for conversion into bisulphite for re-use.

In conclusion this problem of completely working up and utilising the more important compounds contained in these lyes is not so difficult of solution, but it involves the adoption by sulphite pulp manufacturèrs of a series of chemical operaions which, although well defined in character, yet necessitate the investment of additional apital in plant and machinery, and perhaps the manufacture of some additional products other han these named. Few manufacturers seem to have the inclination at the moment to embark on uch undertakings.

HOUSEHOLD AMMONIA.

BY J. F. SNELL.

(Abstract.)

Sixteen samples of "Household ammonia" and five samples of "Pure ammonia," purchased at different places in Eastern Quebec, were submitted to analysis. The "Household ammonias" varied in strength from 1·19 to 11·85 grms. of ammonia per 100 c.c. (average, 4·53 grms.), and the "Pure ammonias" from 22·4 to 24·2 grms. per 100 c.c. (average 34·46 grms.), whilst the cost per pound of ammonia, NH_3, varied from $1.22 to $11.90 (average $4.69) and from $0.99 to $1.46 (average $1.16) respectively.

Edinburgh Section.

Meeting held at Edinburgh on Wednesday, April 19th, 1916.

PROF. JAMES WALKER IN THE CHAIR.

THE VALUE OF SEAWEEDS AS RAW MATERIALS FOR CHEMICAL INDUSTRY.

BY JAMES HENDRICK, B.SC.

Round our coasts seaweed has been used as manure from time immemorial, and for generations the ash of seaweed, or kelp, has been prepared for industrial use. The kelp industry has undergone many vicissitudes during the past hundred years. At the beginning of that period kelp was valued mainly for its alkali, and was used in the glass and soap industries. Its great rival was barilla, obtained chiefly from Spain. After the alkali from both of these was displaced by that made by the Leblanc process, kelp became important as a source of iodine and of potash compounds, but when it had to meet the competition of iodine from the nitrate beds of South America and potash salts from the German mines, the industry again began to languish, and for the past 50 years it has been a struggling decaying industry, though it has always managed to survive to a small extent in the Western and Northern Islands of Scotland and in certain crofting districts of the coast of Ireland.

Attempts were made in the seventies and eighties of last century by Mr. E. C. C. Stanford to improve and organise the seaweed industry of the Western Islands of Scotland. Mr Stanford published in the "Chemical News" and this Journal * several papers during these decades chiefly on products derived from seaweeds, such as algin and alginic acid. The firm with which he was connected still continues to play a leading part in the Scottish kelp industry.

The Scottish kelp industry, however, in spite of the efforts of Stanford and others, has always been a poor, primitive, and badly organised industry, at any rate so far as the production of the kelp itself is concerned. The kelp is produced in an inefficient and badly organised manner by a large number of small makers, the crofters and small farmers of the islands. It is very variable in quality and often very impure. The means of collecting and drying the seaweed are very crude and wasteful. That such an industry finds a difficulty in competing with highly organised and well capitalised modern industries, like the potash industry of Germany and the nitrate industry of South America, is not to be wondered at, but it does not follow that if it were better organised and capitalised, and carried out with greater skill and knowledge, it would not become again a flourishing industry.

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* 1862. On the Manufacture of Kelp. (Abstract.) Chem. News. **5**, p. 167.
1876. Distillation of Seaweed. Chem. News. **34**, p. 237.
1877. On the manufacture of iodine. Chem. News. **35**, p. 172—175.
1883. On Algin: a new substance obtained from some of the commoner species of marine algæ. Chem. News. **47**, p. 254—257; p. 267—269.
1884. On Algin. Jour. Soc. Chem. Indus. **3**, p. 297—303.
1885. Improvements in the manufacture of Algin and other useful products from seaweeds. Eng. Pat. 13,433, Oct. 11, 1884. Abstract. Jour. Soc. Chem. Ind., **4**, p. 594.
1886. On Alginic acid and its compounds. Jour. Soc. Chem. Indus. **5**, p. 218—221.
1899. Improved Pharmaceutical preparations of soluble and insoluble alginates of metallic and other bases. Eng. Pat. 8075, Feb. 18, 1899. (Abstract.) Jour. Soc. Chem. Indus. **18**. p. 398.

That it is not impossible that such a transformation might be effected is rendered at least open to consideration by what has taken place elsewhere. Japan has in quite modern times organised a seaweed industry, and is now able to export large quantities of iodine as well as to supply her own markets, and is also able to produce large quantities of potash salts. Still more recently the United States, in order to render themselves independent of German potash, have been making extensive investigations into the possibilities of the seaweeds of the Pacific Coast as a source of potash salts, and have started to manufacture manures and potash salts on the large scale from these seaweeds.

As I have for many years taken an interest in the use of seaweed as manure,[*] after the outbreak of war, the great increase in the price of potash manures again turned my attention to this subject. Our information concerning the composition of our common seaweeds and the best means of extracting their valuable products, is very defective, as also is our information as to the supplies of seaweed available, the rapidity with which they will renew themselves if harvested, and the cost of harvesting, drying, and burning them on a large scale. I therefore set myself the task of attempting to obtain further information on certain points, with the help of a small grant from the Board of Agriculture for Scotland to defray out of pocket expenses. In order to clear the ground for an improvement of the industry, however, much more is required than can be accomplished by the small scale laboratory work of an individual. We require to deal with the question as the subject of the Pacific seaweeds is being dealt with in the United States, where the U.S. Department of Agriculture [†] with its great means and staff is employing many of its workers to elucidate different parts of the problem, while the University of California Agricultural Experiment Station,[‡] with its powerful staff, is also dealing with different aspects of the many scientific, industrial, and manufacturing questions on which information is required for the successful foundation of an efficient industry. In this country there are many who have not yet learned that great industrial problems cannot be solved in a moment by some sort of scientific sleight of hand, but only by long continued, co-ordinated efforts of various experts who approach the subject from different points of view, and whose work is not merely pigeonholed, but at once followed up and turned to practical account.

Composition of our common seaweeds.

In the United States during the past few years systematic series of analyses have been made of the principal seaweeds which grow on the Pacific Coasts, and the average composition and range of variation of these have been determined with a high degree of certainty. While we have a few individual analyses of our common weeds, which belong to quite different families from those which are attracting attention in America, so far as I am aware no systematic series of analyses of numbers of samples taken under known conditions have been made.

During the past year a considerable number of analyses of our principal species of seaweeds has been made in my laboratory. The samples were taken at all the different seasons of the year, and from various places, both on the Atlantic and North Sea Coasts of Scotland. The average results of these analyses together with the range of variation found for each species are shown in Tables I. to VI.

There are two great families of seaweeds which are found round our coasts in sufficient quantity to be of economic importance. These are, first, different species of the genus *Fucus*, which grow in abundance between tide marks, and are known by such names as black wrack, bladder wrack, black tang, etc.; and second, different species of the genus *Laminaria*, which grow in comparatively shallow water, but below low water mark, so that they are always at least partly covered by water, and are known as drift weed, May weed, tangles, etc. Of these the *Laminariæ* are richer in both potash and iodine than the *Fuci*, and in recent times kelp has been made from them only. At one time, when kelp was of value as a source of alkali, *Fuci* were also used, but when the value of the kelp came to depend on the iodine and potash it contained, the use of *Fuci* was given up.

There are two very similar species of *Laminaria*, *L. digitata* and *L. stenophylla*, which are found in abundance. Of these *L. digitata* is the more abundant and the more important. *L. stenophylla* is by some botanists classed as merely a variety of *L. digitata*. These weeds are anchored to rocks and stones by a root or holdfast, but in stormy weather, especially in winter, they are torn from their anchorage in large quantities and washed ashore. The weed consists of a stem or stipe and a frond or leaf. The stems are known as tangles, and are gathered in large quantities in the kelp producing areas, and dried during winter and early spring. The ash of these forms the valuable variety of kelp known as tangle ash.

The fronds of these plants break off naturally in spring, and when there is a suitable wind and tide at this season of the year immense quantities of the fronds are washed ashore. This forms what is called May weed or driftweed. This is dried in the kelp-producing areas in late spring and early summer, and its ash forms ordinary kelp.

In Table I. average analyses are given of the stems and fronds of *L. digitata*, together with the range of variation of both. As it is difficult to obtain mature samples of *L. digitata*, except when they are washed ashore, few of the samples analysed were directly cut or torn from the rocks. Most of them were gathered from the shore where they had been thrown up by the tide. They may therefore have been knocked about in the water for some time. Most of the samples also were obtained from remote kelp-producing districts in the Western Islands and Northern Islands, and sometimes several days elapsed before they reached the laboratory. Several of the earlier samples were undoubtedly partially dried before they reached me. The stems do not dry readily and the minimum amount of moisture found in them was 75·5%. No fresh sample gathered from the rocks however, and transported to the laboratory under conditions which would certainly prevent loss of moisture contained less than 80 % of moisture. In the case of the fronds only 56·88 % of moisture was found in one sample, but probably the moisture in fresh samples does not fall below 70 %.

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[*] See "The Use and Value of Seaweed as Manure." Trans. Highland and Agri. Soc. 5th Series, X., 118—134, 1898.

[†] Potash from Kelp. By F. K. Cameron. Report No. 100. U.S. Dept. of Agr., 1915.

[‡] Economic Value of Pacific Coast Kelps. By J. S. Burd. 1915. Bulletin No. 248. University of California Agr. Expt. Station.

Availability of the Nitrogen in Pacific Coast Kelps. By Guy R. Stewart. J. Agric. Research. Vol. IV., No. 1, April, 1915, p. 21.

Organic Constituents of Pacific Coast Kelps. By D. R. Hoagland. J. Agric. Research. Vol. IV., No. 1, April, 1915, p. 39.

Table III. gives similar analyses of *L. stenophylla*. This species is more readily obtained direct from the rocks as it grows very close to low-water mark. The samples were all obtained under such conditions that it is certain that very little moisture could have been lost before they reached the laboratory. They therefore more nearly represent the true maximum, minimum, and average of moisture which may be expected in fresh samples.

Tables II. and IV. give a summary of the same analyses for *L. digitata* and *L. stenophylla* but calculated to percentages of the dry matter.

A comparison of the figures in Tables I. and II. with those in Tables III. and IV. shows the great similarity in composition of *L. digitata* and *L. stenophylla* both as regards stems and fronds

TABLE I.

Composition of Laminaria digitata.

	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems. 15 samples.	Fronds. 12 samples.
	%	%	%	%	%	%
Water	84·70	84·68	75·50	56·88	82·90	75·00
*Organic matter	12·12	32·66	8·62	9·81	10·99	19·69
Ash soluble in water	6·78	7·41	3·56	2·64	4·80	4·06
Ash insoluble in water, but soluble in dilute HCl.	1·94	2·63	0·78	0·66	1·21	1·06
Siliceous matter	0·21	0·42	0·02	0·01	0·10	0·19
*Containing nitrogen	0.31	0·59	0·15	0·18	0·22	0·29
In soluble ash :—						
Potash	2·92	2·51	1·18	0·65	1·83	1·17
Soda	1·30	1·55	0·62	0·36	0·90	0·96
Sulphuric anhydride	0·95	1·46	0·34	0·46	0·48	0·74
Total halogen as chlorine	2·52	2·54	0·65	0·68	1·75	1·36
Iodine	0·131	0·170	0·072	0·023	0·094	0·084

TABLE II.

Composition of dry matter of Laminaria digitata.

	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems. 15 samples.	Fronds. 12 samples.
	%	%	%	%	%	%
*Organic matter	70·59	86 84	55·81	62·08	64·25	77·99
Ash soluble in water	30·54	30·96	21·92	9·27	28.08	16·92
Ash insoluble in water, but soluble in dilute HCl.	11·48	9·32	4·72	2·59	7·08	4·33
Siliceous matter	2·17	1·78	0·11	0·05	0·59	0·76
*Containing nitrogen	1·64	2·06	0·93	0·71	1·28	1·19
†*In soluble ash :—*						
Potash	12·67	9·40	7·00	2·26	10 66	5·19
Soda	7·73	7·86	3·80	1·09	5·32	4·06
Sulphuric anhydride	5·46	6·10	2·17	1·89	2·81	3·00
Total halogen as chlorine	12·20	12·51	3·87	2·38	10·27	5·88
Iodine	0·760	0·482	0·455	0·098	0.552	0·329

TABLE III.

Composition of Laminaria stenophylla.

	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems. 8 samples.	Fronds. 8 samples.
	%	%	%	%	%	%
Water	85·70	83·60	79·12	74·02	83·22	78·54
Organic matter	15·41	21·55	8·75	11·32	11·04	16·74
Ash soluble in water	4·97	4·22	4·37	3·38	4·71	3·74
Ash insoluble in water, but soluble in dilute HCl.	1·45	1·38	0·70	0·81	0·96	0·93
Siliceous matter	0·30	0·17	0·01	0·01	0.07	0·05
Containing nitrogen	0·25	0·27	0·13	0·16	0·17	0·21
n soluble ash :—						
Potash	2·19	1·20	1·60	0·72	1·93	0·94
Soda	1·01	1·17	0·62	0·85	0.82	1·08
Sulphuric anbydride	0·39	0·67	0·25	0·34	0·30	0·50
Total halogen as chlorine	2·01	1·57	1·52	1·20	1·82	1·36
Iodine	0·098	0·081	0·033	0·050	0·061	0.064

TABLE IV.

Composition of dry matter of Laminaria stenophylla.

	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems. 8 samples.	Fronds. 8 samples
	%	%	%	%	%	%
•Organic matter	73·80	82·94	60·15	69·03	65·27	77·53
Ash soluble in water	33·57	25·75	20·90	13·20	28·64	17·91
Ash insoluble in water, but soluble in dilute HCl.	7·42	5·42	4·84	3·67	5·72	4·37
Siliceous matter	1·56	0·84	0·04	0·03	0·37	0·19
•Containing nitrogen	1·26	1·55	0·86	0·61	0·98	1·05
In soluble ash :—						
Potash	15·16	7·31	7·64	2·74	11·85	4·54
Soda	6·03	7·12	3·17	4·49	4·98	5·09
Sulphuric anhydride	1·91	2·67	1·59	1·69	1·78	2·35
Total halogen as chlorine	13·56	9·71	7·28	5·31	11.13	6·56
Iodine	0·501	0·492	0·236	0·205	0·355	0·304

TABLE V.

Composition of chief varieties of Fucus.

	Maximum.			Minimum.			Average.		
	Fucus vesiculosus.	*Fucus nodosus.*	*Fucus serratus.*	*Fucus vesiculosus.*	*Fucus nodosus.*	*Fucus serratus.*	*Fucus vesiculosus.* 8 samples.	*Fucus nodosus.* 10 samples.	*Fucus serratus* 8 sample
	%	%	%	%	%	%	%	%	%
Water	74·15	77·07	78·89	60·40	65·17	70·89	68·12	69·60	73·63
•Organic matter	30·54	28·45	25·63	21·19	17·41	15·74	25·50	24·14	20·76
Ash soluble in water	5·20	5·73	4·75	3·78	4·42	3·83	5·02	4·89	4·13
Ash insol. in water, sol. in dil. HCl.	1·93	2·16	1·62	0·55	0·76	0·96	1·13	1·24	1·19
Siliceous matter	0·39	0·38	0·86	0·07	0·01	0·02	0·23	0·13	0·29
•Containing nitrogen	0·61	0·39	0·46	0·16	0·19	0·23	0·32	0·29	0·30
In soluble ash :—									
Potash	1·23	0·95	1·12	0·71	0·53	0·86	0·94	0·79	0·98
Soda	2·03	2·03	1·28	1·17	1·32	1·12	1·36	1·59	1·19
Sulphuric anhydride	2·86	1·91	1·33	1·37	1·34	0·89	1·76	1·59	1·01
Total halogen as chlorine	1·65	1·23	1·35	0·55	0·83	0·98	1·04	1·01	1·19
Iodine	0·026	0·067	0·019	0·004	0·012	0·008	0·010	0·026	0·013

The figures also show that the stems are much richer than the fronds in total ash constituents and especially in potash and chlorine. In iodine there is no great difference.

In the stems on the average 35% of the dry weight consists of ash constituents and in both species the average percentage of potash is over 10. In *L. stenophylla* the average potash amounts to nearly 12% and the maximum is 15·16%.

High as these percentages of ash and potash are, they do not equal those found in some of the Giant kelps of the Pacific Coast. There was found in the dry matter of 51 samples of *Nereocystis luetkeana* analysed in the laboratories of the Bureau of Soils, U.S. Department of Agriculture, an average of total soluble salts 46·9%, potash 20·1%, iodine 0·13%. Another of the more important of these great Pacific seaweeds is *Macrocystis pyrifera*, and 58 samples of this, analysed in the same laboratories, gave, on the average, total soluble salts 30·0%, potash 12·6%, iodine 0·23%. These averages are for both stems and fronds taken together, but as in the case of *Laminariæ*, these Pacific seaweeds have higher percentages of potash in the stems than in the fronds, and individual samples of the stems of *Nereocystis* are recorded to have contained 30% of potash in the dry matter. On the other hand both the stems and the fronds of our *Laminariæ* contain far more iodine than the American seaweeds.

Fresh clean stems of *Laminariæ*, tangles, unmixed with sand, if dried and ground, would form a manure of considerable value. Such a materi would contain on the average about 10% of potas and 1% of nitrogen. In America steps have bee taken to place on the market manures prepare by drying and grinding the Pacific coast seawee referred to above. The iodine, which in th country is in ordinary times the most valuab material obtained from seaweed, is lost if the sea weed is treated in this way. But in Ameri they propose to prepare manures from seawe on a very large scale, and if the iodine were al obtained from all the weed, the amount produce would be greater than the market could absor and in any case the amount of iodine present much smaller than in our weeds.

In the stems of *Laminariæ* the potash is on th average double the soda ; on the other hand in th fronds the percentages of potash and soda are ve similar. In the ash of both stems and fronds t percentage of chlorine greatly exceeds that sulphuric anhydride, but the excess is mu greater in the stems than in the fronds.

These analyses show that the stems of *Laminar* (tangles) will yield an ash much richer in pota than the fronds, and that in the stems the solu ash will consist to a large extent of potassi chloride. The ash of the fronds will contain l potash and more soda, and though these alka will be present mainly as chlorides a consideral proportion of sulphate will also be found.

As stated above, analyses were made of samp collected at all seasons of the year. No wide a characteristic differences were found in samp

TABLE VI.

Composition of dry matter of chief varieties of Fucus.

	Maximum.			Minimum.			Average.		
	Fucus vesiculosus.	*Fucus nodosus.*	*Fucus serratus.*	*Fucus vesiculosus.*	*Fucus nodosus.*	*Fucus serratus.*	*Fucus vesiculosus.* 8 samples.	*Fucus nodosus.* 10 samples.	*Fucus serratus.* 8 samples.
	%	%	%	%	%	%	%	%	%
•Organic matter	82·19	81·68	80·98	77·14	75·88	74·54	80·10	79·31	78·63
Ash soluble in water	19·37	20·37	20·39	14·65	14·33	12·94	15·62	16·21	15·87
Ash insol. in water, sol. in dil. HCl.	5·84	6·11	5·56	2·15	2·71	3·78	3·54	4·05	4·51
Siliceous matter	1·30	1·34	2·94	0·22	0·05	0·06	0·74	0·43	0·99
•Containing nitrogen	1·54	1·66	2·18	0·54	0·60	0·72	0·99	0·98	1·19
In soluble ash :—									
Potash	3·76	3·01	5·28	2·58	1·27	2·72	2·94	2·58	3·77
Soda	5·09	7·19	5·78	3·71	4·38	3·99	4·25	5·38	4·57
Sulphuric anhydride	7·21	5·83	4·58	4·53	4·40	2·89	5·47	5·28	3·86
Total halogen as chlorine	5·02	5·32	6·01	2·11	2·67	3·40	3·24	3·39	4·56
Iodine	0·103	0·238	0·067	0·013	0·042	0·024	0·034	0·086	0·048

TABLE VII.

Composition of ash of seaweed.

	Ash in weed as received.	Potash (K_2O) in ash.	Potash as K_2SO_4.	Iodine in ash.	Lb. iodine per ton of ash.
	%	%	%	%	
Laminaria digitata (stems) :—					
Maximum	8·19	35·62	65·94	2·15	48·16
Minimum	4·76	20·10	37·21	1·056	23·65
Average (15 samples)	6·09	29·89	55·34	1·548	34·68
Laminaria digitata (fronds) :—					
Maximum	10·46	26·50	49·05	2·729	61·13
Minimum	3·75	16·80	31·10	0·39	8·74
Average (12 samples)	5·31	23·34	43·19	1·697	38·01
Laminaria stenophylla (stems) :—					
Maximum	6·15	39·31	72·77	1·581	35 41
Minimum	5·47	27·07	50·11	0·594	13·31
Average (8 samples)	5·75	33·73	62·45	1·045	23·41
Laminaria stenophylla (fronds) :—					
Maximum	5·25	23·58	43·65	1·725	38·64
Minimum	4·26	16·25	30·08	0·958	21·46
Average (8 samples)	4·72	19 90	36·84	1·364	30·55
Fucus nodosus :—					
Maximum	8·02	15·95	29·53	1·159	25·96
Minimum	5·53	9·47	17·53	0·217	4·86
Average (10 samples)	6·19	12·86	23·81	0·418	9·36
Fucus vesiculosus :—					
Maximum	9·06	20·82	38·54	0·558	12·50
Minimum	4·66	12·26	22·68	0·069	1·55
Average (8 samples)	6·38	14·95	27·67	0·177	3·96
Fucus serratus :—					
Maximum	6·64	20·76	38·43	0·30	6·72
Minimum	4·88	14·31	26·49	0·12	2·69
Average (8 samples)	5·60	17·57	32·51	0·220	4·93

TABLE VIII.

Analyses of kelp samples.

	1914.						1915.				
	Tangle ash.		Kelp.				Kelp.				
Distinguishing mark. Place of origin.	D Heisker Island.	F S. Uist.	A N. Uist.	E S. Uist.	B N. Uist.	C N. Uist.	G S. Uist.	H Benbecula.	I Benbecula.	J N. Uist.	K N. Uist.
	%	%	%	%	%	%	%	%	%	%	%
Mineral matter sol. in water	61·99	55·26	59·54	57·04	20·70	31·25	61·66	69·08	70·16	43·59	59.06
Mineral matter insol. in water, but sol. in dil. HCl.	16·97	19·43	28·78	23·06	29·94	29·59	24·16	23·55	15·63	40·65	31·12
Siliceous matter	11·67	12·90	6·97	7·84	27·59	15·53	6·64	1·02	8·28	11·23	5·57
Soluble in water :—											
Potash	24·05	20·69	21·96	15·10	5·17	8·51	19·24	8·98	10·32	8·97	10·84
Soda	10·44	8·90	16·85	13·68	2·55	10·05	9·45	15·93	15·02	9·37	10.90
Sulphuric anhydride	4·00	4·19	2·68	10·42	8·11	6·65	9·04	9·79	7·91	5·37	10·49
Sulphur as sulphide	0·54	0·61	2·26	0·30	0·25	0·12	0·24	1·49	0·96	1·33	0·54
Total halogen as chlorine	19·45	21·80	25·67	20·23	1·60	8·84	22·35	27·83	30·36	16.16	20.52
Iodine	0·90	1·19	0·55	0·67	0·10	0·30	1·14	0·58	0·59	0·41	0·37
Lb. iodine per ton	20·26	26·66	12·42	15·01	2·13	6·72	25·63	12·95	13·31	9·20	8·29

either of stems or of fronds collected at one season compared with those collected at another. It does not follow, however, that there are not differences, for the number of samples collected at any one season was comparatively small and the individual variations between different samples collected at the same season are considerable. It would, therefore, require a much more extensive series of analyses to show whether there are, on the average, moderate differences in composition between samples collected at one season as compared with those collected at another.

With similar reservations it may be stated that no characteristic differences were found between seaweeds collected on the Atlantic coast as compared with those of similar kind collected on the North Sea coast.

The three chief varieties of *Fucus* found round our coasts are *F. vesiculosus*, *F. nodosus*, and *F. serratus*. Analyses of these calculated on the fresh seaweed and on the dry matter are given in Tables V. and VI.

Table V. shows that these plants contain on the average less moisture and more combustible carbonaceous matter than the *Laminariæ*. The water was not found to be as high as 80% in any of the 26 samples analysed. Some of the samples had undoubtedly lost a little moisture before they were received at the laboratory, but on the other hand certain of the samples which were weighed out in the laboratory within a few hours of being cut from the rocks, and which had been meantime packed in such a way that they could not lose any moisture, contained under 70% of moisture. It is clear then that these seaweeds contain normally a considerably larger percentage of dry matter than the *Laminariæ*.

On the other hand the *Fuci* are much poorer in the valuable constituents potash and iodine than either the fronds or stems of *Laminariæ*. Of the three species, *F. serratus* is richest in potash, and *F. nodosus* in iodine. But only *F. serratus* averages over 3% of potash in its dry matter and the maximum amount of potash found is only 5·28%. In all three species there is on the average a greater percentage of soda than of potash, and only in *F. serratus* is the chlorine higher than the sulphuric anhydride. The iodine in all three species is under 0·1% of the dry matter, and, except in *F. nodosus*, very much under it. One can readily understand, therefore, why the use of these species in making kelp was given up when iodine and potash came to be the constituents on which the value of kelp depended.

Recently dried ground seaweed has been placed on the market in this country as a manure. Such samples as I have seen consisted almost entirely of ground *Fuci*. It is evident that such a material cannot form a rich manure. Even if quite dry and free from silicious matter, it cannot be expected to contain more than 1% of nitrogen and 3% of potash.

Composition of the ash of seaweeds.

In America the term "kelp" is applied to seaweeds themselves, but in this country the term means the ash of seaweeds. This ash is prepared in a crude way by drying the tangles and drift weed in the open exposed to the weather and then burning the dried seaweed in an open fire on the ground or on a rough hearth made of stones. Further, the seaweed is collected when washed up by the tide on open sandy beaches, and it is, therefore, apt to contain more or less sand. The beaches of most of the districts where kelp is made consist of shell sand, and therefore the sand which is mixed in greater or less quantity with the seaweed, is a mixture mainly of silica and calcium carbonate.

A number of samples of kelp made in the seasons 1914 and 1915 was obtained from the Western Islands, and analyses of these are given in Table VIII. On the other hand in Table VII. the chief figures are given for the ash of the samples analysed in the laboratory. In preparing the ash in the laboratory the seaweed was burned at low red heat in a muffle, and as the analyses in Tables I. to VI. show, contained little silicious matter.

Table VII. shows that ash prepared in this way contains on the average about 30% of potash in the case of stems of *L. digitata* and nearly 34% in the case of stems of *L. stenophylla*. Two samples of tangle ash shown in Table VIII., though both were sent to me as selected samples of good quality, contain considerably less than these percentages of potash. In the case of fronds, Table VII. shows that the average potash of the ash of *L. digitata* is over 23% and of *L. stenophylla* about 20%, but most of the samples of kelp in Table VIII. contain much less than 20% of potash. Similarly, in the case of iodine, the percentage found even in the best samples in Table VIII. is much below the average found in the corresponding ash samples prepared in the laboratory. It is evident, then, that kelp and tangle ash, as ordinarily produced, contain far lower percentages of potash and iodine than clean samples of ash of the stems and fronds of *Laminariæ* prepared in the laboratory.

Further, the analyses show that kelp varies very greatly in quality. While a few of the samples contain quite fair amounts of both potash and iodine, the majority are low in both constituents, and some are so poor as to be of very low value indeed. Table VIII. shows that one of the causes of poverty of certain samples is the presence of considerable quantities of sand. While some of the samples are as free from silicious matter as could be expected, others contain quantities which are altogether excessive. Even the two good samples of tangle ash contain a considerable proportion of this impurity.

Table VII. shows that even if we did not consider the iodine at all, clean ash of *Laminariæ*, stems or fronds, would form a valuable potash manure. At the present time, when potash is quoted at nearly 20s. a unit, it would pay well to prepare such ash for direct use as potash manure. As a basis for a permanent industry, however, both potash and iodine should be taken into account. The amount of iodine present is on the average very great, especially in the ash of the fronds of *L. digitata*, in which it averages 38 lb. per ton, in spite of the fact that two of the twelve samples analysed contained an abnormally low proportion of iodine. It may be noticed that the range of variation of iodine is very great.

In America the whole of the Pacific coast has been carefully surveyed and mapped as to the occurrence and extent of seaweed beds or groves. Estimates have also been made of the annual crop of valuable seaweeds which could be harvested. In the case of certain districts the crop amounts to millions of tons. Similar surveys require to be made in this country.

In order to avoid admixture with sand, the seaweeds on the Pacific coast are not gathered from the beaches, but are harvested by specially equipped barges. The same type of harvester would probably not be suitable for work on our coasts, but there seems no reason why methods of harvesting suitable for our conditions should not be devised. At any rate if a survey shows that great quantities of seaweeds are available, there is a good case for further inquiry and experiment. At present the kelp producers are entirely at the mercy of the weather for a crop. If suitable winds do not blow there is no cast of weed. If it is practicable, as in America, to reap the crop of seaweed by means of a harvester, it would make the supply not only cleaner, but more certain.

If we turn to the figures for the ash of *Fucus* in Table VII. we see that even *F. nodosus* contains on the average nearly 13 % of potash, or as much as is contained in the well known potash manure Kainit. As the different *Fuci* are generally found mixed together, if *Fucus* ash were prepared, it would probably be a mixed ash. The mixed ash of the three species would on the average contain about 15 % of potash. At the present time such a material would form a very valuable potash manure.

Fuci contain so little iodine that they do not seem worth further consideration in connection with a permanent kelp industry, but as a temporary expedient during the present scarcity of potash manures, it would probably pay kelp makers well to dry and burn *Fucus*. These seaweeds can be obtained round many parts of the coast where *Laminariæ* cannot be obtained, and they can be gathered at many times when driftweed and tangles are not to be had. They are more readily dried than *Laminariæ*, for, as we have seen, they contain less moisture, and are not so thick as tangles. Before the war, good kelp was worth some £5 per ton to the producers; at present the ash of *Fucus* if sold for its potash alone, and if it is clean and well made, is worth much more than this figure.

The loss of potash and iodine in the manufacture of kelp.

It has been shown above that kelp and tangle ash contain much lower percentages of potash and iodine than are contained in pure carefully prepared samples of ash of driftweed and tangles, and that though this poverty is in part due to the dilution of the kelp and tangle ash with sand, this is not sufficient to account for the low quality of most samples, which can only be due to serious losses of potash and iodine during preparation. There are two obvious ways in which such loss can take place: (1) soluble constituents may be washed out by exposure to the weather during the drying of the seaweed, and (2) constituents may be lost or rendered insoluble during burning.

Two samples of tangles which had been air-dried in the ordinary way for the manufactnre of tangle ash were analysed during the course of my investigations. One of these, Sample No. 11, contained 24·5 % of moisture, and the other, Sample No. 27, contained 29·0 % of moisture. These were carefully prepared samples which were said to have been prepared without any excessive exposure to weather, and were considered to be of good quality. The composition of their dry matter, stated in the usual form, is shown in Table IX.

TABLE IX.

Air dried tangles. Composition of dry matter.

Reference No. of Sample.	11	27
	%	%
Organic matter	78·27	74·29
Ash soluble in water	13·78	19·39
Ash insoluble in water, but soluble in dilute HCl.	7·79	5·86
Siliceous matter	0·16	0·46
	100·00	100·00
Containing nitrogen	1·62	1·51
soluble ash :—		
Potash	2·07	6·04
Soda	0·62	4·82
Sulphuric anhydride	2·86	2·85
Total halogen as chlorine	4·05	6·34
Iodine	0·256	0·389

The potash, soda, chlorine, and iodine in oth these samples are low in comparison with the averages in Table II., indeed in both samples the potash and iodine are both below the minima found in the samples recorded in Table II. On the other hand the organic matter and the nitrogen are both high. It is therefore very probable that both samples had lost soluble constituents, including both potash and iodine, during drying. Sample No. 11 had lost much more seriously than Sample No. 27, and contained only a fraction of the normal amount of potash. In neither case is the loss of iodine, as compared with the average, so serious as the loss of potash. This is especially noticeable in the case of No. 11, in which the potash is only about one-fifth of the average while the iodine is about half the average. It will be shown later that the potash is more readily leached out of seaweed by cold water than the iodine.

These two analyses, so far as they go, indicate that very serious loss, especially of potash, may take place during the drying of seaweed. Much more, however, is needed to establish what is the magnitude of the loss which actually takes place in practice. A considerable number of experimental dryings would require to be made under the conditions of practice. The materials dried would require to be weighed and average samples taken for analysis at the start and at the finish. I am at present carrying out some experiments on these lines, but much more than I have at present means to attempt requires to be done.

It is also in my opinion important that experiments should be made on a large scale on artificial drying and the cost of such treatment determined. In the United States the drying of seaweed is all being done by means of modern steam-heated drying plant. In any case, the drying of tangles at least, which are collected and dried during the winter, should be carried out under cover. Cheap erections which will keep out the rain so as to prevent the washing away of soluble constituents while they let the air circulate freely, are all that is required. The tangles might also be burned under cover and the heat of the combustion used to assist in drying fresh tangles.

The losses which take place during burning also require to be determined by large scale experiments carried out under the ordinary conditions of working. It is commonly said that if the kelp fires are allowed to become too fierce serious loss takes place by volatilisation, and the makers are advised to burn at a low temperature and not to allow the ash to become slagged. The samples of kelp which I saw in the Western Islands were not, generaly speaking, badly slagged, but seemed to have been produced at a moderate temperature. So far as I saw the actual kelp burning and conversed with the burners, they seemed to be aware of the importance of keeping a slow fire.

Meantime, a few laboratory experiments have been made on the effects of temperature on the composition of seaweed ash. The seaweeds were all burned in porcelain basins in an ordinary gas-heated muffle, and the temperatures were approximately measured by observing whether substances of known melting point, namely, zinc, aluminium, sodium chloride, and potassium sulphate, were melted or not. Five experiments were made on the same sample of tangles and the results are shown in Table X. In the first three experiments the dried ground seaweed was ignited without admixture. In experiment (a) the temperature was not allowed to exceed a low red heat, and probably did not rise above 500° C. The ash obtained in this way was loose, friable, and dark in colour. This was the method used in preparing the ash for analysis through all the series of analyses of seaweed samples recorded above. It was found that when burnt in this way no iodine was lost, for check experiments were made in which the seaweed was charred below red heat in presence of excess of alkali, without obtaining a higher percentage of iodine.

In experiment (b) the seaweed was burned at a low red heat and then, at the end, the temperature was allowed to rise to a bright red till the seaweed ash fused. The ash obtained in this way was solid and dark in colour.

In experiment (c) the temperature was quickly raised to bright red heat and the ash was heated at this temperature for 3 hours. The temperature of the muffle was sufficient slightly to fuse crystals of sodium chloride, but potassium sulphate was not affected. The temperature was therefore probably about 800° C. The ash obtained was fused and nearly white.

Table X.

Effect of temperature of ignition on composition of seaweed ash.

Per cent. of dry tangles.

	Ignited without admixture.			Mixed with silica and calcium carbonate.	
	(a)	(b)	(c)	(d)	(e)
Total residue after ignition	32·87	32·37	—	—	—
Water soluble ash ..	28·24	26·53	27·03	26·63	23·74
Potash............	11·75	11·50	11·54	11·17	9·85
Soda	3·96	4·00	3·36	3.48	3·17
Sulphuric anhydride	2·41	2·28	2·39	2.13	2·61
Total halogen as chlorine	10·48	10·16	10·29	9·90	8·96
Iodine	0·50	0·453	0·49	0·479	0·336

Table X. shows that no serious loss of either potash or iodine took place even in (c). It seems then that seaweed may be burned at a full red heat till the ash is quite fused, without any serious loss of either potash or iodine, provided the weed is not mixed with any impurity.

As a rule seaweed gathered on the beaches of the Outer Hebrides is mixed with some shell sand. In experiments (d) and (e) the effect of such an admixture was tested. On *a priori* grounds it was considered that such an admixture might cause loss through the acid silica driving off iodine at the temperature of the fire, and through the silica fusing with lime from the shells and with potash from the seaweed to form an insoluble glass.

The seaweed was mixed before ignition with 10 % of its weight of a mixture of 90 % of fine sand and 10 % of pure precipitated chalk. The dry seaweed had therefore admixed with it 9 % of silica and 1 % of calcium carbonate.

In experiment (d) the mixture was first charred at the lowest possible temperature and the temperature was then gradually raised till it reached bright red heat, the temperature at which sodium chloride just began to melt. The ash was fused and formed a grey, frothy looking slag.

In experiment (e) the muffle was at bright red heat before the seaweed mixture was put in. The muffle was maintained at a bright red heat, which melted sodium chloride but did not melt potassium sulphate, for four hours. A frothy, fused, almost white ash, was obtained.

The table shows that there was little loss in (d) though the percentage of soluble potash was appreciably lowered, but that in (e) there was considerable loss both of iodine and of soluble potash. It is probable, therefore, that if seaweed ash is strongly heated for a considerable time, along with a mixture of silica and calcium carbonate, such as shell sand, there will be considerable loss of both iodine and potash. It is important therefore that so far as possible admixture with sand should be avoided. Such admixture is avoided if the seaweed is harvested from the water, as is done in America, and not collected from a sandy beach.

Leaching of potash and iodine from seaweed by water.

Experiments were made to try to what extent the potash and iodine can be leached from seaweed by water. The main object was to find whether it would not be possible to extract the valuable constituents from the seaweed without drying and burning it.

The first experiments were made with fresh tangles which were cut into thin slices. These were extracted by a cold diffusion process on a principle similar so that which is adopted in the extraction of sugar from sugar beet. The slices as they were extracted were moving in the opposite direction to a current of water, so that fresh water first meets the nearly extracted slices, and at the other end the solution which is being drawn off finally passes over fresh slices. The slices after extraction were dried, weighed, and analysed, and the extracts were also analysed. It was found that by this method over 80 % of the potash could be extracted, 81·5 % in one experiment and 81·0 % in another, but that the iodine was not nearly so well extracted, 64·1 % being obtained in one experiment and only 48·6 % in the other.

It was thought that possibly better results would be obtained if the tangles were first dried and ground, but even worse results were obtained in this way.

Experiments were next made in which both stems and fronds of *Laminariæ* were heated with steam under pressure in an autoclave and then extracted. Both *L. stenophylla* and *L. digitata* were used in these experiments. The seaweed was first put through a mincer and well pulped. Weighed portions were then placed in flasks and steam-heated for half an hour to a temperature of 150° C. After heating, the pulps were much less viscous and the liquid was much more easily expressed from them than from the un-heated pulp. They were placed in cloth bags and squeezed in a screw press which expressed liquid equal to about 60 to 65 % of the weight of the original sample. The pressed pulp was then moistened with water sufficient to bring it back to its original weight and after being allowed to soak for half an hour, was again pressed. In the first set of experiments which were made with stems and fronds of a sample of *L. stenophylla*, the washing with water was repeated five times, but in the second set of experiments, made with a sample of *L. digitata*, the washing was repeated twice only, as it was found that after two washings and pressings over 90 % of potash and iodine were extracted. The whole of the extracts were analysed separately and the residual pulp left after extraction was also analysed. The results are summarised in Tables XI and XII. In Table XI, the composition of the original seaweed is given alongside the total material extracted, calculated as a percentage of the original seaweed. In Table XII the percentage of each substance found in the extracts and in the extracted pulp is given. The figures for the extracts and for the extracted pulps were determined independently.

The Tables show that heating in an autoclav enables the iodine to be much more thoroughl extracted than when a process of cold diffusio is used. The potash also is better extracte by this method. Probably the heating break up the cells, and also to some extent hydrolyse their constituents. In any case in using thi process over 90 % of both potash and iodin was extracted from both stems and fronds. Wit more efficient presses the soluble material woul be still more thoroughly extracted. It is notic able that by this method the iodine is quite as easily and thoroughly extracted as the potash.

Unfortunately this method extracts a very large proportion of organic matter from both stems and fronds. This causes no difficulty in removing iodine from the solution, but it adds greatly to the difficulty of separating potash in a marketable condition. Possibly the extracted organic matter might itself yield by-products of value, but this is a point which requires separate investigation. The solutions obtained were dark coloured and opalescent. Attempts were made to clarify and remove the colouring matter with precipitants such as lime, aluminium hydroxide, basic lead acetate, etc. All of these gave bulky precipitates which did not settle readily, though it was found possible completely to clarify the liquid by the use of a centrifugal machine. The precipitants, however, did not remove nearly all the organic matter, and on evaporating down the bulk of the extracts it was found that the organic matter left interfered seriously with all attempts to crystallise out potash salts.

TABLE XI.

Material extracted in water after heating in autoclave.
Percentages of original seaweed.

	Laminaria stenophylla.				*Laminaria digitata.*			
	Stems.		Fronds.		Stems.		Fronds.	
	Original composition.	Total extracted.	Original composition.	Total extracted.	Original composition	Total extracted.	Original composition.	Total extracted.
	%	%	%	%	%	%	%	%
Organic matter	8·75	4·68	17·13	12·19	9·81	3·35	18·08	9·53
Ash soluble in water	4·80	4·63	3·36	3·03	4·54	4·12	4·23	3·88
Ash insol. in water, but sol. in dil. HCl.	0·71	0·44	0·85	0·44	0·86	0·30	0·87	0·37
Potash.....................	2·12	2·06	0·87	0·78	1·82	1·66	1·31	1·21
Soda	0·95	0·91	0·99	0·95	0·83	0·75	0·95	0.86
Sulphuric anhydride	0·25	0·26	0·57	0·46	0·34	0·27	0·73	0·60
Total halogen as chlorine ...	1·92	1·915	1·18	1·15	1·84	1·80	1·45	1·41
Iodine	0·033*	0·025*	0·064*	0·063*	0·094	0·086	0·023	0·020
Nitrogen	0·134†	0·074†	0·149†	0·048†	0·18	0·057	0·19	0·028

* Iodine determined in first 3 extracts only. † Nitrogen determined in first 2 extracts only.

TABLE XII.

Extraction of seaweed after heating in autoclave.
Percentages found in extracts and in pulp.

	Laminaria stenophylla.				*Laminaria digitata.*			
	Stems.		Fronds.		Stems.		Fronds.	
	In extracts.	In extracted pulp.	In extracts.	In extracted pulp.	In extracts.	In extracted pulp.	In extracts.	In extracted pulp.
	%	%	%	%	%	%	%	%
Organic matter	53·50	38·25	71·09	25·43	34·13	56·79	52·70	38.55
Ash soluble in water	96·47	5·62	90·19	7·74	90·76	9·24	91.95	8·51
Ash insol. in water, but sol. In dil. HCl.	60·08	40·67	51·29	50·82	34·88	65·12	42·90	57·09
Potash.....................	94·69	2·77	89·89	7·58	91·21	9·34	92·80	8.15
Soda	95·36	3·37	95·57	8·08	90·37	9·63	90·53	9.47
Sulphuric anhydride	96·85	9·02	79·81	15·79	79·42	23·53	82·27	17·73
Total halogen as chlorine...	92·65	0·26	95·24	3·82	97·83	1·63	97·24	2·76
Iodine	89·31*	7·01	98·43*	0·79	91·49	8·51	95·24	4·76
Nitrogen	50·92†	39·23	32·21†	61·74	31·66	66·67	14·74	84·21

* Iodine determined in first 3 extracts only. † Nitrogen determined in first 2 extracts only.

Serious difficulties therefore, would have to be overcome before processes of extracting undried seaweed by water could be made a basis of a commercial method for obtaining potash compounds. Much further chemical investigation, both on the laboratory scale and on the experimental manufacturing scale, would be required to solve the problems involved. Probably the presence of organic matter would not seriously interfere with the recovery of iodine on the manufacturing scale. At any rate no serious difficulty was found in removing iodine from the water extracts on the laboratory scale.

In order to make a process of water extraction a commercial success it would probably be necessary to recover both the potash and iodine. Unless means can be found for dealing with the organic matter and recovering the potash salts, it does not seem worth while to deal further with the recovery of iodine by itself.

Experiments on the extraction of potash and iodine from seaweeds by treatment of the undried material with water have also been made recently in America.*

Summary.

The stems of *Laminaria digitata* and *Laminaria stenophylla* (tangles) are the most valuable of the seaweed substances which occur in great quantities round our coasts. They are rich in both potash and iodine, and are the most likely seaweed substance to form the basis of a permanent chemical industry.

Surveys require to be made to find the quantities available round our coasts. The best methods of harvesting them, the cost of conveying them to convenient centres, and the cost of artificial drying also require to be determined.

The fronds of *L. digitata* and *L. stenophylla* are also valuable but are not nearly so rich in potash as the stems.

The potash and iodine can both be almost completely extracted in solution from *Laminariæ* if the seaweed is first heated under pressure to about 150° C. The iodine can be readily distilled from the solution so obtained, but as there is much organic matter in the solution it is more difficult to recover the potash salts.

In the ordinary preparation of kelp, great losses of both potash and iodine take place. A large part of this loss appears to take place through the leaching away of soluble constituents by exposure to rain during drying. Drying should therefore take place under cover.

During the burning of kelp, if sand is present and the temperature of the fire is high, serious losses of iodine and of soluble potash may take place. The presence of sand is very injurious to the kelp, and experiments should be made to find whether seaweed cannot be harvested direct from the water instead of being collected from the beaches.

Seaweeds of the *Fucus* family, which grow between tide marks, are not nearly so rich in potash as the *Laminariæ*, and they are very poor in iodine. They are, however, sufficiently rich in potash to make it worth while as a temporary measure, during the present scarcity of potash, to prepare ash from them for use as potash manure.

Discussion.

Mr. W. G. O'BEIRNE said that the kelp trade could not be compared with the potash trade in Germany and the iodine trade in South America, because the kelp trade was subject to a great variety of adverse influences, such as winds, tides, rain, dew, etc.

Professor Hendrick had mentioned about £1 per unit for potash in seaweed. He did not know where so high a price could be obtained. The Scottish farmers would not give so much. As to the iodine in tangle-ash, he had never seen, during his 40 years' experience, such an amount as 38 lb. per ton in any considerable quantity of tangle-ash. He agreed that a lot of iodine and potash was lost on exposure to the air and the rain in drying; that could not very well be helped in our climate.

A considerable loss of iodine occurred in high temperature burning when sand was present, and it was almost always present more or less; the higher the percentage the more serious the damage became. In some cases even tangle-ash contained as much as 25% of sand, but he had found the silicious sand to be more injurious than the shell sand, which was largely calcareous.

By Professor Hendrick's proposed method of extraction, very weak solutions would be obtained, so weak that even with the present high prices of iodine and potash the process could not be made to pay. His Company had tried almost everything in that way with unsatisfactory results. He did not altogether agree with Professor Hendrick as to organic matter; in fact, he was nearly certain it would not be possible to get pure iodine from a solution containing soluble organic matter. Even a minute amount of such soluble organic matter would so affect iodine that it could not be used for making some salts, such as sodium iodide, since it would impart a dirty grey colour to the product. It had been alleged that light and heavy oils, alcohols, acetic acid, ammonia, illuminating gas, etc., might be obtained as distillation products; but all they had succeeded in obtaining was some evil smelling tarry water, which did not lend itself to any useful purpose. They had erected works at Tiree, North Uist, and Clydebank, and had spent over £40,000 on those works, all of which was lost.

They had also tried a wet method for utilising all the constituents of the weed. Treatment with water removed a great part of the soluble salts, but in very dilute solution. When the residue was treated with sodium carbonate, "alginic acid" was obtained, leaving a non-fibrous residue called "algulose," which constituted 14 or 15% of the weed. None of these products had been commercially successful.

The American Government had done a great deal towards solving the potash problem, but so far no American company had met with any great success, and he was sure that what they in this country had done would compare favourably with the American efforts. Some persons from their works had been requested to go to America to superintend some of their operations.

Dr. LAUDER asked whether it would be possible to found a potash industry in this country, without adequate protection against German competition.

Commenting on the effect of the temperature at which the weed was burned on the yield of potash, he said that samples of wood ash from furnaces where the temperature was high generally contained a lower percentage of potash than samples burned at what was probably a lower temperature. The lower percentage of potash in the former case had been attributed to loss owing to the higher temperature of burning.

Professor HENDRICK, in reply, said he was very gratified to find how closely Mr. O'Beirne and he agreed on most points, especially as they naturally approached the subject from somewhat different standpoints. He fully recognised that before his experiments could be translated into manufacturing work much experimenting on a manufacturing scale would be necessary. He quite agreed with Mr. O'Beirne that tangle-ash prepared in the islands never contained 38 lb. of iodine per ton; but taking the tangles themselves, clean and fairly pure and fresh, and preparing the ash in the laboratory, his figure was correct. The loss of iodine in practice was, in his opinion, mainly in the drying and not in the burning. The samples of tangle-ash and kelp he had seen were generally not slagged, and therefore had been produced at a comparatively low temperature, because probably the material slagged at about 800° C. That also bore upon the point raised by Dr. Lauder: the temperatures used in the furnaces he referred to were probably greater than 800°. He had not attempted to work at temperatures higher than those used by the kelp makers, which were probably not above 800° C.

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* J. G. Burd. Bulletin No. 248. University of California Experiment Station. pp. 205–210.

Liverpool Section.

Meeting held at the University on Wednesday, March 22nd, 1916.

MR. JOHN GRAY IN THE CHAIR.

SOME TECHNICAL APPLICATIONS OF CAPILLARY AND ELECTROCAPILLARY CHEMISTRY.

BY W. C. McC. LEWIS, M.A., D.SC.

Survey of the more important capillary phenomena.

Capillary chemistry, as the name suggests, deals with phenomena which occur at the surface or interface which separates two phases. The term "surface" or "interface" in this connection does not refer to the mathematical concept of a surface (which has no physical existence). What is meant is the very thin interfacial layer caused by the interpenetration of both phases, which extends to a very slight depth not exceeding the effective range of molecular attractions, that is in all probability a few millionths of a centimetre. It might be thought that effects which are limited to such dimensions would never play any significant rôle in physico-chemical phenomena. This is true up to a certain point. Given the proper conditions, however, surface effects play not only a significant, but even a decisive part in the observed phenomena. The necessary condition is that the surface shall be large compared to the mass or bulk of at least one of the phases. Under this condition it is to be expected that the force known as surface tension may lead to the production of phenomena not observable when the phases which constitute the system are present in bulk. To illustrate the point, let us consider the phenomenon of adsorption. Suppose we have an aqueous solution of say sugar in contact with an oil in which both sugar and water are insoluble, then if the presence of the sugar modifies the interfacial tension between the oil and the water, it will be found that the concentration of the sugar in the interfacial layer is not identical with its concentration in the bulk of the solution. This surface-concentration effect is denoted by the term adsorption, to distinguish it from absorption which means the distribution of the solute throughout the entire bulk of a phase. The phenomenon of adsorption is one of the most important and characteristic features of capillary chemistry. It was first put on a sound theoretical basis by Willard Gibbs, who showed that the phenomenon depended upon the effect produced by the dissolved substance upon the value of the interfacial tension existing between the two immiscible phases. Gibbs proved by thermodynamic means that if a dissolved substance was capable of lowerng the interfacial tension, then the substance would be positively adsorbed at the interface, hat is, its concentration in the surface layer would be greater than its average concentration in the bulk of the same phase. On the other hand, if the dissolved substance was capable of raising the nterfacial tension it would suffer desorption at the urface, that is, its surface-concentration would be ss than its average concentration in the bulk of he phase.

One can test Gibbs' expression by forming an mulsion of, say, hydrocarbon oil in an aqueous solution of some substance which is quite insoluble n the oil in the ordinary sense, but which has the roperty of lowering the interfacial tension oil-ater. It will be found that the concentration of e dissolved substance throughout the bulk of the ater is less than its concentration previous to the rmation of the large interface produced by emulsifying the oil. That is, some of the substance is now closely adhering to the oil/water interface at a higher concentration than that possessed by it in the bulk of the water. The bulk concentration has consequently been depleted to allow of the adsorption layer being formed. Two conditions are postulated in Gibbs' deduction, first, the phenomenon must be reversible, that is, if the concentration of the solute in the bulk of the aqueous phase be diminished the surface concentration must likewise diminish, and secondly the bulk concentration must not exceed the limits of applicability of the perfect gas laws.

The reference to the term *emulsions* suggests two other kinds of systems very similar in nature and behaviour, namely *suspensions* and *colloidal solutions*. Suspensions, emulsions, and colloidal solutions are all ultimately governed by the same laws. They are all fine grained systems, possessing large interfacial area compared to the mass of the disperse phase. Suspensions represent systems having the largest size of particles (diameter approx. 10^{-4} cm.), emulsions come next with diameter of the order 10^{-5} cm., and colloidal solutions represent the highest stage of subdivision with particles the diameter of which is usually of the order 10^{-6} cm. It is an important though not easily understood fact, that great variation in size of the particles in one and the same system renders the system an unstable one, with the result that the particles, instead of remaining in permanent distribution throughout the liquid medium agglomerate or coagulate, giving rise to a jelly-like mass, called a *gel*, to distinguish it from the stable suspended state, which is termed the *sol*. Since suspensions, emulsions, and colloidal solutions are characterised by the possession of large interfacial area, it is obvious that adsorption effects may take place upon the particles of these systems, just as in the case of porous bodies possessing large surface area, such as charcoal, textile fabrics, paper, sand, and soil. Suspensions, emulsions, and colloidal solutions possess in addition certain well-marked characteristics more particularly associated with the phenomenon of their stability in the disperse or sol form, and the conditions which determine the conversion of the sol into the agglomerated or gel form. It is necessary to consider some of these characteristics very briefly and, for the sake of simplicity, we shall restrict ourselves to colloidal solutions.

The first point is the determination of the average *size of particles* in a colloidal solution, or what amounts roughly to the same thing, the apparent *molecular weight* of the colloid in the sol form. From the fact that colloid particles are invisible under a high power microscope, Bredig inferred that the diameter must be less than 10^{-4} cm. From the fact that colloidal solutions possess the property of polarising light, Lobry de Bruyn concluded that the diameter could not be less than 5—10$\mu\mu$, that is, of the order 10^{-6} to 10^{-7} cm. Other considerations also based upon optical effects have led to the value 5×10^{-6} cm. for the average diameter of colloidal metals. As regards molecular weight, the result of applying the ordinary osmotic expression—which, by the way, seems to be a perfectly justifiable procedure in view of the work of Perrin and others—has led to enormous values, *e.g.*, 5000 for gelatin, 15,000 for albumin in water.

A further point of interest is the so-called *Brownian movement*, exhibited by suspended particles and due to the bombardment of the particles by the molecules of the medium. Although this phenomenon is of great theoretical interest it is not proposed to consider it further in this place, since in the few technical applications of capillary chemistry which it is proposed to deal with later no explicit use of the phenomenon is made.

We may now pass to what is probably the most important phenomenon in connection with colloids, namely, the *electric charge* which the particles possess and the mechanism of *coagulation*, which is intimately connected with the removal of the electric charge. Practically all particles in the stable colloidal or emulsoidal state are electrically charged. In aqueous solution, colloidal metals, sulphides, and oil emulsions are negatively charged, whilst colloidal hydroxides and many organic substances are positively charged. The sign of the charge is most conveniently determined by placing the colloidal solution or emulsion in a U-tube fitted with platinum electrodes and observing the direction of motion of the particles under the applied electromotive force. This movement is termed *cataphoresis*. When the particles arrive at the electrode, which is naturally charged in the opposite sense to that of the particles themselves, the latter are discharged and coagulate together to form a gelatinous mass at the electrode which is easily distinguishable by the eye. It is a remarkable fact that the removal of the charge should bring about coagulation. The simplest view of the matter—though probably an inadequate view—is that coagulation is prevented by the electrostatic repulsions of charges of the same sign, and that when the repulsion is removed by the discharge, the accidental impacts of the now uncharged particles result in the building up of large aggregates which are precipitated by the action of gravity. That gravity does not cause the precipitation of individual particles even apart from their charge is probably due to the fact of Brownian movement, the particles being retained in suspension in virtue of the bombardments by the molecules of the medium. A matter of the greatest uncertainty is the problem of the ultimate source of the electric charge which the particles carry. We know that colloids can be discharged and coagulated, not only by contact with an oppositely charged electrode, but also by means of electrolytic ions of opposite sign, the coagulating effect of such ions increasing generally with their valency. Thus $Al^{\cdot\cdot\cdot}$ ion, which possesses three positive charges, is a better coagulant of a negatively charged colloid such as colloidal arsenic sulphide than is $Ba^{\cdot\cdot}$, which carries two positive charges, and this in turn is much more effective than a monovalent ion such as $Na^{\cdot}$. In view of the fact that ions can bring about discharge it has been inferred that the charge in the first place was conferred by the adsorption upon the surface of the colloid of one of the ions of the medium, say $H^{\cdot}$ or OH', when water is the medium. Such a view as this receives considerable support from the behaviour of a colloid such as albumin, which has been shown by Hardy to be neutral or nearly so in pure water, positively charged in acid solution where $H^{\cdot}$ is in excess, and negatively charged in alkaline solution where OH' is in excess. I am inclined to think, however, that albumin is rather a special case. The difficulty of accepting the ionic-charge view as a sufficient one is evident when it is remembered that colloidal solutions may be obtained in media in which it is difficult to believe that ions exist. Thus Billiter has prepared colloidal platinum in chloroform, in which the colloid is electrically charged, and what is equally remarkable the charge is a positive one, although in water, colloidal platinum is negatively charged. Further, the process of spraying liquids through an orifice into a vacuum or into a gas confers a charge upon the particles. This process is hardly distinguishable from the more familiar cases of frictional electricity. In my opinion the origin of the charge carried by a colloid or emulsion particle is the same as that which we recognise as frictional electricity. In this connection it is very significant that in general the sign of the charge carried by a particle is determined by the relative values of the dielectric constant of the disperse phase and the medium the phase which possesses the higher dielectric constant being the positively charged one. Now water is a substance with a characteristically high dielectric constant and it is to be anticipated therefore that in the majority of emulsions and colloidal solutions which contain water, the water will be positively charged with respect to the particles, or, what is the same thing, the particles will be negatively charged with respect to the medium. Although one can obtain positively charged colloids in water it can probably be stated that the majority of colloidal solutions in water contain particles which are negatively charged. It would be rash, however, to believe that dielectric constant is the only determining factor. Even granting the frictional idea we are still met with the difficulty of visualising with any degree of clearness the relative distribution of the opposite charges existing respectively on the particle and upon the neighbouring molecules of the medium. The usual view is due to Helmholtz and is therefore spoken of as the "Helmholtz double-layer" theory. According to this, a colloid particle and the surrounding layer of molecules of the medium can be regarded as a small condenser with a certain potential difference between the surface of the colloid and the nearest layer of molecules. But this does not really take us very far unless we postulate something further about this system. It will be observed that a system represented by a charged colloid particle surrounded by a layer of oppositely charged molecules is, strictly speaking, electrically neutral as far as an external field of force is concerned. An effective charge can only be produced in such a system if there is a certain amount of "give" between the nucleus and the outer layer and the fact that colloids do move in an electric field is evidence that such a "give" takes place. Lamb (Phil. Mag., 1888) is practically the only investigator who has attempted to deal quantitatively with this point by introducing a factor called the "facility of slip" into his expression for the potential difference across the "double-layer." It is obvious that any attempts to determine the *actual* charge carried by a colloid particle are very liable to error. What we do measure is the much smaller quantity, namely the *effective* charge which is dependent upon the magnitude of the facility of slip. If the facility of slip were zero, that is if there were no "give" between the layers, the colloid-condenser system would possess no effective charge at all, though the true charge upon the particle might be considerable. The results of such determinations have hitherto been very discordant and we really do not know with any certainty the true charge on a colloid particle.* Although this is the case with regard to the charge, the value of the potential difference between the colloid particle and the surrounding medium is much more accurately known. We are particularly indebted to E. F. Burton (Phil. Mag. 1906) for having carried out the first quantitative measurements in this direction. As a rough approximation one may say that the potential difference amounts to 0·05 volt for practically all colloids and emulsions. The determination of this potential has great significance for the phenomenon of coagulation, for it has been found that by addition of a suitable electrolyte it can be reduced to zero, and may even be carried through zero to real values of opposite sign. The position at which the potential difference is zero has been called by Hardy the isoelectric point, and it was considered that this corresponded to the optimum condition for coagulation, or what is the same thing, at the isoelectric point the colloid is most unstable. Although this is nearly true, the actual coincidence of isoelectric point and maximum instability has been called in question. This problem is therefore in a state of considerable uncertainty. A similarly unsatisfactory state of things exists in relation to the discharging effect produced by ions when we come to examine the phenomenon closely. It is easy to conceive of a positive ion, such as Al''', being adsorbed upon a negative colloid and discharging it—but what rôle are we to attribute to the negative ion originally associated with the Al''' ion? It is known, for example, that aluminium sulphate possesses a different coagulating power from aluminium chloride—but why? We can only say that we do not know. Even the recent work of Bancroft (Trans. Amer. Electro-Chem. Soc., 1915, 27, 175), which has increased our knowledge of such phenomena very considerably, does not get us further than the conclusion that there is a *specific* adsorption effect entering in all cases, specific not only with respect to the ions, but likewise with respect to the colloid. It is clear that an immense field lies untouched in such problems as these.

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* For a fuller discussion of the problem see the chapter on colloids contained in the Author's "System of Physical Chemistry" in Sir William Ramsay's series of Text books.

Before passing from the problem of electric charge and coagulation it is necessary to deal very briefly with the closely allied phenomena of *colloid-protective effect* and *peptonisation*. It is well-known that a colloidal solution of platinum in water can be rendered much more stable by the addition of a small amount of gelatin. The gelatin acts as a preservative. In this case one colloid stabilises or protects the other. In the phenomenon of peptonisation we have what may be described as the reverse of coagulation. That is certain gels may be converted into sols by the action of reagents. Thus the gel hydroxides of zinc, aluminium, and chromium can be converted into the sol form by addition of excess of caustic potash. It is to Bancroft (*loc. cit.*) that we owe the idea that protective effect and peptonisation are one and the same thing. To illustrate the point a sentence or two may be quoted from a recent paper by Bancroft (*l.c.*) dealing with the behaviour of nixtures of chromic and ferric salts with excess of lkali. "Hydrous [hydrated] chromic oxide is peptonised by caustic potash whilst hydrous erric oxide is not. If the chromium salt is present n large amount relatively to the iron salt, the erric hydroxide will adsorb the peptonised hromic hydroxide and be peptonised by it thereby going apparently into solution. If the ferric salt s present in excess, it will adsorb the peptonised hromic hydroxide carrying it out of the liquid hase. It is to be noticed that the chromic ydroxide, when in excess, acts as a so-called rotective colloid to the iron hydroxide."

There still remains one other phenomenon of apillary chemistry the importance of which is ery great both from the scientific and technical tandpoint, namely the phenomenon of *electro-smosis* or *endosmosis*. By electro-osmosis is eant the movement of a liquid through a membrane or through a capillary tube towards one of he electrodes when the membrane or tube is laced in an electric field of force acting between the vo electrodes. The phenomenon is due to the ct that at the glass liquid interface there is a otential difference due to charges of opposite sign sident upon the glass and the neighbouring olecules of the liquid. These charges are not gidly fixed and can therefore slip from one olecule to another in a sense parallel to the xis of the tube. It has long been known that water be placed in a vessel divided in half by a rtical porous membrane and an electrode be aced in each half, then the water will move through e membrane under the influence of the external M.F. so that the level rises in one half and falls in the other. This phenomenon is similar to cataphoresis with this difference, that in cataphoresis the liquid medium remains approximately stationary during the passage of the suspended particles through it, whilst in electro-osmosis the medium itself moves, the diaphragm being fixed. From what has been said already regarding the origin and magnitude of the electric charge on colloid particles it is obvious that our knowledge of the phenomenon of electro-osmosis is somewhat unsatisfactory. In this as in other applications of capillary and electrocapillary chemistry, technical practice is considerably ahead of theory.

Some applications of capillary and electrocapillary chemistry to chemical industry.

The following list, which is by no means exhaustive, will serve to illustrate the variety of technical processes in which capillary effects play an important rôle.

Rubber preparation. Vulcanisation.
Separation of ore constituents.
Sprayers for crops. Soil fertility.
Rôle of colloidal iron in plant growth.
Medicinal emulsions. Milk. Cream formation.
Beverages. Liquid foods. Enzymes. Inorganic ferments.
Peptonisation. Clotting. Physiological fluids.
Emulsions for photographic purposes.
Gums and adhesive materials.
Inks and marking fluids. Pigments.
Dyes and dyeing. Bleaching, tanning, staining.
Paper sizing and colouring. Carbon and other copying papers.
Soap manufacture and cleansing action.
De-emulsification of water in steam turbines.
Filtration processes. Peat drying, etc.
Sewage treatment. River sludge. Charcoal purifiers.
Colloidal metals in fused melts. Ruby glass. Opaque glass. Enamel.
Cement. Mortar. Plaster.
Rôle of colloids in electrolysis.
Contact catalytic processes.

A few of the problems involved in some of the above applications of capillarity will be considered under the following heads:

(*a*) General capillary principles.
(*b*) Technically important emulsions and colloidal solutions.
(*c*) Adsorption.
(*d*) Coagulation.
(*e*) Selective adsorption (of ions).
(*f*) Protective effect.
(*g*) Electro-osmosis.

(A) *Application of general capillary principles to certain technical problems.*

As an example we may consider the theory of wetting and the *determination of wetting power*. This is of great importance especially in agricultural practice since it is a determining factor in the efficiency of liquid sprayers. A special case has recently been examined by Cooper and Nuttall (J. Agric. Science, 1915, 7, 219—230). These investigators point out that the efficiency of a spraying liquid is not solely dependent upon the amount of toxic substance present, the wetting power being of equal importance. The wetting power depends upon the value of the interfacial tension between two phases, this value determining whether a liquid A will wet or run over the surface of a second liquid or solid B. The value of the interfacial tension can be modified by adsorption phenomena since positive adsorption necessarily accompanies a decrease in tension. The lower the tension the greater the wetting power. To get efficient spraying it is therefore necessary to have present some substance which markedly lowers the tension. For this purpose soap or a substance having a "soap basis" is particularly suitable and is therefore recommended by these authors.

(B) *Technically important emulsions and colloidal solutions.*

One of the most important emulsions we have already referred to in sprayers or spraying liquids. These usually consist of an oil of some kind emulsified with water which contains a substance possessing toxic properties, such as basic copper salts in the case of potato spraying to prevent potato blight. In such cases as these the emulsion which is formed by mechanical means is very far from being uniform and can scarcely be regarded as stable. In the case of medicinal emulsions, such as cod liver oil emulsion, the preparation is carried out with greater care, a much more uniform and therefore more permanent emulsion resulting. Artificial beverages are for the most part emulsions or colloidal solutions. Cocoa and coffee for example may be regarded as emulsions, tea as a colloidal solution. The production of tannin-free tea depends upon the fact that the colloidal tannin can be coagulated and separated. As regards natural emulsions, the most important of all is of course milk. Milk is only a moderately stable emulsion and in many respects this is a decided advantage, otherwise cream might have remained an unknown commodity.

Another exceedingly important emulsion which occurs naturally is rubber latex. Reference will be made to this later in dealing with its coagulation.

Besides colloidal solutions in which the liquid medium is usually water or aqueous solutions, there are a number of others which are only liquid in the sense of being mobile at relatively high temperatures. I refer to glasses and enamels. Ruby glass, for example, is a very beautiful illustration of a true colloidal solution of extremely high viscosity, the colloid being a metal, the medium a mixture of fused salts. Many such colloidal solutions have been known for centuries. Among recent preparations of such solutions may be mentioned that of translucent glass. Such substances, however, are of very complex composition, so that whilst one feels justified in instancing them as examples of the colloidal state it must at the same time be confessed that the knowledge we possess of colloids is far too limited to be of much use in dealing with complex cases and still less with suggesting improvements on rational lines. It would appear that empirical methods must unfortunately be relied on for perhaps a long time yet in such cases, for the lag between theory and practice is unfortunately great.

The question of photographic emulsions will be briefly considered in dealing with electro-osmotic processes.

(C) *Technical applications of adsorption.*

Technical processes in which adsorption plays an essential part are very numerous. In the place of first importance one should mention *dyeing* processes. It is now fairly generally recognised that the first stage in such processes is a true adsorptive one. Dyestuffs are generally characterised by exerting a very marked lowering effect upon surface and interfacial tension. It follows therefore from Gibbs' principle that they are largely adsorbed, with the result that in the surface layer (which probably does not exceed 10^{-6} cm. in thickness) the concentration of the dye becomes great, eventually exceeding the limit of solubility which it possesses in the ordinary sense. The result is that precipitation or coagulation takes place and this in many cases is accompanied or succeeded by ordinary chemical combination with certain of the amphoteric substances present in the material to be dyed. It is clear, of course, that adsorption cannot cover the whole phenomenon, for adsorption in the sense of Gibbs' theory is a reversible process, whilst dyeing is essentially an irreversible process, the fastness of the dye being dependent upon the fact of irreversibility. In the case of *tanning* the process is very similar. A reference will be made to tanning later from the standpoint of electro-osmosis. It will be observed that in dyeing and tanning we are dealing primarily with the adsorption of colloidal matter upon a surface, most dyestuffs such as Congo red belonging to the group of so-called "electrolytic colloids," that is the colloidal part functions as an ion(anion). *Bleaching* processes, whilst being fundamentally adsorptive in nature, differ from the preceding cases in that the bleaching agent is not usually a colloid and therefore its effect upon the surface is a better defined chemical process. A bleaching agent such as sodium hypochlorite lowers the surface tension of water and hence is positively adsorbed at the surface.

Surface-adsorption of molecules and ions of electrolytes plays a fundamental rôle in *agricultural problems.* One of the results so far obtained in this very complex subject is the conclusion that the general character of a soil is as much governed by the size of grain, that is, by the surface area of the soil particles, as by their chemical nature. Heavy clay means small porosity and therefore small surface and small adsorbing power for salts and non-electrolytes dissolved in the water present. The result is that this material is unsatisfactory. The function of adsorption in soils is to retain the soluble salts from being washed away too far from the surface of the ground during heavy rain. The extent to which adsorption occurs depends not only upon the soil but also upon the nature of the fertiliser. The question of the efficiency of fertilisers would lead us too far, but that the problem is fast becoming an exact applied science is very evident. It is clear on general grounds that capillary chemistry plays a great rôle in such problems, as we have already seen in connection with the theory of wetting, but it is to be feared that many of the workers in this field have not fully realised the significance of capillarity for the processes concerned.

A further important technical application of adsorption is found in the methods of *water* and *sewage purification* in so far as *filtration* is concerned. The functions of porous substances such as charcoal and sand are so familiar that they need not be considered at length. It is sufficient to point out that capillary adsorption is the fundamental factor, though, as in dyeing and tanning, the irreversibility of the process is an essential ; and in so far as irreversibility exists the phenomenon is not covered by the simple capillary theory. Purification problems also come under the head of coagulation of colloids and a brief reference to them will be made there.

Another field in which adsorption plays a part is that of the *cleansing action of soap* and the *clarification of liquids* such as wines. In the case of soap there is no doubt that the alkali produced as a result of hydrolysis acts as a peptoniser or emulsifier for the fatty matter which is to be removed, and the intimate contact, which is necessary to attain this, is possibly brought about by the fact that the soap, both unhydrolysed and as colloid ions, depresses the interfacial tension with the result that adsorption of the soap takes place and capillary wetting occurs easily. In the case of clarification processes the results of a particula investigation may be cited as illustrative, th object being to find a good clarifying agent fo certain wines which would be effective withou altering the taste appreciably. According t F. La Marca (see this Journal, 1915, p. 1060 "experiments with nine types of Italian wines indicated that fish glue was the best clarifying agent." The tannin and extract content can be reduced by adsorption upon the fish glue without altering other constituents. "Egg albumen is also an excellent clarifier and does not alter the composition of the wine." "Aluminous earth markedly reduces the acid content and also the extract but not the colour or the tannin." "Acidity and colour are diminished by charcoal which also reduces the tannin to a slight extent." The *specific* effects of adsorption upon surfaces of different nature manifest themselves here very clearly.

(D) *Application of coagulation principles.*

Coagulation, as already pointed out, is brought about by removing the electric charges which are situated upon the colloid or emulsion particles and which go to maintain these in a stable sol form. The discharging process is most conveniently carried out by means of electrolytic ions of opposite sign to that possessed by the colloid. The colloid may also be discharged by being carried to an electrode, the discharge at the electrode being presumably quite analogous to the discharge of an ion in ordinary electrolysis. It is of some interest to consider one or two large scale applications of both of these methods of producing coagulation. First of all, coagulation by ions.

A very important application of this is found in one of the methods employed for rectification of current, that is the transformation of alternating into direct current. In this connection the *aluminium rectifier* is well known. A condenser is placed in the alternating current line, one plate of the condenser being of aluminium, the space between the plates being filled with an aqueous solution of a salt. On the aluminium plate there is rapidly formed some colloidal aluminium hydroxide and if this can be made to coagulate and adhere to the plate the current taken off will be unidirectional. The problem is, therefore, to choose an electrolyte which will most completely effect the coagulation of the colloid. Since aluminium hydroxide is a positively charged colloid the discharging effect must be brought about by an anion, and further as we have seen the higher the valency of the ion the more effective it will be. Thus the salts of monovalent acids—such as nitrates, chlorides, acetates, etc.—are inefficient. Salts of divalent acids such as sulphates, carbonates, and tartrates, are moderately efficient. That is to say, a rectifier containing such divalent salts will rectify current whose voltage does not exceed 30—50 volts. If the current is at a higher voltage the rectification is only very partial and incomplete. Using trivalent radicles such as phosphates, citrates, or borates, the efficiency of the rectifier is much increased as it is now capable of dealing with a pressure of over 200 volts. It is interesting to note also that silicates, though strictly speaking belonging to a divalent acid, are exceedingly efficient, no doubt due to the fact that the coagulant is here itself functioning as a colloidal anion though a clear explanation of the mechanism is wanting. Obviously much investigation remains to be done. t would be interesting to try other colloidal anions of much greater complexity than colloidal ilicate, such for example as organic electrolytic olloids like Congo red. The point as to whether he molecular mass of the coagulant is significant s well as its valency also requires investigation.

Another important application of coagulation is met with in the *de-emulsification of water* contaminated with oil, the oil being in the form of an emulsion. It is an important engineering problem especially in connection with the forced lubrication steam turbines, and has been solved with some considerable success by the use of alum. The oil particles are negatively charged and can, therefore, be discharged by a cation of high valency such as $Al^{\cdot\cdot\cdot}$. The alum solution is run slowly into the emulsion, the oil coagulates on the top and may be run off. The result is that a considerable quantity of oil is recovered which would otherwise have run to waste and at the same time the oil is prevented from fouling the heated parts of the engine. It may be remarked that oils, otherwise very similar, differ much in the ease with which they become emulsified (cf., for example, A. Philip, this Journal, 1915, 34, 697).

The next problem to be touched upon is *river sludge* formation and *sewage precipitation*. The fact that material which remains in suspension as long as the liquid medium is fresh water but is deposited when carried to the mouth of a river where the medium is now salt, obviously suggests that coagulation has been brought about by the sodium and calcium salts of the sea water. When this process goes on for centuries formation of deltas results. As a rule coagulation of this kind is anything but desirable. In other cases, however, notably when a river overflows its banks, the result may be beneficial. The fertility of the Nile valley, for example, may be ascribed to this cause, the rich colloidal matter in the river water being precipitated upon the adjacent soil. In view of the large amount of sewage annually carried down by rivers the question has been raised as to whether it may be possible to recover by means of regulated coagulation some of the valuable fertilising materials represented by the phosphorus, nitrogen, and potassium contained in the sewage. As a matter of fact an attempt has been made along these lines in Germany but so far the efficiency is low. It is nevertheless a very important problem. Our present practice of getting rid of sewage somehow can scarcely be the last word on the subject.

As a final illustration of coagulation by chemical means, that is by ions or even by change in the nature of the solvent by large addition of non-electrolyte, a reference may be made to one or two methods for the *coagulation of rubber latex*. A method suggested by Fulton and Macallum (Eng. Pat. 9066 of 1914) depends as far as I see upon the change in the nature of the medium. The latex suspended in water is treated with aldehydes or ketones other than formaldehyde. As an example 80—90 parts of water are added to 10—20 parts of aldehyde or ketone and the solution may be used with about half its volume of latex which is preferably sprayed over the coagulant. An alternative method of treatment which causes coagulation and at the same time sterilises the rubber is that proposed by S. C. Davidson (Eng. Pat. 22,138 of 1914). A solution of one part of sodium thiosulphate in 16 parts "alkalised cresol," that is a solution of cresylic acid in aqueous sodium or potassium hydroxide, is stirred into Hevea latex in the proportion of 1—5%. The latex is allowed to stand for 24 hours and is then coagulated by means of a 1—2% solution of sulphuric acid. Other acids such as acetic, trichloracetic, or hydrochloric may be used. The SO_2 evolved on addition of the coagulating acid possesses a preservative effect upon the rubber. It is somewhat obscure why it should be necessary to allow the latex to remain so long in contact with the thiosulphate. The thiosulphuric acid may of course exert an incipient coagulating action or it may be that the thiosulphate requires this time to take the place of other salts already adsorbed upon the latex particles. That is to say it may be a case of preferential or selective adsorption. I have no idea as to how efficient this actual process may be. It serves, however, to indicate how much purely scientific work remains to be done in order to supply us with a larger number of general principles which would serve as guides in this or other colloid problems.

Let us turn now to the alternative method of colloid coagulation by bringing the colloid directly into contact with an oppositely charged metal electrode. This has had up to the present less utility than the ionic method. De-emulsification may be easily effected upon the laboratory scale, but I do not know if it would compare with the alum method on the large scale. The method, however, has been employed for sewage treatment. According to A. M. Williamson (Trans. Amer. Electrochem. Soc., 1915, 27, 193) an installation in America deals with as much as a million gallons of sewage per day. On general grounds one would think that the electrical method should be efficient in that all the colloidal material would automatically separate itself at both electrodes according to the sign of the charge. The method would, however, be more economic of current the smaller the content of electrolytic salts present.

(E) *Selective adsorption.*

This principle has been made use of in a method proposed for the *separation of radioactive salts* (Ges. für Elektro-Osmose, Eng. Pat. 10.083 of 1914). The salts are in a state of adsorption upon colloid material, this condition being the result of a preliminary treatment. The point is to remove the adsorbed radium salts as completely as possible from the colloid material and from other salts, *e.g.*, barium. This is effected by adding to the colloidal solution certain other salts at suitable concentration. These salts are preferentially taken up by the colloid, the radium salt thus passing into solution. By way of illustration, a MnO_2 adsorption product of Ra and Ba in a fine state of subdivision is boiled with NH_4Cl solution of certain strength and the solution filtered. On analysis it is found that the solid matter contains 32·7% of the Ba and 64·7% of the Ra originally present. That is, a certain amount of separation of Ra and Ba has been effected. Although a single run leads only to a partial separation the method is interesting and suggestive.

(F) *Application of the "Protective" effect.*

Reference has already been made to the protective and preservative action of gelatin upon colloidal platinum. In a process patented by the Gesellschaft für Elektro-Osmose (Eng. Pat. 9261 of 1914), the object of which is to *prepare stable colloidal solutions of metals* in general, use is made of *colloidal silicic acid* as the protective colloid. The silicic acid is obtained in a pure state by a method which will be referred to later. As an example of the procedure adopted, a metal salt, *i.e.*, a silver or gold salt, is reduced by a suitable reagent such as hydrazine hydrate in presence of the silicic acid. A stable solution of silver or gold results, which is purified from the electrolytes by electrolysis. In a later patent (Eng. Pat. 15,267 of 1914) it is claimed that the protective effect of silicic acid can be extended to the preparation of stable metals prepared by Bredig's sparking method, the instance quoted being nickel. Further applications of the salt-reduction method in presence of silicic acid deal with the preparation of colloidal selenium, palladium, and platinum. It would appear, therefore, that the method is a fairly general one. A further instance of protective effect is to be found in a process for *sizing and colouring parchment paper* (E. Fues, Eng. Pat. 19,816 of 1914). A solution which contains both an acid and a basic dyestuff may in general be regarded as an unstable one. In the presence of some size, however, precipitation can be prevented, the size acting as a protective colloid. The mixture of dyestuffs can therefore be successfully applied, in this case, to the paper.

(G) *Applications of electro-osmosis.*

This is one of the most important branches of applied electro-capillary chemistry. As an example of a general type of problem to which electro-osmosis is applicable one may instance *filter press* work. In this connection F. Ulzer (Z. angew. Chem., 1915, 28, i, 308), describes a process whereby filtration of liquids containing very fine particles can be made without clogging the filter cloth. The filter is of the usual form, consisting of a number of chambers in each of which electrodes are placed. The chambers are first filled with liquid, the current is passed, and the suspended matter wanders to one or other of the electrodes, becomes electrically discharged, and is deposited. The liquid can now be made to pass with relative ease through the filter cloth. Clogging of the latter is thus largely diminished, and hence excessive pressure is not required. The author claims that the method separates the finest particles from liquids and can be used for mineral colours, dyestuffs, barium sulphate, and other suspensions. Strictly speaking, the process is an illustration of cataphoresis and coagulation rather than electro-osmosis, but the arrangement is very similar to that employed in electro-osmotic problems generally. A second instance is the application of electro-osmosis to the preparation of pure colloids, the case in point being the preparation of *colloidal silicic acid* of low molecular weight, that is, in a state of fine subdivision (Ges. für Elektro-Osmose, Eng. Pat. 9273 of 1914). To begin with, an alkali silicate solution of 5—10% strength is placed in an anode compartment, the electrodes being preferably perforated. When the product is to be used medically the anode consists of platinum gauze. Brass wire net serves as the cathode, the electrodes being separated by an electrically neutral membrane, consisting of carborundum and corundum. The process begins with low voltage, which is ultimately raised to 60—70 volts to remove all the alkali from the compartment. The colloidal silicic acid negatively charged,* is precipitated at the anode, the sodium leaving the compartment. Traces of foreign acids present with the silica are removed by transferring the solution to a vessel serving as a cathode and electrolysing, the anode being surrounded by parchment.

A further illustration of the applicability of electro-osmosis deals with the *tanning of hides* and *impregnation of similar materials.* In the usual method of tanning, the material is brought into contact with the tanning liquid under suitable conditions of concentration and temperature, and allowed to remain in contact for a length of time In the present process (Ges. für Elektro-Osmose Eng. Pat. 19,849 of 1914) the tanning action is accelerated and possibly improved by bringing the tanning colloid into very close contact with the hide by electrical means. The hide is kept at a suitable potential, positive or negative, and the tanning substance, which is naturally charged moves up to and is discharged upon the surface A few details are given in the abstract (this J. 1915, 34, 1021), and are as follows :—

"Hide is tanned by electro-osmosis by utilising the material to be treated as a partition, withou fitting it tightly to the walls, to divide the space between suitable diaphragms, the latter being s selected that the active constituents canno migrate through them, whereas substances affect ing the osmotic action unfavourably pass throug and are separated from the liquid. Constituent which hinder or delay the process are remove from the hides or skins electro-osmotically b desorption before the actual tanning. Durin treatment the hides or skins are caused to acquire automatically a potential suitable for the tanning substances used; with tannin this must be of an electro-positive character, with chromium compounds, electro-negative."

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* It is not quite clear what sign the charge possesses under the circumstances. Usually SiO_2 *sol* is negative, but becomes posit in acid solution.

As a final example of electro-osmosis we may briefly consider the manufacture of *gelatin for photographic emulsions* (Ges. für Elektro-Osmose, Eng. Pats. 21,448 and 21,481 of 1914). The object is to get a gelatin free from fat and from mineral and reducing constituents. The procedure is as follows. A solution of gelatin enclosed between electrically indifferent diaphragms is subjected to an external voltage. The inorganic ions migrate through the diaphragms in the ordinary way and so are removed. At the same time any albuminoid bodies are coagulated and can be mechanically separated off. The resulting gelatin is thus free from turbidity which sometimes manifests itself owing to the presence of albumin. Exactly the same procedure is applicable to the manufacture of *high grade glue*. Modifications may be introduced in the form of electrically charged diaphragms for the separation of other constituents, thereby yielding a very pure product.

From the survey given above, it is evident that the subject of capillary and electrocapillary chemistry is one of great magnitude and importance both from the scientific and from the technical aspects. In the present situation it is plain that technical application has considerably outrun theory, and if future industrial development is not simply to be on empirical lines, it is essential that scientific investigation must be greatly accelerated. At the present time capillary chemistry does not occupy the place it should in our University curricula. But as things stand it is impossible to deal with the subject effectively. From the manufacturers' standpoint, a serious lesson might be drawn from the activities of a single German firm, the Gesellschaft für Elektro-Osmose, from whose patents several illustrative examples have been taken. It is fairly evident that such processes can only be dealt with and extended by proper scientific control. It has been repeated *ad nauseam* that this is the only way to advance not only in regard to the applications of capillary chemistry, but in all applied chemistry. It does not, however, appear, even yet, to have been sufficiently realised.

Muspratt Laboratory,
The University, Liverpool.

London Section.

Meeting held at Burlington House on Monday, May 1st, 1916.

MR. A. R. LING IN THE CHAIR.

THE SULPHUR IMPURITY IN COAL GAS.

BY PROF. FRANK CLOWES, D.SC. (LOND.).

(Abstract).

Although the progress made in the removal of he sulphur impurity in coal gas has, until recently, een very slow and unsatisfactory, its removal is a roblem which has always been of the greatest nterest to chemists. The recent progress will be est appreciated by presenting a short summary of he past and present state of the matter within ecent years.

Coal may contain from about 0·5 to 4% of sulphur, which is partly present as inorganic and partly in organic compounds. Good gas coal should contain not more than 2·5% of sulphur. The modern method of carbonisation at high temperature in fireclay, instead of iron, retorts ensures a larger yield of gas, but also causes a larger proportion of sulphur from the coal to pass into the gas; and, unfortunately, this increase in sulphur is mainly in the form of sulphur compounds of an organic nature, which have proved difficult of removal, and not in the form of hydrogen sulphide, which can be readily dealt with. The crude gas escaping from the retorts may contain 1·6% by volume of hydrogen sulphide and 0·03% of vapour of carbon bisulphide and other organic sulphur compounds.

These sulphur impurities distribute themselves amongst the products obtained in the purification processes. The tar and the ammoniacal liquor contain some of the sulphur impurities; but reliance is mainly placed upon hydrated ferric oxide for the removal of the hydrogen sulphide, and the organic sulphur compounds are in some works subsequently, in great part, removed by "sulphided lime."

This "sulphided lime" is prepared by passing coal gas containing hydrogen sulphide, but free from carbon dioxide, over freshly-slaked lime. Its use removes the remaining sulphur impurities incompletely, and sulphur equal to 10 grains per 100 cubic feet still remains in the gas; whilst the gasmaker maintains that as a purifying agent it is uncertain in its action, and that its removal is attended with nuisance and with injury to the health of workmen.

As a rule, the purification by "sulphided lime" is only carried out in those gasworks which are required by law to keep the proportion of sulphur in their gas supply within a limit of about 20 grains per 100 cubic feet. This has until recent years been the case with the large metropolitan gas supply, and with a few other of the large centres; but the process of sulphur purification has usually been a voluntary one, and has not been extended beyond the removal of hydrogen sulphide by means of oxide of iron.

This purification by iron oxide alone is entirely satisfactory when carburetted water gas is used, since water gas is free from sulphur compounds other than hydrogen sulphide, although it contains much of that gas.

The London gas supply has been under stringent requirement of purification for a special reason. Originally, the metropolis was supplied by an unnecessarily large number of gas companies, and difficulties arose with regard to conflicting areas of supply. The Gas Act of 1860 recognised certain areas of supply for a limited number of companies; and in return for the monopolies thus created, special limits of impurity in the gas were enacted, and the necessary machinery for prescribing methods of testing the gas and for carrying out the testing was subsequently arranged. The total sulphur in the metropolitan gas supply was not allowed to exceed 17 grains per 100 cubic feet in summer and 22 in winter.

These limits were applied to or adopted by a large number of provincial gas undertakings. Statistics obtained in 1903 showed that 28 provincial companies had sulphur limits legally prescribed, 17 having a limit of 20 grains, the remainder varying between 18 and 32. Other returns showed that 66 provincial companies, which were under no legal limitations, voluntarily purified their gas to a similar degree, as shown by their own tests; some of these reduced the sulphur to 8 grains per 100 cubic feet, and some even lower than that. Returns obtained in 1901-2 showed that at least 60% of the entire gas supply to England and Wales was under either compulsory or voluntary sulphur limitation. Five large Continental towns were under sulphur limits varying between 17·5 and 26; these towns had a supply under the Imperial Continental Gas Association.

In 1901, however, the metropolitan gas companies asked to be relieved of the limitation prescribed for the sulphur impurity, basing their request mainly on the uncertainty in working the "sulphided lime" process, and on its offensive and unwholesome product. It was also suggested that the gas consumers, in districts where this purification was not carried out, made no complaint of their gas supply, and also that the introduction of the mantle burner certainly led to a considerable reduction in the amount of gas burned for illuminating purposes, and to a corresponding diminution of the amount of oxidised sulphur products thus introduced into the atmosphere of our dwellings.

The Board of Trade appointed a committee on which scientific men and the gas industry were represented, to inquire into this request, with a view of legislating both on this and on other matters raised by the companies. The London Gas Act was the legislative result, embodying the recommendations of this committee.

It will be of interest to look into the evidence submitted to the committee by various experts, since it represents the most recent knowledge on the question of sulphur impurity in coal gas; and the decision arrived at by the committee is certainly of the greatest importance, because it directly led to the discovery and perfecting of a new method of sulphur purification by our President and certain members of his staff which cannot fail to be of the greatest interest and importance to the gas industry generally.

The Board of Trade committee decided to recommend a method of testing for the hydrogen sulphide impurity in coal gas which was considered to be less stringent than that in use: a wet lead-paper was to be exposed at intervals for three minutes only to the gas, instead of a dry paper being exposed continuously for at least fifteen hours. Opinions differed, however, as to the relative stringency of these two methods of testing.

But the more important decision was relative to the sulphur compounds other than hydrogen sulphide. Basing their opinion mainly on the difficulties stated by the gas companies to arise from the use of "sulphided lime" and "the fact that no effective substitute for lime has been found . . . they are of opinion that the requirement that the sulphur impurities should be removed to such an extent as to demand the use of lime should be discontinued; they refrain from suggesting the imposition of any modified restriction in place of that now existing . . . but that official tests should continue to be made, and that the amount of impurity should be ascertained and recorded."

It was inferred from experiments, made by the gas companies with disuse of lime, that the total sulphur in the gas would not exceed 35 to 40 grains of sulphur per 100 cubic feet. This main ground for the decision of the committee will be adverted to later on, but two other grounds on which the decision was based may now be considered.

It was assumed that the absence of complaint by the gas consumers in districts where lime purification was not used was evidence that the additional amount of sulphur in such gas supplies was not prejudicial. But it must be remembered that there was available an alternative electric illuminant for the use of those consumers who appreciated the objection to the impure gas supply; and the chemist who has had to protect the ignorant or careless consumer against the impurity of his supply of foods and drugs will not be largely influenced by the absence of protest from the indifferent consumers of impure gas.

Another ground for the committee's decision was stated to be that the evidence as to the prejudicial effect of the sulphur impurity was of a conflicting nature. There was, however, evidence furnished of the objectionable and destructive effect of the oxidised sulphur products from gas combustion, which was not disputed and appears, indeed, to be irrefutable.

Dr. Haldane gave it as his opinion as a physiologist, that the presence of the sulphur products of combustion in any degree in the air of a room would cause discomfort to the average person, and was objectionable on the score of health in the case of delicate persons. He found that gas not purified by lime caused discomfort of the kind referred to. At the same time the sulphur products would be of little, if any, value for disinfectant purposes, since 0·06 % of sulphur dioxide in the air was fatal when breathed by men or animals, while air employed for disinfectant purposes contained not less than 15 %.

But the destructive effect of these oxidised sulphur products on leather and fabrics was the most serious fact; and this was abundantly proved by the experiments of Dr. Gordon Parker and others, and was endorsed by a committee of the Royal Society of Arts, consisting of leather experts and chemists.

These experiments proved that the products of the burning of sulphur-containing gas caused leather to become rotten, and ultimately to crumble to dust. They showed that this effect was produced on leather which was originally free from acid, and that it was by the absorption of acid from the products of combustion that the destruction was brought about. It was shown, also, that no permanent damage was caused to leather by merely heating it for some time even to 180° F., and that the damage was, therefore, entirely due to the sulphur acids. This damage and destruction was shown to be produced on other fabrics, and it was proved that not only the bindings of books in the library, but also the leather and fabrics used in the furnishing of the house were subject to the same result.

A possible objection, that bookbindings rotted in libraries where no coal gas had been burned, was readily explained by the fact that leather is sometimes prepared and dyed with the use of sulphuric acid, and that such leather retains this acid against all washing processes. The free acid is, however, only present in more modern samples of leather, and it is these leathers which rot, and not those of an earlier date.

It can hardly be imagined that one would willingly allow so destructive an agent as the sulphur product to be introduced into the internal air of a house, and then rely on its rapid removal by ventilation or other means, since its complete removal could not be immediately effected and secured before some damage was done. It was stated, however, that the plaster and freshly limewashed surfaces of the ceilings and walls of rooms would remove these destructive substances; but as a matter of fact the surface presented to the air of the room is usually protected by the use of size, even if it is not coated with paint, varnish, or glaze, or if it does not consist of some utterly ineffective substance such as wood.

It certainly behoves us to avoid the unnecessary combustion of impure gas in our rooms, since this adds to the oxidised sulphur products which may occasionally arrive from the external air of the central parts of our large towns. Unfortunately, the continued use of raw coal in the domestic grate is producing sulphur acids in the external air, and although these are constantly and rapidly removed by wind and rain and by ordinary atmospheric circulation, there are times of stagnation and fog when their removal is very slow.

Experiments have proved, however, that these acids are rarely present in town air in the free state, but are neutralised and rendered comparatively innocuous by the ammonia also evolved from coal during its combustion in the grate. It has been also shown that the coal gas, which has been purified from ammonia in the gasworks, furnishes free sulphur acids during combustion, from its sulphur impurity, and the free acids may be detected in the internal air of our rooms.

The smoke and other products of the combustion of raw coal are, however, rapidly decreasing in amount, as heating and cooking are being increasingly done by means of coal gas or electricity; and by securing the purity of coal gas, this improvement will be materially assisted in the external air, and the condition of the internal air of rooms in which gas is burned in the open for heating and illuminating will become unobjectionable.

There is no doubt, however, that the decision of the Board of Trade Committee was mainly influenced by the strong objections raised by the representatives of the gas companies against the use of "sulphided lime," and by the fact that no efficient, inoffensive, and unobjectionable substitute for this purifier was known.

This difficulty has recently been removed, since Dr. Charles Carpenter, the President of our Society of Chemical Industry, working for some years in co-operation with officials of his gas company, has perfected a simple, economical, and successful process for largely reducing the sulphur impurity of coal gas without the use of "sulphided lime." And it is probable that the incitement to perfect this new process arose largely from the statements made before the Board of Trade Committee and from the decision at which the Committee arrived.

The investigation which resulted in the new process proceeded on the idea, which had long been held, that the most practical method of reducing the amount of sulphur compounds, by the removal of the carbon bisulphide, would consist in suitably heating the gas, and then removing the hydrogen sulphide thus produced by means of iron oxide. During the many years of this experimental investigation it was proved hat the readiest means of effecting the purification was by passing the gas at a temperature of about 50° F. over fireclay surfaces impregnated with reduced nickel. Under this treatment the carbon bisulphide and free hydrogen in the coal gas urnished carbon and hydrogen sulphide. This hydrogen sulphide was removed by subsequent xposure of the coal gas to iron oxide, and the arbon deposited on the fireclay-nickel surface was hen burned off, leaving that surface again effective or continuing the purification of the gas. By his procedure the sulphur of the coal gas was educed to about 8 grains per 100 cubic feet.

The perfecting of this process involved a careful tudy of the most suitable surface for inducing he chemical change at a low temperature, such s would not be injurious to the useful intrinsic ualities of the gas; it also involved much ingenuity n devising methods for bringing the gas to the equired temperature and maintaining it at this emperature for the necessary time.

The process has now been working continuously n four of the largest works of one of our large etropolitan gas companies for periods varying om two to three years. It has continued hroughout this time to show unimpaired efficiency, as developed no practical difficulty, and its ontrol has amounted to the simplest routine, hile its results have given satisfaction alike to the les department of the gas company and to the nsumers of their supply.

It may be stated that another somewhat similar ocess, depending on a different chemical change, seems to promise equally good results in the hands of an investigator in France. And there can be no doubt that the success attained by our countrymen will not only greatly encourage the further development of the process of our military ally, but will also lead to the practical realisation of another process which promises to remove the larger portion of the sulphur which still remains in the gas after the removal of the carbon bisulphide.

It is therefore certain that the immediate possibility of distributing a much purer gas supply is now presented to the gasmaker; and it is to be hoped that those concerned in the great gas industry will quickly avail themselves of the opportunity thus afforded them of placing the industry in a strong and impregnable position in the face of serious competition, and of giving their consumers the satisfaction of burning a gas which is almost unobjectionable.

Discussion.

Dr. Charles Carpenter emphasised the difficulties to which Professor Clowes had referred, under which those who were responsible for the conduct of gas undertakings in London had suffered. Professor Clowes had pointed out that perhaps it was not altogether satisfactory from the chemical standpoint that despite the fact that some of the most able chemists, dating back to the time when Dr. Brande was the Secretary of the Royal Institution, had given their attention to the problem, it seemed to have been regarded as an insoluble one. The curious part of the catalytic process was, that in practically all its details it was suggested 30 or 40 years ago. The method of heating the reaction furnace by gas producers had first been used by Siemens, with the advantage in the control of heat which his furnace gave. Breaking up the gas into a great number of small currents had also been suggested, as well as the use of an earth clay absorbent for carrying the catalyst. Indeed, there was hardly an item of the plant as it successfully existed to-day, that had not been put forward in one way or another a great many years ago. He wished to emphasise the lesson which he thought was to be drawn from the successful achievement in making a success of the process. In the past engineers of reputation had worked at the problem from their point of view, and chemists from theirs. To some extent they had worked in collaboration: but he believed that, of all those who applied themselves to the problem of the extraction of carbon bisulphide, Mr. Harry Jones was the only one who not only did it successfully, but obtained the bisulphide in separate form as a by-product. The real lesson to be learned from the particular process referred to was, that they had just as good brains in Britain as anywhere, and it was a mistake to think that any particular country had a monopoly of brains suited to chemistry. They had not taken full advantage of those they had, and he thought they had been particularly backward in obtaining the collaboration of the engineer, which was so important to the chemical operations of to-day. If the future of the British chemical industry was to be what he believed it could be, that could only be brought about in his opinion by bringing the engineer into the equation with the chemist.

Mr. Harry Jones said that before the introduction of Harcourt's process for estimating sulphur in gas, which only occupied a few minutes, the old Referee system had been used, in which the gas was burnt in an alkaline atmosphere; that process required 24 hours to carry out. At one of the Enquiries in Parliament, Dr. Keates had pointed out that gas companies making five or six million cubic feet of gas per day were using lime purifiers 40 ft. square and 5 or 6 ft. deep, and the lime was thrown away when it was in a really useful condition for removing sulphur. For the most efficient use of the lime it had been found necessary to remove the carbon dioxide before the sulphur. Three consecutive sets of purifiers were used, the first containing lime to remove carbon dioxide, the second containing "efficient" lime, and lastly the oxide purifiers in which all the surplus sulphuretted hydrogen was removed. By that method much less lime was used and it could be used for years instead of days. Using the old method it was found that gas sometimes contained 200 grains of sulphur, whereas it should have only contained 20 grains; 6 grains per 100 cub. ft. seemed to be an irreducible minimum.

Mr. Butterfield said that the sulphur compounds about which Professor Clowes had been speaking represented only 1/18th to 1/20th of the sulphur initially in the crude gas. At any rate whether they removed those sulphur compounds from the gas supply or not, the general vitiation of the atmosphere was greatly diminished as compared with the burning of coal. With regard to the history of the removal of sulphur compounds other than sulphuretted hydrogen from gas, he referred to a Report of Mr. Robert Harris, who was Engineer at the Bow Common Works of the Great Central Gas Company, dated September 1st, 1869, in which ten methods of dealing with the sulphur impurities were described. The last process, viz., the passing of the gas over lime first, and afterwards through oxide of iron, was reported to have removed about 40% of the sulphur compounds. They knew now the reason why a better result had not been achieved, *i.e.*, Mr. Harris had not realised how the lime should be used. It was one of the original Gas Referees who first put in print how the lime should be used, and he was unwise enough to take out a patent for the process, with the result not merely that he lost his position as a Gas Referee, but also practically precluded the gas referees for all time from taking out any patent, even though it was solely for the protection of the manufacture of an article in order to see that it was properly standardised. There was another process of Mr. Vernon Harcourt's, apart from the one their President had subsequently elaborated. This other process had been tried at the Westminster Gas Works in 1871. According to it a perforated metal wad was placed in the mouthpiece of each retort, but the report stated that it proved unworkable in the opinion of Mr. Harcourt himself. With regard to the effect of sulphur compounds when gas was used for illuminating purposes, the amount of sulphur burned in illuminating a room to a satisfactory extent was now about 1/10th of that it was before the introduction of the incandescent burner. Therefore legislation requiring a company to keep the sulphur compounds in the gas down to a minimum, which was necessary before the introduction of the incandescent burner, became ridiculous at the present time. It was a matter of the proportion of sulphur dioxide in the air of the room whether harmful effects were obtained. He thought there was no question that in all the cases where very harmful effects were shown, much more gas had been burned than was necessary for the proper illumination of the cubic space in which those samples were exposed. He had given figures as to the ratio of carbon dioxide to sulphur dioxide in a room properly illuminated by gas, and at the same time ventilated to the ordinary factory standard of ventilation, in lectures delivered two or three years ago before the Institute of Chemistry. Those figures showed that the sulphur dioxide from gas used purely for illuminating purposes was negligible in the air which one breathed in a properly ventilated room. The harm of the sulphur compounds in his opinion came in the destruction of the burner fittings themselves, which in the case of the inverted gas burner were exposed directly to the products of combustion in a concentrated form. He remembered when a Provincial Gas company had sought relief from sulphur restrictions some time ago, the fact which seemed to bear weight with the Parliamentary Committee was the exhibition of two inverted burners, one of which had been used on a gas supply containing the full amount of sulphur compounds and the other on one from which the sulphur compounds had been removed. The difference in the corrosion was marked. From the questions which were put to him as a witness, he thought the Committee was disposed to impose any restrictions on the Gas Company which they could have complied with without the use of lime. At that date Dr. Carpenter's process was not known, and there was then no process without the use of lime which appreciably reduced the sulphur compounds. If the Committee had had Dr. Carpenter's present process before it, they would undoubtedly not have removed the restrictions altogether.

Dr. Rideal said that prior to 1904 he had visited several countries in connection with the sulphur question, and was astonished to find that in Brussels, Berlin, Vienna, and Paris, the sulphur problem had not been before them in the way it had been in England for the last 40 or 50 years. In Berlin and in Vienna it seemed unknown, and he could not find any lime purifiers at all. Out of 400 grains of sulphur in crude gas 360 grains was removed by the oxide of iron purifiers; the fighting prior to the Sulphur Clauses being abolished was all about whether the 40 residual grains could be reduced to 20. The amount of sulphur that was evolved where coal was burned in the domestic grate had never been subjected to any legislation, and it seemed to show that the efforts of chemists had been directed to a wrong purpose. It was useless to legislate for the removal of sulphur from gas when the sulphur in the paraffin which was used in a lamp or oil engine and in the coal used in the grate was many times more than that in the gas itself. It had been shown conclusively that the darkening or tarnishing of metals in vitiated air was due to the action of sulphuretted hydrogen, and not sulphuric acid. Sulphuretted hydrogen was produced by the incomplete combustion of coal in grates in towns, and in country places from manure heaps and decaying vegetables.

The Chairman said that he had noticed when lime purification was discontinued, the amount of copper sulphate formed by the impinging of gas flames on vessels in his laboratory had very much augmented. A considerable amount of this salt was swept from beneath his copper vessels every week. He was sure that the products of the incomplete combustion of coal gas, *e.g.*, when a flame impinged upon a metal surface such as an inverted incandescent mantle or the bottom of a copper vessel, contained sulphuretted hydrogen. In the summer time, when there were no coal fires silver plate was blackened by burning coal gas in a room. The presence of arsenic in sulphuric acid made from pyrites was well known, but arsenic was also present in sulphuric acid made from recovered sulphur.

ERRATUM.

In the discussion on Prof. Armstrong's paper as reported in this Journal of May 15th, 1916 on page 504, col. 1, line 1, for "Mr. Gardner read "Mr. C. S. Garland."

Nottingham Section.

Meeting held at Nottingham on Wednesday, January 26th, 1916.

MR. JOHN WHITE IN THE CHAIR.

NOTE ON THE ACTION OF LIME IN THE UNHAIRING PROCESS.

BY J. T. WOOD, F.I.C., AND D. J. LAW, B.SC., F.I.C.

In a recent thesis presented to the University of Michigan by A. A. Schlichte on "The changes in skins during their conversion into leather."[*] the author shows that skins can be unhaired by sterile limes. His work was carried out in a very careful manner, and from his bacteriological results there seems to be no reason to doubt the conclusions arrived at. The editor of the Journal of the American Leather Chemists' Association suggested to Mr. Schlichte that he might be in error as to the actual sterility of his lime liquors after the pieces of hide had been in for a considerable time, and several tests had been made on the condition of the hide by opening the vessels. Mr. Schlichte replied that the precautions taken were the same which he has used in very many experiments, and the proportion of contaminated cultures has been only one in 2500. Further, in one experiment (No. 41) two flasks were charged, and left unopened for five months.

The editor appears to base his remarks on a paper by Mr. H. G. Bennett, published in the November issue of the same Journal, but we wish to point out that Mr. Bennett's conclusions still leave the question unsettled, although he says: "The hair is loosened almost entirely by the chemical action of enzymes which are supplied by the bacteria thriving in lime liquors. These enzymes dissolve the softer keratins and hair roots. This enzyme action is probably assisted to some extent by the chemical action of lime, not so much by its solvent effect, which is extremely small, as by its softening effect, which facilitates the enzyme action. If the keratinous matters yield any sulphur to the liquor, sulphydrate of lime will be formed, which will cause a very slight but direct chemical solvent effect."

The question was discussed in a paper by one of us in 1910,[†] in which it was pointed out that in ordinary working practice the main unhairing action in the limes is due to ammonia. The source of the ammonia was attributed to bacterial action, because the production of ammonia by the action of lime on skin in the cold appeared to be doubtful. Schlichte does not state whether his sterile limes which unhaired contained ammonia; this would be a most important point. In the same paper attention was also called to the fact, first stated by Payne, that calcium hydrosulphide, or sulphydrate, is produced by the action of caustic lime on the sulphur in the hair, and that this has an unhairing action.

The present note is to give the results of a hitherto unpublished experiment carried out by the authors in 1910, which appears to throw some light on Mr. Schlichte's results.

Although it is difficult to sterilise skin effectively without altering it to some extent, it is comparatively easy to sterilise hair and lime water. The experiment was made to determine the action of lime water on calf hair. Two bottles were prepared containing a few grams of pure lime, and 200 c.c. of water. One of these was sterilised by steaming in the usual way, and then partly filled with clean calf hair, which had been sterilised by boiling. The other bottle contained calf hair in lime water without any sterilisation. The bottles were sealed antiseptically, and put away in a dark cupboard. The hair was observed to be gradually attacked in both bottles. After an interval of 114 days, the hair had almost completely disappeared in both bottles, whilst the liquid above was of a yellow colour. That in the unsterilised bottle gave off ammonia on boiling. 25 c.c. distilled into 25 c.c. *N*/10 acid required 20·7 c.c. *N*/10 soda for neutralisation, *i.e.*, the ammonia was equivalent to 1·05 c.c. *N*/10 acid, or 0·00567 grm. nitrogen, equivalent to 0·227 grm. per litre nitrogen in solution. The liquid on acidifying and boiling gave off H_2S, and a precipitate was formed (sulphur ?). The soluble sulphur was estimated by oxidation with bromine water, and precipitating with barium chloride. 15 c.c. gave 0·031 grm. barium sulphate, equivalent to 0·00426 grm. sulphur, or 0·284 grm. sulphur per litre.

On opening the sterile bottle inoculations were made into nutrient gelatine tubes. These showed no growth after one week at room temperature, so that the solution was sterile. The clear supernatant liquid was analysed in the same way as that in the unsterilised bottle. Ammonia was present; 25 c.c. of the liquid distilled into 25 c.c. *N*/10 acid required 21·6 c.c. *N*/10 soda for neutralisation, so that ammonia equivalent to 3·4 c.c. *N*/10 acid, or 0·2312 grm. ammonia per litre, or 0·1904 grm. nitrogen per litre was present. On acidifying and boiling H_2S was given off. 20 c.c. after oxidation with bromine as before yielded 0·0194 grm. barium sulphate, equivalent to 0 002664 grm. sulphur, or 0·13332 grm. sulphur per litre. The results are shown in the table, grms. per litre :—

	Unsterilised.	Sterilised.
Nitrogen in solution	0·227	0.1904
Sulphur	0·284	0·1332

The sulphur in the unsterilised bottle was equivalent to 2·13 grms. per litre Na_2S+9H_2O. That in the sterile bottle was equivalent to 1 grm. per litre.

Schlichte found that in sterile limes the hair could be removed with difficulty after 11 days, but after 13 days it could be removed easily.

In order to ascertain whether a sterile solution containing an equivalent amount of sulphur in the form of sodium sulphide would unhair sterile skin, calf skin was sterilised by the Seymour-Jones process. The sterilising solution was made up of 5·5 c.c. 90 % formic acid, and 0·2 grm. mercuric chloride, the skin being left in this solution for 24 hours. The skin was found to be quite sterile by bacteriological tests. It was then placed in a sterile solution, consisting of excess of lime, and 1 grm. of crystallised sodium sulphide. The skin when put into this solution turned a pale green colour, and retained its swollen condition in the lime, although the acid was, of course, neutralised. In 44 hours the hair could be removed with some difficulty, but after a further 12 hours it slipped easily. The solution and the skin were both sterile to bacteriological tests. It is thus shown that 1 grm. per litre of sodium sulphide in the presence of lime will unhair skin in a sterile solution.

The action of lime on hair in the cold is slow, but it is greatly accelerated by heat. Calf hair boiled for one hour with lime water, and afterwards kept at 37° C. for 12 hours, contained (0·255 grm. per litre) sulphur; depilation was complete in 48 hours in this solution.

With regard to the influence of time on the action, a flask containing sterile lime and sterile calf hair, after standing for eleven days at room temperature, was found to contain 0·077 grm. sulphur per litre. This is not so much as that found in the original experiment above cited, but was found to be sufficient to loosen the hair.

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[*] Journal American Leather Chemists Assoc., 1915, p. 526, 585.

[†] This Jour., 1910, p. 667.

In the experiment cited it will be noted that more sulphur is dissolved under non-sterile conditions than under sterile conditions, although it is possible that some sulphur was lost in sterilising the hair, as a portion of the sulphur is very loosely held. The experiment, however, supports the conclusions reached by one of us (this J., 1910, 668), namely, that if sufficient time be given, a sterile lime will unhair skin.

To sum up, the unhairing action of lime water in practice appears to be due to several causes :—

1. Ammonia, produced generally by bacterial action in the old limes, but also by the chemical action of lime on the hair and certain constituents of the skin.

2. Weak proteolytic enzymes produced by bacteria.

3. Sulphur compounds formed by the action of lime on the easily dissolved sulphur in the hair.

Each of these actions will cause depilation, and in practice all three are present. In Schlichte's experiment, No. 3 is the probable cause of the depilation.

It is possible that the swelling of the skin in the sterilising solution, and the subsequent neutralisation by the lime, may have some effect in the unhairing. In this case, the part played by the sulphur would not be essential, but merely an accompanying effect. This point is being further investigated.

Since Mr. Law joined H.M. forces, I have had considerable assistance in the analytical work from Mr. A. Baumfield, to whom our thanks are due.

Discussion.

Mr. J. M. **Wilkie** observed that the concentration of soluble sulphur, which was initially zero, rose as the action progressed, so that an explanation was still required as to the mode of action of the sodium sulphide produced.

Mr. **Dunford** asked whether sulphur disintegrated or dissolved the hair as well as keratin.

Dr. **Prideaux** asked whether ammonia and sodium sulphide had the same dehairing influence.

Mr. **Pentecost** expressed surprise to hear that sodium sulphide did not injure the skins, because in the case of animal products such as silk sodium sulphide was very injurious ; it took away that loose, pleasant feel. Lime acted in the same way, but it was more energetic than sulphide.

Mr. **Innes** said that the function of the liming process was not only to unhair. In their own experiments they had been led to suspect a certain amount of putrefaction. The action of lime might be hydrolytic or it might be a purely solvent action. An excessive liming would destroy the fibre and possibly the same thing could happen with keratin.

Mr. **Duncalfe** said that the horn part of animals consisted of keratin, growing in close contact with the horn pith in the same way as hair on skin ; it was very difficult to remove the horn from the pith in the ordinary way, the general process being to keep the horns for a very long time in the open air ; that process, he concluded, was due to bacterial action, probably producing ammonia. If horns were allowed to get hot the horn would come away very much more quickly, probably owing to the bacterial action being very much more rapid. The bacterial action in that process was very great, judging from the liquid that came away.

Mr. **Wood** said that in ordinary practice the bacterial action was very prominent in all those cases. The prevalent idea was that this was really the cause, as it had been stated by several authors that sterile liquors would not unhair. Probably the action Mr. Duncalfe mentioned was very much the same as took place if a skin were left lying about : the hair would become loose and could be pulled out. With regard to the elimination of putrefaction, there were difficulties in the way of using disinfecting materials in the soak. It was usual to use some coal tar product like phenol, but formaldehyde was fatal. It was impossible to make glue of the pieces afterwards. It had been found by Stiasny that each alkali had a different action. The swelling action depended on the hydroxyl-ion concentration but not the unhairing action. Keratin did not swell ; it simply softened. Sulphide dissolved it absolutely, hair root as well, but ammonia just dissolved the layer round the root of the hair. That question of hydroxyl-ion concentration had been gone into very thoroughly, and it had been found that the order of swelling was the opposite to that of unhairing. Silk was not keratin, but was allied to keratin. Hair contained about 80 % keratin ; horn probably the same. In practice the unhairing action was always due to bacteria when they were present in quantity ; bacterial action alone was sufficient to unhair. Sulphide unhaired by dissolving the hair, whereas bacteria only attacked the hair roots. That was why the old system of sweating (hanging the skin in a cool place) was still used, because the wool was not damaged and was more lustrous than if removed by any other method.

Meeting held at Nottingham, on Wednesday, March 22nd, 1916.

MR. JOHN WHITE IN THE CHAIR.

NOTE ON THE TENSILE STRENGTH OF ARTIFICIAL SILKS, WITH REFERENCE TO THEIR USE IN THE LACE AND HOSIERY TRADES.

BY S. J. PENTECOST.

A section of the Nottingham lace trade is at the present time threatened with the danger of serious injury, owing to the tendency to use artificial silks of inferior tensile strength, for the production of certain lace goods which have to bear some strain in the finishing processes and in subsequent wear.

Chardonnet silk, made by projecting collodion into air or water, and subsequently denitrating, is extraordinarily brilliant, but owing to its loss of strength and elasticity when wet, it is not well suited for manufacturing goods that have to be stretched or pulled out. A further drawback has been found in the tendency for this silk to become rotten in stock owing to a development of sulphuric acid in the fibre. This is often accompanied by the formation of white opaque places on the fabrics. For this reason, and the important factor of relative cost, this class of artificial silk has been replaced by those products obtained by dissolving the cellulose direct, without previous nitration.

The Glanzstoff and Thiele processes consist in dissolving cellulose in ammoniacal solution of copper hydroxide and forcing the liquid through fine spinning nozzles into a precipitating medium consisting of 32 parts caustic soda, 8 parts glucose, and 100 parts water. In this the copper is dissolved out of the fibre at a temperature of 50° C. for fine threads and 75° C. for thick threads. The threads are afterwards washed in dilute acid. By Thiele's process very fine threads are produced.

Viscose silk is made by treating cellulose with caustic soda of mercerising strength and subjecting the product to the action of carbon bisulphide vapour. The cellulose xanthate thus formed is dissolved to an 8 to 10% cellulose strength, and projected into suitable aqueous precipitating media. This class of silk is being produced in increasing quantities at Coventry, as well as abroad, and by reason of its softness, brilliance, and strength when in a wet state, has found its way into the Nottingham and Lancashire textile industries. It is supplied in sizes of 75 deniers and upwards.

By treating artificial fibres with formaldehyde in the presence of dehydrating substances, the strength of the silk in the wet state is very much increased. The affinity for direct dyes is however decreased by this treatment, and want of levelness in dyeing results.

The difficulties of using artificial silk in the lace machine have been gradually overcome, and a large variety of lace goods are now made on the levers, warp, plain net, and embroidery machines, either with artificial silk alone or mixed with cotton or with natural silk. When worked in embroidery machines for the production of pattern on cotton net, the strength of the artificial silk is of less moment; but if used for the production of veilings or goods that have to bear a strain in the dyeing and dressing processes as well as the subsequent wear, then the strength of the fibre both in the wet state and the dry is of the greatest importance. The greater part of the artificial silk veilings at present made in Nottingham are made from the best and strongest material, and give satisfaction to the wearer. There are some, however, still made of the nitrocellulose silks, and these scarcely nold together in the dyeing process, and will bear no strain when dressed.

I have had several samples of recently manu-actured artificial silks tested for breaking strength 1) in the dry, (2) in the wet, and (3) when dried fter wetting. In each case 6 inches of thread was uspended so as to avoid twisting, and a vessel ttached to the lower end. Water was run into the essel from a burette till the vessel dropped. In all ases the tests were carried out under identical onditions, and the figures given represent the reaking strength of the threads in grammes.

Silk and size.	Dry.	Wet.	Redried.
Chardonnet 120 den.	42	0.	95
Glanzstoff 130 den.	40	35	41
Viscose 120 den.	51	50	51.5
Viscose 200 den.	91	86	88

To distinguish one make of artificial silk from ie other, perhaps the treatment with concentrated lphuric acid is the most satisfactory. This gives distinct red brown coloration with viscose, and llow or yellow brown with cuprammonium silk, hile nitrocellulose silk gives a faint yellow colour. nder the microscope the last named silk may distinguished from the others by the central nal. Treated with methylene blue it also kes a deeper colour.

The lace-maker, however, will do well in choosing s silk, not to trust entirely to these tests; but make use of the local conditioning house and sure the breaking strength is equal to the scose standard, both wet and dry.

Discussion.

The Chairman suggested that it might be ssible to have the provisions of the Foods and ugs Act extended to protect buyers of artificial silks in view of the difficulty of distinguishing them except by actual tests.

Mr. J. T. Wood asked what was the relative strength of threads of viscose and real silk.

Dr. R. M. Caven asked in what way the sulphuric acid was formed in the fibres of nitrocellulose silks.

Mr. Duncalfe asked whether the density of artificial silks gave any indication of their origin.

Mr. S. G. Sastry asked whether artificial silk goods were washable.

Mr. Pentecost, in reply, said it would be a great advantage if the one silk could be called viscose silk or some similar name so that it could not possibly be confounded with cuprammonium silk or nitrocellulose silk. He cordially supported the Chairman's suggestion that it should be compulsory to describe the article. Viscose was roughly about half the strength of real silk when threads of the same thickness were compared. The density of artificial silk was greater than that of real silk, and when wet it swelled more than natural silk. So far as he knew, artificial silk goods were washable and had fair wearing qualities. In reply to Dr. Caven, nitrocellulose silks, which had become rotten when stored, were found to contain about 1% of free sulphuric acid, probably produced by the decomposition of unstable sulphuric acid compounds in the fibre by heat, etc.

Yorkshire Section.

Meeting held at Leeds, on Monday, April 10th, 1916.

MR. F. W. RICHARDSON IN THE CHAIR.

THE ESTIMATION OF BENZENE AND TOLUENE IN COMMERCIAL MIXTURES.

BY A. EDWARDS.

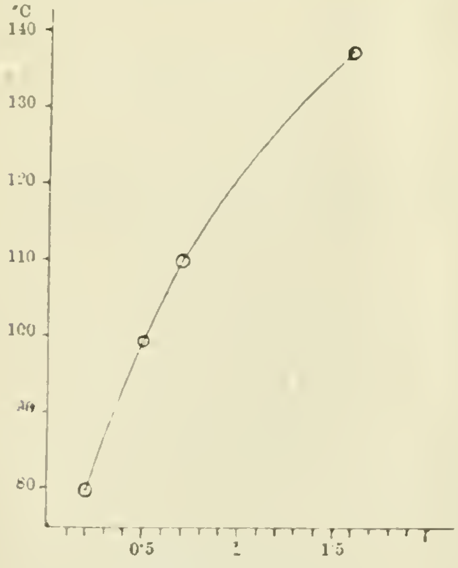
The initial call for toluene for the manufacture of explosives led to its evaluation by a simple method devised by Dr. Colman. The limiting of its use to material containing between 50 and 75% of toluene rendered this method unwieldly for general application to very varying ranges, since the errors of the determination are multiplied according to the necessity for the dilution with pure toluene, benzene, or xylene. Moreover the supply of pure hydrocarbon is an item when many analyses are made.

It occurred to me that if the constituents of naphtha could be isolated readily in pairs, use could be made of the boiling point composition curves of each pair, namely, benzene-toluene and toluene-xylene. The curves function throughout the whole range of mixtures possible: and they have this advantage—that they may be deduced from the vapour pressures of each constituent if necessary. I am greatly indebted to a work on "Fractional Distillation" by Prof. Sidney Young, from which calculated data for the molecular composition-boiling point curve of benzene and toluene were obtained. The volume composition boiling points were deduced therefrom and subsequently the curve was checked by admixtures of the pure constituents, and the new curve given found to fall slightly lower, the maximum deviation being 0·2° C. The curve for toluene and xylene also given was similarly constructed from known admixtures of the pure constituents.

Conversation with other chemists discloses the fact that considerable discrepancies are found between the returns for toluene content obtained by themselves, and by the official chemists, using the Colman method. A discussion of the differences is desirable, since any method of analysis proposed may suffer like vagaries from the same causes.

The obvious errors of graduated cylinders may be satisfactorily checked against standard burettes. But the greatest source of error lies in the thermometer. It is to discrepancies in the scale readings and varying stem immersion that the bulk of the differences between the results of one operator and another are to be attributed. Minor discrepancies may be introduced by failure to dry the distillates, and failure to apportion correctly the loss on distillation.

For the purpose of checking the thermometer and constructing the boiling point composition curves, quantities of reputedly pure benzene, toluene, and xylene were taken and refractionated through a column, the products collecting within a variation of 0·2° C. being accepted as pure and assigned the values of benzene 80·2° C., toluene 110·7° C., xylene 139° C., at 760 mm. barometric pressure. The thermometers were then checked at the boiling points of each hydrocarbon and in steam, all at 760 mm. pressure, and any variation from the above values plotted against the scale readings. The curve appended gives the result for one of the best thermometers examined. In the construction of the boiling point composition curves



the scale readings at all points have been corrected by the indication of this thermometer curve. The variation of boiling point for changes of barometrical pressure is 0·47° C. for every 10 mm. of mercury, and is approximately the same for the three hydrocarbons.

Every thermometer used for the estimation of toluene and benzene by any method involving distillation should be checked as above, and due allowance made for the height of the barometer at the time the estimation is conducted.

Separation into distillates of two components.

The separation is made by distillation through a Young's 12-bulb column, dividing the range 80·2° C. to 139° C. into four parts with refractionation of the two middle portions. The presence of carbon bisulphide and low boiling paraffins—"forerunnings"—necessitates an additional separation to 80·2° C. The scheme varies with the character of the material, and is fully set forth under "Crude benzol," etc. The mixture may be fractionated in the manner described by James (this Journal, Feb. 29th, 1916, p. 236). The fractions are dried by plaster of Paris and the boiling points taken.

Boiling point of fractions.

In ascertaining the boiling point of the fractions it is necessary to keep the composition of the liquid phase constant throughout the determination. The apparatus illustrated (Fig. 1) consists of a wide-mouth flask fitted with a cork carrying a reflux condenser and a short length of ½-inch diam. glass tubing reaching to a point just clear of the bottom of the flask. A thermometer is inserted in the tube so that its bulb is ¼ of an inch from the surface of the liquid. A hole is blown in the tube just below the bottom of the cork to allow the vapour to circulate. The capacity of the bulb should be such that the liquid fills about one half of it; 50 to 120 c.c. is a suitable volume. The liquid is caused to boil up the tube and over the bulb of the thermometer until the temperature is constant. The flame is then shifted slightly to one side so that ebullition takes place outside the tube, the temperature again being read when constant. This temperature is corrected by the thermometer curve and for the barometric pressure; reference to the boiling point composition curve discloses the proportion of each constituent present.

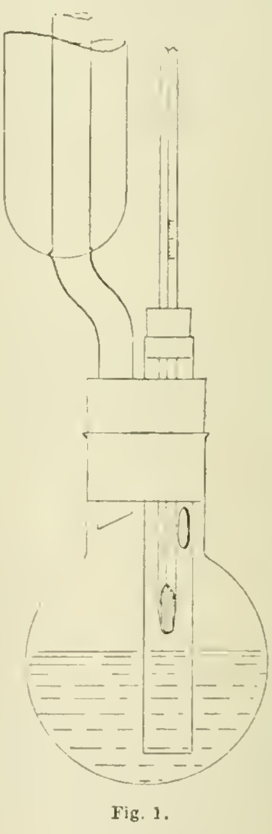


Fig. 1.

Application to commercial fractions.

The method has been of great use in the control of stills for the production of rectified benzol and toluol. The washed "once run" benzol, toluol, or solvent is fractionated as outlined elsewhere and the composition read from the curves. The yield of products closely follows the amounts indicated by analysis. One is able to give the still-man a dip to which he can safely go in his storage tank before reaching the cut point for the next constituent.

The working of the stills may be closely followed by applying the boiling point determination to the runnings direct, without refractionation, since the working columns themselves are sufficiently efficient to pass only admixtures of two constituents, either benzene + toluene or toluene + xylene.

Crude benzol.

In the analysis of crudes containing creosote it is necessary to rectify to 180° C. through a column, followed by a second fractionation of the distillate to 115° C. The product is washed with acid and alkali, dried, and fractionated to 139° C. In this distillate there is usually a considerable proportion of forerunnings present boiling below 80·2° C. These must be removed otherwise the boiling point of the benzene + toluene fraction would be lowered and indicate a deficiency of toluene. The scheme of four fractions is extended to include one for forerunnings. We then have :—

1. Up to 85° C.
2. 85° to 96° C.
3. 96° to 110·7° C.
4. 110·7° to 125° C.
5. Residue at 125° C.

All the fractions except the 2nd and 5th are refractionated ; from No. 1 all that comes over to 80·2° C. is collected separately ; the residue goes to No. 2 ; Nos. 3 and 4 are fractionated to 110·7° C., the distillates going to No. 2 and the residues to No. 5. The boiling points of Nos. 2 and 5 are then taken ; the proportion of the forerunnings collected separately is added to the benzene indicated by the curve. The toluene indicated will be exact, but the benzene will be impure according to the quantity of forerunnings present.

Rectified benzol.

The presence of forerunnings in rectified benzol renders the composition somewhat uncertain as with crude benzol. By rectification to 80·2° C., allowing the thermometer to dwell on this point for a few moments, followed by a re-distillation of the distillate to 80·2° C., they may be separated, and the true composition of the residue found from the boiling point composition curve. The proportion of toluene is indicated correctly, but the true proportion of benzene cannot be ascertained until the identity of the forerunnings is established. After treatment for the removal of carbon bisulphide these forerunnings have a sp.gr. of 0·864 to 0·885 with a boiling point of 72° to 73° C. The low boiling point is certainly not due to the presence of members of the C_nH_{2n+2} series of hydrocarbons exclusively.

Rectified toluol.

Separation into four fractions with refractionaion of the second and third is sufficient.

Rectified solvent naphtha.

It is necessary in these days to know the proportion of toluene present before submitting it for sale. A preliminary rectification to 145° C., followed by a rectification of the distillate to 139° C. and a direct determination of the boiling point of the second distillate is sufficient.

Experimental gas washings. Rich oil.

A preliminary distillation without a column is made to 230° C. ; the distillate is treated like crude benzol.

Tar.

The tar is distilled in a copper cylindrical still to 30° C. and the distillate treated like crude benzol. The technical difficulty met with in distilling tar due to the presence of water may be overcome by jacketing the still as indicated in the sketch—Fig. 2—leaving a few holes in the top of the jacket for the escape of products of combustion. The details of the still and jacket are : Still, 8 inches diam., 8 inches high to the dome ; neck, 1¼ inches diam. by 1¼ inches long, of solid drawn copper tubing ; all joints brazed. Jacket of sheet tin, 10 inches diam. by 11½ inches high ; top punched with 1¼ inch diam. hole to take the neck of the still, and with six ⅜-inch holes evenly spaced 3 inches from the centre ; three springs at the base projecting inwards 1 inch to act as distance pieces by bearing on the side of the still. The still is supported 1 inch above the top of a Fletcher's triple concentric ring burner by a four-legged stand.

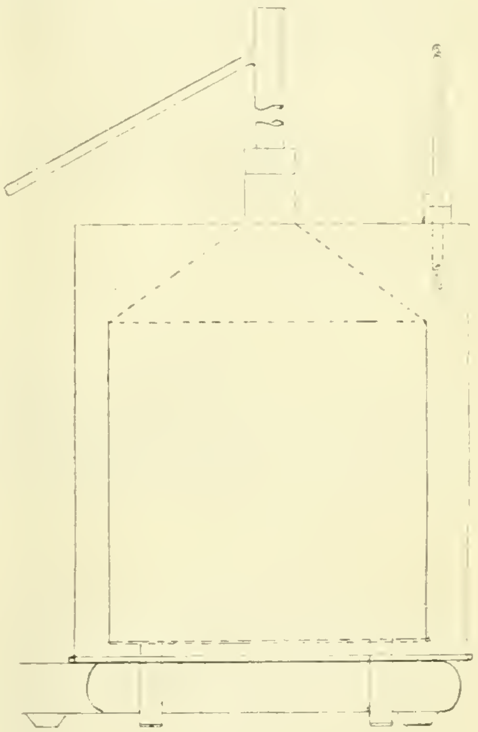


Fig. 2.

The distillation is started with the outer ring only burning ; the products of combustion pass up the jacketed space and do not directly heat the bottom of the still. A thermometer in the jacket may indicate 230° C. with a rich tar containing up to 5 % water without danger ; the light oil and steam leave the still head at 105° to 110° C. Distillation is allowed to proceed until the still head temperature begins to rise and the distillate slackens, when the inner rings of the burner may be started and the outer one closed down. A very bad tar containing a small quantity of light oil and much free carbon may require a temperature of 150° C. in the jacket—still head 100° to 103° C. —until most of the water has been driven off. It is an advantage to work with a long still head, say 10 inches from the side tube to the top of the cork. Should the jacket be too hot and the contents of the still froth up into the head, the burner may be promptly turned out before the tar reaches the side tube, and a slightly lower temperature tried in the jacket after the tar has subsided. Condensation need not be feared since the vapours are superheated.

Boiling Points of Mixtures of Toluene with Benzene and Xylene.

Toluene. % by volume.	Boiling points, °C.	
	Benzene and toluene.	Xylene and toluene.
0	80·2°	139°
10	81·8	134·4
20	83·7	130·3
30	85·75	126·7
40	88·1	123·5
50	90·75	120·8
60	93·8	118·4
70	97·2	116·3
80	101·0	114·3
90	105·3	112·5
100	110·7	110·7

The boiling point composition curves may be constructed by using the above figures.

Discussion.

The Chairman said that recently he had made a number of determinations of benzene in the Bradford gas, washing with alcohol and water, but was not satisfied with the method; could Mr. Edwards suggest anything better? Had anything been done to obtain the refractive indices? That was a constant that could be readily obtained and would probably give valuable information.

Mr. Wilson Haig asked if the method agreed with that used by the official chemists. He was glad to hear of a safe still for tar, and asked where it could be purchased.

Mr. George Ward asked if the thermometers had been checked at the National Physical Laboratory.

Mr. Edwards replied that an accurate method of estimating benzene in coal gas by absorption had still to be devised. He indicated a possible method by measurement of the vapour pressure of benzene in the gas which gave promising results, but which had not been fully worked out and checked. His method for the estimation of toluene agreed with that used by the official chemists to 0·5% upon the only sample so far tested. The thermometers had not been checked at the National Physical Laboratory. The combination of still and jacket that he had devised was perfectly safe and could be made by any coppersmith according to specification.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

***English.*—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.**

***United States.*—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.**

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I.—GENERAL; PLANT; MACHINERY.

Graphite lubricants: "Kollag" and "Oildag." H. Freundlich. Chem.-Zeit., 1916, 40, 358—359.

Microscopic and ultramicroscopic examination of samples of "Kollag" and "Oildag" showed that submicrons, *i.e.*, particles of less than 500 $\mu\mu$ diameter, were present in abundance in both. Coarser particles were also present, but scarcely any of larger diameter than 6μ. The number of particles of diameter between 2μ and 6μ was somewhat greater in "Oildag" than in "Kollag" and, in agreement with this, sedimentation took place somewhat more rapidly in the former. Both preparations, diluted with sesamé oil, passed through filter-paper apparently unchanged at first, but the "Oildag" blocked the pores of the paper, and yielded a clear filtrate, in less time than the "Kollag" preparation.—A. S.

Patents.

Cooling, purifying, and drying the air in enclosed, or partly enclosed, chambers; Manner of, and means for ——. A. J. Roach-Cuming, London. Eng. Pat. 5078, Apr. 1, 1915.

The cooling agent (brine) is fed into the uppermost of a series of stepped vessels contained in the chambers and flows down to the lowest vessels, from which it may be run to waste or returned to the upper vessels. The upper vessels are provided with coils, immersed in the brine, through which a refrigerating agent such as ammonia gas is circulated.—W. H. C.

Furnaces; Process and apparatus for charging ——. L. D. Anderson, Midvale, Utah, Assignor to United States Smelting, Refining, and Mining Co. U.S. Pat. 1,176,878, Mar. 28, 1916. Date of appl., Oct. 5, 1914.

The components of the charge for an elongated furnace are placed separately in approximately parallel rows of equal length on a charging floor They are then mixed, while maintaining the length of the body of material, and charged uniformly into the furnace.—W. H. C.

Furnace. W. S. Rockwell, Assignor to W. S Rockwell Co., New York. U.S. Pat. 1,177,058 Mar. 28, 1916. Date of appl., July 28, 1915.

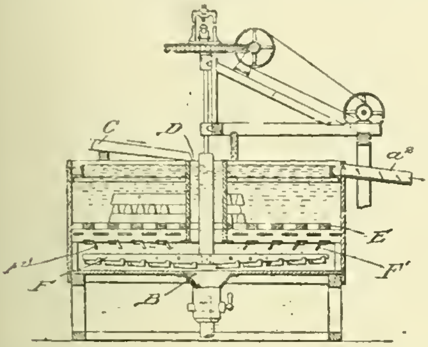
The heated gases from the combustion chamber of a furnace are introduced into the heating chamber through passages formed in ledges along the walls of the latter. The spent gases are discharged from the heating chamber through passages in the ledges which alternate with the inlet passages.—W. H. C.

Kiln: Continuous-firing ——. D. A. Benson Frostburg, Md. U.S. Pat. 1,177,225, Mar. 28 1916. Date of appl., Nov. 4, 1915.

The kiln consists of inner and outer semi-circular arches, the heating furnaces being in the side wall of the outer arch. The hot gases pass into the lower part of the space between the arches, which i divided by transverse vertical partitions of spaced bricks, and are discharged into the central archway The material to be heated is contained in the upper part of the space between the arches, on a floor just above the crown of the inner arch.—W. F. F.

Precipitating apparatus. J. Irving, jun., Douglas, Ariz., Assignor to The Dorr Cyanide Machinery Co., Denver, Colo. U.S. Pat. 1,177,109, Mar. 28, 1916. Date of appl., Sept. 14, 1915.

THE solution to be precipitated is fed through the shoot, C, into the central pipe, D, passes to the bottom, and is spread out by the agitator, F. It then passes upwards through the solid precipitant, which rests on the perforated frame, E, F^1, and the residual liquid flows away by the shoot, a^2. The precipitate sinks and is moved towards the discharge opening, B, by the agitator, F.—W. H. C.



Homogenizer or emulsifier. H. L. Draper, G. Hĕnry, and E. T. Heninger, Kokomo, Ind. U.S. Pat. 1,177,236, Mar. 28, 1916. Date of appl., Mar. 20, 1915.

THE mixed materials are forced against a fan with spiral blades, mounted on a vertical axis in an emulsifying chamber, so as to cause it to rotate. The emulsion passes out through openings in the upper part of the chamber into a surrounding casing from which it is discharged.—W. F. F.

Rectifying columns; Cooling trays for ——. E. Barbet et Fils et Cie. First Addition, dated Apr. 25, 1914, to Fr. Pat. 469,979, June 4, 1913 (this J., 1915, 16).

To ensure that the bubbles of vapour come into contact with cooled liquid, the coils through which the cooling medium flows are placed close o the outside of the perforations in the caps, hrough which the bubbles of vapour pass upwards.—W. H. C

Distillation and rectification of all volatile products by multiple effect; Process of ——. E. Gazagne. Fr. Pat. 477,268, June 8, 1914.

THE principle of multiple effect is applied to the ontinuous or intermittent distillation of volatile iquids. The first vessel of the series is supplied with heating medium from external sources and ach subsequent vessel is heated by the vapour iven off in the preceding vessel.—W. H. C.

Evaporating apparatus with intensive circulation. E. Barbet et Fils et Cie. First Addition, dated Apr. 25, 1914, to Fr. Pat. 474,327, Nov. 20, 1913 (this J., 1915, 1078).

N order to work with very small differences of mperature, the liquid is circulated from chamber o chamber of a multiple effect system in the pposite direction to that in which the steam rculates.—W. H. C.

iquids with vapours or gases; Process and apparatus for ensuring the contact of ——. L. M. Croizat. Fr. Pat. 476,913, Dec. 29, 1914. Under Int. Conv., Jan. 13, 1914.

NUMBER of transverse partitions, each consisting of a series of stepped, concentric, perforated trays, are arranged in a cylindrical chamber. The liquid is fed into the outermost tray of the upper partition, flows round and then overflows into the next concentric tray, and so on to the centre. It then flows by a pipe to the outer tray of the next partition below, and so on to the bottom of the chamber, from which it is discharged. The liquid is prevented from passing through the perforations in the trays by the pressure of the gas, which enters at the bottom and is discharged from the top of the chamber.—W. H. C.

Apparatus for pneumatic conveying of solids. British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, U.S.A. Eng. Pat. 7263, May 14, 1915.

Apparatus for conveying and compressing materials by screw action. O. O. Erfurth, Teuchern, and Internationale Patentverwertungs-Ges. m.b.H., Berlin. Eng. Pat. 14,357, Oct. 11, 1915.

Furnace-charging mechanism. A. C. Nelson, Lakewood, Ohio. U.S. Pat. 1,177,720, Apr. 4, 1916. Date of appl., Sept. 17, 1915.

Boiler, retort, and superheater; Combined ——. J. C. Mims, New Orleans, La., Assignor to Forest Products Co. U.S. Pat. 1,177,793, Apr. 4, 1916. Date of appl., Aug. 27, 1915.

Temperature-regulator for furnaces. H. E. Gilbert, Conshohocken, Pa. U.S. Pats. 1,177,858 and 1,177,859, Apr. 4, 1916. Date of appl., Dec. 9, 1914.

Filter-presses; Means for pressing drying filter-cakes in ——. A. L. Genter, Berlin. Eng. Pat. 1302, Jan. 26, 1915.

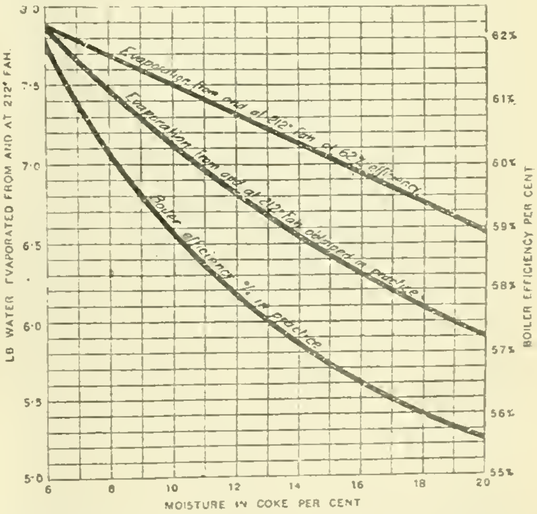
SEE Ger. Pat. 287,318 of 1914; this J., 1916, 243.

Process of producing graphite in colloidal form. Eng. Pat. 8640. *See* VII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Gas-coke fuel; Effect of the presence of moisture in ——. P. Beatty and A. F. Smith. Elect. Review; through J. Gas Lighting, 1916, **134**, 176—177.

DETAILS are given of results obtained during the consumption of 10,000 tons of gas-works coke in the boiler-house of a tramway power station in



Buenos Aires. When dried at 110° C. the coke contained C 88·15, H 0·94, S 1·51, ash 9·81 % and had a calorific value of 13,660 B.Th.U. per lb. The moisture content varied from a minimum of 6 (in dry weather) to about 20 %, the average being about 13 %. The coke was burned under hand-fired boilers of the marine type, the average consumption per kilowatt-hour being 3·675 lb., the weight of water (at 212° F.) evaporated per lb. of fuel 6·72 lb., and the average boiler efficiency 57·6 %. The best results were obtained during trials extending over one month, when a large portion of the coke containing 6 % of moisture was used and an average evaporation of 7·9 lb. of water (at 212° F.) per lb. of fuel attained, representing a boiler efficiency of 62 %. On this basis, the theoretical effect of increasing the moisture content of the coke from 6 to 20 % should be as indicated by the upper curve of the figure; but the actual effect, as shown in the middle and lower curves, was much greater.—W. E. F. P.

PATENTS.

Briquetting [coal]; Method of ——. E. R. Sutcliffe, Leigh, Lancs., and Pure Coal Briquettes, Ltd., Cardiff. Eng. Pat. 5019, Mar. 31, 1915.

THE material is finely ground and compressed into briquettes at a pressure of 1—5 tons per sq. in. The briquettes are broken into small pieces and compressed at 8—10 tons per sq. in. in a mould which permits of the lateral expansion of the block while it is being compressed.—W. F. F.

Fuel; Artificial or block ——. H. Faraday, Irlams-o'-th'-Height, Lancs. Eng. Pat. 11,406, Aug. 7, 1915. Addition to Eng. Pat. 19,495, Sept. 7, 1914 (this J., 1915, 824).

GROUND, pulverised or granular coke, coke dust or breeze, used alone or mixed with an equal quantity of bituminous coal or anthracite or a mixture of the two, may be added to a binding agent consisting of maize and sodium chloride.—W. F. F.

Coke ovens or the like: Process and apparatus for heating ——. A. Roberts. Fr. Pat. 477,761, Feb. 22, 1915.

COKE ovens are built up from bricks moulded in such a way that passages for the heating gases are formed in the walls. The mixed gas and air pass first through a straight passage and then through tortuous passages, while moving through the walls of the oven from top to bottom. The zone of combustion in the passages is about the level of the top of the charge of coal within the oven, so that a cooler space is maintained above the charge. Adjacent ovens are built so as to allow for expansion when heated.—W. F. F.

Gas; Apparatus for making ——. H. A. Carpenter, Sewickley, Assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S.Pat. 1,177,171, Mar. 28, 1916. Date of appl., Oct. 12, 1911.

A REFRACTORY material capable of being heated to a high temperature without decomposition is enclosed within a metal casing, lined with heat-insulating material. The casing is constructed of metal plates extending vertically the height of the apparatus, and having overlapping edges, by means of which adjacent plates are fastened together. The expansion of the refractory material and of the metal casing is provided for. Gas retorts are placed along the middle of the refractory material, and mouth pieces are provided in alinement with the retorts.—J. B. C. K.

Gas-producer. J. O. Carrey, Assignor to Carrey Process Co., St. Louis, Mo. U.S. Pat. 1,176,429, Mar. 21, 1916. Date of appl., Apr. 1, 1915.

THE interior of a vertical producer having a rotating grate section is divided into two unequal compartments by an inclined partition. The smaller compartment or distillation chamber has, at the upper end, an exit pipe through which the volatile distillation products are conducted to a point below the larger compartment or producer chamber, whence they are forced upwards through the latter as the fuel bed is advanced by the rotation of the grate section.—W. E. F. P.

Gas; Apparatus for generating ——. H. F. Wallmann, Chicago, Ill. U.S. Pat. 1,177,581, Mar. 28, 1916. Date of appl., Dec. 14, 1910.

IN a gas producer two separate heating conduits are located on opposite sides of a chamber in which the fuel is distilled. Each of these heating conduits is constructed to discharge the gases from a combustion chamber against the wall of the distillation chamber, and a portion of the gas from the latter is withdrawn through a perforated wall of the gas conduit in order to supply the combustion chamber with gaseous fuel. Several alternative arrangements of the heating conduits with respect to the distillation chamber and conduit of the producer are described, and the use of liquid fuel and of superheated steam is also provided for.
—J. B. C. K.

Gas; Process and apparatus for the preparation of lighting and heating —— *formed essentially of hydrogen and methane with little or no carbon monoxide.* L. Vignon. Fr. Pat. 477,083, May 25, 1914.

A HORIZONTAL or slightly inclined rotary retort is charged with coal, anthracite, or coke, and quicklime, which are mixed by rotation of the retort. The mixture is heated to 900°—1000° C., and water or steam passed in till the temperature falls to 700° C. The gas is withdrawn and air passed through to raise the temperature to 900°—1000° C. and regenerate the lime. (See Fr. Pat. 461,699 of 1909; this J., 1910, 1366.)
—W. F. F.

Water-gas generator, especially for small installations. Dellwik-Fleischer Wassergas-Ges. m. b. H. Ger. Pat. 290,604, Jan. 15, 1915.

THE pipe through which the air blast is supplied communicates with the pipe leading from the generator to the scrubber and is provided with a simple valve and with a safety valve in the form of a tube dipping into water contained in a vessel beneath the scrubber. By means of a lever the gas-outlet pipe of the generator, the steam-supply pipe, and the air-supply pipe are controlled simultaneously, so that during the gas-making period the gas flows direct to the scrubber, whilst during the blowing period, the air is prevented from passing to the scrubber by the safety valve.
—A. S.

Gas-scrubbing apparatus. B. M. Ferguson, Chicago, Ill. U.S. Pat. 1,176,747, Mar. 28, 1916. Date of appl., Mar. 4, 1915.

SUPERIMPOSED perforated grid plates are arranged in pairs, the openings of adjacent plates being so constructed that by lateral movement of one plate over the other the size of the openings can be increased or diminished at will, and the rate of flow of gas through the apparatus thus regulated. The pairs of plates are arranged "in staggere relation" one above the other, and a baffle-plate is also employed above the grid plates, against which the gas impinges before it leaves the apparatus.—J. B. C. K.

Gas-purifying apparatus. C. H. Clower, Philadelphia, Assignor to Cruse-Kemper Co., Ambler Pa. U.S. Pat. 1,177,586, Mar. 28, 1916. Date o appl., July 3, 1915.

A GAS-TIGHT casing or enclosure is provided wit detachable linings to the walls, and the purifyin material is enclosed between the linings and the outer wall of the enclosure. The linings have openings for the passage of the gas to be purified. A gas-receiving conduit extends upwards through the bottom of the apparatus, and an outlet from one of the compartments of the casing allows the gas to escape after purification.—J. B. C. K.

Mexican flux and crude oils; Process of rendering —— available as a fuel. O. Falkenwalde, Baltimore, Md. U.S. Pat. 1,177,105, Mar 28, 1916. Date of appl., July 17, 1914.

The oil is emulsified with water at 150°—210° F. (65°—99° C.) and the mixture fed to a burner. —W. F. F.

Hydrocarbon fuel principally applicable to internal combustion engines and process of manufacture. F. Berlioz. Fr. Pat. 477,145, May 28, 1914.

A heavy or light hydrocarbon is nitrated with a mixture of nitric and sulphuric acids, and the product used in a mixture in the following proportions: Petroleum lamp oil 40—50 parts, benzol 30—20 parts, light petroleum spirit boiling below 150° C. 25 parts, nitrated hydrocarbon 5 parts.—W. F. F.

Explosive mixtures of air and any heavy hydrocarbon (crude petroleum, heavy oil, etc.): Process of manufacturing in the cold —— by successive atomisation. A. Bruneau and E. Potron. Fr. Pat. 477,748, June 27, 1914.

The oil is atomised by successive jets of air until the required proportion of air has been added. This may be done in a single apparatus in which the velocity of the added air at each stage is greater than that of the oil or mixture of oil and air, or several successive sprayers may be used. The oil is thus very finely divided. Drops of liquid may be removed by screens, and the mixing may be facilitated by heat. The process may be applied both to light and to heavy oils.—W. F. F.

Fine fuel; Feeding and burning ——. W. D. Wood, New York. U.S. Pat. 1,178,436, Apr. 4, 1916. Date of appl., Apr. 17. 1914.

Burning pulverised fuel. H. R. Barnhurst, Catasauqua, Pa. U.S. Pat. 1,178,464. Apr. 4, 1916. Date of appl., Mar. 31, 1914.

Gas retorts and the like; Machines for stoking ——. J. Terrace, Grimsby. Eng. Pat. 6165, Apr. 24, 1915.

Gas retorts; Charging and discharging apparatus for ——. J. B. Hansford, Assignor to F. J. Bancroft, New Barnet. U.S. Pat. 1,178,317, Apr. 4. 1916. Date of appl., Mar. 3. 1915.

Gas retort furnaces and similar apparatus; Method of heating ——. A. G. Glasgow. Fr. Pat. 476,796, Dec. 14. 1914. Under Int. Conv., June 27. 1914.

EE Eng. Pat. 22,425 of 1914; this J., 1915. 413.

Gas-producer. W. B. Chapman, Assignor to Chapman Engineering Co., Mount Vernon, Ohio. Re-issue No. 14,098. Apr. 14, 1916, of U.S. Pat. 1,162,452, Nov. 30, 1915. Date of appl., Feb. 29, 1916.

EE this J., 1916, 104.

Producer-gas; Apparatus for producing ——. E. Fleischer, Dresden-Altstadt, Germany. U.S. Pat. 1,178,391. Apr. 4, 1916. Date of appl., Aug. 25, 1914.

EE Fr. Pat. 471,341 of 1914; this J., 1915, 414.

oal or other materials; Process of treating ——. L. P. Burrows. Fr. Pat. 477,427, Jan. 28, 1915.

EE Eng. Pat. 1206 of 1915; this J., 1916, 526.

Asphalt; Refining —— and manufacture of asphalt cements from natural asphalts. C. N. Forrest, Rahway, N.J., and The Barker Asphalt Paving Co., Philadelphia, Pa., U.S.A. Eng. Pat. 15,979, Nov. 12, 1915.

See U.S. Pat. 1,163,593 of 1915; this J., 1916, 118.

Hydrocarbons; Process and apparatus for the treatment of liquid ——. Standard Oil Co. Fr. Pat. 476,782, Dec. 17, 1914.

See U.S. Pats. 1,122,002 and 1,122,003 of 1914; this J., 1915, 132.

Petroleum of high boiling point; Process and apparatus for converting —— into products of lower boiling point. Standard Oil Co. Fr. Pat. 477,404. Jan. 26, 1915.

See U.S. Pat. 1,132,163 of 1915; this J., 1915, 415.

[Petroleum] oils; Process of refining ——. Gulf Refining Co. Fr. Pat. 477,668, Feb. 12, 1915. Under Int. Conv., Feb. 12, 1914.

See U.S. Pat. 1,127,465 of 1915; this J., 1915, 268.

Aluminium chloride: Manufacture of —— [from residues obtained in the treatment of petroleum]. Gulf Refining Co. Fr. Pat. 477,667, Feb. 12, 1915. Under Int. Conv., Feb. 12, 1914.

See U.S. Pat. 1,099,096 of 1914; this J., 1914, 783.

Manufacture of gas, hydrogen, carbon, benzine, spirits, greases, etc., refining petroleum, shale oil, animal black, etc. Fr. Pat. 477,411. *See* IIb.

Process of distilling organic compounds, e.g., hydrocarbon oils. Eng. Pat. 4694. *See* III.

Use of residual liquors from retting of textile plants as an agglutinant or binding medium. Fr. Pat. 477,622. *See* V.

Hydrogen generator. Ger. Pat. 290,529. *See* VII.

Retort ovens heated externally for the production of hydrogen from iron and steam. Ger. Pat. 290,657. *See* VII.

Treatment of megass for use as fuel. Eng. Pat. 14,983. *See* XVII.

Apparatus for gas analysis. Ger. Pat. 290,992. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Candle power of various flames; Effect of atmospheric pressure on the ——. E. B. Rosa, E. C. Crittenden, and A. H. Taylor. Amer. Illuminating Eng. Soc., Sept., 1915. J. Gas Lighting, 1916, **134**, 178—180. (See also this J., 1915, 72.)

The investigation was made with a tank apparatus permitting photometric measurements of flames at pressures corresponding to a range of two or three miles in altitude and under varying conditions of atmospheric humidity. Observations of candle power were made, against an electrical standard, on the standard Harcourt and Hefner lamps, and on the flames obtained by burning gas at 5 cub. ft. per hour in Sugg's "F" argand, Bray's No. 7 slit union, and von Schwarz's "No. 8 E.H." burners, the results being shown by means of curves. The light of flames is affected by atmospheric pressure because the rate of diffusion of oxygen through the burning fuel in them increases as the atmospheric pressure falls; so that the glowing particles of carbon set free in the earlier stages of combustion enter on the later stage of oxidation more quickly, with the result that the number of glowing particles in existence at one time is smaller. and the light emanating from them correspondingly reduced. This reduction is partly neutralised by the higher temperature resulting from the more vigorous combustion. by which each carbon particle is caused to emit more light, but only for the shorter time of its existence. A flame on the verge of smoking may actually emit more light when the pressure is reduced a little, but a point is soon reached at which the reduction in the number of carbon particles overbalances the effect of their higher temperature. and the reduction in the light becomes more and more rapid as the pressure is further decreased. Generally speaking, the whiter the flame the more remote the smoking point and the more rapid the variation of the light with change of pressure. At a pressure of 20 in. the flames named gave the following percentages of their light at normal pressure (30 in.): acetylene 52, open-flame gas-burners 63—72, Harcourt lamp 73. Hefner lamp 86, the order following the change of colour of the flame from white to red. The effects of humidity and atmospheric vititation on the Harcourt lamp and the various gas flames were also determined. At the lower degrees of humidity (up to 25 litres of water vapour per cub. m. of dry air) the flame of the von Schwarz gas burner showed a decrease of 5 % in light for each volume per cent. of water vapour in the air. as compared with 5·7 % for the flame of the Harcourt lamp, the light from which was also decreased by 3·4 % by an increase of 0·1 % in the carbon dioxide content of the air. It is pointed out that the latter figure affords only a rough indication of the magnitude of the effect of bad ventilation. and that elaborate means of controlling the composition of the air would be necessary if a flame standard were taken as the basis of a fundamental unit of light intended to be accurate within 0·1 %. A mixed gas (coal gas 30; water gas 70 %) having a calorific value of 630 B.Th.U. per cub. ft. and an illuminating power (flat flame) of 20—23 candles was used in the investigation, and the conclusions apply strictly only to gas of the same character and quality. Curves showing the effect of barometric pressure on the candle power of this gas. as determined by means of the Harcourt lamp and the gas burners above referred to, are given.—W. E. F. P.

Absorption of gases in vacuum tubes and allied phenomena. Brodetsky and Hodgson. *See* XI.

Patents.

Gas. hydrogen. pure carbon, carbon electrodes. benzine. spirits, greases. etc.; Process and apparatus for manufacturing ——. refining petroleum. shale oil. bone black. etc, C. Faucheux. Fr. Pat. 477,411. June 13, 1914.

Tars or crude oils derived from coal. petroleum, shale, wood. peat. bone, etc., other distillation products. illuminating or power gas, are passed with or without steam, over graphite. retort carbon, animal black, etc.. heated to 350°—1000° C. At low temperatures. the water remains undecomposed and the main products are benzol and other spirits and greases. At higher temperatures, more gas and less heavy products are produced. Pure carbon is deposited on the contact material. The gas may receive a preliminary washing with water to remove phenols and ammonia. and a subsequent treatment with sodium sulphate and milk of lime to remove hydrogen sulphide. The process may be continuous or intermittent.—W. F. F.

Peat; Treatment of ——. Wetcarbonizing, Ltd. Fr. Pat. 476,756, May 6. 1914.

See Eng. Pats. 9392 and 11,133 of 1913 and 18,030 of 1914; this J., 1914. 911, 912. The heat of the water used for cooling the gases produced by the gasification of the treated peat, may also be utilised for heating the raw peat.

Metallic filaments for incandescence electric lamps; Manufacture of ——. J. A. Scoular. Assignor to Dick. Kerr, and Co., London. U.S. Pat. 1,178,418. Apr. 4, 1916. Date of appl., May 28, 1914.

See Eng. Pat. 14,807 of 1913; this J., 1914, 854.

Devices for the discharge of electricity through a vacuum, gases, or vapours. Eng. Pat. 5741. *See* XI.

III.—TAR AND TAR PRODUCTS.

Phenylhydrazine; Reduction of some mono- and disazo derivatives of phenols and aromatic hydroxyaldehydes with ——. E. Puxeddu. Gaz. Chim. Ital., 1916, **46**, I., 211—219.

Reduction was effected by heating the azo compound with phenylhydrazine, without adding a solvent. The azo compounds used were benzeneazothymol, m.pt. 112°—114° C., benzeneazocarvacrol, m.pt. 85° C., disazothymol, m.pt. 180°—185° C., disazocarvacrol, m.pt. 181°—185° C., and benzeneazosalicylaldehyde, m.pt. 132° C In all cases the azo group or groups were reduced to amino groups; the salicylaldehyde derivative yielded the phenylhydrazone of aminosalicylaldehyde. m.pt. 165° C. Aminothymol melts at 178°—179° C., and aminocarvacrol at 131° C. The diamino derivatives of thymol and carvacrol could not be isolated in a pure state owing to their instability, but they were characterised by means of the hydroxythymoquinones (m.pt. 165° and 180° C. respectively) formed from them by oxidation with ferric chloride.—A. S.

2.3-*Dithiosulphindene.* A. Mannesier. Gaz. Chim. Ital., 1916, **46**, I., 231—240.

In the preparation of thiosaccharin by heating saccharin with phosphorus pentasulphide at 220° C. (see this J., 1915, 851), a small quantity of another substance of m.pt. 98° C. is also formed. It can be obtained in better yield by heating thiosaccharin or sodium saccharinate with phosphorus pentasulphide and has been identified as 2.3-dithiosulphindene, $C_6H_4{<}\begin{smallmatrix}S\\CS\end{smallmatrix}{>}S$. It crystallises in red needles from organic solvents. When boiled with alkali hydroxides or carbonates it yields dithiosalicylic acid, $COOH.C_6H_4.S.S.C_6H_4.COOH$; the latter is also formed, in nearly theoretical yield, by reduction with sodium and alcohol, but is accompanied by a small quantity of another substance, m.pt. 214° C., probably dithioindene, $C_6H_4{<}\begin{smallmatrix}CH_2\\S\end{smallmatrix}{>}S$.—A. S.

Patents.

Organic compounds [hydrocarbon oils]; Process of distilling ——. S. Schlupper, Bochum, Germany. Eng. Pat. 4691, Mar. 25, 1915. Under Int. Conv., Mar. 27, 1914.

A mixture of hydrocarbons, *e.g.*, gas-washing oil containing benzol. toluol. xylol, naphthalene, etc., passes from a reservoir through a heater, where it is raised to 140°—145° C., and thence to a steam-heated still. The vapour rises into the upper part of the still where it is washed by another portion of the washing oil at about 20° C. The high-boiling vapours are thus condensed and carried down into the lower part of the still, while the low-boiling vapours pass to a condenser.
—W. F. F.

Quinoline-4-carboxylic acids; Preparation of substituted ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,703, Dec. 17, 1913.

Equivalent amounts of isatin and ketones are condensed in presence of an excess of aqueous

ımmonia, and the resulting amide saponified. The preparation of 2-methylquinoline-4-carboxylic ıcid, tetrahydro-*meso*-acridinecarboxylic acid, 2-phenylquinoline-4-carboxylic acid, and 2-*p*-tolyl-3-phenylquinoline-4-carboxylic acid is described.
—F. W. A.

-Nitro-2-aminoanthraquinone ; Preparation of ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 290.814, June 21, 1914.

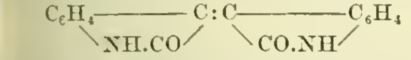
A solution of 2-aminoanthraquinone in conentrated (preferably monohydrate) sulphuric acid, ; treated direct with the calculated amount of itrating agent at a low temperature ; preminary protection of the amino-group by acetylting, etc., is unnecessary.—F. W. A.

'reparation of spirit lacquers, polishes, leather dressings, insulating materials, etc., from wood tar. Ger. Pat. 290,818. *See* XIII.

V.—COLOURING MATTERS AND DYES.

ıdine of Laurent and iso-indigo of Wahl and Bagard ; Probable identity of the ——. L. Lefèvre. Bull. Soc. Chim., 1916, **19**, 111—113.

IE substance, indine, obtained by Laurent in 41 by the action of caustic potash on isatide lphide, and later prepared by Knop (J. prakt. ıem., **97**, 65) by the dehydration of dioxindole, considered to be identical with iso-indigo,

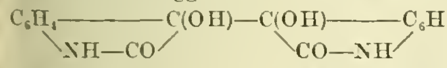


$$\begin{array}{l}C_6H_4\text{———}C:C\text{———}C_6H_4\\ \quad\diagdown NH.CO\diagup\quad\diagdown CO.NH\diagup\end{array}$$

tained by Wahl and Bagard (this J., 1909, 420) the condensation of oxindole and isatin.
—F. W. A.

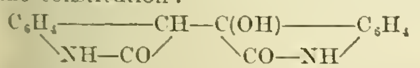
ıtide and isatan ; Constitution of ——. L. Lefèvre. Bull. Soc. Chim., 1916, **19**, 113—116.

E synthesis of isatide by Heller (Ber., 1904, **37**,) by the condensation of 1 mol. of dioxindole h 1 mol. of isatin and by the oxidation of xindole, led him to assign a quinhydrone mula to isatide. This view is considered incort as isatide is a colourless, stable substance. heating, isatide yields isatin and indine or ndigo (see preceding abstract), and the following nula is hence suggested :



$$\begin{array}{l}C_6H_4\text{———}C(OH)\text{—}C(OH)\text{———}C_6H_4\\ \quad\diagdown NH\text{—}CO\diagup\qquad\diagdown CO\text{—}NH\diagup\end{array}$$

ıioisatide is produced by the action of hydrogen hide on a boiling alcoholic solution of isatin ; treatment with caustic potash, the monothio pound and finally isatin are produced, tions which may be explained by the above ıula but not by Heller's formula. Isatan, ıined by the action of ammonium sulphide on ioisatide or by reduction of isatin by means of um amalgam in acid solution, is considered to : the constitution :



$$\begin{array}{l}C_6H_4\text{———}CH\text{—}C(OH)\text{———}C_6H_4\\ \quad\diagdown NH\text{—}CO\diagup\quad\diagdown CO\text{—}NH\diagup\end{array}$$

eating isatan, indine is obtained.—F. W. A.

-loroanthraquinone-2-carboxylic acid. F. Ullınn and H. Bincer. Ber., 1916, **49**, 732—749.

LORO-2-METHYLANTHRAQUINONE was obtained od yield by heating 2-methylanthraquinone, lved in nitrobenzene, with sulphuryl chloride, esence of iodine, on the water-bath under a : condenser. The crude product contained 6 % of isomers chlorinated in the side chain. s purified by heating with an alcoholic solupf potassium sulphide, filtering, and passing air through the hot solution, whereby the potassium salt of 2-methylanthraquinone-1-mercaptan formed at first was oxidised to 2.2′-dimethyldianthraquinone-1.1′-disulphide. This was oxidised by nitric acid to 2-methylanthraquinone-1-sulphonic acid, and the sulpho group replaced by chlorine by treatment with hydrochloric acid and sodium chlorate. 2.2′-Dimethyl-1.1′-dianthraquinonyl was obtained in a yield of 58·6 % of the theoretical, by dissolving the chloromethylanthraquinone in fused naphthalene and heating with copper (compare Scholl, this J., 1907, 679). 1-Chloroanthraquinone-2-carboxylic acid was prepared from the chloromethylanthraquinone by the method used by Ullmann and Dasgupta (this J., 1914, 305) for the preparation of 2-chloroanthraquinone-3-carboxylic acid : yield, 79·5 %. The acid when heated with ammonia under pressure yields 1-aminoanthraquinone-2-carboxylic acid. It also reacts very readily with aromatic amines ; the 1-anilinoanthraquinone-2-carboxylic acid when heated with concentrated sulphuric acid yields 2.1-anthraquinone-acridone. β-Naphthylamino-1-anthraquinone-2-carboxylic acid when dissolved in nitrobenzene and heated with acetyl chloride or acetic anhydride, yields, in a similar manner, anthraquinonenaphthacridone (5.′6′-phthaloyl-3.4-naphthacridone), which forms a violet-red vat by which fibres are dyed a similar colour, changing to a pure red on oxidation.—A. S.

Saffron ; Determination of nitrogen in —— *as a means of detecting adulteration.* M. Pierlot. Ann. Falsif., 1916, **9**, 24—29.

Genuine saffron contains from 2·22 to 2·44 % of nitrogen as determined by Kjeldahl's method ; the stamens which are sometimes found in unsorted samples of saffron contain about 2·7 % of nitrogen. The nitrogen is present almost entirely in organic combination (as protein and probably also as lecithin), only from 0·015 to 0·04 % of ammonia being formed when the saffron is distilled with magnesia under reduced pressure. When saffron contains potassium nitrate, a not infrequent form of adulteration, the organic nitrogen is determined after the nitric nitrogen has been removed by treatment with ferrous chloride and hydrochloric acid ; the quantity of nitrate present may be determined by reduction with Devarda's alloy and subsequent distillation of the ammonia produced.
—W. P. S.

Iron-cyanogen colours. Bock. *See* XIII.

Condition of Dutch chemical industry at the beginning of 1916. *Proposed founding of a Dutch coal-tar colour industry. See* Trade Report.

Patents.

Seleno-phthaleins and their halogen derivatives ; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 290.540, Nov. 14, 1913.

Phthalins obtained by reduction of phthaleins and their halogen derivatives are treated in suitable solvents with selenium halides, and, if necessary, converted into seleno-halogen derivatives by the action of halogens. The products obtained are of value as dyestuffs and for therapeutic purposes.—F. W. A.

Condensation products of the anthraquinone series [anthraquinoneketomorpholines] : Preparation of —— *containing nitrogen.* Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 290,983, Sept. 19, 1913.

Halogen-acetyl compounds of *o*-aminohydroxyanthraquinones, or their derivatives, are treated with reagents which yield a halogen hydracid. The anhydrides of *o*-aminohydroxyanthraquinoneglycollic acids obtained are regarded as anthraquinoneketomorpholines, and are dyestuffs or intermediate products. As distinguished from the known anthrapyridones, coloured vats are obtained from which cotton is dyed slightly.—F. W. A.

Anthraquinone dyestuffs : Production of basic ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,984. Jan. 18, 1914.

Anthraquinone derivatives containing a halogenated fatty acid amide residue, or anthrapyridones halogenated in the pyridone ring are treated with tertiary amines. The stable halogen salts of quaternary bases produced are basic dyestuffs soluble in water. The products also find application as intermediate compounds and in the preparation of valuable therapeutic substances.
—F. W. A.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Wood cellulose ; Removal of resin from manufactured ——. A. D. J. Kuhn. Papierfab., 1915, **13**, 725—729, 744—745. Z. angew. Chem., 1916, **29**, Ref., 183.

The removal of resin from sulphite wood pulp is best effected by washing with hot water, not in the digester but in the stuff-chest outside the digester. The usual method of sprinkling has not much cleansing effect because the rinsing water tends to take the shortest path from the inlet to the outlet, so that large masses of stuff escape the washing altogether. It is recommended that the stuff be diluted largely with hot water and stirred up and washed by blowing in large quantities of air. The inlet for hot water is situated underneath the false bottom and filtered air at a pressure of 6—8 atmos. is forced through a system of hard lead perforated pipes attached to the false bottom. A charge of 15 tons of pulp can be washed in 37 minutes and the bleaching qualities of the pulp are improved by the treatment.—J. F. B.

Cellulose : Action of sulphuric acid in making solutions of ——. W. Zänker. Kunststoffe, 1916, **6**, 17—19. Z. angew. Chem., 1916, **29**, Ref., 182.

As a general rule solutions of derivatives prepared from cellulose modified by oxidising agents or acids are easily manipulated in the spinning process, but yield weak threads. If, however, the quantity of acid acting on the cellulose be extremely small, no deleterious effect is observed but in the initial stages an actual increase of strength is noted. For instance, cotton-cellulose containing about 0·01 % of sulphuric acid shows no perceptible modification, but the solutions prepared from such cellulose have a satisfactory viscosity and the threads are strong. In the preparation of cellulose acetate, the favourable effect of traces of acid in the fibre is noted and such acid constitutes a more satisfactory catalysing agent than traces of acid added to the liquid.—J. F. B.

Patents.

Silk rags and the like ; Process for the extraction and recovery of loading ingredients from waste materials such as ——. E. Beisenherz, Essen-Ruhr, Germany. Eng. Pat. 4901, Mar. 30, 1915. Under Int. Conv., Mar. 30, 1914.

Waste silk rags containing loading materials, *e.g.*, compounds of tin, zirconium, etc., are washed and steeped in a solution of acid ammonium oxalate at 80° C. for 2—4 hours until the metallic compound is extracted. The extract is separated and the metal compounds precipitated by the addition of ammonia in excess. When the liquid is distilled, the free and a portion of the combined ammonia is recovered, and the residual solution containing acid ammonium oxalate is used for a further extraction.—J. F. B.

Silk ; Method of weighting ——. Schadd und Korteling. Fr. Pat. 477,698, Feb. 15, 1915. Under Int. Conv., Feb. 26, 1914.

Silk is treated before weighting with reducing solutions, *e.g.*, 1—2 % (calculated on the weight of silk) of 40 % formaldehyde solution, and simultaneously stretched to its elastic limit in order to remove air from the interior of the fibres.—F. Sp.

Weighting of silk : Process for the ——. Gebr. Schmid, Basle. Ger. Pat. 291,009, Jan. 26, 1915.

The silk is repeatedly treated alternately in a metallic chloride and an alkali phosphate bath and finally treated with an alkali silicate bath. A bath of zinc chloride, alone or in combination with tin chloride, is used in which silk and silk cocoons are dissolved or to which aqueous extracts of silk residues are added. A fuller lustre, good elasticity and strength, and higher degree of weighting ar attained than if tin chloride alone is used ; ar increased affinity for dyestuffs is also noted.
—F. W. A.

Flax fibres ; Purification, decolorisation, an disinfection of —— by treatment with sulphu dioxide. A. Leconte. First Addition, date Aug. 1, 1914, to Fr. Pat. 468,312, Feb. 11, 191 (this J., 1914, 958).

The process of the main patent may be applied t the treatment of flax threads and of tow, some what stronger sulphurous acid being used in th steeping process, which is continued for one two days longer and is followed by one or tw more rinsings. It has been found of advantag to use wooden vats, and a turbine or perforate dryer is preferable to the hydraulic press.—F. W.

Agglutinant or binding medium ; Use of residu liquids, obtained in the retting of textile plan [flax, hemp, etc.], as ——. L. Penkala. Fr. Pa 477,622, June 23, 1914.

The gummy, resinous, and gelatinous substanc contained in the residual liquors obtained in t retting of flax, hemp, etc., are employed as agglutinant, either in an aqueous, viscous, gelatinous form, or as powder or solid in t making of briquettes, or in place of tar for treati road dust.—B. N.

Bacterial diastases ; Application of —— to textile industries. A. Boidin and J. Effro First Addition, dated Jan. 18, 1915, to Fr. P 475,431, Feb. 21, 1914. (See Eng. Pat. 1411 1915 ; this J., 1915, 1201.)

In eliminating amylaceous, gelatinous, nit genous, etc., dressings, by treating at a relativ low temperature, it is advantageous to add to t solutions of bacterial diastases a certain quant of soya bean or a cereal.—B. N.

Fibrous material [fibrous asphalt product] ; Pro of disintegrating ——. R. P. Perry, Montcl N.J., Assignor to Barrett Manufacturing U.S. Pat. 1,177,267, Mar. 28, 1916. Date appl., Mar. 23, 1915.

Fibrous material or paper is treated with emulsion of water and a suitable oil, *e.g.*, petrol to soften it and cause it to unite readily wit bituminous binder, such as asphaltum ; the n is then disintegrated in intimate adhering cont with the bituminous binder without destroy its fibrous character.—J. F. B.

Plastic materials from fibrous substances and binding agents obtained by the action of sulphur, sulphur chloride, or nitric acid on oils, tars, etc.; Production of ——. N. Reif, Hanover. Ger. Pat. 290,783, Mar. 30, 1915. Addition to Ger. Pat. 288,532 (this J., 1916, 418).

THE process claimed in the main patent is modified by introducing heating agents direct into the mixture composing the binding medium. For example, a mixture of 25 parts of oil, 5 parts of resin, and 4·5 parts of sulphur, heated to 130° C., is pulverised and mixed with 12·5 parts of superheated steam at 400° C. and 4 atm. pressure, whereby it is heated to 200° C., and the components caused to interact. The mixture is condensed, for example, on peat, and the resulting mass made homogeneous; the product contains 25% of the binding medium.—F. W. A.

Cellulose; Method of making pure ——. J. Daniel and F. J. Benoist. First Addition, dated Apr. 16, 1914, to Fr. Pat. 465,471, Nov. 28, 1913 (this J., 1914, 588).

THE mixture of trichloroethylene, caustic soda, an alkali carbonate, and an alkali sulphite, claimed in the principal patent, is replaced by a mixture of trichloroethylene and any alkali. The purification of the cellulose is rapid and complete.—F. SP.

Cellulose; Method of making a compound of ——. La Soie Artificielle. Fr. Pat. 477,655, June 24, 1914.

A NEW condensation product of cellulose is obtained by treating it with trioxymethylene in the presence of ferric chloride or organic acids, with or without dehydrating agents (*e.g.*, alum, calcium chloride, etc.). The product weighs more than the original cellulose, and liberates formaldehyde on hydrolysis. *Example.* Cellulose is treated with ferric chloride and formaldehyde and dried under high vacuum. Trioxymethylene is thus produced. On stoving, the condensation product is formed. It possesses greater resistance to water than the original cellulose.—F. SP.

Adhesives [from cellulose esters]. J. Matray. Fr. Pat. 477,294, June 9, 1914.

CEMENTS suitable for sticking glass to glass, or glass to celluloid, cellulose acetate, or any other cellulose ester, are prepared by adding resins such as gum elemi or Venice turpentine to solutions of cellulose esters. *Examples (a):* 20 parts of gum elemi dissolved in 10 parts of amyl acetate or acetone, is added to 10 parts of nitrocellulose dissolved in 90 parts of amyl acetate. (*b*) 20 parts of gum elemi or Venice turpentine dissolved in 10 parts of tetrachloroethane is added to 10 parts of cellulose acetate dissolved in 90 parts of tetrachloroethane.—F. SP.

Paper; Manufacture of —— *and emulsions or sizes therefor.* J. A. de Cew, Montreal, and R. J. Marx, London. Eng. Pat. 13,588, Sept. 24, 1915.

A SUBSTITUTE for waxed paper is produced by adding to the stock in the beating engine the emulsion described in U.S. Pat. 1,174,697 of 1916 (this J., 1916, 533).

Cellulose esters: Preparation of solid or hardened solutions of ——. W. Plinatus. Fr. Pat. 476,991, Mar. 27, 1914.

SEE Eng. Pat. 16,940 of 1913; this J., 1915, 793.

Cellulose compounds; Manufacture of ——. Courtaulds, Ltd., W. H. Glover, and L. P. Wilson. Fr. Pat. 477,492, Jan. 13, 1915. Under Int. Conv., May 27, 1914.

SEE Eng. Pat. 13,055 of 1914; this J., 1915, 606.

Cellulose compounds; Manufacture of ——. Courtaulds, Ltd., and L. P. Wilson. Fr. Pat. 477,493, Jan. 11, 1915. Under Int. Conv., June 18, 1914.

SEE Eng. Pat. 14,675 of 1914; this J., 1915, 606.

Viscose; Treatment of ——. Soc. Anon. Franç. Kodak. Fr. Pat. 477,735, Feb. 19, 1915. Under Int. Conv., Feb. 21, 1914.

SEE U.S. Pat. 1,117,604 of 1914; this J., 1915, 24.

Agglomerate for paving, electrical insulation, and as a celluloid substitute. Fr. Pat. 477,682. *See* IX.

Detergent composition [for treating raw silk or mixed silk and cotton goods]. Eng. Pat. 28,803. *See* XII.

Process for waterproofing porous materials, such as leather, fabrics, and paper. Fr. Pat. 477,767. *See* XV.

Treatment of sawdust or other materials containing cellulose in order to increase the yield of alcohol and facilitate recovery of by-products. Fr. Pat. 476,696. *See* XVIII.

Manufacture of ethyl alcohol from cellulosic substances. Fr. Pat. 477,077. *See* XVIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Dyeing process: Theory of the ——. P. Pfeiffer and F. Wittka. Chem.-Zeit., 1916, 40, 358.

IF glycocoll or a polypeptide be added to a colourless ammoniacal solution of Magenta or to a brownish-red acetic acid solution of the quinonoid ethyl ester of tetrabromophenolphthalein, it combines immediately with the colour base or colour acid to form a typical colour salt, indicated by the production of a red coloration in the former and a blue coloration in the latter case. Amino-acids and polypeptides, and hence probably also proteins, such as wool fibre and silk fibre, combine with neutral salts to form molecular compounds, and therefore in the dyeing of wool and silk there may be formed not only colour salts of the fibre substance with colour acids and colour bases, but also molecular compounds of the fibre substance with colour salts. Polyhydric alcohols, and hence probably also cellulose, form similar molecular compounds, and the formation of molecular compounds probably plays an essential part in the dyeing of cotton with substantive dyestuffs.—A. S.

PATENTS.

[Hank] dyeing; Machines for —— *or for similarly treating yarns.* A. E. Sellers, Huddersfield. Eng. Pat. 10,687, July 23, 1915.

THE dye-tank is divided into compartments by upper and lower racks or gratings, and the yarn is supported on rods in the middle compartment, between the racks. To obtain uniform circulation of the dye-liquor, the bars forming the racks are arranged at gradually increasing distances apart, starting from the end of the tank containing the propellors, and the bottom of the vat is inclined upwards from the same end. To facilitate the removal of the hanks, the upper rack is divided into two sections, the upper portion being separable from the portion carrying the hank-supporting rods.—F. W. A.

Dyeing of skins, hair, feathers, etc.; Process for the ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 291,008, July 30, 1914.

THE mordanted or unmordanted material i

treated with a solution of 1.5-dihydroxy-2-aminonaphthalene ; the dyeings may be developed by air-oxidation, thus avoiding damage, and the method can therefore be used for dyeing in conjunction with natural colouring matters, which are affected by other oxidising agents, such as hydrogen peroxide.—F. W. A.

Printing colours ; Production of dust-free, dry, transfer —— for embroidery, etc. E. Dzieyk, Berlin. Ger. Pat. 290,598, July 29, 1914.

SUITABLE dyestuffs are ground with Manila copal and paraffin oil. The colours obtained are transferred to the fabric and fixed by spraying with alcohol as usual, well-defined designs being obtained. —F. W. A.

Fast prints on textile fibres ; Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,975, July 7, 1914.

SULPHONIC acids of 1.4.5.8-tetrahydroxyanthraquinone are printed with aluminium compounds. Whereas these sulphonic acids only give unsatisfactory grey-green shades on chrome mordant, bright blue prints similar to Methylene Blue and of great fastness to soaping and to light are obtained on aluminium mordant.—F. W. A.

Fast shades ; Production of —— and new [disazo] dyestuffs therefor. Levinstein, Ltd. Fr. Pat. 477,306, Jan. 19, 1915.

SEE Eng. Pat. 28,569 of 1913 ; this J., 1915, 318.

Sulphur from sulphurous gases ; Recovery of elemental ——. W. F. Lamoreaux and C. W. Renwick. Fr. Pat. 477,795, Feb. 25, 1915.

SEE U.S. Pat. 1,140,310 of 1915 ; this J., 1915, 716.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Oxalic acid and crystallised sodium sulphate ; Reaction between ——. E. Kohn-Abrest. Ann. Falsif., 1916, **9**, 68—69.

WHEN a mixture of oxalic acid and crystallised sodium sulphate is placed in a stoppered bottle, partial liquefaction takes place in about 24 hours, a saline magma forming beneath the liquid layer. For example, a mixture of crystallised sodium sulphate, 300 grms., and oxalic acid, 80 grms., yielded a liquid of sp.gr. 1·345, containing sodium bisulphate, 80 grms., sodium hydrogen oxalate, 3·3 grms., and water, 105 grms. ; the magma contained sodium bisulphate and sodium sulphate, 117 grms., and sodium hydrogen oxalate, 91·2 grms. Sodium hydrogen oxalate and sodium bisulphate are the chief products of the reaction ; on account of its lower solubility the sodium hydrogen oxalate may be separated readily from the bisulphate and sulphate.—W. P. S.

Billiter-Leykam electrolytic cell for production of alkali and chlorine. J. Yamasaki. J. Chem. Ind., Tokyo. Japan, 1916, **19**, 257—276. (See also Allmand, this J., 1912, 1123.)

THE electrolysis was carried out at 45° and at 60° C. The alkali liquor produced, had a concentration of 3·5 to 4·5 *N*, and the current efficiency of the process was over 92 %. When employing a carbon anode, and a current density of 6 to 7 ampères per sq. dcm., the E.M.F. was 3·6 volts at 60° C., 4·2 volts at 45° C., and the gas produced contained 95 % of chlorine. When the temperature was raised the current efficiency fell off slightly, and the voltage was considerably reduced. Rock salt can be used in the cell without disturbing the operation of the process.—J. B. C. K.

Water-glass and alkali silicates. W. Pukall. Ber., 1916, **49**, 397—436.

THE author studied the action of cold water and of steam under pressure on a series of glasses prepared by fusing mixtures of very finely ground Hohenbocka glass sand and potassium or sodium bicarbonate. The products obtained by direct fusion all have similar properties. Those containing up to 4 mols. SiO_2 to 1 mol. of alkali oxide are soluble in water and are present in commercial water-glasses. The products richer in silica are decomposed by water. When decomposed by acids they yield gelatinous silicic acid. In the potassium series, $K_2Si_2O_5$ and the products from $K_2Si_{10}O_{21}$ onwards, and in the sodium series Na_2SiO_3 and $Na_2Si_2O_5$ and the products from $Na_2Si_6O_{13}$ onwards can be obtained crystalline without difficulty. The silicates of this type are considered to be all derived from metasilicic acid. The products obtained by the action of steam under pressure, *e.g.*, by heating with a small quantity of water in a sealed tube, have quite different properties. Only products containing an even number of silicon atoms in the molecule are formed and they are readily obtained crystalline. In the potassium series $K_2SiO_3,2H_2O$ (or more probably a hydrate of $K_2Si_2O_5$), $K_2Si_2O_5,2H_2O$, $K_2H_2Si_4O_{10}$, $K_2H_2Si_6O_{14}$, and $K_2H_2Si_8O_{18}$ were isolated. These compounds resemble the natural zeolites in their properties. Except $K_2Si_2O_5$ they are insoluble in, but slowly decomposed by cold water, and decomposed more rapidly by hot water and by acids, yielding the disilicate and a silicic acid with 2 atoms of silicon less than the original compound ; the silicic acid retains the crystalline form of the original silicate. In the sodium series only $Na_2Si_2O_5,\frac{1}{2}H_2O$ could be isolated ; other compounds, if formed, appeared to decompose into the disilicate and silicic acid, the latter separating in the form of a crystalline sand or as more or less colloidal, rod-like forms, but never as a jelly. The silicates obtained by the action of steam under pressure are considered to be derived from a disilicic acid, $(HO)_2SiO_2Si(OH)_2$, and it is probable that the natural zeolites are compounds of alkali or alkaline-earth silicates of this type with aluminates and ferrites. Sand, gravel, burnt or raw clay, pieces of granite, etc., if mixed with 10 % of an alkali silicate melt rich in silica, and compressed, will yield artificial stone similar to natural sandstone, clay schist, etc., when treated with steam under pressure. Products prepared with potassium silicates retain their hardness when exposed to water, but those prepared with sodium silicates soon disintegrate. The potassium silicates of the zeolite type, if prepared in considerable quantities at a reasonable price, may prove of value as fertilisers and for the manufacture of non-poisonous glazes for cheap pottery.—A. S.

Barium oxalate [; Hydrates of ——]. W. O. de Coninck. Bull. Soc. Chim., 1916, **19**, 110—111.

FOUR hydrates of barium oxalate have been prepared, viz., the tri-, di-, mono-, and hemi-hydrate. The difference between the optimum temperatures for the formation of the mono- and dihydrates, 15°—18° C. and 22°—25° C. respectively, is insufficient for a method to be devised for the estimation of oxalic acid as barium oxalate. Acid barium oxalate only forms the-hydrate, $Ba(HC_2O_4)_2.2H_2O$. —F. W. A.

Cerous salts ; Action of oxidising agents on ——. G. A. Barbieri. Atti. R. Accad. Lincei, 1916, [v], **25**, i, 37—43. J. Chem. Soc., 1916, **110**, ii., 199—200. (Compare this J., 1907, 715.)

A HOT solution containing not more than 1 % of cerous sulphate and not less than 25 % of sulphuric acid, is readily oxidised by potassium permanganate, ceric sulphate being formed ; if 30 %

of sulphuric acid is present, the oxidation proceeds rapidly even in the cold. This method is, however, unsuitable for the volumetric estimation of cerium, since the yellow colour of the ceric sulphate renders the end-point indefinite. If to a solution of a cerous salt are added excess of iodic acid and then sufficient nitric acid to dissolve the cerous iodate precipitated, complete and rapid oxidation to ceric iodate is effected by permanganate in the hot: $5Ce(IO_3)_3 + KMnO_4 + 5HIO_3 + 3HNO_3 = 5Ce(IO_3)_4 + KNO_3 + Mn(NO_3)_2 + 4H_2O$. This reaction cannot be employed for the volumetric estimation of cerium, since after complete oxidation of the latter, reduction of the permanganate is continued, although more slowly, by the manganous salt formed. It does, however, serve for the quantitative separation of cerium from the other elements of its group, for instance, lanthanum, which form iodates soluble in dilute nitric acid and form compounds of only one type. Permanganate is reduced even in the cold by a solution of cerous phosphate in excess of phosphoric acid, a bulky, white, gelatinous precipitate being formed which contains all the cerium as basic ceric phosphate, the ratio $Ce : P_2O_5$ being about 4 : 3. Since the supernatant liquid remains colourless, this reaction may be employed for the estimation of cerium, the procedure being as follows: The cerous solution is diluted, where necessary, so as to contain not more than 0·1 grm. of cerium per 100 c.c. To 100 c.c. of the liquid are added 20 c.c. of phosphoric acid solution (sp. gr. 1·55) and then, drop by drop, $N/10$ permanganate solution until the precipitate acquires a faint rose-red colour. The liquid is next heated on a water-bath and the addition of permanganate continued until the supernatant liquid assumes a pale pink colour persistent in the hot. This method gives good results even when the cerium is accompanied by other rare-earth elements; the quantity of phosphoric acid added should be sufficient to keep these elements in solution, even in the hot. If thorium is present, addition of phosphoric acid produces a precipitate of basic thorium phosphate, which is but slightly soluble in acids, but the presence of this precipitate does not disturb the oxidation of the cerous phosphate. Further, the titration is not affected by small proportions of manganous salts, whereas no volumetric method hitherto known is applicable when the cerium is accompanied by manganese.

The investigations of von Knorre (this J., 1898, 491), Witt and Theel (this J., 1900, 766), and Meyer and Marckwald (this J., 1901, 62) show that persulphates oxidise cerous salts in the hot, but not in the cold. The author finds that, if a little silver nitrate is added to a solution containing an alkali persulphate and cerous nitrate or sulphate, oxidation of the cerous salt by the persulphate commences immediately and proceeds until all the cerium is converted into ceric salt, which forms a yellow solution or a precipitate, according as the liquid is acid or neutral. The catalytic action of the silver depends on its conversion by the persulphate from the univalent to the divalent form. This reaction serves for the purification of a crude cerium salt, since in neutral solution any other rare-earth metals remain dissolved, whilst almost the whole of the cerium is precipitated as basic salt.

Beryllium from gadolinite; Extraction of ——. C. James and G. A. Perley. J. Amer. Chem. Soc., 1916, 38, 875—877.

The finely powdered mineral is decomposed by heating with concentrated sulphuric acid, the sulphated product extracted with water, the solution precipitated with a hot solution of oxalic acid, allowed to stand for 12 hours, and the rare earth oxalates filtered off and washed with boiling water. The filtrate is treated preferably as follows:—The solution is oxidised, *e g.*, by potassium bromate, to remove the oxalic acid, and ammonia solution is added (about a litre for an initial charge of 75 kilos.), followed by a solution of caustic soda until the odour of ammonia becomes apparent. The mixture is well boiled, and the hydroxides, separated by filtration, are stirred with sufficient hydrochloric or sulphuric acid to dissolve about two-thirds of the whole. The acid extract, containing the beryllium and some iron, is heated to boiling, precipitated with caustic soda until a little of the filtered liquid gives a light-coloured precipitate with ammonia, and the whole filtered. The filtrate is again heated to boiling, treated with a little sodium hypobromite, and precipitated with caustic soda until the liquid gives a white precipitate with ammonia. The mixture is filtered, sodium hydrogen sulphide is added to the filtrate to separate the last traces of iron (the precipitate and the preceding precipitate containing beryllium being worked up with a subsequent batch of material), and, after boiling off hydrogen sulphide, the beryllium is at once precipitated by adding a concentrated solution of sodium carbonate and boiling the mixture thoroughly. The precipitated basic carbonate is filtered off and well washed with boiling water. If the filtrate from the rare-earth oxalates be very rich in beryllium, it may be oxidised and the boiling solution precipitated with caustic soda until nearly all the iron is removed, and then the last traces of iron removed by adding more caustic soda and sodium hydrogen sulphide, as already described. Although not offering a quantitative separation of beryllium from iron, the method is rapid and suitable for use on the large scale, and gives a product which is completely soluble in sodium bicarbonate solution.—F. Sodn.

Lead peroxide; A new method of preparing active ——. G. Panopolus. Chem.-Zeit., 1916, 40, 339—341.

Divalent lead compounds are oxidised by potassium persulphate to lead peroxide and lead sulphate. The yield of peroxide is increased when the temperature is raised. Soluble lead salts are affected less than the monoxide, giving relatively much sulphate. The sulphate itself is practically unacted upon in the cold, but the action is accelerated by heat, a small yield of inactive peroxide resulting. In general, the amount of peroxide formed in acid solution is small, but it is much greater in presence of free alkali (particularly when the latter is added little by little) owing to the lead sulphate being removed as fast as it is formed. With a constant quantity of persulphate the yield of peroxide increases with the amount of alkali used. In a strongly alkaline plumbite solution oxidation is very rapid, and the peroxide is precipitated along with unchanged lower oxide. A minimum yield of 93% of pure amorphous peroxide was obtained with the following quantities of materials: lead monoxide 22 grms., sodium hydroxide 40 grms., potassium persulphate 30 grms., and water 750 c.c. The peroxide made in this way is very reactive.—E. H. T.

Hydrogen peroxide; Catalysis of —— in heterogeneous media. Part I: general considerations; experiments with mercury. G. Lemoine. Comptes rend., 1916, 162, 580—587. (See also this J., 1915, 869.)

The catalysis of hydrogen peroxide in the presence of mercury was found to be periodic, being accompanied by the formation of mercury oxide—red at first but changing to blackish—which then decomposed. The quantity of oxygen evolved from a definite surface of mercury in a given time (30 mins.) was not much affected by the depth of the superposed layer of hydrogen peroxide, indicating that the disturbance produced in the latter by the gas evolution was not sufficient to ensure renewal of the active layer in contact with the mercury.—W. E. F. P.

Oxygen-hydrogen catalysis with colloidal platinum C. Paal and A. Schwarz. J. prakt. Chem., 1916, **93**, 106—118.

The catalysis of oxygen-hydrogen mixtures by platinum sols prepared by the method of Paal and Amberger (this J., 1904, 208), and varying in concentration from N/23 to N/5860, was studied. When observations were made in a gas burette over mercury the reaction proceeded with decreasing velocity, eventually coming to a standstill when about 75 % of the gases had combined, the mercury having poisoned the catalyst. This effect was avoided by carrying out the catalysis in a "duck" on a shaking machine. The results may be briefly summarised as follows:—With platinum concentrations much greater than those used by Ernst (Z. physik. Chem., 1901, **37**, 448), no direct proportionality between the quantity of catalyst and the rate of catalysis could be traced, increase in the former not producing anything like a proportional increase in the latter. Shaking did not cause any very notable increase in velocity. The temperature coefficient of the reaction was small. With much lower concentrations of platinum (N/455 to N/4550) shaking produced an appreciable acceleration, but still no direct proportionality was observed between the amount of catalyst and the reaction velocity.—G. F. M.

Oxygen; Absorption of —— in alkaline solutions. F. Henrich and K. Kuhn. Z. angew. Chem., 1916, **29**, 149—153. (Compare this J., 1916, 308).

Absorption of oxygen by alkaline pyrogallol solutions is more rapid with potash than with soda as alkali (this J., 1916, 308), but nevertheless equally favourable results can be obtained with either alkali, when much more dilute solutions than usual are employed. Thus solutions containing 1 mol. of pyrogallol with from 2—6 mols. of sodium or potassium hydroxide, of about 2·5—10 % pyrogallol concentration, completely absorbed the oxygen from air after about 2 mins. shaking. 1.3.4-Trihydroxybenzene, when employed with about 6 mols. of potassium hydroxide, is as good an absorber as pyrogallol. It is best prepared by hydrolysing 20 grms. of its triacetyl-derivative with a solution of 40 grms. of caustic potash in 80 c.c. of water in an atmosphere of hydrogen. Hydrolysis is complete without external heating in 10—15 mins., and the resulting solution is ready for use. According to the percentage of oxygen in the gaseous mixture, absorption with this solution is complete in from 0·5—2 mins.—G. F. M.

Phosphorus; Blackening of yellow ——. W. N. Rae. J. Amer. Chem. Soc., 1916, **38**, 887—888.

A dull black coating observed on sticks of yellow phosphorus proved to be copper phosphide, and when a clean copper wire was placed in distilled water with some pure phosphorus, both wire and phosphorus developed a coating of black phosphide in two days. Purified phosphorus underwent no change when kept under distilled water in sealed tubes for seven months in the dark, but exposure to light, under the same conditions, caused reddening, owing to the formation of red phosphorus. It is recommended, therefore, that phosphorus be kept in distilled water, in stoppered jars, in the dark, and that iron tongs be used to remove the sticks.—F. Sodn.

Phosphorus; Black ——. I. A. Smits, G. Meyer, and R. P. Beck. Proc. K. Akad. Wetensch. Amsterdam, 1916, **18**, 992—1007. J. Chem. Soc., 1916, 110, ii., 185—186.

The black phosphorus obtained by Bridgman (this J., 1914, 787) has a much greater density (2·69) than that found for violet phosphorus (2·21—2·34), and this would seem to support the view that it represents a new modification. At temperatures below 550° C. the vapour pressure of black phosphorus did not reach a constant value. At somewhat higher temperatures, a constant value was reached, and this was very nearly equal to the vapour pressure of violet phosphorus. At 570° C. the black modification has a higher vapour pressure than the violet form. In presence of iodine as catalyst, the melting points of the black and violet forms were found to be 587·5° and 589·5° C. respectively. The relation between the two modifications is discussed with especial reference to the fact that it has not yet been found possible to convert violet into black phosphorus even under pressures up to 12,500 kilos. per sq. cm.

Sulphur: A crystalline modification of —— forming spherulites composed of fine helicoidal fibres. P. Gaubert. Comptes rend., 1916, **162**, 554—556.

The modification described was produced, with other spherulitic forms, by cooling molten sulphur rapidly from above 120° C., and more abundantly from above 160° C. The spherulites were bluish by transmitted light, only slightly birefringent, and variable in structure, many being composed of simple and curved fibres and having sectors in which the helical curves of the fibres were different. The crystalline system has not yet been determined.—W. E. F. P.

Grey acetate of lime: Restricted dealings in ——. Board of Trade J., May 11, 1916.

The Ministry of Munitions draws attention to the fact that dealings in grey acetate of lime are now subject to the restrictions imposed under Regulation 30a of the "Defence of the Realm (Consolidation) Regulations, 1914." Applications to buy, sell, or deal in this substance should be addressed to the Director of Propellant Supplies, Ministry of Munitions, 32, Old Queen Street, London, S.W.

Potash; American production of ——. U.S. Geol. Survey, Apr., 1916.

During 1915 potash was recovered as a by-product from the manufacture of Portland cement at Riverside, Cal.; in addition to the value of the potash, the method saves additional material to be converted into cement, and eliminates the dust nuisance. A discharge of 100 tons of dust a day over the surrounding orange groves has been prevented. Potassium sulphate from alunite was first placed on the market late in October, 1915, by a company at Marysvale, Utah. The production has not been large so far. A plant was established in the spring of 1915 at Hoffland, near Alliance, Nebraska, and during about half of the year obtained potash salts from the brine of an alkaline lake in that region. In addition to the output from these sources, potash was marketed in 1915 from kelp obtained along the Pacific coast. Operations are in progress at Searles Lake and at Keeler, on the shores of Owens Lake, Cal. One company is erecting a plant near Great Salt Lake, and another will soon be started at the south end of the lake. The by-product, bittern, at solar-evaporation plants on San Francisco Bay, has also received some attention. A small quantity of potash salts was probably produced from various silicate rocks and minerals during 1915, and found its way into mixed fertilizers without intermediate refinement.

The value of the potash salts produced in the United States in 1915 is estimated at $342,000.

Revision of atomic weights of cadmium and zinc. Electrolytic determination of the metals in their bromides. Baxter and others. *See* X.

Potassium bichromate as an analytical standard. Bruhns. *See* XXIII.

PATENTS.

Alkali-chloride solutions; Apparatus for decomposing [electrolysing] ——. K. Heinemann, Pirna, Germany. U.S. Pat. 1,176,551, Mar. 21, 1916. Date of appl., Mar. 27, 1914.

In an electrolytic cell for decomposing solutions of alkali chlorides by means of a flowing mercury cathode, the stationary bottom-plate is nearly horizontal and has a number of impediments arranged in rows upon its surface, the rows being at right angles to the direction of the mercury current and each impediment inclined more on the side against which the mercury impinges than on the opposite side.—W. E. F. P.

[Ammonia] condenser. P. De C. Ball, Ferguson, Mo. U.S. Pat. 1,177,166, Mar. 28, 1916. Date of appl., Mar. 5, 1915.

A series of inclined pipes are provided with return bends at their ends, so as to form a condenser coil. The liquid ammonia collects at the lower end of each pipe and forms a trap or seal. Each of the inclined pipes has an inlet opening at its lower end and an overflow opening at its upper end, and the pipes are so arranged that the surface of the liquid ammonia which condenses is above the plane of the inlet opening, and below the plane of the overflow opening. —J. B. C. K.

Ammonium chloride; Preparation of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 290,747, June 18, 1914.

An alkali chloride, in presence of a small quantity of water, is treated with sulphuric acid and ammonia. Under the influence of the heat of the reaction alkali sulphate separates, and ammonium chloride crystallises out from the mother liquor at once on cooling.—B. V. S.

Zinc oxide and pure hydrogen; Simultaneous production of ——. A. A. Quentin and C. Guillien. Fr. Pat. 476,994, May 18, 1914.

The method depends upon the decomposition of water by fused zinc, the bath of zinc being kept molten by the combustion of portion of the gas produced by the reaction. The apparatus consists of a bath for the molten zinc, in which is a perforated steam-coil connected with an outer coil heated by a burner. At the top of the bath an inclined surface is fixed, which carries the zinc oxide away as it forms.—J. B. C. K.

Sodium sulphate; Manufacture of ——. L. P. Basset. Fr. Pat. 477,353, June 11, 1914.

Sulphur dioxide is caused to react with sodium chloride when the latter salt is in the state of vapour, or in the finely divided state produced by condensation of the vapour. The sulphur dioxide may be mixed with an excess of dry air, in which case sodium sulphate and chlorine will be produced, or an excess of air and steam may be employed, in which case sodium sulphate and hydrogen chloride will be obtained. The sodium chloride is volatilised in a furnace surmounted by a dome, or connected with a chamber, in which the reaction between the volatilised chloride and the sulphur dioxide can occur; or the sodium chloride may be volatilised in the furnace in which the sulphur dioxide is produced. The process may also be combined with the manufacture of cement from calcium sulphate, clay, and carbon, sodium chloride being mixed with the cement raw materials, and a blast of air introduced into the rotary kiln about half way along its length.—J. B. C. K.

Eau de Javelle; Solid product which yields —— *when dissolved in water.* F. A. Bonnaud. Fr. Pat. 477,691, Jan. 14, 1915.

The solid, which may be prepared in the form of a powder or of compressed blocks, contains three constituents, which on solution in water yield the chlorine required for the formation of hypochlorite, with the equivalent amount of potassium or sodium hydroxide, and a colouring matter which will produce the reddish-yellow tint characteristic of ordinary *Eau de Javelle.* A suitable mixture is bleaching powder 34%, potassium bichromate 2%, sodium carbonate, potassium carbonate, and sodium sulphate 64%. On treatment with hot or cold water, the compound yields a coloured liquid containing sodium or potassium hypochlorite, and a precipitate which consists chiefly of calcium sulphate.—J. B. C. K.

Nitrous gases; Manufacture of ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 477,726, Feb. 19, 1915. Under Int. Conv., Mar. 3, 1914.

The highly diluted nitrous gases obtained by the oxidation of atmospheric nitrogen are absorbed in a solution of alkali, for example sodium carbonate, and the sodium nitrate and nitrite thus formed are then decomposed by heating the solution with oxides or hydroxides of heavy metals of alkaline-earths. By this treatment the nitrous gases are obtained in a much more concentrated state, and the alkali is recovered in a form fit for further absorption of the dilute gases. The production of pure alumina from bauxite may be combined with this process of concentrating nitrous gases. —J. B. C. K.

Graphite; Process of producing —— *in colloidal form.* H. Karplus, Berlin. Eng. Pat. 8640, June 11, 1915.

In a process for producing colloidal graphite (for use as a lubricant) without calcination, finely divided natural or artificial graphite—in particles or granules of uniform size—is peptised by means of relatively small quantities (5 to 10%) of strong oxidising agents at a temperature precluding appreciable formation of graphitic acid, and the product treated with an aqueous solution of an organic non-electrolyte or hydrophilous colloid to separate non-colloidal constituents. For example, 1 kilo. of natural graphite from which the ash constituents have been previously removed by known means is mixed with 3 kilos. of concentrated sulphuric acid, and 150 grms. of solid potassium permanganate or 200 of sodium bichromate is gradually stirred into the mixture, the temperature of which is maintained at 40°—50° C. After a few days, 300 grms. of water and the same quantity of oxidising agent as that already used are added; when the oxidation is sufficiently advanced (as ascertained by testing the hydrosol) the mixture is poured into 10 litres of water and the graphite filtered off and washed with distilled water. The peptised graphite is then thoroughly incorporated with 10 litres of water containing 50 grms. of saponin in solution, and subjected to a mechanical deposition process to separate any remaining non-colloidal particles.—W. E. F. P.

Micaceous graphite; Method of purifying ——. H. A. Dallemagne. Fr. Pat. 477,743, June 26, 1914.

The crude graphite is intimately mixed with sulphuric acid and calcium fluoride, and the mixture heated. The nascent hydrofluoric acid reacts with the micaceous constituents and transforms the silicic acid into volatile silicon tetrafluoride, while the excess of sulphuric acid reacts with the bases to form soluble sulphates, which are removed by washing with hot water.—J. B. C. K.

Hydrogen generator. K. Schaefer, Charlottenburg. Ger. Pat. 290,529, May 3, 1914.

THE generator is provided at the bottom with a conical grate below which is a closed heating chamber. A larger number of nozzles or slits can be obtained with a conical than with a flat grate, thus ensuring finer division of the hot gases. The emptying of the shaft is also easier as the conical grate guides the material to the lateral outlets.—B.V.S.

Hydrogen from iron and steam; Retort-ovens for the production of ——. W. Näher and M. Nöding, Pforzheim. Ger. Pat. 290,657, Dec. 1, 1914.

A NUMBER of interchangeable cylindrical iron retorts are arranged round a tar-oil flame, in a cylindrical furnace. The waste gases are discharged at the bottom of the furnace so as to avoid losses of the atomised oil. Gas can be generated after an hour's heating.—B. V. S.

Ammonia; Process of producing —— by means of gas generators. A. Bambach, Cologne, Germany. Eng. Pat. 3175, Feb. 6, 1914.

SEE Fr. Pat. 469,331 of 1914; this J., 1915, 79.

Graphite in colloidal form; Process of producing ——. H. Karplus, Berlin. U.S. Pat. 1,175,958, Mar. 21, 1916. Date of appl., June 26, 1915.

SEE Eng. Pat. 8640 of 1915; preceding.

Utilisation of Leblanc alkali waste for the production of cement or hydraulic lime. Fr. Pat. 477,324. *See* IX.

Mechanical furnaces for roasting pyrites and the like. Ger. Pat. 290,534. *See* X.

Process and apparatus for the treatment of gases by the electric arc. [*Fixation of nitrogen.*] Fr. Pat. 477,476. *See* XI.

VIII.—GLASS; CERAMICS.

Ceramic ware; Raw materials for fine ——. J. Dorfner. Sprechsaal, 1915, 48, 209 *et seq.* Z. angew. Chem., 1916, 29, Ref., 105.

THE so-called "rational analysis" is unsatisfactory for the examination of fine clays or bodies, as it does not indicate the nature and amount of the "clay substance" nor the refractoriness of the material, and it is useless for coarser clays; it only gives approximately correct results with the purest kaolins and its use in calculating the "formulæ" of other clays is not permissible. An accurate chemical investigation of clays and bodies in general can only be made by means of an ultimate analysis; the formula calculated from such an analysis of the finest particles of a completely homogeneous sample indicates satisfactorily the true composition of the fluxes, the ratio of basic to acid constituents, the probable behaviour of the material when heated, and the relative proportions of the refractory and fusible constituents. The composition of satisfactory bodies usually lies within the limits RO, $0\cdot5$—$8Al_2O_3$, $2\cdot5$—$35SiO_2$. No porcelain is known in which the RO is composed exclusively of potash and in no stoneware is the RO entirely lime. The composition of the RO bases is of the greatest importance. If the molecular composition is kept constant in a series of glazed bodies, a large proportion of potash will increase the finishing temperature of the mass; a large proportion of lime will reduce the finishing temperature. A low proportion of potash will give a porcelain body of great refractoriness and plasticity. In stoneware bodies, the greater the proportion of lime in the RO bases the greater is their friability, and the less the tendency to crazing. Stoneware bodies rich in potash are stronger. Porcelain bodies low in plastic clay burn whiter and more translucent than others. The ratio of bases to acids in all satisfactory bodies lies between 1 : 1 to 2; the nearer the acids approach to unity the greater is the refractoriness of the material; with a ratio greater than 2 the ware tends to be brittle or to warp or spall.—A. B. S.

Water-glass and alkali silicates. Pukall. *See* VII.

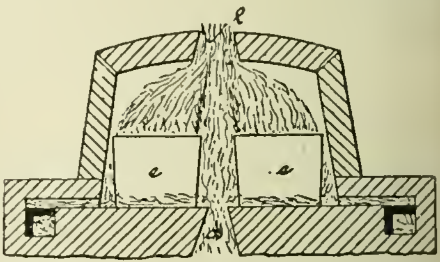
PATENTS.

Quartz-glass or similar hard glasses; Gas-tight sealing of wire in ——. Ehrich und Graetz, Berlin, and E. Podszus, Cologne. Ger. Pat. 290,606, Nov. 16, 1913.

WIRES of molybdenum, or preferably an alloy of molybdenum and a small proportion of tungsten, are fused into quartz-glass by the aid of a flux composed of 10 parts of silica, 1 of alumina, and 1 of boric oxide.—A. B. S.

Glass furnace: Regenerative ——. W. Hirsch, Radeberg. Ger. Pat. 290,804, Jan. 28, 1913.

A FLAME extending the full length of the furnace is brought upwards through the floor, *d*, and a similar flame is brought downwards through the cover, *l*, in order that when they meet they may play around the pots, *c*, *c*, and heat them uniformly, thus combining the advantages of the Siemens' regenerative furnace and the Nehse recuperative furnace.—A. B. S.



Clay products; Leaching apparatus for ——. Soc. d'Exploit. de Proc. Evaporatoires, Prache et Bouillon. First Addition, dated May 27, 1914, to Fr. Pat. 474,318, Nov. 18, 1913 (this J., 1915, 1078).

To facilitate the movement of the solid particles, the apparatus described in the chief patent may be inclined slightly, or it may be in the form of a truncated cone with a horizontal shaft.—A. B. S.

Continuous-firing kiln. U.S. Pat. 1,177,225. *See* I.

Manufacture of filtering cells. Ger. Pat. 290,961. *See* XIXB.

IX.—BUILDING MATERIALS.

Water-glass and alkali silicates. Pukall. *See* VII.

PATENTS.

Cement. E. Brousse. Fr. Pat. 477,174, May 29, 1914.

THE following substances, in a powdered state, are intimately mixed:—Lightly calcined magnesia, free from carbonate, 33%, natural amorphous silica 35%, magnesium chloride 25%, boric acid 5%, soluble casein 2%. Sufficient water is added to this mixture to form a paste of suitable consistency. The cement sets hard after a few hours, does not shrink, is only slightly porous, highly adhesive, and cheap. It is suitable for moulds, plastering, jointless floors, etc. Fillers such as sawdust, sand, etc., may be added.—A. B. S.

Alkali-waste; Utilisation of Leblanc —— for the production of cement or hydraulic lime. L. P. Basset. Fr. Pat. 477,324, June 10, 1914.

Alkali-waste or other material containing calcium sulphide is mixed with clay and coal, calcined in a rotary kiln at 1500°—1600° C., and converted into cement or hydraulic lime with the simultaneous production of sulphur dioxide, sulphur, or hydrogen sulphide in a manner similar to that described in Fr. Pat. 466,518 (this J., 1915, 1094). When an excess of air is present in the furnace, sulphur dioxide is produced; when the air supply is limited, sulphur is set free, and in the presence of steam hydrogen sulphide is evolved. Suitable proportions are 65 parts of alkali-waste and 35 parts of clay. The coal may be mixed with the other ingredients or injected into the furnace with an air-blast.—A. B. S.

agnesia; Increasing the binding power of —— by treatment with steam. F. Grundmann, and Magnesit-Industrie A.-G., Budapest. Ger. Pat. 290,799, June 18, 1912.

Steam is blown into red-hot magnesia which has previously been dead-burned, or water may be sprayed on the material, which is afterwards heated to dull redness and then reduced to powder. The steam or water may be applied to the magnesia before it is withdrawn from the kiln or a separate kiln may be used for re-heating.—A. B. S.

Mortar; Production of —— for facing purposes. R. Brinkmann, Düsseldorf. Ger. Pat. 290,902, Jan. 21, 1914.

A mixture of coarse and fine air-granulated slag has the advantage over that granulated by water, of yielding a mortar which is resistant to weather and frost, on account of the manner in which the grains interlock.—A. B. S.

Agglomerate [for paving, electrical insulation, and as a celluloid substitute]. J. M. P. Perchat. Fr. Pat. 477,682, Sept. 22, 1913.

Palm kernels such as *Borassus*, *Iphœne thebaica*, or *Phytelephas*, are ground, made into a paste with sulphate and chloride of magnesium or zinc, and moulded as desired. The composition may be used for paving, electrical insulation, or as a substitute for celluloid.—W. F. F.

Use of residual liquors obtained in the retting of textile plants as agglutinant or binding medium. Fr. Pat. 477,622. *See* V.

Manufacture of sodium sulphate. Fr. Pat. 477,353. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron and steel; Influence of carbon and manganese upon the corrosion of ——. R. Hadfield and J. N. Friend. Iron and Steel Inst., May, 1916. [Advance proof.] 23 pages.

The steels used in the investigation were of two different types, the first being carbon steels of similar character but containing varying proportions of carbon (up to 1·6%) and manganese (up to 0·9%); and the second manganese steels containing from 2 to 16% Mn. The carbon steels were annealed by slow cooling from 775° C., and the manganese steels quenched in water from 1000° C. (as usual for commercial purposes) before being used in the tests. The corroding media employed were tap-water and sea-water, and the specimens were either immersed or exposed to alternate wet and dry conditions over periods up to 12 months; the specimens were also immersed for 5 or 6 days in solutions of sulphuric acid containing 0·1 and 0·5% H_3SO_4, in frequent changes. As steels rarely contain less than 0·2% or more than 0·8% Mn, the results are considered under headings comprising steels containing (A) less than 0·2%, (B) from 0·2 to 0·7%, and (C) from 2 to 16% Mn. (A) The addition of carbon, up to 1·63%, to pure iron containing less than 0·2% Mn caused a steadily increasing rate of corrosion in tap-water and sea-water, with slight maxima at about 0·6 and 0·8% C; an initial fall in corrosion, with a rapid rise to a maximum at 1·05% C in the wet and dry tests; and a rapid rise in corrosion to a maximum at 0·8% C in dilute sulphuric acid. In all the media the steels in the neighbourhood of the eutectic composition were either corroded somewhat more rapidly or showed a most decided increase in corrosion. (B) The addition of 0·7% Mn to the above steels caused a very slightly increased corrosion in tap-water and sea-water and in the wet and dry tests until the carbon content reached 0·4—0·5%, from which point upwards the manganese generally afforded a slight protection, the latter being very marked in the wet and dry tests; an enormously increased corrosion was observed in dilute sulphuric acid. In these steels the point of maximum corrosion occurred at a lower carbon content than in those containing 0·2% Mn. (C) By increasing the manganese content to 2% upwards, the corrodibility of the steels in neutral solutions was greatly decreased, especially when the carbon content exceeded 0·5%, and the corrodibility in dilute sulphuric acid was greatly enhanced.—W. E. F. P.

Steel; Theory of the corrosion of ——. L. Aitchison. Iron and Steel Inst., May, 1916. [Advance proof.] 15 pages. (See also this J., 1915, 1253; 1916, 50.)

From the results of corrosion experiments on plain and alloy steels in various media, in conjunction with data already published, it is concluded that the corrosion of a steel takes place purely by the action on the ferrite or the solid solution; that the action on pure ferrite may be due entirely to the potential difference set up in consequence of the different solution pressures of the grains of the metal and of the inter-granular cement, the latter probably possessing the greater electromotive force; that to retard or inhibit corrosion the proportion of the third element added to iron and carbon in steels must be sufficient to produce a fairly high percentage in the solid solution; that the electromotive force of the solid solution with respect to the corrosive liquid is the deciding factor in the corrosion of a steel; that the pearlite in a steel does not corrode as a whole but as a mixture of ferrite and cementite, the disappearance of the latter being due to mechanical and not chemical action; and that carbides are not decomposed by ordinary corrosive agents but act merely as cathodes to the anodes of the ferrite or solid solution.—W. E. F. P.

Chromium steel; Initial temperature and critical cooling velocities of a ——. C. A. Edwards, J. N. Greenwood, and H. Kikkawa. Iron and Steel Inst., May, 1916. [Advance proof.] 27 pages.

One inch cubes of a steel containing C 0·63, Si 0·07, Mn 0·17, and Cr 6·15%, were heated in a small electrically heated muffle-furnace, and then cooled at varying rates. Cooling curves were taken and the Brinell hardness of the cooled steels determined. In the first series of tests the samples were heated to exactly 1147° C. and immediately cooled. Pronounced recalescence was obtained with the slower rates of cooling, *i.e.*, more than 12 min. 16 sec. in cooling from 836° to 516° C., without any substantial difference in hardness. Then, abruptly, with a cooling rate of 12 min. 16 sec., the nature of the heat change was considerably modified, the evolution of heat being retarded and less intense, and a pronounced hardening occurred. With increasingly higher rates of cooling the thermal transformation became reduced to extinction, and the hardness steadily rose. Further tests were made in which the initial temperature was caused to vary between 836° C. and 1267° C. As the initial temperature was raised, followed by sufficiently slow cooling to permit the carbide inversion to take place, the temperature at which the change began became somewhat lower, and the hardness became greater; the rate of cooling necessary to eliminate the carbide thermal change down to 516° C. was found to be lower for higher initial temperatures; maximum hardness was produced in each case with the highest rate of cooling, but the hardness was greater, the higher the initial temperature. Further cooling curves taken with quick cooling from different initial temperatures down to low temperatures, showed that the lower the initial temperature the more difficult it was to suppress the carbide transformation, and the less completely this change was prevented, the lower was the hardness. This was also shown by tests in which samples were quenched in water from different initial temperatures. Microscopic examination showed that the appearance of self-hardening coincided with the presence of large quantities of martensite, and that when the thermal transformation had been entirely prevented, with the production of maximum hardness, the steel was purely martensitic in structure. Specimens cooled sufficiently slowly to give maximum recalescence consisted largely of troostitic pearlite. The view provisionally held by the authors of the cause of an increased initial temperature making the self-hardening more evident, is that the chromium carbide, Cr_3C_2, first goes into solution as Cr_6C_4, and is then progressively dissociated into Cr_3C_2 as the temperature is raised. When the steel is again cooling, these molecules only slowly re-associate, and thus the molecular effect of the dissolved chromium carbide is greater as the initial temperature and molecular dissociation increase. This increased number of molecules in solution then enables the carbide point to be more readily suppressed.—T. ST.

Tool steels: Relations between the cutting efficiencies of —— and their Brinell or scleroscope hardnesses. J. O. Arnold. Iron and Steel Inst., May, 1916. [Advance proof.] 3 pages.

THE Brinell hardness of a properly hardened tool is an almost negligible factor of lathe efficiency, which depends almost entirely on the thermal stability of the simple or compound hardenites present. The simple hardenite of plain carbon steel has a thermal stability of which the limit is certainly less than 300° C., whilst the compound hardenite of a C-W-Cr-V high-speed steel, also secured by water quenching, may be rendered stable up to about 700° C. Thus tungsten-chromium steels with an average Brinell hardness number of 602 (mean scleroscope hardness 81·2) gave an average efficiency of 52·6 (cubic inches of standard hard steel shaft removed), the average duration before breaking down being 11 min. 5 sec. Tungsten-chromium-vanadium steels with a Brinell hardness number of 600 (mean scleroscope hardness 78·3), gave, when similarly tested, an average efficiency of 86, the average duration being 16 min. 38 sec. A hardened best crucible-cast plain carbon steel, containing about 1·25% combined carbon, would endure for perhaps two seconds when tested under the same conditions, although its Brinell hardness number would be about 700.—T. ST.

Silver: Spirting of ——. W. Stahl. Metall u. Erz, 1915, **12**, 501—504. Z. angew. Chem., 1916, **29**, Ref., 178. (See also this J., 1916, 311.)

A MUCH greater tendency to spirt is sometimes shown by fine silver obtained from cement silver containing basic iron or copper sulphate as impurity, than by that derived from metal free from sulphates. A probable explanation, based on the reaction relations which exist between silver, sulphur dioxide, silver sulphide, and silver sulphate, is that silver sulphate is formed in not inconsiderable quantity in the melting-down stage, and that with rising temperature this compound breaks down into silver, sulphur dioxide, and oxygen. The sulphur dioxide escapes but the oxygen is retained by the silver. Also, at moderate temperatures, sulphur dioxide can combine with silver with the formation of silver sulphate, which at higher temperatures again decomposes. Whatever the nature of the impurities originally present, silver dissolves oxygen from the air during the refining process, and when the refined metal is poured.
—T. ST.

Copper: Structure of electrolytically deposited ——. A. Sieverts and W. Wippelmann. Z. anorg. Chem., 1915, **91**, 1—45. Chem.-Zeit., 1916, **40**, Rep., 139.

MICROSCOPIC examination of copper deposited on sheet-iron cathodes immersed vertically in sulphuric acid solution showed that the size of the crystals, in acid solution, first diminishes, and then with increasing current density again increases and becomes irregular. The point at which crystals of minimum size are formed is displaced towards higher current density (from 0·05 to 0·1 ampère) by stirring, warming, and raising the sulphate content. Increasing the acid content makes the deposit at higher current densities (over 0·2 ampère) more uniform; additions, such as glycerin and aluminium sulphate, which raise the viscosity, have the same effect. The presence of colloidal materials makes the deposit brittle and cracked, owing to the co-deposition of the colloidal bodies. Deposits obtained from neutral solutions are irregular, those from alkaline solutions are regular, but without recognisable structure. The latter deposits adhere firmly to the electrode, whilst those from acid solutions are easily removed. The copper in the layer first deposited has the greatest hardness.—T. ST.

Ores from Cobalt, Ontario: Metallurgy of the ——. R. W. Bridges. Canadian Min. J., Jan. 15, 1916. Eng. and Min. J., 1916, **101**, 616—617.

DURING the period Dec., 1905 to Feb., 1913, more than 40,000,000 oz. of silver, 2,200,000 lb. of cobalt, 1,500,000 lb. of nickel, and 4,500,000 lb. of arsenic were produced from ores and concentrates from the Cobalt district at the Copper Cliff plant of the Canadian Copper Co. The ore, crushed to pass a 30-mesh sieve, and mixed with suitable fluxes, was smelted in blast-furnaces (32 by 72 in.) having a capacity of 25—30 tons per 24 hours, yielding silver bullion, speiss, and slag. The flue dust and crude arsenic from the blast furnaces and also from the roasting furnaces (see below) were collected, and the flue dust recharged to the blast-furnaces. The crude arsenic was purified by subliming and gave a product containing 99·98% As_2O_3 and 0·03 oz. Ag per ton. The slag was discarded unless it contained more than 10 oz. Ag per ton, in which case it was recharged to the blast-furnaces. The silver bullion, amounting to 75% of the total silver, was in the form of buttons, about 860 fine, easily separated from the speiss. It yielded silver 994 fine after 24 hours in an oil-fired cupelling furnace. The speiss contained Co 25·2, Ni 15·3, As 31·3, Fe 16·1%, and Ag 1·48 oz. per ton. It was ground to 30-mesh with 20% of salt, roasted in Edwards reverberatory furnaces fitted with mechanical rakes, and the product leached first with water and then with sodium thiosulphate solution. The residue was mixed with quartz and smelted in the blast-furnace to remove most of the iron; the slag produced contained 14% Co and 32·8 oz. Ag per ton, and was returned to the blast-furnace with an ore charge. The green speiss obtained contained Co 28·9, Ni 27·8, As 29·5, Fe 3·5%, and Ag 1·341 oz. per ton, and was treated as before, and the final residue, after leaching with thiosulphate, was dried, mixed with 20% of sodium nitrate and 10% of sodium carbonate, and roasted, yielding sodium arsenate, recovered by leaching, and a residue containing Co 30·7, Ni 28·5, As 1·1%, and Ag 34·6 oz. per ton, which was shipped to Germany. The solutions obtained by leaching with water were treated with scrap iron to precipitate copper, and the cobalt and nickel precipitated with caustic soda; the precipitate when dried, and calcined, gave a product containing Co 40, Ni 3, As 0·3% and Ag 15 oz. per ton. Silver was recovered from the thiosulphate solutions by precipitation as sulphide.—A. S.

Matte fusion; Effect of borax in ——. G. E. Johnson. Eng. and Min. J., 1916, **101**, 648—650.

Experiments with a copper matte containing 35% Cu and 17·3 oz. Ag per ton showed that borax may be used to replace partly or wholly the silica in matte fusions without notably affecting the analytical results for silver, providing the silicate (or borate) degree is not higher than corresponds to a monosilicate; the best results are obtained with a silicate (borate) degree between ⅓ and ½.
—A. S.

Cadmium; Revision of the atomic weight of ——. *IV. Electrolytic determination of cadmium in cadmium bromide.* G. P. Baxter, M. R. Grose, and M. L. Hartmann. J. Amer. Chem. Soc., 1916, **38**, 857—867.

The atomic weight of cadmium, determined by electrolysing a solution of highly purified cadmium bromide, in a cell of special design, using a mercury cathode, was found to be 112·407, which confirms earlier results of Baxter and others on the analysis of cadmium chloride and bromide (J. Amer. Chem. Soc., 1905, **27**, 222; 1906, **28**, 770; 1915, **37**, 258). Including the results of previous investigations, the average value is 112·415.—F. Sodn.

Zinc; Revision of the atomic weight of ——. *Electrolytic determination of zinc in zinc bromide.* G. P. Baxter and M. R. Grose. J. Amer. Chem Soc., 1916, **38**, 868—873.

The atomic weight of zinc, based on the electrolysis of specially purified zinc bromide (compare preceding abstract), is given as 65·388.—F. Sodn.

Rapid method for determination of copper and iron. Edgar. *See* XXIII.

Patents.

Iron and steel; Molten alloy for galvanising ——. J. C. Labbé. Fr. Pat. 477,527, Feb. 4, 1915.

The galvanising bath contains Zn 98·2 to 97·2, Sn 1·7 to 2·3, and Cu 0·1 to 0·5%, the copper being added in the form of a zinc or tin alloy. The small additions of tin and copper render the metal very fluid, and adherent to the surface to be coated.—T. St.

Iron; Extraction of —— *free from titanium from titaniferous ferruginous sands.* P. H. Ledeboer, Brussels. Ger. Pat. 290,631, Oct. 31, 1913. Addition to Ger. Pat. 264,018 (see Fr. Pat. 456,401; this J., 1913, 1017).

The titaniferous iron ore, separated as completely as possible from silica, is intimately mixed, in a finely powdered state, with carbon, without the addition of basic materials, and heated in a reducing atmosphere in a reverberatory furnace, to a temperature insufficient to melt the reduced iron, but sufficient to melt the iron titanate formed, which is run off in the molten state.—T. St.

Metals or alloys [of different melting points]; Separation of —— *from a mass of mixed particles of metals or alloys.* V. G. Stevens, Newcastle-upon-Tyne. Eng. Pat. 74, July 1, 1915.

The mass is treated with a liquid or gaseous reagent (a solution of sodium or calcium sulphide or antimony chloride; hydrogen sulphide or the vapour of sulphur or phosphorus) to produce a coating of sulphide, etc., upon some or all of the metallic particles, the separation of which is then effected by liquation, in an electrically heated centrifugal apparatus, with or without the addition of fresh molten metal or alloy. For example, a mixture of copper and lead particles, after treatment with hydrogen sulphide, is heated to just above the melting point of lead and the latter separated centrifugally; a mixture of lead and zinc particles is treated with hydrogen sulphide, then with molten tin at a temperature below the melting point of either lead or zinc, and finally centrifuged to recover the zinc as a tin-zinc alloy.
—W. E. F. P.

[Lead-zinc] mixed sulphide ores; Separation of ——. Minerals Separation Ltd., London, Assignees of Minerals Separation and de Bavay's Processes Australia Proprietary Ltd., Melbourne. Eng. Pat. 4974, Mar. 31, 1915. Under Int. Conv., Apr. 1, 1914.

In the treatment of mixed sulphide ores by froth-flotation, copper, mercury, or a compound of either metal is employed, in addition to the usual agents, to facilitate the production of a float concentrate relatively rich in blende. Instead of adding copper scrap or filings to the charge, the apparatus may be wholly or partly constructed of copper or a copper alloy.—W. E. F. P.

Flotation separatory apparatus and process. J. M Callow, Salt Lake City, Utah, Assignor to Metals Recovery Co., Augusta, Me. U.S. Pat. 1,176,428, Mar. 21, 1916. Date of appl., Dec. 30, 1914; renewed Jan. 21, 1916.

In an apparatus for the treatment of ores by froth-flotation, the charge is aerated and the froth de-aerated by suction. The container for the mixture of comminuted ore, water, and frothing agent consists of a closed tank having a conical bottom provided with adjustable openings for the admission of air, and at the top a transverse froth-collecting conduit communicating with a small discharge tank to the upper part of which the suction apparatus is connected.—W. E. F. P.

Ores; Apparatus for roasting, sintering, or otherwise treating ——. Metallbank und Metallurgische Ges., Frankfort, Germany. Eng. Pat. 5189, Apr. 6, 1915. Under Int. Conv., Apr. 4, 1914.

The charge is supported on a perforated surface and caused to travel above a suction chamber so that adjacent portions are roasted or sintered in succession; the ore-carrying surface consists of a number of shallow, radial compartments mounted on a horizontal, circular, rotating frame, and means are provided for discharging each compartment separately by tilting. Each compartment may form an independent box having its own air chamber, the latter being connected with a suction duct common to all the air chambers; or the gratings of the compartments may be connected in the same plane and moved over a common, stationary suction chamber which does not extend to the point where the compartments are tilted.—W. E. F. P.

Furnace ; Open-hearth ——. R. Eickworth, Dortmund, Germany. U.S. Pat. 1,176,744, Mar. 28, 1916. Date of appl., June 8, 1915.

An open-hearth furnace has, at opposite ends, flues which are adapted to serve for fuel supply and exhaust alternately, and are connected with combustion-flues disposed in the crown of the furnace; compressed air is discharged into the combustion-flues from cooling channels situated above them. —W. E. F. P.

Furnace ; Metallurgical ——. L. Metesser, New Orleans, La. U.S. Pat. 1,177,429, Mar. 28, 1916. Date of appl., Mar. 17, 1915.

In a horizontal furnace of the regenerative type, the grate has fire-bars consisting of horizontal, rotary, water-cooled tubes upon which fixed, vertical discs are spaced. The tubes are fitted, at one end, into the lower part of a water tank enclosed within the furnace casing, and the water emerging from them passes down into the ash-pit, V-shaped in cross-section, provided with an overflow opening, and containing a submerged conveyor on which the ashes are continuously removed. —W. E. F. P.

Furnace ; Mechanical —— *for roasting pyrites and the like.* Maschinenfabrik Akt.-Ges. vorm. Wagner und Co., Cöthen. Ger. Pat. 290,534, Sept. 25, 1914.

The furnace is of the type in which the ore is worked downwards through a series of superimposed chambers by rabbles actuated by a central vertical shaft. The ore is forced onwards between successive chambers by endless screws through channels in the wall of the furnace, and falls through funnels near the centre, alternately, whilst separate channels are provided for the gases to rise through the chambers. The arrangement causes the ore to move forward in a regular manner, and prevents it from forming into masses and stopping the passages from one chamber to another.—T. St.

Gold from concentrates ; Process for recovering —— F. B. Sanford, Dothan, Oreg. U.S. Pat. 1,176,858, Mar. 28, 1916. Date of appl., Jan. 10, 1913; renewed Feb. 17, 1916.

The concentrate is agitated with an aqueous solution of ammonium chloride and sodium phosphate at about 115° F. (46° C.) to render it amenable to amalgamation with agitation. —W. E. F. P.

Preliminary-treatment tank. Refractory ores ; Desulphurising method for treating ——. E. H. Dickie, Goldroad, Ariz. U.S. Pats. (a) 1,177,394 and (b) 1,177,396, Mar. 28, 1916. Dates of appl., Aug. 6, 1914, and Jan. 25, 1915.

(a). An open tank having a horizontal filter at the bottom has a movable support at the top from which one or more tubular agitators depend. Each of the agitators has at the upper end a perforated compartment containing, or lined with, "a value precipitant," and is provided with an external pipe through which air is conveyed to the lower end and blown upwards into the tube. (b). The finely divided ore is agitated in the tank with a solution of caustic soda and potassium acetate and in the presence of "a metallic value precipitant," the solution being afterwards removed. —W. E. F. P.

Zinc ; Process and electric furnace for extracting —— *in a state of purity from its ores.* E. F. Côte and P. R. Pierron. First Addition, dated Nov. 18, 1914, to Fr. Pat. 474,321, Nov. 19, 1913 (see Eng. Pat. 14,192 of 1914; this J., 1915, 497).

The smelting furnace is connected with a vessel which is furnished with a grating covered by a layer of broken electrode carbon, and two horizontal flues are disposed above the vessel through which the uncondensed gases pass into the atmosphere, the small quantities of entrained zinc dust condensing in the flues. Two lateral electrodes, of the same polarity as the electrode forming the walls of the smelting furnace, are arranged in the walls of the vessel at the level of the grating, and a middle electrode, of opposite polarity, is placed parallel to the lateral electrodes and along the axis of the grating. A condensation chamber is arranged below the grating. The zinc vapour from the smelting furnace condenses on the layer of carbon, partly in the form of drops which flow down through the grating, and partly as zinc dust. The layer of carbon is heated to the volatilising temperature of zinc, so that the zinc dust is redistilled and then condensed in the liquid state. In an alternative form, the walls of the vessel form a carbon electrode of the same polarity as the walls of the smelting furnace, the vessel being provided with a grating covered with carbon into which is plunged a carbon electrode of opposite polarity, and the vessel and the smelting furnace may be put into or out of communication by means of a damper. The space below the grating may be put into communication with the atmosphere or a condenser, by means of two conduits and a damper. In a further form, two vessels, constructed as described above, are coupled to the same smelting furnace, the communication channel and condenser being common to the two. One vessel is charged with zinc dust by opening its electric circuit and putting it into communication with the smelting furnace, whilst the other, previously charged with zinc dust, is connected with the condenser, and the electric circuit closed to distil the metal, the vessels being thus used alternately. —B. N.

Furnace for the electrothermic extraction of zinc. A/S Metalforedling, Drontheim, Norway. Ger. Pat. 290,499, Apr. 5, 1914.

The charge is fed into the furnace down a vertical shaft in which the zinc vapours carried along by the gaseous products are condensed by the cooling action of the entering charge. The shaft is made up of sections so that its height, and consequently the length of the charge-column, can be varied as desired.—T. St.

Zinc ; Method of condensing metallic vapours, especially those of —— *in the electric furnace.* A/S Metalforedling, Drontheim, Norway. Ger. Pat. 290,690, May 20, 1914. Addition to Ger. Pat. 289,193 (this J., 1916, 427).

The uptakes are filled with pieces of coke so that they act as gas-cushions and equalise fluctuations of pressure in the furnace.—T. St.

Lead and zinc ; Process for the separation of ——. J. Babé. Fr. Pat. 477,653, June 24, 1914.

Roasted ores containing lead and zinc are intimately mixed with finely powdered sulphur and carbon, and heated to 800°—900° C., whereby lead sulphide is formed and volatilises, leaving the zinc as oxide. Ores containing the metals as sulphides are heated directly with carbon, without roasting or addition of sulphur.—T. St.

Platinum and tantalum ; Alloy of ——. Quennessen, de Belmont, Legendre et Cie. Fr. Pat. 477,270, June 8, 1914.

Claim is made for platinum-tantalum alloys (0·5—20 % Ta) which possess in a high degree the properties of platiniridium ; the relative quantities of tantalum and iridium required to produce the same degree of hardness and mechanical resistance in platinum are as 1 : 5.—W. E. F. P.

Alkali- and alkaline-earth metals ; Preparation of ——. E. Lancesseur and H. Maillard. Fr. Pat. 477,349, June 11, 1914.

To prepare alkali- and alkaline-earth metals in the form of grains or shot resistant or impervious to atmospheric influences, the metal is melted beneath a suitable liquid or solid hydrocarbon or mixture of hydrocarbons (preferably saturated), in a tank divided into compartments by movable partitions, and allowed to solidify while subjected to regular oscillating movements varying in amplitude and rapidity according to the size of grain required. When the process is effected in a hydrocarbon solid at ordinary temperatures, the granulated metal is either removed by sifting while the hydrocarbon is still molten, or obtained disseminated through the latter by further cooling the mass, with which other material (*e.g.* ferrosilicon, used in admixture with sodium for generating hydrogen by reaction with water) may be incorporated before solidification occurs.
—W. E. F. P.

Metals [e.g. nickel] particularly active for catalysis ; Rapid preparation of ——. E. Berger. Fr. Pat. 477,480, June 13, 1914.

The oxide of the metal is reduced by hydrogen in the presence of a dehydrating agent such as lime, baryta, etc., the latter being mixed with the metallic oxide or not. Under these conditions nickel oxide is completely reduced at 209·5° C. in 70 hrs., as against several months required when the dehydrating agent is absent. The catalytic activity of the product may be increased by subjecting the oxide to a series of alternate reductions and re-oxidations terminating in reduction, or by simultaneous oxidation and reduction, for which latter purpose a non-explosive mixture of hydrogen and oxygen is employed.—W. E. F. P.

Apparatus for crushing ore. H. C. Behr, New York. Eng. Pat. 5510, Apr. 12, 1915. Under Int. Conv., Apr. 10, 1914.

[Ore] separator ; Magnetic ——. P. Wright, Vancouver, British Columbia. U.S. Pat. 1,177,981, Apr. 4, 1916. Date of appl., May 14, 1914.

[Ore] separation ; Process of electrical ——. H. A. Wentworth, Lynn. Assignor to Huff Electrostatic Separator Co., Boston, Mass. U.S. Pat. 1.178,430, Apr. 4, 1916. Date of appl., Dec. 21, 1907.

Steel ; Method of treating ——. C. P. Sandberg, London. U.S. Pat. 1.178.352, Apr. 4, 1916. Date of appl., Aug. 9, 1915.

See Eng. Pat. 1878 of 1915 ; this J., 1916, 363.

Copper precipitant. H. L. Sulman and H. F. K. Picard. Assignors to Minerals Separation Amer. Synd. (1913), Ltd., London. U.S. Pat. 1.178.191, Apr. 4, 1916. Date of appl., June 15, 1914.

See Eng. Pats. 1152, 9171, and 16,017 of 1913; his J., 1914, 488.

Copper and nickel from matte and other products ; Separation of ——. N. V. Hybinette. Fr. Pat. 477,516, Feb. 6, 1915.

See U.S. Pats. 1,128,313 to 1,128,316 of 1915 ; this J., 1915, 361.

Zinc ; Process of alloying —— *with iron and steel.* R. B. Wilson. Fr. Pat. 477,732, Feb. 19, 1915. Under Int. Conv., Feb. 19, 1914.

See Eng. Pat. 2389 of 1915 ; this J., 1916, 425.

Metals : Process for pulverising fused —— *and projecting them on to surfaces to form adherent or detachable coatings.* F. C. Ucar. Fr. Pat. 477,753, Feb. 20, 1915. Under Int. Conv., Feb. 23, 1914.

See Eng. Pat. 2413 of 1915 ; this J., 1916, 425.

XI.—ELECTRO-CHEMISTRY.

Overvoltage. C. W. Bennett and J. G. Thompson. J. Phys. Chem., 1916, 20, 296—322.

A general theory of overvoltage is developed, based on the conception that in the transformation of dissolved ions to gaseous molecules or solid metals, or *vice versa*, atomic forms of the elements are produced as unstable, reactive intermediate products. In the change from gaseous molecule or solid metal to dissolved ion, with generation of electricity, the concentration of the intermediate product increases from zero to a maximum value—the equilibrium concentration—but cannot exceed this, or the reaction would reverse. In the opposite change, on the other hand, the intermediate product must be maintained above the equilibrium concentration, otherwise the separation of gaseous molecules or of solid metal would cease, and the excess energy required for this purpose gives rise to an excess back electromotive force or overvoltage varying according to the extent by which the equilibrium concentration is exceeded. The change molecule→atom→ion is thus not completely reversible, and the overvoltage is a measure of the irreversibility. If the reaction : atomic intermediate product→molecular material proceeds rapidly, the overvoltage will be low. In the case of a gas at a metal electrode, for example, the overvoltage will be lower with a metal which catalyses this reaction than with one that does not, and this is in accord with experimental data. Evidence of the formation of these active intermediate products (active hydrogen, active oxygen, active chlorine, atomic zinc, etc.) during electrolysis is quoted, as also is Langmuir's work on active or atomic hydrogen, chlorine, and oxygen (this J., 1915, 490), and it is shown that the reactivity of these products is sufficient to account for overvoltages found experimentally. Active hydrogen is able to reduce cadmium from cadmium sulphate solution and zinc from zinc oxide.—A. S.

Vacuum tubes ; Absorption of gases in —— *and allied phenomena.* S. Brodetsky and B. Hodgson. Phil. Mag., 1916, 31, 478—490.

From the results of experiments made under varying conditions, the authors conclude that in tubes with metallic electrodes the absorption is due mainly to mechanical occlusion of gas by the disintegrated metal of the cathode, though part may be due to liberation of alkali metals by electrolysis of the glass and chemical combination of these metals with the gas.—A. S.

Billeter-Leykam electrolytic cell for the production of alkali and chlorine. Yamasaki. *See* VII.

Patents.

Insulating materials and the like; Manufacture of electric ——. W. E. W. Richards, London. Eng. Pat. 3364, Mar. 2, 1915.

The articles are made from cement and are impregnated with the soluble pitch-like residuum described in Eng. Pat. 3008 of 1912 (this J., 1913, 666).—B. N.

Discharge of electricity through a vacuum, gases, or vapours; Devices for the ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 5741, Apr. 16, 1915.

The cathode is adapted to operate at incandescence, and is provided with a conducting shield, such as a sleeve or spiral of wire, interposed between the region of the cathode subject to erosion and the anode. The shield is spaced away from the cathode, and is electrically connected to its supporting conductor. The invention may be applied to enclosed electric arc lamps.—B. N.

Electrolytic cells; Replenishing ——. W. S. Smith, Grosse Ile, Mich., U.S.A. Eng. Pat. 15,761, Nov. 8, 1915. Under Int. Conv., June 3, 1915.

The level of the electrolyte in the cell is maintained constant by balancing the liquid hydrostatically against an external source of supply, through an intermediate column of immiscible liquid; as the electrolyte in the cell diminishes, fresh liquid passes through the insulating column in the form of drops.—B. N.

Matter [electrical contacts]: Composition of —— *and process of making the same.* A. J. Liebmann, New York. U.S. Pat. 1,177,119, Mar. 28, 1916. Date of appl., Mar. 12, 1915.

A compressed mixture of carbon, powdered copper, and powdered tungsten is used for electrical contacts.—B. N.

Gases; Process and apparatus for the treatment of —— *by the electric arc.* [*Fixation of nitrogen.*] E. Mack. Fr. Pat. 477,476, June 17, 1914.

The gas is treated in a long channel in which an arc is produced from one extremity to the other, the gas being admitted at one end under a certain pressure, which is progressively reduced, so that the gas is at a considerably lower pressure at the opposite end. This is accomplished by forming the channel of alternate large and small sections, or by enlarging the channel at intervals into a bulb-like form, thus retarding the gas at intervals and producing a thorough mixing throughout the whole length of the channel. From a certain point in the channel, the temperature is maintained below a definite limiting value, by withdrawing an amount of heat approximately equal to that produced by the arc in this region. This is accomplished by providing the exit end of the channel with a cooling arrangement on the exterior and a body of low heat conductivity on the interior. Two or more channels may be arranged, end to end, served by the same electric arc.—B. N.

Active material for accumulator plates. Soc. Ind. de l'Accumulateur Alcalin. Fr. Pat. 477,623, June 23, 1914.

Nickel hydroxide is precipitated from a soluble salt of nickel by means of an excess of a boiling mixture of alkali hydroxides, containing at least a small quantity of lithia. The lithium hydroxide is co-precipitated with the nickel hydroxide, and to the latter is added a neutral and insoluble conductor, such as graphite, for forming the active material; in an alternative process, the lithium hydroxide is added with the graphite to the nickel hydroxide.—B. N.

Apparatus for electrolysing alkali chloride solutions. U.S. Pat. 1,176,551. *See* VII.

Agglomerate for paving, electrical insulation, and as a celluloid substitute. Fr. Pat. 477,682. *See* IX.

Preparation of spirit lacquers, polishes, leather dressings, insulating materials, etc., from wood lar. Ger. Pat. 290,818. *See* XIII.

XII.—FATS; OILS; WAXES.

Fatty oils in the light of mesomorphic polymerisation. A. Kronstein. Ber., 1916, **49**, 722—732.

It has been shown previously that when certain polymerisable substances are heated, the viscosity increases progressively until a point is reached when the oily liquid changes suddenly into a jelly. If the heating be interrupted before gelatinisation occurs, a solid polymer of the original substance can be isolated from the viscous oil, and this polymer can be converted into nitro-, bromo-, and other derivatives. This solid polymer, or intermediate product, cannot be isolated from the jelly, and the latter when nitrated or brominated yields derivatives of the intermediate product. The term mesomorphic polymerisation has been applied to reactions of this type (Ber., 1902, **35**, 4150) Non-polymerisable substances retard or prevent the formation of the gelatinous end-product, but have no influence on the formation of the intermediate product. The author has found that al fatty oils are mixtures of polymerisable and non polymerisable glycerides, and that by removing certain proportion of the non-polymerisable sub stances, they yield products which gelatinise o heating just as Chinese wood oil does (see Eng. Pat 17,378 of 1900; this J., 1901, 1123). If a fatt oil be heated in a vacuum-distilling flask, distillatio proceeds smoothly at first, but at a certain stag the residue in the flask froths up, and if the vacuu be not immediately cut off, the gelatinous mas flows over into the condenser. Distillation ceas at this stage, and the amount of distillate collecte is characteristic for each oil, and is termed th "distillation number." In the case of Chines wood oil gelatinisation occurs before distillatio begins. The distillation numbers (per cent. of th original oil) found for different oils were:— Chinese wood oil, 0; linseed oil, 16·2—16·4 perilla oil, 18·5; hemp seed oil, 20·5; walnut oi 23·8—24·0; poppy seed oil, 24·5—25·0; sun flower seed oil, 25·0; soya bean oil, 25·4; almon oil, 33·0; castor oil (at atmospheric pressure 33·5; cottonseed oil, 33·6; maize oil, 35·5; rap oil, 35·6; sesamé oil, 42·5; castor oil (*in vacuo* 48·0; arachis oil, 53·0; olive oil, 54·0. The fin product of a mesomorphic polymerisation canno be reconverted into the monomolecular form further heating but only into the intermediat product. For example, if gelatinised Chinese woo oil be cooled and then again heated, it melts to viscous oil which remains liquid on cooling. Th oil can be gelatinised by further heating in th same way as the original oil, and the successi operations of melting and gelatinising can repeated as often as desired. The jellies fro other oils behave in a similar manner. By addin varying proportions of other oils to Chinese woo oil, mixtures can be obtained which, like the latte gelatinise on heating, without distillation, but mo slowly. Chinese wood oil, on drying, yields a fil which is more resistant to alkali than a film dried linseed oil, whilst in the case of mixtures linseed oil and Chinese wood oil the resistance alkali varies inversely with the time required gelatinise the oil on heating at a definite tempera ture. (See also Schumann; this J., 1916, 54
—A. S.

Oils from Philippine seeds. H. C. Brill and F. Agcaoili. Philippine J. Sci., 1915, **10A**, 105—119.

Dried kernels of the cato nut (*Chisochilon cumingianus*) contained 44·12% fat and 9·00% proteins, and yielded on expression 35·56% of a reddish-brown non-drying oil with purgative properties (about one-fifth of the effect of castor oil). It is made into soap in Manila. Calumpang nuts (*Sterculia fœtida*) contained 52% kernels, with 21·61% of proteins and 51·78% of a sweet yellow oil with slight laxative properties. It is used for culinary purposes, and is a good substitute for olive oil. The kernels of two varieties of pili nuts (*Canarium pachyphyllum*) contained 12·06 and 11·88% of proteins, and 74·39 and 72·53% of a sweet edible oil, respectively. The oils had the following characters:—

	Cato oil.	Calumpang oil.	Pili oil.	
			Long nuts.	Short nuts.
Sp. gr. at 15° C. ..	0·9203	—	—	—
Sp. gr. at 30° C. ..	0·9188	0·9254	0·9067	0·9067
Butyrorefractometer at 30° C.	60—61	63—64	54—54·2	54—54·2
Iodine value (Hübl)	80·78	76·14	61·25	59·61
Reichert-Meissl value	7·34	[illegible]·10	3·3	2·2
Acid value	7·06	·30	2·70	3·13
Saponif. value	192·0	2[illegible]·01	192·6	186·8

"Lumbang bato oil" from *Aleurites moluccana* and "lumbang banucalag oil" from *A. trisperma* compare well with Chinese wood oil and linseed oil in their drying properties. They can be distinguished from each other by the fact that lumbang banucalag oil is soluble in its own volume of absolute alcohol, whereas lumbang bato oil is insoluble in 4 times its volume of alcohol. The other oils had no appreciable drying properties. (See also this J., 1915, 143.)—C. A. M.

Lime seeds; Oil from ——. H. A. Tempany. West Indian Bull., 1915, **15**, 27—28. Bull. Agric. Intell., 1916, **7**, 141—142.

The oil obtained from lime seeds (see this J., 1915, 804) has sp. gr. at 28·5°/25·5° C., 0·9180; refractive index, 1·4700; iodine value (Hübl), 153·9; saponif. value, 339·6; solidif. pt., 6° to 7° C.
—W. P. S.

Shark-liver oil; Unsaturated hydrocarbon in ——. M. Tsujimoto. J. Chem. Ind. Tokyo, 1916, **19**, 277—280.

Oils from the livers of different species of Japanese sharks contain a large proportion of unsaturated hydrocarbons, up to 90% in the case of *Squalus Mitsukurii*. The chief constituent is a hydrocarbon, $C_{30}H_{50}$, which is a colourless oil, with sp. gr. 0·8587 at 15° C. It has pronounced drying properties and forms a bromine addition compound, $C_{30}H_{50}Br_{12}$, and a hydrogen addition compound, $C_{30}H_{62}$. The name "squalene" is suggested for this hydrocarbon.—C. A. M.

Available oxygen in washing preparations containing soap; Determination of ——. A. Grün and J. Jungmann. Seifenfabr., 1916, **36**, 53—55. Z. angew. Chem., 1916, **29**, Ref., 187.

The method of titration with permanganate gives too high results, owing to the end-point not being sharp. The following iodometric method is more accurate:—The material (0·2 grm.) is shaken in a separating funnel with 10 c.c. of sulphuric acid (1 : 4) and 5 c.c. of carbon tetrachloride, the carbon tetrachloride layer withdrawn, and the aqueous layer again shaken with fresh tetrachloride. It is then transferred to a flask, 2 grms. of potassium iodide added, and the liberated iodine titrated with thiosulphate, after the lapse of 30 mins. The presence of water-soluble constituents of the soap does not interfere with the titration.
—C. A. M.

Patents.

Vegetable substances such as oil seed, and particularly copra; Drying ——. E. W. Andersen, Aarhus, Denmark. Eng. Pat. 10,597, July 21, 1915.

The material is dried on a hearth or platform over a kiln, while a glass roof over the hearth admits heat from the sun. Means are provided for adjustable ventilation of the space between the glass roof and the hearth, and for removing volatile products.—C. A. M.

Oils; Apparatus for washing, separating, and concentrating ——. Fiévet et Pingris. Fr. Pat. 477,478, June 17, 1914.

The impure oil is aspirated through a refrigerating vessel and injected, together with water under pressure, into an expansion vessel, whence the mixture passes through a refrigerator into a settling tank. After a first decantation from water and impurities, the oil is passed through a filter into a "concentration reservoir," where it is treated with a saturated solution of sodium chloride or similar salt.—C. A. M.

Beeswax, sugar-cane wax and the like; Bleaching ——. M. S. Salamon, London. Eng. Pat. 5066, April 1, 1915.

Wax is melted over a solution containing 0·5—1% of potassium chlorate and 2—5% of sulphuric acid, and a current of air is blown through the mixture for several hours at 70°—100° C. If required, the wax may be treated subsequently with decolorising carbon.—W. P. S.

Glycerin; Vessel for the preparation of ——. P. Krebitz. Fr. Pat. 476,880, July 20, 1914. Under Int. Conv., June 5, 1914.

In the recovery of glycerin from insoluble soaps by washing with water, a vessel having the form of a truncated cone is used.—C. A. M.

Detergent composition [for treating raw silk and mixed silk and cotton goods]. H. Ockelmann, Gross-Jena, Germany. Eng. Pat. 28,803, Dec. 13, 1913.

The composition may consist of (1) fatty acids, 40, potassium hydroxide, 10, sugar or saccharine matter, 25, and water, 25 grms.; (2) soap, 2000, sugar, 2000, potassium hydroxide, 80, and alcohol, 120 grms.; or (3) potassium hydroxide, 4, sugar, 80—83, and alcohol, 12—14 grms.—W. P. S

Washing compound or soap especially applicable for domestic use also for laundries and such like purposes. G. W. G. Booker, London. Eng. Pat. 5343, Apr. 9, 1915.

Simultaneous washing and blueing of linen is effected by the use of a soap prepared from tallow (80 to 85%), sodium thiosulphate (5%), caustic soda (5%), blue aniline, alizarin or other soluble dyestuff (5%), and water (say 5%). After amalgamation by heat the liquid product is moulded into cakes or tablets.—C. A. M.

Fat extraction; Process and apparatus for ——. C. H. L. Wiese, Neumünster, Germany. Eng. Pat. 3845, Mar. 10, 1915.

See U.S. Pat. 1,160,481 of 1915; this J., 1915, 1244.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Iron-cyanogen colours. L. Bock. Z. angew. Chem., 1916, 29, 166—169.

The distinction between Paris blue and Prussian blue is founded upon the purity of the colour, which depends upon the quality of the materials used in the manufacture. For the purer Paris blues only pure crystallised potassium or sodium ferrocyanide is employed; the cheaper sorts are produced from the ammonium-calcium and potassium-calcium ferrocyanides. Impure liquors containing ferrocyanides, obtained from gas-works, not of sufficient value to work up into pure salts, are converted into inferior varieties of Prussian blue by neutralising or slightly acidifying the diluted liquor with hydrochloric acid, filtering the separated sulphur, treating with ferrous chloride, and then oxidising with potassium chlorate and hydrochloric acid. Ferrous chloride is preferred to ferrous sulphate as it obviates the precipitation of calcium sulphate, which is difficult to wash out; but either of these salts can be used when pure ferrocyanide is employed. In the precipitation of calcium-ammonium ferrocyanide by ammonium chloride, and in that of the potassium-ammonium double salt by means of potassium chloride, the supernatant liquid always contains carbonyl ferrocyanide compounds, from which a violet-blue substance $FeFe(CN)_5CO$ can be isolated, and the presence of the latter causes a violet tinge in the finished blue. Berlin green or Pelouze green produced by the interaction of ferric salts with complex cyanides and also by the oxidation of Prussian blue, is only formed in technical practice as a result of faulty work: it is probably a mixture of Prussian blue and another substance which contains the $(CN)_6$ group in a different and more labile form to that in which it occurs in ferro- and ferricyanides. Prussian blues are now always made by the indirect method, and the large variety of shades obtained results from varying the temperature and the concentration of the solutions, and the method and extent of oxidation. Turnbull's blue is no longer manufactured. There is much uncertainty concerning the production of "steel blue" and Milori blue which differ from Paris blue and Prussian blue by their low density and softness, and by giving a characteristic reddish streak. According to some, they contain more potassium and less iron than Prussian blue, but the chief difference is probably of a physical nature, caused by precipitation in a voluminous form. The presence of stannic oxide in some samples is without significance. Soluble blue is now made commercially by treating finished Prussian blue with a solution of potassium ferrocyanide.—E. H. T

Patents.

Oil-cloth; Process of oxidising and drying ——. H. Pettibone, New Rochelle, N.Y., and J. W. Royer, Passaic, N.J., Assignors to The Standard Oil Co., New York. U.S. Pat. 1,176,982, Mar. 28, 1916. Date of appl., May 3, 1913.

The cloth is coated with linseed or other drying oil and suspended in folds within a chamber through which is passed dry hot air (400° to 600° F., about 205° to 315° C.), so that a temperature of about 200° F. (about 95° C.) is maintained within the chamber. Fresh air being thus constantly brought into contact with the oil effects rapid oxidation and produces a harder, whiter, and more elastic surface.—C. A. M.

Spirit lacquers, polishes, leather dressings, insulating materials, etc.; Preparation of —— [from wood tar]. Chem. Fabr. Flörsheim H. Nördlinger. Ger. Pat. 290,818, July 17, 1914.

The asphaltic substance separated from wood tar by sulphuric acid (Ger. Pat. 286,650; this J., 1916, 106) is soluble in alcohol, wood spirit, acetone, etc., and may be used either alone or in conjunction with other resins soluble in spirit for the preparation of lacquers, etc., which have antiseptic, colouring, waterproofing, and insulating properties. —J. F. B.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Rubber or analogous substances; Process for accelerating the vulcanisation of natural or artificial ——. S. J. Peachey. Fr. Pat. 477,586, Feb. 10, 1915. Under Int. Conv., Feb. 19, 1914.

See Fr. Pat. 4263 of 1914; this J., 1915, 368.

Process of treating hydroxy-compounds with acetylene and new industrial products (diolefines) arising therefrom. Fr. Pat. 477,560. *See* XX.

Preparation of aldehyde-ammonia. Ger. Pat. 290,808. *See* XX.

XV.—LEATHER; BONE; HORN; GLUE.

Patents.

Skins; Process for unhairing —— and cleaning the hair or wool. R. Vidal. Fr. Pat. 476,635, Apr. 24, 1914.

Skins are unhaired or dewoolled by immersion for about two hours in a 5% solution of the composition described in Fr. Pat. 435,047 (this J., 1912, 349). The solution should be at a temperature of 30°—35° C. The hair or wool will be found to be perfectly cleaned. This process prevents any tawing effect.—F. C. T.

Leather, fabrics, and paper; Process for waterproofing porous materials, such as ——. J. Magnin. Fr. Pat. 477,767, Feb. 19, 1915.

Paraffin wax may be dissolved without danger of fire or explosion in chloro-derivatives of ethane or ethylene, in oil of turpentine, or in carbon tetrachloride, and porous material waterproofed by immersion in the solution.—F. C. T.

Preparation of spirit lacquers, polishes, leather dressings, insulating materials, etc. from wood tar. Ger. Pat. 290,818. *See* XIII.

XVI.—SOILS; FERTILISERS.

Distilled water and certain toxic solutions; Some relations of plants to ——. M. C. Merrill. Amer. J. Pharm., 1915, 87, 549—555; 1916, 88, 12—22, 71—82, 156—164.

Seeds of Canadian field peas (*Pisum sativum*) and of horse beans (*Vicia faba*) were washed in running water for 24 hours, sterilised in formalin solution (1 : 600) for 15 mins., and then allowed to germinate under moist paper on galvanised iron "hardware cloth" which was placed over shallow enamelled pans filled with tap water. After 4—5 days growth in the greenhouse, the seedlings were well rinsed with pure distilled water, and then transferred to the culture solution. The water used was distilled water re-distilled in presence of permanganate; its specific conductivity was $2{\cdot}064 \times 10^{-6}$. The effect of growing in pure water was to delay the maturing of the plants when they were subsequently transferred to a nutrient solution (Pfeffer's). After 5—10 days in water, the plants never recovered completely, and after 30—40 days they did not recover at all. The growth and longevity of the plants in pure water were promoted by renewing it every 4 days, showing that increased exosmosis was not the cause of inhibited growth. The plants recovered when the water was renewed every 4 days and also much sooner after growing in water than after growing in dilute toxic solutions. The longest period after which recovery was possible was 4—8 days in $N/100$ and 20 days in $N/1000$ magnesium chloride solution, 16 days in $N/1000$ calcium chloride and magnesium chloride, and about 20 days in $N/12800$ sulphuric acid and in $N/400$ caustic potash. Sterilising the distilled water by boiling it for 30 mins. every 4 days had a marked beneficial effect on the growth as compared with growth in unsterilised water, whether renewed at intervals or not—a result probably due to the destruction of bacterial and fungoid growths. Electric conductivity determinations showed that the exosmosis of salts, etc., from the roots of plants in pure water was greatest when the water was renewed. When the water was not changed the conductivity diminished after 1—2 days, owing to readsorption of electrolytes. The conductivity curve of nutrient solution changed inversely with the growth curve of plants growing therein : it fell rapidly for the first 15 days, then remained horizontal, and finally began to rise after 50 days. The exosmosis after 20 days from plants grown in pure water was greater than that from plants which had been initially grown in nutrient solution and then transferred to water, and the roots of the former plants underwent more deterioration. The evidence indicated that the inhibited growth shown by seedlings reared in pure water was neither a consequence of any toxic property possessed by the water, nor the result of increased exosmosis ; it was probably due to bacterial and fungoid action, facilitated by disorganisation of the plant tissues following upon insufficient nourishment.—E. H. T.

XVII.—SUGARS ; STARCHES ; GUMS.

Molasses ; Preparation of a neutral solution of beet —— for inversion by invertase [in the double polarisation method of determining sucrose]. R. Gillet. Bull Assoc. Chim. Sucr., 1916, **33**, 112—116.

The molasses or other product is defecated with basic lead acetate (sp. gr. 1·262), avoiding an excess, and after filtration, the lead remaining in solution is precipitated by oxalic acid, some decolorising carbon being also added, and the liquid filtered. The acidity is neutralised by the addition of an excess of calcium or barium carbonate (preferably the former) in fine powder, the reaction being hastened by repeated shaking until there is no further evolution of carbon dioxide. On filtration a liquid is obtained which s but slightly acid owing to carbon dioxide, and s suitable for the invertase inversion.—J. P. O

Sucrose ; Formation of alcohol in the determination of——by double polarisation, using yeast at 55° C. as hydrolyst. R. Gillet. Bull. Assoc. Chim. Sucr., 1916, **33**, 97—102.

Following O'Sullivan and Tompson's procedure Ogilvie, this J., 1911, 62), the author has investigated the possibility of the formation of alcohol when inversion is effected with yeast. During he heating for 4—6 hours at 55° C. no indication f alcohol formation is obtained ; but if after ydrolysis the inverted solution be allowed to emain in contact with the yeast for more than hours there is a slight formation of alcohol, specially in the case of bottom fermentation brewery and bakers' yeasts, the amount being somewhat greater in solutions of molasses than in those of pure sugars.—J. P. O.

Patents.

Megass ; Treatment of —— [for use as fuel]. H. W. Aitken, Glasgow. Partly from F. W. Bolk, Pekalongan, Java. Eng. Pat. 14,983, Oct. 23, 1915.

Megass as it comes from the cane mills is cut across the grain into lengths of about ¼ inch, and pressed, *e.g.*, for 1—3 mins. under 250 — 700 atmos. Wet steam or hot water at high pressure is next blown through the megass, which is then in condition to be pressed into permanent briquettes without the use of binding materials, *e.g.*, under 1000—1500 atmos. pressure.—J. H. L.

Sugar : Process for extracting —— from low-grade molasses. J. N. S. Williams, Honolulu, Hawaii. Eng. Pat. 16,799, Nov. 29, 1915.

Molasses is evaporated until almost free from water, and stored, *e.g.*, for 2—6 months or longer in barrels, to permit solidification and graining. The product is comminuted in a pug-mill with so much cold water or other liquid that the mass becomes fluid without the grained sugar dissolving, and the sugar is separated centrifugally.—J. H. L.

Syrups ; Clarification of factory and refinery —— by free phosphoric acid. E. Burban. First Addition, dated Dec. 1, 1914, to Fr. Pat. 474,669, Dec. 15, 1913 (this J., 1915, 1107).

The solution of phosphoric acid employed, may be freed from sulphuric acid and other impurities, including traces of arsenic, by treatment with barium sulphide, which decomposes into barium hydroxide and hydrosulphide in presence of water. This method of treatment enables crude chamber sulphuric acid to be used for preparing the phosphoric acid solution. The precipitate formed by treating sugar syrups with phosphoric acid is colloidal in character and may be separated by decantation. Flocculation may be produced by a suitable rise in temperature, and the subsidence of the precipitate may be accelerated by addition, before flocculation, of a heavy, finely divided precipitate such as barium sulphate, by the use of vessels with walls sloping outwards towards the base, and by the maintenance of uniform temperature during subsidence to minimise convection currents. The decolorising action of the precipitate may if necessary be supplemented by the use of animal charcoal, alumina cream, or other colloidal material. The sludge may be freed from sugar by addition of water and successive flocculations and decantations ; the final coagulation may be effected in presence of some granular filtering matter, and if necessary under pressure, the precipitate then passing to a filter-press.

Adhesive resembling gum arabic ; Preparation of an ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,736, Dec. 13, 1913.

Solutions of soluble starch are prepared with the addition of soluble salts of organic acids, such as sulphonic or carboxylic acids, with or without formaldehyde. In the aliphatic series salts of carboxylic or amino acids may be used ; in the aromatic series, the soluble salts of the sulphonic acids of benzene, phenol, and corresponding amino compounds, carboxylic, hydroxycarboxylic, and aminocarboxylic acids ; salts of the sulphonic acids of naphthalene, the naphthols, dihydroxynaphthalenes, naphthylamines, and aminonaphthols.
—J. F. B.

Bleaching beeswax, sugar-cane wax, and the like. Eng. Pat. 5066. *See* XII.

XVIII.—FERMENTATION INDUSTRIES.

[Brewery] mashes ; Acidification of ——. P. Petit. Brasserie et Malterie, 1916, **5**, 505—507.

MALT mashes, for top- and bottom-fermentation beers, were acidified—at the rate of 1 part of acid (reckoned as lactic acid) per 1000 parts of malt—by addition of subsidiary mashes which had been allowed to acidify spontaneously for 22 hours at 50° C. in open vessels. Several different malts were employed and the brews were made on a large scale. The worts were boiled with hops and fermented. In all cases the beers were less stable than similar ones prepared without acidification; when kept at 25° C. they became cloudy within 1—3 weeks owing in most cases to invasion by lactic bacteria, whilst the beer serving as control remained sound. In similar experiments some years ago the author obtained very satisfactory results from acidification, and he concludes that when acidification is carried out as described above, success or failure depends to a great extent on the character of the malt mashed ; there is perhaps most chance of success when the acid mash is added to the main mash at a relatively low temperature.—J. H. L.

Yeast ; Glycerol and other alcohols as nutriment for ——. T. Bokorny. Allgem. Brauer- u. Hopfenzeit., 1916, **56**, 177—180, 195—196. Z. angew. Chem., 1916, **29**, Ref., 191.

IT is possible to use glycerin as a partial substitute for sugar (molasses) in the production of fodder yeast (cp. Hayduck, this J., 1916, 138, 323). Glycerin and sugar together produce a greater weight of dried yeast than sugar alone, provided the concentration of the glycerin is not too high. In the absence of sugar the yeast can subsist on glycerin as sole carbonaceous food. Other alcohols and phenols investigated by the author are not readily assimilated by yeast.—J. H. L.

Yeast ; Protein and proteolytic enzymes of ——. T. Bokorny. Allgem. Brauer- u. Hopfenzeit., 1915, **55**, 1653—1655. Z. Angew. Chem., 1916, **29**, Ref., 194.

IN experiments on the production of yeast albumose, one-quarter of the total protein of 20 grms. of yeast was converted into albumose by 50 c.c. of $N/1$ or 500 c.c. of $N/10$ sulphuric acid, but $N/100$ acid did not attack the yeast protein. Compared with sulphuric acid, ammonia at equivalent concentrations produced relatively little albumose. The formation of peptone from albumin is effected much more rapidly by animal pepsin than by the proteolytic enzymes of yeast (cp. this J., 1915, 628). Digestion carried out by yeast is characterised by the formation of dark products, reminiscent of meat extracts, which often have a sharp flavour and render the liquid yellow or even dark red. —J. H. L.

Carboxylase. A. Bau. Woch. Brau., 1915, **32**, 405—406.

THE author has repeated his recent tests for carboxylase in beer and dried yeasts (cp. this J., 1915, 1025, 1158), using pyruvic acid solutions containing buffer-salts (cp. Neuberg, this J., 1915, 1265) instead of pure solutions of pyruvic acid or its sodium salt. Carboxylase was found present in three out of the four dried yeasts, but none was found in beer, fermenting wort, or wash waters from yeast. It appears therefore incapable of diffusing from yeast cells into the surrounding liquid so long as the cells remain intact.—J. H. L.

Enzyme action, fermentation, and growth ; Influence of temperature and poisons on ——. O. Rahn. Biochem. Zeits., 1916, 72, 351—377. J. Chem. Soc., 1916, **110**, i., 295—296.

THE action of an enzyme on a substrate has a normal temperature-coefficient ; the higher the temperature, the greater the activity. At the higher temperatures, however, the amount of enzyme rapidly diminishes, and the increased activity acts in opposition to the destruction of the enzyme. The rate of change of the latter process is greater than its increased activity with rise of temperature. At high temperatures it is therefore possible to observe a great initial rate of action, which after a few minutes, or even seconds, comes to a standstill. There is no "optimal" temperature for enzyme action. Enzyme actions are, generally, incomplete actions, which can approach completion at the lower temperatures, and the end-point recedes with higher temperatures. In a fermentation system (for example, with yeast cells) the enzymes are inside the cells as well as outside. The living cell, however, produces continually new quantities of enzyme to replace those destroyed. As the temperature-coefficient of cell destruction is high, a point is reached at which the part destroyed is no longer replaced entirely by that newly-formed. As a consequence the rate of fermentation, which at the start is very rapid, quickly falls off. In fermentation produced by a living cell there is a true optimal temperature, and it is that at which the rate of production of new enzyme is equal to the rate of destruction. Similar considerations can be applied to growth. Poisons accelerate both the rate of action and rate of destruction of enzymes.

Grapes ; Autolysis of ——. E. Pantanelli. Staz. Sperim. Agrar. Ital., 1915, **48**, 783—821. Bull. Agric. Intell., 1916, **7**, 136—139.

WHEN mature grapes are hung in air or in air containing a small quantity of chloroform vapour, formalin, or thymol, auto-digestion of the albumin takes place with the formation of soluble nitrogenous compounds which are not precipitated by cupric hydroxide ; the sugars and acids present are decomposed to a slight extent. The quantity of sugars and acids is decreased to a considerable extent when the grapes are suspended in water free from extraneous micro-organisms. Under anaërobic conditions, whole grapes form alcohol by intercellular respiration of the sugar without the intervention of alcoholic ferments. Mature grapes immersed in water lose their soluble constituents (soluble nitrogenous compounds, sugars, acids, alcohol, etc.) and this loss is increased after the "death" of the grapes, thus facilitating intracellular digestion of the albumin, insoluble carbohydrates, etc. There is greater dissolution and separation of the substances suitable for use by the ferments than occurs during the pressing of grapes. (See also this J., 1915, 645.)—W. P. S.

Rum ; Micro-organisms of ——. E. Kayser. Comptes rend., 1916, **162**, 647—649. (See also this J., 1915, 505, 975.)

TWO yeasts isolated from rum, *viz.*, a bottom-fermentation yeast and a *Schizosaccharomyces*, differing very widely in their capacity for producing higher alcohols during the fermentation of cane molasses worts, were found to manifest a similar difference in beet molasses worts ; the bottom-fermentation yeast produced 7—10 times as much higher alcohols as the *Schizosaccharomyces*. By employing these two yeasts together, seeding them in different amounts or one before the other, it is possible to vary the yield of fermentation products other than ethyl alcohol between the limits of 30—300 mgrms. per 100 grms. of alcohol. By similar means the manufacturer of rum can control the production of higher alcohols and esters.—J. H. L.

Liqueurs ; Determination of essential oils [essences] in ——. A. Bonis. Ann. Falsif., 1916, **9**, 12—14.

THE liqueur is distilled and the distillate is divided into two equal parts; in one the iodine value is determined (see this J., 1915, 413), whilst the other portion serves for the gravimetric determination of the essential oils (see this J., 1916, 432). The weighed residue of essential oil is then dissolved in a mixture of alcohol and water so that the volume and alcohol content of the solution shall be the same as those of the distillate, and the iodine value is again determined. The quantity of essential oils in the liqueur in then calculated from the results obtained. It is claimed that the results obtained are more reliable than those found by the iodine method or by the gravimetric method alone.—W. P. S.

Liqueurs; Determination of essential oils [*essences*] *in* ——. L. Ronnet. Ann. Falsif., 1916, **9**, 14—16.

Aniseed essence and Chartreuse essence (see Muttelet, this J., 1916, 432) have iodine values of 1·68 and 1·66, respectively; the mixtures of essential oils distilled from liqueurs prepared with these essences have practically the same values, so that the latter may be used as coefficients in calculating the essential oil content of the liqueurs. For other liqueurs, the iodine value or coefficient will, of course, depend on the nature of the essential oils present; if this is not known, or a specimen of the actual essence is not available for the determination, the essential oils may be extracted from the liqueur as described by Muttelet (*loc. cit.*) and their iodine value then determined. The iodine value expresses the quantity of iodine (in grms.) absorbed by 1 grm. of the oil.—W. P. S.

Liqueurs; Determination of essential oils (essences) in ——. *Peppermint liqueur.* C. F. Muttelet. Ann. Falsif., 1916, **9**, 70—73.

A method described previously by the author (this J., 1916, 432) yields reliable results when applied to the determination of total essential oil in peppermint liqueur. Owing to the fact that menthol does not absorb iodine, the official (French) method, which depends on the iodine absorption of the sample, is not capable of indicating the presence of added menthol in this liqueur. If, however, the essential oils are separated as described and their iodine absorption is determined, the presence or absence of added menthol is indicated.—W. P. S.

Hydrolysis of vegetable proteins by papain. Deleanu. *See* XIXa.

Patents.

Beer; Method of preparing ——. O. M. Lamsens, Detroit, Mich. U.S. Pat. 1,177,117, Mar. 28, 1916. Date of appl., Apr. 17, 1915.

By lowering the temperature of yeast while in contact with beer, a sufficient amount of proteolytic enzymes is liberated from the yeast to prevent coagulation of proteins when the beer is chilled. —J. H. L.

Sawdust or other materials containing cellulose; Treatment of —— *to increase the yield of alcohol and facilitate the recovery of by-products.* P. L. F. Nicolardot. Fr. Pat. 476,696, May 2, 1914.

In the treatment of sawdust, or other material containing cellulose, with the object of producing alcohol and organic by-products, the vapours which escape when the digesters are opened are condensed in contact with alkaline-earth carbonates, which retain the acids but allow aldehydes, etc., to pass. The large proportion of organic acids remaining in the liquor in the digesters, which hinders the fermentation of the dextrose, is almost entirely removed by vacuum distillation. The acid vapours are absorbed in milk of lime in large receivers acting as vacuum accumulators.—F. Sp.

Alcohol; Manufacture of ethyl —— *from cellulosic substances.* E. Gazagne and R. de Demuth. Fr. Pat. 477,077, May 23, 1914.

Peat, sawdust, or similar material, is saccharified by heating under pressure with mineral acid, and then systematically extracted with hot water or vinasse in a battery of extraction vessels. To ensure a good fermentation, complementary saccharifiable matters, relatively rich in nitrogen and phosphorus, are added to the charge in the autoclave, or they may be saccharified separately and added to the juice after extraction. Before fermentation the juice is neutralised solely or in part with ammonium or alkali hydroxides or salts. The yeast employed is specially acclimatised to juices from cellulosic materials containing tannins. —J. H. L.

Butyl alcohol; Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 289,687, Oct. 2, 1914.

Molasses is fermented by *Bacillus butylicus.* —J. H. L.

Plastic masses [*from yeast*]; *Manufacture of* ——. H. Blücher, Leipzig, and E. Krause, Steglitz, Germany. Eng. Pat. 11,563, Aug. 10, 1915. Addition to Eng. Pat. 76, Jan. 1, 1914 (this J., 1915, 972).

See Ger. Pat. 289,597 of 1915; this J., 1916, 130.

Application of bacterial diastases to the textile industries. Addition to Fr. Pat. 475,131. *See* V.

XIXa.—FOODS.

Milk; Experiments on the prolonged pasteurisation of ——. C. Barthel. Kungl. Land.-Akad. Handl. Tidskr., 1915, **50**, 610—648. Bull. Agric. Intell., 1916, **7**, 143—146.

Experiments with the "holder" process (see this J., 1916, 323) yielded very satisfactory results. Heating milk at 145° F. (63° C.) did not affect the albumin, soluble phosphates, or enzymes, with the exception of amylase, which was destroyed at a relatively low temperature; about 95% of the micro-organisms in the milk was destroyed. Milk from cows suffering from mammary tuberculosis was pasteurised by the process mentioned above and then given to guinea pigs; none of the animals became infected. Other guinea pigs fed on the non-pasteurised milk were all attacked by tuberculosis.—W. P. S.

Milk; Detection of added water in —— *by a simplified molecular concentration constant.* L. Mathieu. Ann. Falsif., 1916, **9**, 15—48.

Since recording results obtained previously (see Mathieu and Ferre, this J., 1914, 214) the author has determined the molecular concentration constant of 93 samples of milk; the maximum value obtained was 82·2, the minimum, 72·9. The higher value is generally found during the summer, and it is recommended that the maximum limit should be fixed at 83 instead of 79 as found in the first set of experiments.—W. P. S.

Fat in milk; Influence of the proportion of —— *on that of the solids-not-fat.* C. Porcher. Ann. Falsif., 1915, **8**, 385—397.

Successive fractions of milk from the same milking show progressive increase in the amount of fat and decrease in the amount of solids-not-fat. The wide variations between the extreme figures are greatly reduced by calculating the solids-not-fat upon the fat-free milk by means of the formula :—

$$X = \frac{Y \times 1000}{1000 - (F \div 0.92)},$$

where X represents the corrected solids-not-fat, Y the crude solids-not-fat, F the fat of sp.gr. 0·92, per litre of milk. For example, the crude solids-not-fat in the fractions of one sample of milk ranged from 107·13 to 100·65, the corresponding corrected figures being 109·31 and 105·50. This correction should always be made when drawing deductions as to the watering of milk.—C. A. M.

Fat in cream ; Determination of ——. L. Lindet. Ann. Falsif., 1915, 8, 291—294.

One drop of the cream (about 0·04 c.c.) is delivered from a standardised pipette on to the surface of a piece of paper. At the same time ten weighed particles of butter freed from water (about 0·01 grm. each) are placed at intervals on the surface of a second piece of paper from the same sheet, and the two pieces are left for 2 to 3 hours in an oven at 105° C. The diameters of the stains are then measured, in two directions if necessary, and the proportion of fat in the cream calculated from the relative areas. For example, if the ten pieces of butter weighed 0·102 grm. and the stains covered a total area of 96·75 sq. cm., 0·001 grm. of butter covered 0·948 sq. cm. Then if the stain from the cream (0·044 c.c.) covered an area of 9·60 sq. cm., the cream contained 0·0101 grm. of fat (=22·9%). The method is not applicable to milk or cheese.—C. A. M.

Indole in cheese. V. E. Nelson. J. Biol. Chem., 1916, 24, 533—536.

Indole was found in minute quantities in Limburger and Camembert cheese, and in the former phenolic substances were also present. In no cheeses was scatole detected, and in other varieties than the above, such as Cheddar, Swiss, etc., indole was likewise absent. The presence of indole seems not to be due to the *B. acidi lactis* or *B. bulgaricus*, since when these organisms were grown in a medium containing tryptophane no indole was formed.—G. F. M.

Vegetable proteins ; Hydrolysis of —— by papain. N. T. Deleanu. Bull. Sci. Acad. Roumanie, 1915—1916, 4, 207—216. J Chem. Soc., 1916, 110, i., 296.

Various vegetable proteins when heated rapidly with papain are hydrolysed, and yield proteose, peptones, and amino-acids. Some of the proteins can be degraded into amino-acids at any temperature, whereas in the case of others the hydrolysis only takes place at medium temperatures not exceeding 45° C. Coagulated proteins are attacked with greater difficulty than the uncoagulated, but the products of degradation are the same in both cases. Animal proteins, either coagulated or dried, are not attacked by papain. The proteins of seeds of lupins, when treated with papain, do not yield arginine, as they do on autolysis or germination.

Spices ; Analysis of ——. C. Arragon. Ann. Falsif., 1915, 8, 345—346.

Water :—20 grms. of the spice is distilled with 60 c.c. of oil of turpentine (b.pt. 140° to 160° C.), and the distillate collected in a narrow cylindrical vessel, holding about 50 c.c. and graduated in twentieths of a c.c. After centrifuging for 15 mins. the vessel is immersed in water at 15° C., and the volume of water read. *Essential oil and fat* :—10 grms. of the powdered spice is dried for 6 hours over sulphuric acid in a desiccator, and extracted with anhydrous ether. The extract is slowly distilled (1 drop per second) until the residue is of syrupy consistence, and the remainder of the ether is then expelled by gently warming the flask and introducing a current of air. The residue of essential oil and fat is weighed, and the former removed by distillation with steam. *Starch* :—2 grms. of the spice is boiled for 1½ hours beneath a reflux condenser with 150 c.c. of water and 15 c.c. of hydrochloric acid (sp. gr. 1·125). After cooling, the liquid is neutralised with 10% sodium hydroxide solution, treated with 5 c.c. of basic lead acetate solution, made up to 250 c.c. and filtered, and 25 c.c. of the filtrate boiled with 60 c.c. of Fehling's solution and 60 c.c. of water. The amount of dextrose found multiplied by 0·90 gives the quantity of reducing substances calculated as starch.—C. A. M.

Determination of nitrogen in saffron as a means of detecting adulteration. Pierlot. *See* IV.

Glycerol and other alcohols as nutriment for yeast. Bokorny. *See* XVIII.

Protein and proteolytic enzymes of yeast. Bokorny. *See* XVIII.

Patents.

Pectous compounds ; Manufacture of ——. R. Douglas, Rochester, N.Y., U.S.A. Eng. Pat. 6497, April 30, 1915.

To prevent starch producing a turbidity in concentrated pectin solution (see Eng. Pat. 12,438 of 1913 ; this J., 1914, 763), the latter, before concentration, is treated at 135° F. (57° C.) with a suitable quantity of malt extract until the starch is converted. The solution is then filtered and concentrated.—W. P. S.

Roots and rhizomes containing sugar ; Produc manufactured by roasting ——. J. Giband and O. I. Bang. Fr. Pat. 477,284, Jan. 13, 1915.

Claim is made to a product prepared by roasting beetroots, Jerusalem artichokes, carrots, etc. with or without coffee, it may be consumed in the form of aqueous infusions.—J. H. L.

Beverage extracts ; Manufacture of ——. J. L Kellogg, Battle Creek, Mich., U.S.A. Eng. Pat 349, Jan. 8, 1915. Under Int. Conv., Jan. 28, 1914

See U.S. Pat. 1,097,720 of 1914 ; this J., 1914, 803

Milk ; Preparation of dried ——. Casein, Ltd Fr. Pat. 476,719, Dec. 11, 1914. Under Int Conv., July 1, 1914.

See Eng. Pat. 1409 of 1914 ; this J., 1915, 149.

XIXb.—WATER PURIFICATION ; SANITATION

Water ; Indicators for the determination of temporary hardness in ——. J. F. Norton and H. I Knowles. J.Amer.Chem.Soc., 1916, 38, 877—881

Comparative experiments with methyl red, sodium alizarinsulphonate, methyl orange, lacmoid phenacetolin, and "butter-yellow" (dimethyl aminoazobenzene) on waters of known composition showed that the bicarbonate alkalinity (temporary hardness) is best determined by titration in presence of the last-named indicator The titration is performed so that the colou matches that of a standard (containing the same amount of indicator) which is prepared by adding 0·1 c.c. of an alcoholic solution of "butter-yellow" (2 : 1000) and 0·40 c.c. of *N*/50 sulphuric acid to 100 c.c. of distilled water. Lacmoid gave the best results in the presence of alum, but low value in determining bicarbonates ; its use is not recommended where the alkalinity exceeds 100 parts pe million.—F. Sodn.

Night-soil ; Treatment of ——. F. Garrigou. Comptes rend., 1916, **162**, 649—651.

The following process has given satisfactory results on a small scale, *e.g.*, in vessels of 1 cubic metre capacity. The liquid and solid portions are treated separately. The urine is fermented until the urea and purine compounds have been transformed into ammonium carbonate, and this is then decomposed by addition of finely powdered calcium sulphate. The calcium carbonate formed is allowed to subside and the supernatant liquid, which is free from disagreeable odour, may be concentrated for the recovery of ammonium sulphate. The calcium carbonate sludge contains organic matter and may be used as a fertiliser. The solid matters of the sewage, after being compressed if necessary, are heated in an autoclave for 15 mins. at 140°—150° C. The steam is then allowed to escape through condensing coils, and the ammonia carried off with it is absorbed in acid. The residue in the autoclave forms a dry pulverulent fertiliser and is quite sterile.—J. H. L.

Patents.

Sewage ; Tanks for the purification of ——. G. W. and J. F. Naylor, Denby Dale, Yorks. Eng. Pat., 9870, July 7, 1915.

In tanks for the purification of sewage wherein air is forced through porous tiles, the latter are arranged at the bottom of the tank in continuous rows, curves, or circles in such a manner as to enclose areas which are available for the deposition of sludge.—W. P. S.

Purifying liquids : Apparatus for ——. L. M. Booth, Plainfield, N.J. U.S. Pat. 1,177,167, Mar. 28, 1916. Date of appl., June 30, 1914.

A cylindrical tank is provided with a segmental reaction compartment in its upper portion, the lower part of the tank, which is of relatively large cross-sectional area, being employed as settling space. A pipe or conduit discharges the liquid from the reaction compartment at a point near the bottom of the settling compartment.
—J. B. C. K.

Filtering cells ; Manufacture of ——. A. Hambloch, Andernach, and C. Mordziol, Coblenz. Ger. Pat. 290,961, May 7, 1915.

Porous lava, with or without addition of pumice or grog (burnt fireclay) and substances such as clay, ime, or magnesia, capable of improving the plasticity, is mixed with trass mortar, moulded, and burnt. The cells thus produced have coniderable strength and are specially suitable for iltering drinking water.—A. S.

XX.—ORGANIC PRODUCTS ; MEDICINAL SUBSTANCES ; ESSENTIAL OILS.

Morphine hydrochloride, standardised morphine hydrochloride solution, and morphine syrup ; Analysis of ——. M. François and E. Luce. Ann. Falsif., 1916, 9, 83—90.

N addition to the determination of moisture and morphine in morphine hydrochloride, it is recommended that the hydrochloric acid be also determined, since this will give the molecular weight f the base and indicate whether or not other rganic bases are present. The hydrochloric acid s determined by titrating a solution of the dried ample with silver nitrate, using potassium chromate as indicator. The strength of morphine ydrochloride solution may be determined by vaporating from 20 to 40 c.c. of the sample, nd weighing the residue after it has been dried t 100° C. for 2 hours ; a determination of the ydrochloric acid is also of advantage in this case. A method proposed for separation of morphine (for the purpose of identification) from morphine syrup depends on the formation of morphine periodide. 50 grms. of the syrup, 50 grms. of water, 20 grms. of sodium sulphate, and 0·5 grm. of finely-divided asbestos are placed in a flask and 50 c.c. of $N/10$ iodine solution is added. The morphine periodide formed adheres to the asbestos and, after 30 mins., the latter is collected on a cotton-wool filter, the periodide then dissolved in sulphurous acid, the solution rendered slightly ammoniacal, and the morphine extracted with amyl alcohol. The amyl alcohol solution is shaken with dilute hydrochloric acid, the acid solution is separated and evaporated, and the usual tests are applied to the residue. To determine morphine in morphine syrup, 10 c.c. of the sample is treated with 1 c.c. of $N/10$ iodine solution ; after 5 mins., 1 c.c. of concentrated ammonia is added and, after a further 45 mins., the brown-red coloration is compared with that produced under the same conditions by 10 c.c. of a syrup of known morphine content.—W. P. S.

Cinchona alkaloids ; Variation of the mutual influence of —— *on their optical rotatory power as a function of the temperature.* C. Montemartini, and F. Bovini. Gaz. Chim. Ital., 1916, **46**, I., 153—171.

If two cinchona alkaloids be present together in solution, either in the free state or as salts of the same acid, the rotatory power of the mixture at the ordinary temperature is not equal to the sum of the rotatory powers of the two components. If by varying the conditions this mutual influence could be annulled, it would be possible from determinations of the rotatory powers of different salts of a mixture of cinchona alkaloids, to calculate the proportions of the various alkaloids present. With this object in view the authors undertook the determination of the rotatory powers of the various cinchona alkaloids and their salts, alone and in admixture, at different temperatures, in order to ascertain if at a particular temperature the observed and calculated rotatory powers of the mixtures were identical. Experiments with the dihydrochlorides and bisulphates of quinine and cinchonine are described in the present paper. The results obtained show that the specific rotatory power of the alkaloid salts mentioned decreases with rise of temperature, as also does the difference between the observed and calculated rotatory powers in the case of the mixtures. With the dihydrochlorides this difference is negligible at about 91° C., but in the case of the bisulphates, a notable difference between the observed and calculated values persists even at the higher temperatures.
—A. S.

Digitalis seeds : Glucosides of —— *and their decomposition products.* H. Kiliani. Ber., 1916, **49**, 701—721.

The following method is simpler and cheaper than the author's earlier method (this J., 1901, 1234) for the separation and isolation of *Digitalis* glucosides. One part of *Digitalinum germanicum* is dissolved in 4 parts of water, and the solution is mixed first with 0·8 part of 95 % alcohol and then with amyl alcohol (10 c.c. for each 100 grms. of *Dig. german.*), and allowed to stand. After 24 hours the pasty mass is transferred to a large suction filter, avoiding agitation. The residue on the filter is washed with a small quantity of water to which 10 % of alcohol by weight is added, and dried on a porous plate *in vacuo*. The yield of crude digitonin is 44—45 %. The mother liquor is evaporated at 35° C., the residue dried *in vacuo*, warmed gently with 4 parts of 95 % alcohol, cooled, and 2 parts of ether added gradually, with constant agitation. After 36—48 hours the supernatant solution is separated and treated as described previously (this J., 1914, 1071) for the recovery of *Digitalinum verum.* The crude digitonin is dissolved in 5 parts of boiling 85% alcohol, allowed to crystallise, and the crystals (A) separated after 2 days and washed with 85% alcohol. The mother-liquor is evaporated, the residue dissolved in 6 parts of 50% alcohol, the solution allowed to stand for 8 days, and the deposit (B) which forms is separated. The crystals (A) are dried *in vacuo*, dissolved in 10 parts of 50% alcohol, and the solution allowed to crystallise. The crust (A_1), composed of gelatinous granules, which separates at first (24 hours) is removed, and after a further period of several days the digitonin crystals are separated and purified by washing with 50% alcohol. The evaporation residue of the mother liquor when dissolved in 50% alcohol and treated again as described, yields a granular crust (A_2) and a further quantity of digitonin. The deposit (B) and crusts (A_1 and A_2), dried *in vacuo*, are dissolved in 14 parts of hot 60% methyl alcohol. On cooling, pure gitonin (see Windaus and Schneckenburger, this J., 1913, 988) separates. The mother liquor is evaporated at 35° C., and the residue dissolved by treating first with 6 parts of pure methyl alcohol and then adding 4 parts of water, and warming. On standing, a new glucoside separates from the solution. It sinters at 220° C., and melts at 225°—230° C., and is sparingly soluble in 85% alcohol, even on boiling.

The preparation of the methyl and ethyl esters of digitogenic acid is described; the analytical results for these esters indicate that their formation is accompanied by elimination of a third molecule of water in addition to the two corresponding to the normal esterification process. By the oxidation of digitogenic acid with a hot mixture of chromic and sulphuric acids, a crystalline tribasic acid, $C_{16}H_{24}O_7$, was obtained, together with at least two other acids.—A. S.

Lemongrass oil; Citral content of ——. Perf. and Essent. Oil Rec., 1916, **7**, 95.

Bourbon lemongrass oil of sp.gr. 0·889 and citral content 78%, after keeping three years in a previously opened tin and also in a tin not previously opened, showed a diminution of citral content to 60% and 68% respectively, the specific gravity increasing to 0·895 and 0·892. Cochin lemongrass oil on keeping showed a similar diminution of citral content, whilst the increase in specific gravity was still more pronounced. To prevent such changes lemongrass oil should be thoroughly dried before storage and be kept in completely filled vessels without access of light or air.—T. C.

Geranium oils; Distinguishing tests for Algerian and Bourbon ——. Perf. and Essent. Oil Rec., 1916, **7**, 91.

The principal characters by which Algerian and Bourbon geranium oils may be distinguished are the specific gravity, the percentage of esters, the refractive index, and the ratio of citronellol to total alcohols. Algerian oil has usually sp.gr. 0·897 to 0·902, whilst Bourbon oil has sp.gr. 0·888 to 0·896, the lower specific gravity of the latter being probably due to the higher proportion of citronellol esters present. Algerian oil contains usually 21% to 26% of esters, whilst the finest Bourbon oil contains 29% to 38%; the refractive index of the former oil is usually near to 1·470, whilst that of the latter is usually below 1·466. Algerian oil contains 74% of total alcohols, including 33% of citronellol, whilst Bourbon oil contains 73% of total alcohols, with 44% of citronellol.—T. C.

Eucalyptus Smithii; Essential oil of —— from various forms of growth. H. G. Smith. J. Roy. Soc. New South Wales, 1915, **49**, 158—168. J. Chem. Soc., 1916, **110**, i., 272—273.

As the time seems to be approaching when a choice will have to be made of the best species of eucalypts for cultivation, attention is called to *E. Smithii*, the leaves of which produce one of the best cineol-pinene eucalyptus oils yet examined. The tree is valueless for timber, but is remarkably vigorous, and seems to flourish after repeated loppings. Indeed, it is best to cultivate the "suckers" which rapidly grow out of the stumps of the felled mature trees, as these produce more leaves and are more easily harvested. The oil contains a very high percentage of cineol, also pinene, a phenol (*d*-eudesmol, m.pt. 79° C.), a paraffin (m.pt. 64° C.), a small quantity of esters and of a sesquiterpene, and a small amount of volatile aldehydes which soon disappear and change into agreeable sweetbriar-like perfumes. The oil is almost free from objectionable constituents, and may be purified without distillation, merely by shaking it with very dilute sulphuric acid for some hours and then with anhydrous sodium carbonate. Cultivated trees can be profitably cut at three years old, and then every two years.

Essential oils; Determination of the iodine value of ——. R. Marcille. Ann. Falsif., 1916, **9**, 6—11.

Determinations of the iodine value of a large number of essential oils, under the conditions given previously (see this J., 1915, 443), showed that exposure to light has a considerable influence on the iodine absorption. In the cases of aniseed and star-aniseed oils the iodine value was higher when the mixture of oil and Hübl reagent was exposed to light than when the absorption took place in the dark. With all other oils (bergamot, orange, cinnamon, caraway, lemon, coriander, cumin, eucalyptus, juniper, clove, hyssop, balm-mint, mint, neroli, turpentine), exposure to light diminished the iodine value. Oil of fennel sometimes showed a higher iodine value when the reacting mixture was exposed to diffused light. In the case of aniseed oil the iodine value was 1·36 in the dark and 1·84 in bright light; the decrease in the value for the other oils in some cases amounted to over 50% of the value determined in the dark. In determining the iodine value of essential oils, the time of contact with the Hübl reagent should be prolonged for more than 3 hours; 12 hours' contact is recommended. Attention is drawn to the fact that the iodine value decreases when an essential oil is kept for some time exposed to air and light; the iodine value of a specimen of aniseed oil fell from 1·25 to 0·24 when the oil was kept in a thin layer in a corked flask for 6 months.—W. P. S.

ω-Sulphonic acids of p-aminophenyl salicylate and their derivatives. J. Abelin and M. Perelstein. Annalen, 1916, **411**, 216—244.

ω-Sulphonic acids of amines, having the general formula $R{\cdot}NH{\cdot}CHR'{\cdot}O{\cdot}SO_2H$, (in which R=alkyl or aryl, R′=hydrogen, alkyl, or aryl) are most easily obtained by treating aldehyde or ketone bisulphites with amines. The addition of sodium acetate assists the reaction, but it must not be used if the product is sensitive to alkali. Primary amines react more readily than secondary amines. Of the two possible formulæ, $R{\cdot}NH{\cdot}CHR'{\cdot}SO_3H$ and $R{\cdot}NH{\cdot}CHR'{\cdot}O{\cdot}SO_2H$, the latter is the more probable on the following grounds: (1) The products of reduction with metal and acids reduce indigo-carmine strongly on warming, probably owing to the formation of sulphoxylates. (2) The $—O{\cdot}SO_2Na$ group is easily replaced by the —CN radicle. (3) The alkylene radicle is easily split off in the form of an aldehyde, *e.g.*, ω-methylsulphonic acids and their salts give Schryver's reaction for formaldehyde (this J., 1909, 956). *p-Aminophenyl salicylate ω-methylsulphonic acid* is prepared by heating on the water bath 10 grms. of *p*-aminosalol, suspended in a little water, and a concentrated solution of 80—100 grms. of formaldehyde sodium-bisulphite, until complete solution takes place. The sodium salt of the acid separates on cooling, and yields the acid when acidified. It forms colourless needles, insoluble in water, decomposing at 134° C. Its alkali salts are strong bactericides, owing to the separation of formaldehyde. They also increase the solubility in water of various xanthine derivatives, *e.g.*, caffeine, theophylline. The acid forms salts with various organic bases, but when treated with antipyrine, sulphur dioxide is evolved, and the compound obtained is a salt of the acid with *p*-aminosalol. An attempt to prepare the acid by condensing salicylic acid with *p*-aminophenol-ω-methylsulphonic acid in the presence of phosphorus oxychloride, failed owing to the reaction between the two latter on heating. The stability of the ω-alkyl- or aryl-sulphonic acids of aromatic amines decreases with increasing molecular weight of the aldehyde component.—F. Sp.

Analysis of spices. Arragon. *See* XIXa.

Patents.

Therapeutic compounds [*chloralisovaleramide and butylchloralisovaleramide*]; *Manufacture of* ——. J. Longman, London. Eng. Pat. 5113, Apr. 1, 1915.

Chloralisovaleramide is prepared by heating a mixture of isovaleramide, 26, and chloral hydrate, 43·4 grms., at 90°—95° C. for 1 hour; the mixture first melts and then re-solidifies. The product is re-crystallised from benzene; it melts at 135°—136° C., is slightly soluble in water and readily soluble in alcohol and in ether. The corresponding butylchloral compound is obtained by heating a mixture of isovaleramide, 25, and butylchloral hydrate, 49 grms., at 105°—113° C. for 90 mins. The product, re-crystallised from benzene, melts at 126°—127° C., and is soluble in ether and alcohol, but only with difficulty in water. Both these compounds possess sedative but not hypnotic properties.—W. P. S.

Perfumes: *Extraction of* —— *and their subsequent incorporation in various bodies.* E. Landry, Deroy Fils Aîné, and J. Rennotte. Fr. Pat. 477,267, June 8, 1914.

Extraction is effected by liquid carbon dioxide or a similar non-poisonous, inodorous substance which is gaseous at ordinary temperatures. By evaporating off the solvent at a low temperature the loss of perfume or essence is reduced to a minimum. Where desired, as for instance with coffee, the extract thus obtained is mixed with an aqueous extract of the residue from the carbon dioxide treatment.—B. V. S.

Hydroxy-compounds; *Process of treating* —— *with acetylene and new industrial products* [*diolefines*] *arising therefrom.* G. Boiteau. Fr. Pat. 477,560, Feb. 19, 1914.

The action of acetylene on hydroxy-compounds, particularly alcohols, by heating in the presence of a catalyst such as a mercury salt, produces ethers which have not so far found industrial application. By dehydrating these ethers, for instance by heating them with various oxides, silicates, sulphates, or phosphates, useful substances are obtained, some of which are new. From primary and secondary alcohols diolefines are obtained. For example, methyl alcohol and acetylene give $C_4H_{10}O_2$, which on dehydration loses 2 mols. of water, giving butadiene.—B. V. S.

Aldehyde-ammonia; *Preparation of* ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 290,808, Apr. 30, 1914.

Ammonia and acetaldehyde are mixed at low temperatures either as such or in concentrated aqueous solution, the ammonia always being kept in excess. Good yields of aqueous solutions of aldehyde-ammonia are obtained. The compound may be used as an accelerator in the vulcanisation of natural or synthetic rubber.—F. W. A.

Salts of fatty acids: *Process for producing* ——. J. Ederer, Wildau, Assignor to Holzverkohlungs-Ind. A.-G., Constance, Germany. U.S. Pat. 1,178,223, Apr. 4, 1916. Date of appl., Apr. 6, 1914.

See Ger. Pat. 272,036 of 1913; this J., 1914, 568.

Preparation of substituted quinoline-4-carboxylic acids. Ger. Pat. 290,703. *See* III.

Preparation of selenophthaleins and their halogen-derivatives. Ger. Pat. 290,540. *See* IV.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Exposure in photography; *Process for reduction of time of* ——. L. Paris and G. Picard. Fr. Pat. 477,173, May 29, 1914.

Phosphorescent substances, such as calcium and zinc sulphides, are either incorporated in the sensitive film or emulsified with gelatin or a varnish and coated on the sensitive surface or on a separate support.—B. V. S.

Local reduction, intensification or colouring of photographic images; *Process for* ——. Klimsch u. Co., Frankfort. Ger. Pat. 290,719, Nov. 29, 1913.

Solutions of the required reagents are made, either in a viscous solvent or in aqueous solution, thickened by the addition of substances such as gum arabic, gelatin, common salt, or preferably glycerin. Such solutions, when applied locally to a photographic film, penetrate the film without running or spreading.—B. V. S.

Tellurium toning-bath for photographic silver images. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 290,720, Feb. 17, 1915. Addition to Ger. Pat. 271,041 (this J., 1914, 503).

Solutions of tellurium dioxide, or of tellurous or telluric acid, in alkali sulphide solution are used. —B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Glyceryl trinitrate (*nitroglycerin*); *Vapour pressure of* ——. A. Marshall and G. Peace. Chem. Soc. Trans., 1916, **109**, 298—302. (Compare this J., 1904, 158.)

The vapour pressure of nitroglycerin was determined by passing dry air through a tube containing powdered cordite, the objections to the determination previously made by bubbling air through liquid nitroglycerin that the air might not have been fully saturated and that globules of liquid might have been mechanically carried over being thereby obviated. The cordite was placed in a U-tube in a thermostat, and the air was led thence into a condensing tube immersed in a cooling mixture, and the weight of nitroglycerin condensed determined by direct weighing. The following values for the vapour pressure in mm. at various temperatures are selected from the results obtained:—20° C., 0·00026 mm.; 30°, 0·00083 mm.; 40°, 0·0025 mm.; 50°, 0·0072 mm.; 70°, 0·041 mm.; 80° C., 0·098 mm.—G. F. M.

Blackening of yellow phosphorus. Rae. *See* VII.

Patents.

Explosives and other analogous substances; Process and apparatus for drying ——. E. I. Dupont de Nemours Powder Co. Fr. Pat. 477,343, Jan. 22, 1915.

The material is treated with a hot liquid, preferably without solvent action upon it, and having a relatively high ignition point. Thus, in the case of smokeless powder, oil at, say, 100° C. is made to circulate through the material, while the vapours liberated are condensed. Subsequently the oil is extracted from the powder and the residue washed with a suitable solvent (acetone, etc.). A stabilising agent, such as diphenylamine, may be dissolved in the oil to prevent it from dissolving diphenylamine, etc., present in the powder. The apparatus comprises a receptacle, with or without steam jets, connected with a condenser, with a tank for heating the oil and means for circulating the oil; or two chambers may be connected with the oil tank, with means for transferring the material from one chamber to the other.—C. A. M.

Explosives: Manufacture of ——. Palmer-Perchlorate Powder Co. of Canada, Ltd. Fr. Pat. 477,678, Feb. 13, 1915.

Ammonium perchlorate (say 82 kilos.), with or without potassium perchlorate, is mixed with zinc powder (10 kilos.) and combustible carbon compounds not reducible by zinc, *e.g.*, petroleum jelly (5 kilos.) and asphaltic pitch such as is left as a residue in the distillation of petroleum (3 kilos.). If the last ingredient does not contain sulphur a small amount (up to 5%) of sulphur may be added, and the final admixture effected by the addition of alcohol and benzene. Such explosives detonate perfectly and have great stability.
—C. A. M.

Powder applicable as explosive and pyrotechnic product. J. M. P. Perchat. Fr. Pat. 477,681, Sept. 20, 1913.

The seed-kernels of the fruits of several species of palm such as *Borassus*, *Iphœna thebaica* and *Phytelephas* are ground, freed from fat, and used as combustible constituents in explosives or fireworks. The powder, which burns silently and without smoke, may also be used in the manufacture of nitroglycerin explosives.—C. A. M.

Explosives. Soc. Anon. d'Explosifs et de Prod. Chim. Fr. Pats. (A) 477,776 and (B) 477,777, June 30, 1914.

(A) Salts of mono- or poly-sulphonic acids of hydrocarbons or their nitro or halogen derivatives, alone or in admixture with other combustible substances, are mixed with oxidising agents, and in particular with nitrate of sodium, potassium, or ammonium. (B) Salts of mono- or poly-sulphonic acids of nitro derivatives of phenolic compounds are used in place of the sulphonates described in (A).—C. A. M.

Nitrocellulose; Method of treating washing liquor from the manufacture of ——. C. Claessen, Berlin. Eng. Pat. 6363, Apr. 28, 1915.

See Ger. Pat. 288,459 of 1911; this J., 1916, 558.

XXIII.—ANALYSIS.

Potassium bichromate as an analytical standard. I. G. Bruhns. J. prakt. Chem., 1916, **93**, 73—105.

Potassium bichromate by reason of its physical properties and the stability of its solutions, is an excellent analytical standard for oxidation processes (4·9033 grms. per litre = $N/10$ solution). Its equivalents with respect to potassium iodide and ferrous salts by comparison with potassium permanganate are identical within the limits of unavoidable error, or in other words an increased oxidising action on hydrogen iodide over that on ferrous sulphate could not be detected. With different samples of the carefully purified salt differences of 0·10—0·12% were found. Comparison with pure sodium chloride through oxalic acid and permanganate confirmed the hitherto unexplained "over-value" of potassium bichromate; in the case of one specimen of Kahlbaum's 100 c.c. $N/100$ $K_2Cr_2O_7$ = 100·13 c.c. $N/100$ NaCl. The over-value was not uniform and varied considerably with different samples. In the indirect standardisation of permanganate solutions against bichromate by means of ferrous solutions, an external indicator may be avoided by adding nearly the requisite quantity of bichromate and finishing off with permanganate. The colour change is clearly visible and may be rendered more evident, if desired, by adding a small quantity of potassium ferricyanide or of cobalt sulphate to the solution.
—G. F. M.

Indicators from animal tissues. W. J. Crozier. J. Biol. Chem., 1916, 24, 443—445.

The black tunicate of Bermuda, *Ascidia atra*, contains in its test a deep purple substance readily extracted by acetone, and less easily soluble in alcohol, which at hydrion concentration of $10^{-7 \cdot 6}$ and less becomes green. The change is clearly defined and reversible. The yellow balanoglossid, *Ptychodera sp.*, secretes when stimulated, a yellowish pigment, which turns reddish brown at $H = 10^{-8}$. The pink pigment of *Chromodoris zebra*, which has been previously described, turns blue at about $H = 10^{-5 \cdot 9}$. An orange red annelid, probably *Eupolymnia aurantiaca*, occasionally found among blocks of coral rock, gives with aqueous alcohol a bright red extract of the integument which changes to orange on standing for some days. It shows a sharp transition from red to bright green at about $H = 10^{-10}$.—G. F. M.

Copper and iron; Rapid method for the determination of ——. G. Edgar. J. Amer. Chem. Soc., 1916, **38**, 884—887.

Both metals are determined in the same solution by a modification of Volhard's method, as follows:—The solution, containing sulphuric acid, is nearly neutralised with ammonia or sodium carbonate, saturated with sulphur dioxide, heated to boiling, and treated with a measured excess of standard ammonium thiocyanate to precipitate the copper. The mixture is then boiled vigorously for 10 minutes in a current of carbon dioxide, to remove sulphur dioxide, cooled, whilst carbon dioxide is still introduced, and filtered, preferably through asbestos. The precipitate is washed with cold water, and the filtrate and washings, after adding dilute sulphuric acid and excess of standard silver nitrate to precipitate the unused thiocyanate, are titrated with permanganate in the usual way. The colour of the permanganate is removed by adding a trace of ferrous sulphate, and the excess of silver at once precipitated by titrating with thiocyanate. The amount of copper present is calculated from the difference between the total volume of thiocyanate used and that equivalent to the silver nitrate added (1 c.c. $N/10$ thiocyanate = 0·006357 grm. Cu). The method is said to be highly accurate and admirably adapted to the analysis of ores.—F. Sodn.

Indole and scatole; Some colour reactions of ——. V. E. Nelson. J. Biol. Chem., 1916, **24**, 527—532.

Dimethylaniline, glycollic acid, and glyceric aldehyde give violet to reddish violet colour reactions with minute traces of scatole in presence of sulphuric acid, whilst indole gives a similar colour with pyruvic aldehyde and sulphuric acid in presence of ferrous sulphate. Very sensitive colour reactions are also obtained with vanillin in presence of a mineral acid. Thus in presence of hydrochloric acid indole gives with a few drops of 5% alcoholic solution of vanillin an orange coloration, and scatole an intense violet. Similar colours are produced when sulphuric, phosphoric, or hydrofluoric acid is used. These reactions are of the order of sensitiveness of one part in two to three million. Since the scatole colours are soluble in chloroform or amyl acetate, whilst the indole colours are only very slightly soluble in these solvents, both substances can be detected qualitatively in a mixture. The red coloration given by scatole with vanillin and sulphuric acid is distinguished by its solubility in chloroform from a similar colour given by tryptophane. Green or blue colorations are given by vanillin in amyl, butyl, or propyl alcohol in presence of mineral acids; in acetone solution a deep blue colour is produced on the addition of hydrochloric acid, whilst xylene gives a rose-red.—G. F. M.

Determination of nitrogen in saffron as a means of detecting adulteration. Pierlot. *See* IV.

Action of oxidising agents on cerous salts. Barbieri. *See* VII.

Absorption of oxygen in alkaline solutions. Henrich and Kuhn. *See* VII.

Effect of borax in matte fusion. Johnson. *See* X.

Revision of atomic weights of cadmium and zinc. Electrolytic determination of the metals in their bromides. Baxter and others. *See* X.

Determination of available oxygen in washing preparations containing soap. Grün and Jungmann. *See* XII

Preparation of a neutral solution of beet molasses for inversion by invertase in the double polarisation method of determining sucrose. Gillet. *See* XVII.

Formation of alcohol in the determination of sucrose by double polarisation, using yeast at 55° C. as hydrolyst. Gillet. *See* XVII.

Determination of essential oils (essences) in liqueurs. (1) Bonis. (2) Ronnet. *See* XVIII.

Determination of essential oils (essences) in liqueurs. Peppermint liqueur. Muttelet. *See* XVIII.

Detection of added water in milk by a simplified molecular concentration constant. Mathieu. *See* XIXa.

Influence of the proportion of fat on that of solids-not-fat in milk. Porcher. *See* XIXa.

Determination of fat in cream. Lindet. *See* XIXa.

Analysis of spices. Arragon. *See* XIXa.

Indicators for determination of temporary hardness in water. Norton and Knowles. *See* XIXb.

Analysis of morphine hydrochloride, standardised morphine hydrochloride solution, and morphine syrup. François and Luce. *See* XX.

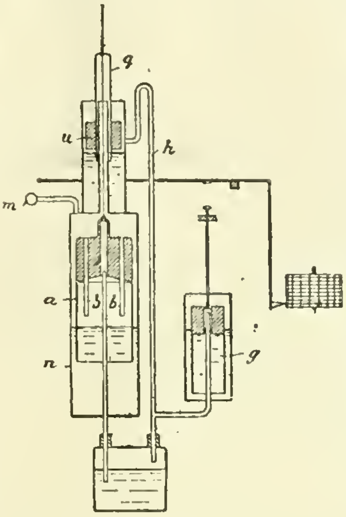
Distinguishing tests for Algerian and Bourbon geranium oils. *See* XX.

Determination of the iodine value of essential oils. Marcille. *See* XX.

Patent.

Gas analysis; Apparatus for ——. N. J. Traberg, Copenhagen. Ger. Pat. 290,992, Mar. 18, 1914.

The measuring vessel, *a*, in the top of which are several inlet tubes, *b*, is surrounded by the gas holder, *n*, connected with the inlet tube, *m*, for the gas under examination. Above the gas holder is a bell, *q*, to which is attached the plunger, *u*, the immersion of which in a sealing liquid automatically closes the air tube, *h*, of the registering bell, *g*. To work the apparatus periodic raising and lowering of the parts, *a* and *q*, is necessary, and this may be done by clockwork or other mechanical device.—C. A. M.



Trade Report.

Dutch chemical industry at the beginning of 1916; Condition of ——. Proposed founding of a Dutch coal-tar colour industry. Chem.-Zeit., 1916, 40, 351—352.

The article is based partly on information given in a note on the economic condition of Holland published by the Dutch Government on Mar. 31, 1916. Sulphuric acid works have been very busy, notwithstanding difficulties in obtaining raw materials, and new works are to be erected. In superphosphate works which make their own sulphuric acid, overtime is being worked, but in other cases work has been restricted owing to the shortage of sulphuric acid. Great activity has prevailed in the manufacture of pharmaceutical products, fats and oils, soaps, and varnishes, but manufacturers of pigments have suffered in some cases from slackness in the building trade, from lack of raw materials, and more recently from restrictions hindering exports to England. At first the British Government allowed pigments to be imported from Holland provided a declaration was made that less than 25% of the value was raw material of German, Austrian, or Turkish origin, but now the exact percentage has to be stated. The manufacture of incandescence mantles in Holland before the war suffered greatly from German competition, but after war broke out the industry was very prosperous for a time, largely owing to the increased trade with England, and several new works were established. More recently the position has become less favourable and some of the new works have had to close, owing to the failure to obtain adequate supplies of raw materials from Germany and to the determination of England to become independent of the Dutch product. The future of the industry is regarded as very uncertain. There are only two small coal-tar distilleries and three small coal-tar colour works in Holland, which has depended almost exclusively on Germany for its supplies of dyestuffs. Since the outbreak of war the German Government has permitted the exportation to

Holland of dyestuffs equivalent to 50% of the 1913 consumption up to Oct. 1915, and of 75% since that date. On Jan. 25, 1916, however, the German dyestuff exporters were ordered to price their goods in Gulden, using the pre-war exchange value of M1.70, and this of course had the effect of considerably increasing the real price of the goods. As a result of a conference of the leading Dutch consumers of dyestuffs, an attempt is being made to deal with the question through diplomatic channels, and steps are also being taken to organise a coal-tar colour industry. A company has been formed, which will be connected with the Naarden chemical works and will confine itself at first to the manufacture of aniline oil. It will be financed by the Nederlandsche Handelsmaatschappij and is assured of the support of the large consumers of dyestuffs and of the producers of raw materials. Apart from difficulties due to inadequate supplies of raw materials and of coal or other sources of power, it is pointed out that Holland lacks the requisite supply of trained chemists and experienced workmen, and it is considered that there is less probability in Holland even than in England and the United States of the establishment of a coal tar colour industry capable of competing with that of Germany.—A. S.

Prohibited exports. Revised and complete list. A Royal Proclamation, dated May 10th, 1916, revokes all previous orders as to the prohibition of exports from the United Kingdom, and contains a schedule setting forth all the goods to which prohibitions now apply.

The exportation of the goods mentioned in the Schedule is prohibited as follows :—Goods marked 1, to all destinations ; Goods marked 2, to all ports and destinations abroad other than ports and destinations in British Possessions and Protectorates ; Goods marked 3, to all destinations in foreign countries in Europe and on the Mediterranean and Black Seas, other than France and French Possessions, Russia, Italy and Italian Possessions, Spain, and Portugal, and to all ports in any such foreign countries, and to all Russian Baltic ports.

Abstract of schedule.

^{3}Absinthe. ^{1}Aeroplane dope. ^{2}Alunite. ^{3}Armour plates, armour quality castings, and similar protective material. ^{2}Asbestos and articles manufactured wholly or partly of asbestos. ^{3}Asphalt and liquid or solid bitumen. ^{3}Balsams. ^{2}Beeswax. ^{2}Bones in any form and bone ash. ^{3}Camphor. ^{3}Candles (except candles manufactured wholly or partly of paraffin wax or tallow). ^{2}Candles manufactured wholly or partly of paraffin wax or tallow. ^{2}Capsicum. ^{1}Capsicum, oleo-resin of. ^{1}Carbon, Brazilian. ^{3}Carbon, gas. ^{1}Carbons, suitable for searchlights. ^{3}Casein and preparations thereof. ^{1}Celluloid. ^{1}"Celluloid" sheet, non-inflammable, and similar transparent material non-soluble in lubricating oil, petrol or water.

Chemicals, drugs, dyes and dye stuffs, medicinal and pharmaceutical preparations and tanning extracts, the following :—^{2}Acetanilide. ^{1}Acetates, all metallic. ^{1}Acetic acid. ^{1}Aceto-celluloses. ^{1}Acetone and its compounds and preparations. ^{1}Acetylsalicylic acid (aspirin) and its preparations. ^{1}Alcohol, absolute. ^{1}Alcohol, methylic. ^{1}Aluminium nitrate. ^{2}Aluminium, oxides of, and mixtures containing aluminium oxides. ^{3}Aluminium, salts of (except aluminium nitrate and sulphate, alumino-ferric and ammonium alum). ^{2}Aluminium sulphate. ^{2}Alumino-ferric. ^{1}Amidol and mixtures containing amidol. ^{1}Amidopyrine. ^{2}Ammonia and its salts, whether simple or compound (except ammonium nitrate, perchlorate, and sulphocyanide). ^{2}Ammonia, liquefied. ^{2}Ammonia liquor. ^{2}Ammonium alum. ^{1}Ammonium nitrate, perchlorate, and sulphocyanide. ^{1}Amyl acetate. ^{1}Anthracene oil. ^{3}Antimony, compounds of (except sulphides and oxides of antimony). ^{2}Antimony, sulphides and oxides of. ^{1}Antipyrine (phenazone) and its preparations. ^{1}Anti-tetanus serum. ^{3}Arsenic, compounds of arsenic, and mixtures containing arsenic. ^{3}Barium sulphate. ^{1}Belladonna and its preparations. ^{1}Belladonna alkaloids, and their salts and preparations. ^{2}Benzoic acid (synthetic) and benzoates. ^{1}Benzol and its compounds and preparations. ^{3}Bismuth and its salts (except bismuth nitrate). ^{1}Bismuth nitrate. ^{3}Bleaching powder. ^{3}Borax and mixtures containing borax. ^{3}Boric acid. ^{3}Boron compounds. ^{2}Bromine and alkaline bromides. ^{1}Caffeine and its salts. ^{2}Calcium carbide. ^{3}Calcium sulphate. ^{3}Calcium sulphide. ^{2}Cantharides. ^{1}Carbolic acid and compounds thereof, and preparations containing carbolic acid. ^{1}Carbon disulphide. ^{2}Carbon tetrachloride and its preparations. ^{1}Cerium, oxide and salts of. ^{1}Chloral and its compounds and preparations. ^{1}Chlorates, all metallic. ^{2}Chlorine. ^{2}Chromium, compounds of (except chromium acetate, chromium chlorate, and chromium nitrate), and mixtures containing such compounds of chromium. ^{1}Chromium acetate. ^{1}Chromium chlorate. ^{1}Chromium nitrate. ^{1}Coal tar, all products (except creosote) obtainable from and derivatives thereof, suitable for use in the manufacture of dyes and explosives, whether obtained from coal tar or other sources, and mixtures containing such products or derivatives. ^{1}Cobalt nitrate. ^{2}Cobalt, oxides and salts of (except cobalt nitrate), and mixtures containing such oxides or salts of cobalt. ^{2}Cocaine and its salts and preparations. ^{2}Colchicum and its preparations. ^{1}Collodion. ^{1}Copper acetate. ^{3}Copper, compounds of (except copper acetate, copper iodide, copper nitrate, copper sulphate, and suboxide of copper), and mixtures containing such compounds of copper. ^{2}Copper iodide. ^{1}Copper nitrate. ^{2}Copper, suboxide of, and mixtures containing suboxide of copper. ^{2}Copper sulphate. ^{3}Creosote. ^{1}Cresol, compounds and preparations of cresol (except saponified cresol) and nitrocresol. ^{2}Cresol (saponified). ^{1}Cyanamide. ^{1}Diethylbarbituric acid (veronal) and veronal sodium. ^{1}Dimethylaniline. ^{1}Dyes and dyestuffs manufactured from coal tar products, and articles containing such dyes or dyestuffs. ^{1}Emetin and its salts. ^{1}Ergot of rye. ^{1}Ether, acetic. ^{1}Ether, formic. ^{1}Ether, sulphuric. ^{1}Eucaine hydrochloride, eucaine (benzamine) lactate, and their preparations. ^{3}Formic acid ^{2}Formic aldehyde. ^{1}Fusel oil (amyl alcohol) ^{1}Gentian and its preparations. ^{1}Glycerine, and preparations containing glycerine not otherwis specifically prohibited. ^{1}Green oil. ^{2}Guaiacol an guaiacol carbonate. ^{3}Halogen derivatives o aliphatic hydrocarbons (except ^{2}carbon tetrachloride). ^{1}Henbane and its preparations. ^{2}Hexamethylenetetramin (urotropin) and its compound and preparations. ^{2}Hydrobromic acid. ^{2}Hydrochloric acid. ^{1}Hydroquinone and mixtures containing hydroquinone. ^{1}Indigo, natural an synthetic. ^{3}Iodine and its compounds and preparations. ^{3}Iron sulphates. ^{1}Ipecacuanha root ^{2}Magnesium chloride and sulphate and mixture containing magnesium chloride or sulphate ^{1}Manganese, peroxide of. ^{2}Mercury, compound and preparations of (except nitrate of mercury and mixtures containing such compounds mercury. ^{1}Mercury nitrate. ^{1}Methylanilin ^{1}Methyl salicylate, and preparations containin methyl salicylate. ^{1}Metol, and mixtures containin metol. ^{1}Naphthalene and its compounds an preparations. ^{1}Neo-salvarsan. ^{1}Nickel nitrat ^{2}Nickel, oxides and salts of (except nickel nitrate and mixtures containing such oxides or salts nickel. ^{1}Nitrates, all metallic. ^{1}Nitric aci ^{1}Nitro-toluol. ^{1}Novocain and its preparation ^{3}Nux vomica and its preparations. ^{3}Nux vomic alkaloids and their salts and preparations. ^{1}Opiu and its preparations. [1]Opium alkaloids and their salts and preparations. [2]Oxalic acid. [2]Paraffin, liquid, medicinal. [1]Paraformaldehyde. [1]Paraldehyde. [1]Perchlorates, all metallic. [1]Phenacetin and its preparations. [1]Phosgene (carbonyl chloride). [2]Phosphorus and its compounds. [1]Picric acid and its components. [1]Platinum, salts of. [1]Potash, caustic, and articles containing caustic potash. [1]Potassium chlorate, and mixtures containing potassium chlorate. [1]Potassium cyanide, and mixtures containing potassium cyanide. [1]Potassium nitrate (saltpetre). [1]Potassium perchlorate. [1]Potassium permanganate. [2]Potash salts (except potassium chlorate, cyanide, nitrate (saltpetre), perchlorate and permanganate), and mixtures containing such potash salts. [1]Pyridine. [1]Pyrogallic acid, and mixtures containing pyrogallic acid. [2]Quinine and its salts. [1]Radium compounds [1]Saccharin. [1]Salicylic acid and its preparations. [1]Salipyrine. [1]Salol and its preparations. [1]Salvarsan. [2]Santonin and its preparations. [2]Senna leaves and pods. [2]Soda, caustic. [3]Sodium carbonate and bicarbonate. [3]Sodium cyanide, and mixtures containing sodium cyanide. [2]Sodium hyposulphite (thiosulphate), and mixtures containing sodium hyposulphite. [2]Sodium prussiate, and mixtures containing sodium prussiate. [1]Sodium salicylate and its preparations. [3]Sodium sulphate and bisulphate (nitre cake). [3]sodium sulphide. [1]Spent oxide. [2]Stramonium leaves and seeds. [3]Strontium sulphate. [1]Sulphonal. [1]Sulphur and preparations containing sulphur. [1]Sulphur, chlorides of. [1]Sulphur dioxide, liquefied. [1]Sulphuric acid. [1]Sulphuric acid, fuming (oleum). Tanning extracts, the following:—[1]Chestnut extract. [1]Oakwood extract. [1]Valex. [1]Valonia. [2]Other extracts and substances for use in tanning. [2]Tartaric acid, cream of tartar, and alkaline tartrates. [1]Theobromine sodium salicylate. [1]Thorium, oxides and salts of. [1]Thymol and its preparations. [2]Tin, chlorides of. [3]Tin, compounds of (except chlorides and oxide of tin). [2]Tin, oxide of. [1]Toluol and its compounds and preparations. [1]Triphenyl phosphate. [1]Trional. [1]Trioxymethylene. [2]Tungsten, oxides and salts of. [3]Ultramarine, and mixtures ontaining ultramarine. [2]Urea and its compounds. Xylol and its compounds and preparations. [2]Zinc hloride and sulphate, and mixtures containing ine chloride or sulphate.

[3]China stone. [3]Clay, china, potters', and ball. Coal, except coal allowed by the Commissioners of Customs and Excise to be shipped as bunker oal. [1]Coal tar. [2]Coke, except petroleum coke. Coke, petroleum. [3]Cordite presses. [3]Cork and ork dust and articles wholly manufactured from ork or cork dust or both. [3]Cotton, all manufactures, mixtures and products of, not otherwise pecifically prohibited. [1]Cotton pulp. [1]Cotton rags nd rags containing cotton. [3]Cotton, raw. [1]Cotton hoddy. [1]Cotton wadding and articles containing otton wadding. [1]Cotton waste and articles containing cotton waste. [1]Cotton wool and articles ontaining cotton wool. [2]Crucibles (plumbago). Cylinders, metal, such as can be used for containing compressed gas. [3]Dextrin. [1]Electrodes, carbon, or electric furnaces. [3]Emery, corundum, natural r artificial (such as alundum) carborundum and crystolon and manufactures thereof. [1]Esparto rass. [1]Explosives. [2]Fats, all animal and vegetable, nd articles and mixtures containing such fats. Fatty acids and articles and mixtures containing fatty acids. Ferro alloys, the following:—[2]Ferro-rium. [2]Ferro-chrome. [2]Ferro-manganese. Ferro-molybdenum. [2]Ferro-nickel. [2]Ferro-tanium. [1]Ferro-tungsten. [2]Ferro-vanadium. Spiegeleisen. [1]Ferro-silicon. Forage and food hich may be used for animals, the following:—Brewers' and distillers' grains. [3]Brewers' dried east. Cakes and meals, the following:—[3]Coconut d poonac cake. [2]Compound cakes and meal. Cotton seed cake, and cotton seed meal. [3]Fishmeal and concentrated fish. [3]Gluten meal or gluten feed. [3]Ground nut or earth nut cake and meal. [3]Hempseed cake and meal. [3]Husk meal. [2]Linseed cake and meal. [3]Locust bean meal. [3]Maize germ meal. [3]Maize meal and flour. [3]Meat meal. [3]Palmnut cake and meal. [3]Poppy seed cake and meal. [3]Rapeseed or colzaseed cake and meal. [3]Sesame seed cake and meal. [3]Soya bean cake and meal. [3]Sunflower seed cake and meal. [2]Whale cake. [2]Whale meal. [2]Malt dust, malt flour, culms, sprouts or combings. [2]Fuel, manufactured. [2]Fustic (chips and extract). [1]Glass for optical instruments. [3]Glucose. [2]Graphite, and mixtures containing graphite. [2]Guanos. [3]Gums (except such as contain caoutchouc and except gum tragacanth). [2]Gums containing caoutchouc. [1]Gum tragacanth. [1]Incandescent mantles. [3]Incorporators. [2]Lacs, not lac including dye. [2]Logwood (chips, extract, and preparations). [2]Lubricants and articles and mixtures containing lubricants. [1]Magnesite and magnesite bricks. [1]Magnesite, caustic or lightly calcined, and dead burnt magnesite. [2]Manures, compound, containing nitrate or phosphate.

Metals and ores, the following:—[1]Aluminium, alloys of aluminium, and manufactures of aluminium. [2]Antimony and alloys of antimony. [3]Arsenical ore. [2]Bauxite. [1]Cerium and its alloys (except ferro-cerium, the exportation of which is prohibited to all ports and destinations abroad other than ports and destinations in British Possessions and Protectorates). [2]Chrome ore. [2]Cobalt, cobalt ore, and alloys of cobalt. [3]Copper ore. [2]Copper, unwrought and part wrought, all kinds, including alloys of copper (such as brass, gun metal, naval brass and delta metal, phosphor copper, phosphor bronze, and solder containing copper), copper and brass circles, slabs, bars, ingots, scrap, rods and plates and also wrought copper of the following descriptions:—Copper and brass pipes, sheets, condenser plates, copper wire, brass wire, bronze wire, perforated brass sheets, perforated brass linings, and copper foil. [3]Copper manufactures, the following:—All articles wholly or partly manufactured of copper or its alloys not otherwise specifically prohibited. [1]Iron ore. [1]Iron, pig. [1]Iron pyrites. [1]Iron scrap. [2]Lead ore. [1]Lead, pig. [2]Lead, pipe, scrap, or sheet, and solder containing lead. [1]Magnesium and its alloys. [2]Manganese and manganese ore. [1]Mercury. [2]Molybdenum and molybdenite. [2]Nickel, alloys of nickel, and nickel ore. [1]Platinum, alloys of platinum, and manufactures containing platinum. [2]Scheelite. [2]Selenium. [2]Sodium. [1]Spelter and spelter dross. [1]Steel containing tungsten or molybdenum, and any tools or other articles made from such steel. [2]Steel and steel articles containing chrome, cobalt, nickel, or vanadium. [1]Steel angles, channels, joists, tees and other steel sectional material. [1]Steel billets, blooms, and slabs. [1]Steel bridge work, pier work, and structural material. [1]Steel flats, rounds, and squares (except carbon steel for tools and steel for mining purposes). [1]Steel ingots. [1]Steel plates and sheets ⅛ inch thick and over. [1]Steel scrap. [1]Steel sheet bars. [1]Steel tubes. [1]Steel wire. [1]Steel wire rods. [2]Tin, alloys of tin not otherwise specifically prohibited, and manufactures of tin (except hollow-ware, tin plates, and receptacles made from tin plates). [2]Tin ore. [3]Tin plates and receptacles made from tin plates. [1]Tungsten (except tungsten filaments for electric lamps). [2]Tungsten filaments for electric lamps. [2]Vanadium. [2]Wolframite. [2]Wulfenite. [2]Yellow metal. [1]Zinc ashes. [2]Zinc ore. [1]Zinc, alloys of zinc, and manufactures of zinc. [2]Mica, mica chimneys, mica splittings, micanite, and micanite cloth. [2]Mineral jellies. [3]Monazite sand. [2]Motor spirit (except benzol, the exportation of which is prohibited to all destinations). [3]Oil, blast furnace. [3]Oils, creosote, except wood tar oil. [2]Oil fuel, except oil fuel allowed by the Commissioners of Customs and Excise to be shipped for use on board the exporting ship. [2]Oil fuel, shale. [2]Oils, all animal and vegetable (not including essential oils), and articles and mixtures containing such oils. [2]Oil waste. [2]Oil, whale (train, blubber, sperm), seal oil, shark oil, fish oil generally, and mixtures of the foregoing. [2]Oil, wood tar. Oleaginous kernels, nuts, seeds, and products, the following :—[2]Castor beans. [2]Coconuts. [2]Copra. [2]Cotton seed. [2]Ground nuts, earth nuts, or pea nuts (Arachides). [2]Hempseed. [2]Linseed. [2]Palm nuts and palm kernels. [2]Poppy seeds. [2]Rape or colza seed. [2]Sesame seed. [2]Soya beans. [2]Sunflower seed. [3]Other oleaginous kernels, nuts, seeds, and products. [2]Paraffin oil. [2]Paraffin wax. [3]Peat. [2]Petroleum, fuel oil. [2]Petroleum, lighting oil. [2]Petroleum, gas oil. [2]Petroleum spirit and articles containing petroleum spirit. [3]Petroleum and its products not otherwise specifically prohibited. [2]Phosphate rock, namely :—Apatites. Phosphates of lime and alumina. [1]Photographic sensitive films, plates, and printing paper, whether exposed or not. [2]Pitches derived from fats, greases, oils or fatty acids. [2]Plumbago. [1]Powder, aluminium. [2]Powder, bronze (except aluminium powder). [3]Bean flour and meal. [3]Cassava powder. Provisions, including :—[3]Egg, yolk and liquid, and albumen. [2]Lard and imitation lard. [2]Malt. [3]Malt sugar. [2]Margarine. [3]Meat, extract of. [2]Milk, condensed or preserved. [1]Pulp-board waste. [3]Resins and resinous substances (except such as contain caoutchouc). [2]Resinous substances containing caoutchouc. [3]Rock crystal [2]Rubber (raw, waste, and reclaimed), solutions containing rubber, jellies containing rubber, and any other preparations containing rubber, and also balata, gutta-percha, and the following varieties of rubber, viz :—Borneo, Guayule, Jelutong, Palembang, Pontianac, and all other substances containing caoutchouc. [2]Rubber, gutta-percha or balata, goods made wholly or partly of. [3]Rum and imitation rum. [3]Sabadilla seeds and preparations therefrom. [3]Salt, rock and white (except table salt). [2]Shellac. [1]Silica bricks. [3]Slagwool. [1]Soap containing more than 1% of glycerin. [3]Soap (except soft soap) containing 1 % or less of glycerin. [2]Soap, soft, containing 1 % or less of glycerin. [2]Spiegeleisen. [1]Spirits, methylated. [1]Spirits of a strength of not less than 43° above proof. [3]Starch. [2]Tar, vegetable. [2]Tar, wood. [2]Turpentine (oil and spirit), and articles containing turpentine. [2]Turpentine substitute, and articles containing turpentine substitute. [3]Wax, carnauba. [2]Waxed paper. [2]Waxes, mineral and vegetable (except carnauba), and composite waxes. [2]Wool grease.

Prohibition of exports from British India, the self-governing Dominions, Egypt, and certain other British Possessions.

A "Supplement" to the April 13th issue of the "Board of Trade Journal" contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana. The price is 3d.

Contraband of war. Revised and complete list. [Cd. 8226.]

A list has been issued showing the various articles declared to be contraband of war in the Proclamations now in force, and arranged alphabetically. In present circumstances His Majesty's Government consider that for practical purposes the distinction between the two classes of contraband has ceased to have any value. The list is as follows.

Acetic acid and acetates, acetic ether, acetones, and raw and finished materials usable for their preparation ; aluminium, alumina, and salts of aluminium ; ammonia liquor, ammonium salts ; aniline and its derivatives ; antimony, together with the sulphides and oxides of antimony; arsenic and its compounds, arsenical ore ; asbestos. Barium chlorate and perchlorate ; bauxite ; benzole and its mixtures and derivatives ; bones in any form, whole or crushed, and bone ash ; borax, boric acid, and other boron compounds ; bromine. Calcium acetate, calcium nitrate, and calcium carbide ; camphor ; capsicum ; carbon disulphide ; carbon, halogen compounds of ; carbonyl chloride ; carborundum in all forms ; casein ; caustic potash and caustic soda ; celluloid ; charges and cartridges of all kinds and their component parts ; chlorides, metallic (except chloride of sodium) and metalloidic ; chlorine ; chrome ore ; cobalt ; copper pyrites and other copper ores ; copper, unwrought and part wrought ; copper wire, alloys and compounds of copper ; corundum, natural and artificial (alundum), in all forms ; cresol and its mixtures and derivatives ; cyanamide. Ethyl alcohol ; explosives, whether specially prepared for use in war or not. Ferro alloys, including ferro-tungsten, ferro-molybdenum, ferro-manganese, ferro-vanadium,, and ferro-chrome ; formic ether ; fuel other than mineral oils ; fuming sulphuric acid. Glycerin. Hydrochloric acid. Iodine and its compounds ; iron, electrolytic ; iron, hæmatite, and hæmatite iron ore ; iron pyrites. Lead and lead ore ; lubricants. Manganese and manganese ore ; manganese dioxide ; materials used in the manufacture of explosives ; mercury ; methyl alcohol ; mineral oils, including benzine and motor spirit ; molybdenum and molybdenite. Naphthalene and its mixtures and derivatives ; nickel and nickel ore ; nitric acid and nitrates of all kinds. Oils and fats, animal, fish, and vegetable, other than those capable of use as lubricants, and not including essential oils ; oleaginous seeds, nuts and kernels ; oleum. Paraffin wax ; phenol (carbolic acid) and its mixtures and derivatives ; phosphorus and its compounds ; phosgene ; potassium salts ; powders, whether specially prepared for use in war or not ; prussiate of soda. Resinous products ; rubber (including raw, waste, and reclaimed rubber, solutions and jellies containing rubber, or any other preparations containing rubber, balata, and gutta-percha, and the following varieties of rubber—viz. : Borneo, Guayule, Jelutong, Palembang, Pontianac, and all other substances containing caoutchouc), and goods made wholly or partly of rubber. Scheelite ; selenium ; soap ; sodium, sodium chlorate and perchlorate, sodium cyanide ; solvent naphtha and its mixtures and derivatives ; starch ; steel containing tungsten or molybdenum ; sulphur, sulphur dioxide, sulphuric acid ; sulphuric ether. Tanning substances of all kinds, including quebracho wood and extracts for use in tanning ; tin, chloride of tin, and tin ore ; toluol and its mixtures and derivatives ; tungsten ; turpentine (oil and spirit). Urea. Vanadium. Wood tar and wood tar oil. Xylol and its mixtures and derivatives. Zinc ore.

British India. Revised import and export duties.

The "Indian Tariff (Amendment) Act, 1916," contains the revised Schedules to the Indian Tariff Act of 1894 and specifies in detail the duties now leviable on goods imported into and exported from British India. Schedule II. (Import Tariff and Schedule III. (Export Tariff) are reprinted in full in the Board of Trade Journal of April 13th 1916.

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Journal and Patent Literature.

'ATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:— Patent number, date, name of patentee, and title of invention.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56, Rue Feron, 8, Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

ehaviour of iron towards water and aqueous solutions in the steam boiler. Bosshard and Pfenninger. *See* X.

PATENTS.

rying machines; Rotary ——. The Liquid Purification Co., Ltd., and H. W. Seymour, Leeds. Eng. Pat. 7198, May 13, 1915.

rotary drying machines having transverse lates between which balls are placed to break p the material, the plates are perforated and fting devices are provided to raise the balls that their breaking action is increased.—W.H.C.

rying liquid materials; Method of ——. O. S. Sleeper. Assignor to Buffalo Foundry and Machine Co., Buffalo, N.Y. U.S. Pat. 1,178,108, Apr. 4, 1916. Date of appl., Oct. 3, 1912.

HE liquid is fed under pressure to the underside an internally heated rotating drum, and a film liquid is picked up by the drum, dried, and e dried product detached, before the same rt of the drum comes within reach of the pply. Any excess of liquid drains back from e drum and is returned to the feed tank.—W.H.C.

rying liquids; Apparatus for ——. *Apparatus for drying liquid materials.* O. S. Sleeper, Assignor to Buffalo Foundry and Machine Co., Buffalo, N.Y. U.S. Pats. (A) 1,179,569, Apr. 18, and (B) 1,180,449, Apr. 25, 1916. Dates of appl., June 16 and 22, 1915.

) THE liquid is fed into one end of a pan set on rocking support beneath a rotary drying drum, ich picks up a film of the liquid. The excess liquid overflows from the pan into a tank and pumped back into the pan. The drum is ated internally and is surrounded by an outer sing. (B) The liquid is fed to the pan by a e which passes through the bottom of the sing, and the overflow from the pan is regulated an adjustable gate valve.—W. H. C.

ying apparatus. F. Kleinschmidt, Buffalo, N.Y. U.S. Pat. 1,179,192, Apr. 11, 1916. Date of appl., Mar. 28, 1912.

HORIZONTAL drying drum is rotated in a furnace ove the fire-place, which has a perforated front ll above the fire door and a bridge wall. The terial to be dried is fed into the end of the drum ich is over the fire-place and is discharged m the other end, into which a portion of the e gases is introduced. The flue gases pass ough the furnace and are withdrawn through feed pipe by an injector and delivered into a denser. The condensed water is drawn off m the bottom and the uncondensed gases are ivered from the upper part of the condenser o the ash-pit of the furnace.—W. H. C.

Solid or liquid matters from hot or cold gas or air; Method and apparatus for effecting removal of ——. J. Fisher, Wood Green, and W. J. Fiddes, Tottenham, Middlesex. Eng. Pat. 9911, July 7, 1915.

A PORTION of the already cleaned gas or air is withdrawn from the conduit and is passed at an increased pressure into the incoming current of uncleaned gas or air as a jet or film, directed so as to divert the particles of dust or moisture out of the main stream, towards suitable depositing chambers, where they are collected and removed. —W. H. C.

Ball-grinding mill. G. M. Newcomer, Assignor to F. L. Smidth and Co., New York. U.S. Pat. 1,177,648, Apr. 4, 1916. Date of appl., Apr. 22, 1915.

THE spaced, segmental liner plates of a ball mill are slotted along radial lines to relieve the strains produced by the peening action on the plates. —W. H. C.

Bone black; Process of reconditioning ——. J. W. Scott, Englewood, N.J., Assignor to Arbuckle Bros., New York. U.S. Pat. 1,177,725, Apr. 4, 1916. Date of appl., Dec. 28, 1914.

THE bone black is mixed with a small proportion of powdered quicklime and calcined, these operations being repeated as often as is necessary, and the final product is washed.—W. F. F.

Hygroscopic substances; Method of protecting —— *from atmospheric moisture.* R. S. Sperry, Assignor to Scovill Manufacturing Co., Waterbury, Conn. U.S. Pat. 1,178,187, Apr. 4, 1916. Date of appl., Oct. 23, 1915.

A CURRENT of cool dried air is directed downwards upon the hygroscopic substance which is being handled, so as to form a "blanket" of cool dry air between the substance and the surrounding atmosphere.—W. H. C.

Mixing and treating apparatus. A. E. Smaill, Ottawa, Canada. U.S. Pat. 1,178,957, Apr. 11, 1916. Date of appl., Jan. 15, 1915.

THE materials are fed into one end of a heated rotating drum by a spiral conveyor having Z-shaped blades working in a fixed pipe which makes a gas-tight connection with the end of the drum. The treated materials are withdrawn by a similar tube and conveyor at the other end of the drum. The conveyor in the latter case is provided with a flanged disc which lifts the treated material into the tube. Gas can be introduced into and withdrawn from the drum through the hollow cores of the conveyors.—W. H. C.

Catalyser. A. A. Wells, Montclair, N.J. U.S. Pat. 1,179,484, Apr. 18, 1916. Date of appl., Oct. 17, 1913.

FRAGMENTS of glass about 0·5 in. diameter are coated with about 1% of their weight of reduced nickel.—W. F. F

Kiln. H. P. Jenks, Vigo, Ohio. U.S. Pat. 1,179,928, Apr. 18, 1916. Date of appl., Oct. 6, 1914.

The kiln is provided with a double floor, the space between the floors being divided by parallel partitions, forming conduits which are connected together by cross passages. The floor above the latter is perforated so that the hot gases from a furnace may circulate through the space between the floors and into the kiln. A second furnace is connected directly with the kiln, from which a discharge flue is provided.—W. F. F.

Kiln; Rotary ——. W. D. Mount, Saltville, Va., Assignor to Mathieson Alkali Works. U.S. Pat. 1,179,952, Apr. 18, 1916. Date of appl., Jan. 11, 1916.

A number of plungers actuated by springs are mounted on the lining wall of the kiln and have a portion projecting outside which can be struck, so as to dislodge the contents of the kiln.—W. F. F.

Liquids; Apparatus for removing gases from and purifying ——. F. Münzinger, Berlin, Assignor to General Electric Co. U.S. Pat. 1,180,786, Apr. 25, 1916. Date of appl., Nov. 14, 1914.

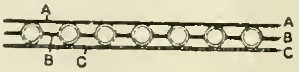
The liquid to be treated passes upwards through a stack of tubes into the innermost of a series of concentric annular chambers which communicate with one another alternately above and below. One of the chambers contains a steam heating coil and the liberated gas escapes by an automatic valve at the top of the casing. The liquid finally passes downwards through a casing which surrounds the inlet tubes and thus gives up some of its heat to the incoming liquid.—W. F. F.

Filtering apparatus. C. Bosch, Augsburg. Ger. Pat. 290,739, Oct. 21, 1913.

A series of chambers, of the shape of inverted truncated cones, are arranged one within another and packed with filtering material. The chambers are connected by suitable passages, so that the liquid, in passing through the apparatus, flows repeatedly in different directions.—A. S.

Filter- or press-plate for the dehydration of pulp, paper, peat, or the like. Maschinenbau-Anstalt Humboldt, Cöln-Kalk. Ger. Pat. 291,010, June 23, 1914.

The filter-plate is formed by a plate, B (see fig.) composed of slotted tubes, placed between two flat perforated sheets, A, C. The three plates may be screwed together.—A. S.



Crystallisation of hot salt solutions; Apparatus for ——. P. Schilde, Hersfeld. Ger. Pat. 291,065, July 3, 1913.

A tank, open at the top, is divided by partitions into a lower, closed cooling chamber and an upper crystallising chamber open at the top. The partitions are so arranged that the cooling liquid and the solution to be crystallised flow in opposite directions, alternately up and down through the tall, narrow compartments of the respective chambers. The compartments of the crystallising chamber communicate, at the bottom, with lateral chambers, also divided into compartments, in which the crystals collect, whilst the mother liquor overflows at the top and returns to the crystallising chamber. The compartments of the lateral chambers are connected by tapering passages, so that the crystals form plugs therein, and mother liquor is thus prevented from passing from one compartment to the next or from coming in contact with the conveyor used for discharging the crystals.—A. S.

Furnaces; Apparatus for introducing goods into and removing same from annealing or other ——. A. Smallwood, London. Eng. Pat. 6330, Apr. 28 1915.

Packing for machinery. P. Hourlier, Assignor t L'Air Liquide (Soc. Anon. pour l'Etude e l'Exploit. des Proc. G. Claude), Paris. U.S Pat. 1,179,185, Apr. 11, 1916. Date of appl. Oct. 11, 1913.

See Eng. Pat. 23,564 of 1913; this J., 1914, 241

Boiler for the production of steam or evaporation o solutions. H. Scheftlein, Assignor to Nors Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway U.S. Pat. 1,180,545, Apr. 25, 1916 Date of appl., Nov. 1, 1913.

See Fr. Pat. 451,515 of 1912; this J., 1913, 601

Gas furnaces, particularly for heating boilers Eng. Pat. 11,502. *See* IIB.

Filter-press, especially for the filtration of sugar juic and the like. Ger. Pat. 291,316. *See* XVII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Producer gas: A frequent source of error in th analysis of ——. F. Hoffmann. Chem.-Zeit. 1916, 40, 412—413.

Owing to the frequently occurring incomplet absorption of carbon monoxide by cuprous chlorid solution in the analysis of producer gas, not onl is the amount of that substance erroneously determined, but also, by an equal amount, too mucl hydrogen and too little methane are found. It i recommended that the use of cuprous chloride b omitted altogether, and the three combustibl gases be determined indirectly by simultaneou combustion in oxygen.—G. F. M.

Ammonium sulphate; Modified type of plant for th manufacture of —— [*in small gas works*]. E Fukuda. J. Chem. Ind., Tokyo, Japan, 191 **19**, 227—239.

The plant described, designed by the auther, ha been installed at several small gas works in Japa It consists of a preheater, a superheater, a stil a trap-box or separator, a siphon pot, a saturato an overhead gas liquor tank, and an overhea liming tank. The still is a rectangular horizont box provided with a large number of trays forme of wide gas pipes and arranged in steps. It is s in the flue between the gas-retort furnace an the chimney, and the ammoniacal liquor is ru into the still through the preheater and supe heater. The superheater is placed in the low part and the preheater in the upper part of t still. When using ammoniacal gas liquor of lo strength (0·77 Tw. at 60° F. (equivalent to 0·25-0·30 % NH_3) the ammonium sulphate crystals for slowly and only require removal at intervals fro the fishing pocket of the saturator. The experimental results obtained with the modified pla at the Matsumoto Gas Works are as follows:- The efficiency of the still is 96·23 %,the yield fro 100 galls. of gas liquor being 22·9 lb. of ammoniu sulphate as compared with 23·8 lb. by calculatio The sulphate produced contained 24·67 %NH The total cost of operating the plant per 100 lb. ammonium sulphate is 4s. 7d., and the estimate annual profit on an output of 5½ tons is £69 8s equal to 46 % on a capital outlay of £150.
—J. B. C. K.

Insulating oils. Report of Sub-committee of Inst. Electrical Engineers. J. Inst. Elect. Eng., 1916, 54. 497. (Compare this J., 1915, 1133).

The suitability of an oil for use as a cooling insulating medium, *e.g.*, in transformers, is judged from the results of the following tests: (1) the tendency to sludge, by a modification of Michie's method (this J., 1914, 1196) in which the oil is subjected to the action of heat and oxygen for a given time and the amount of solid precipitated is determined; (2) loss by evaporation, by heating the oil at 100° C. for 8 hrs. under specified conditions; (3) flash-point by the Gray or Pensky-Martens instrument; (4) viscosity at 15·5° C., 50° C., and 80° C. by the Redwood viscosimeter; (5) determination of the acidity or alkalinity, and of the iodine value by Hübl's process (compare Radcliffe and Polychronis, this J., 1916, 340); (6) specific gravity is determined at 15·5° C., 50°C., and 80° C. by a specific gravity bottle or pyknometer, and the coefficient of expansion calculated; (7) the cold test (solidification); (8) moisture absorption estimated by means of (9) dielectric (breakdown) test; (10) specific resistance; (11) thermal transference, by the method of the National Physical Laboratory; and (12) specific heat at 15·5° C., 50°, and 80° C.—F. W. A.

Patents.

Patent fuel; Manufacture of ——. F. C. Yeo, Swansea, and T. A. Goskar, West Cross. Eng. Pat. 4980. Mar. 31, 1915.

The fuel mixture is heated by hot air or hot gases and steam, in a closed heating and mixing chamber through which it is passed by mechanical means. The heating agent is allowed to come into direct contact with the fuel mixture, and can only escape from the vessel with the same, through the controlled outlet. The mixture is finally passed through a closed cooling chamber, and is then briquetted.—J. B. C. K.

Gases and vapours; Combustion of ——. C. D. McCourt, Streatham Hill, and Commercial Laboratories, Ltd., Camberwell. Eng. Pats. 6312, Apr. 28, and 7920, May 28, 1915.

A combustible mixture which contains all the air necessary for the complete combustion of the fuel constituent, at a very low pressure, and produced by the direct and injective action upon the atmosphere of a jet or jets of gaseous or vaporous fuel, at the pressure ordinarily obtaining within the mains or pipes of a town's system of gas-supply, is supplied to a perforated slab or block, at a pressure considerably below ⅛-in. water-gauge, over an aggregate cross-sectional area of perforations of considerable extent, and the rate of supply of the mass of combustible mixture per unit perforation, and therefore the rate of generation of heat by its combustion per unit perforation, are both relatively small, so that the emperature of the exit ends of the perforations s not raised to such a degree as to admit of the backward propagation of combustion. The pparatus comprises a perforated slab or block of efractory material, supported in an iron casing, venturi tube or the like, connected at one end with he casing, and having at the other end a fuel jet, r fuel jets, in connection with a supply of gaseous r vaporous fuel, the arrangement being such hat the optimum amount of air from the atmophere is driven into the casing, by the jet or jets f fuel, and forms a combustible mixture which ontains all the air necessary for the complete ombustion of the fuel constituent. Reference as been directed, in pursuance of Sect. 7, Subect. 4, of the Patents and Designs Act, 1907, to ng. Pats. 1785 of 1874; 25,808 of 1909; 2839, 9,490, and 25,714 of 1912; this J., 1910, 1448; 913, 198, 936.—J. B. C. K.

Coal; Process of treating ——. C. H. Smith, Short Hills, N.J. U.S. Pat. 1,177,727, Apr. 4, 1916. Date of appl., Sept. 18, 1915.

Coal, having a content of moisture or other volatile matter too high for the production of metallurgical coke, is crushed and heated till the volatile content is reduced to the desired amount. The residue is cooled, pulverised, and coked. —W. F. F.

Coal gas; Process of and apparatus [retort] for the manufacture of ——. A. Waddell, Dunfermline. Eng. Pats. 5611 and 14,142, Apr. 14 and Oct. 6, 1915.

Coal passes downwards through a vertical retort in which the temperature increases from top to bottom. Near the bottom, but before the zone of highest temperature is reached, the retort walls are inclined successively in opposite directions to ensure mixing of the charge. The inclined bottom of the retort is of large area and is heated by flues within the walls. The gas may be withdrawn either at the top or near the bottom of the retort. —W. F. F.

Oil-gas; Manufacture of ——. Hollandsche Residugas Maatschappij Systeem Rincker-Wolter, The Hague, Holland. Eng. Pat. 6285, Apr. 27, 1915. Under Int. Conv., Feb. 24, 1915.

Liquid hydrocarbons are converted into oil-gas, by contact with glowing coal or coke in the customary manner, and water gas or other gas containing hydrogen is led into the oil-gas generator with the object of converting the oil residues into hydrocarbons that can be gasified. The formation of tar in the oil-gas generator is thus avoided. Two generators are used, each serving as a water-gas generator and an oil-gas generator alternately. —J. B. C. K.

Gas-producers. C. W. Lummis, Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,178,086, Apr. 4, 1916. Date of appl., May 12, 1914.

A charge of fuel is fed from a hopper into a pocket above the producer, so that the pocket is partly filled. The pocket is then moved horizontally and the fuel falls through a shoot into the producer, the top of the pocket being closed by a slide to prevent escape of gas. The shoot is provided with vanes, one of which may be adjustable, to spread the fuel as it falls.—W. F. F.

Coal-gas and other gases; Purification of ——. G. Wilton, London. Eng. Pat. 4682, Mar. 25, 1915.

The gas is subjected to cooling and pressure, in contact with the products of condensation. Under these conditions the tar will absorb the whole of the benzene, toluene, carbon bisulphide, and light hydrocarbons, while the ammoniacal liquor will absorb practically the whole of the ammonia, hydrogen sulphide, and carbon dioxide. Modifications of the process consist in raising the gas to the maximum pressure by successive steps, and in bringing the gas into contact with the ammoniacal liquor and tar in separate vessels. A pressure of 30 lb. and a temperature of 60° F. (15·5° C.) are recommended for carrying out the process. —J. B. C. K.

Gases; Means for removing dust from [hot] ——. A. M. Duckham, Ashtead, Surrey. Eng. Pat. 10,244, July 14, 1915.

A filtering material, such as slag wool, asbestos, steel turnings, etc., is contained in a box with top and bottom of expanded metal, the top being adjustable in height to vary the thickness of filtering material. The box is raised and dropped

by rotary cams to shake out the dust, and the gas is passed through from below upwards.
—W. F. F.

[*Petroleum*] *oils: Cracking of* ——. W. A. Hall, London. Eng. Pat. 1594, Feb. 1, 1915.

The oil is forced under a pressure of about 75 lb. per sq. in. through a system of tubes heated to somewhat below the desired cracking temperature, so that the vapours and gases produced attain a velocity of about 5000 ft. per minute. The vapours and gases are then expanded into a much larger pipe, provided with baffles; the velocity is thus reduced suddenly and the kinetic energy of the vapours and gases is transformed into heat, so that the desired cracking temperature is attained in the larger pipe without external heating. The deposition of carbon and the formation of uncondensable gases are diminished by this method. The heated tubes may be of 1 in. diam. and about 300 ft. long, and the larger pipe 12—16 in. diam. and 12 ft. high. For the production of motor spirit the tubes are heated to 550° C., whilst when it is desired to produce aromatic hydrocarbons a temperature of 720° C. is used.—A. S.

Hydrocarbons from crude oil; Process and apparatus for recovering volatile ——. C. M. Gay, Los Angeles, Cal. U.S. Pat 1,179,001, Apr. 11, 1916. Date of appl., Sept. 9, 1913.

Crude oil is heated sufficiently to assist in atomising it, but without producing any distillate, and is atomised by means of natural gas substantially at atmospheric pressure. Gasoline is separated by condensation from the saturated natural gas, which is again used for atomising.—F. W. A.

Still: Crude-oil ——. C. E. Sampson and W. Woods, Alameda, Cal. U.S. Pat. 1,177,816, Apr. 4, 1916. Date of appl., Feb. 16, 1915.

Pipes arranged in zigzag groups in a vertical plane are fixed in headers mounted in parallel vertical walls. Baffles are provided extending from one wall nearly to the other and resting on the pipes, so that hot gases ascend from the smaller ends of the chambers thus formed into the larger ends of the chambers next above. The oil is passed upwards through the pipes.—W. F. F.

Refining oil; Apparatus for —— [*by distillation*]. J. R. Timmins and O. Swain, Okmulgee, Okla. U.S. Pat. 1,179,243, Apr. 11, 1916. Date of appl., Mar. 8, 1915.

The hot gases and vapours pass from the still to a primary tubular condenser, which they enter at a distance above the lower end of the vertical condensing pipes and are brought into contact with a flowing film of condensed liquid for a short time only. The liquid is separated at the bottom of the condensing pipes and conveyed back to the still for retreatment, and the gases and vapours pass into a secondary condenser, arrangements being made by means of a by-pass so that the vapour may pass directly into this secondary condenser if necessary.—F. W. A.

Petroleum and other liquids; Apparatus for distillation and fractionation of ——. H. L. Burleson, Belvedere, and P. W. Prutzman, Berkeley, Cal. U.S. Pat. 1,180,237, Apr. 18, 1916. Date of appl., Apr. 11, 1913.

The liquid to be distilled is passed in a thin film down a zig-zag series of flat-bottomed tubes of D-section provided with vapour traps at the junctions of the tubes, inlets for liquid at the upper and vapour exits at the lower end of each tube. The tubes may be evacuated, and are supported in a heating chamber by transverse tubular supports; the upper sides of the tubes are covered with heat insulating material. The liquid to be distilled is preheated in a coil beneath the heating chamber.—F. W. A.

Pulverised fuel; Feeding ——. C. J. Gadd, Lebanon, Pa. U.S. Pat. 1,179,087, Apr. 11, 1916. Date of appl., Mar. 12, 1914.

Feeding and burning prepared coal; Apparatus for ——. W. G. Wilson, Elizabeth, N.J. U.S. Pat. 1,179,488, Apr. 18, 1916. Date of appl., Apr. 29, 1914.

Chamber-oven of the reversing flame type. A. Gohmann, Assignor to Stettiner Chamotte-Fabr. A.-G. vorm. Didier, Stettin, Germany. U.S. Pat. 1,180,027, Apr. 18, 1916. Date of appl., June 28, 1913.

See Fr. Pat. 459,101 of 1913; this J., 1913, 1149.

Gases for heating purposes: Process of obtaining ——. E. Knoevenagel, Heidelberg, Assignor to Athion Ges. m. b. H., Mannheim-Waldhof, Germany. U.S. Pat. 1,178,858, Apr. 11, 1916. Date of appl., Sept. 15, 1913.

See Fr. Pat. 462,740 of 1913; this J., 1914, 304.

Ceresin and the like from residues of mineral oil; Process of obtaining ——. J. Mijs, Bussum, Netherlands. U.S. Pat. 1,178,532, Apr. 11, 1916. Date of appl., May 11, 1912.

See Eng. Pat. 10,256 of 1912; this J., 1913, 13.

Process and apparatus for the commercial production of hydrogen. Fr. Pat. 476,901. *See* VII.

Lubricant and process of making the same. Eng. Pats. 11,129 and 14,520. *See* XII.

System for sweating wax. U.S. Pat. 1,180,599. *See* XII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Determination of acetone when present in systems of methyl alcohol, water, and potassium fluoride, and equilibria in systems of methyl ethyl ketone, water, and inorganic salts. Frankforter and Cohen. *See* XX.

Use of the electric spark for pulverising solutions and for obtaining monochromatic light. Hirschel. *See* XXIII.

Patents.

Oil or illuminating gas; Apparatus for distilling shale or coal for production of ——. J. W. Fell, Sydney, N.S.W. Eng. Pat. 6613, May 3, 1915. Under Int. Conv., Jan. 5, 1915.

The shale or coal is gasified in a producer or retort provided with a by-pass from the main flue, by means of which producer-gas or water-gas may be injected into the lower portion of the producer or retort. The injected gas is preheated by passing through the flues that surround the retort.
—J. B. C. K.

Wood; Process and apparatus for destructive distillation of ——. J. L. Dornon, New Orleans, La. U.S. Pat. 1,179,616, Apr. 18, 1916. Date of appl., Apr. 30, 1915.

A hot, inert gas is passed through a long chamber containing the wood to be distilled. The latter is moved forward intermittently and at each successive step it is exposed to gas at a higher temperature. Part of the gas which has been i contact with the wood is withdrawn for the recovery of by-products and the remainder is again passed through the chamber. When required the gas is heated out of contact with the wood.—A.B.S.

Gas furnaces, particularly for heating boilers. Soc. du Gaz de Paris. Eng. Pat. 11,502, Aug. 9, 1915. Under Int. Conv., Sep. 12, 1914.

The products of combustion from a gas-heated, vertical boiler are cooled by contact with copper pipes through which cold water enters the boiler. The combustion products are thus freed from the greater part of the steam and thereby prevented from damaging the flue and chimney. To secure ample draught, the exit flue is passed through the steam chamber of the boiler or is heated by a separate burner. The arrangement proposed increases the original cost of the boiler, but a saving on the whole plant is effected, as it is not necessary to construct the flue and chimney of lead or galvanised iron in order to prevent corrosion.—A. B. S.

[Arc light] electrode. C. R. Krueger, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,173,005, Feb. 22, 1916. Date of appl., Apr. 3, 1915.

A luminous arc light electrode is composed of 57·25 parts of magnetite, 28·75 of rutile, 10 of arc-furnace titanium carbide, 4 of chromite, and 1 part of lithium fluoride as a flux. With titanium carbide, the amount of chromite used in this type of electrode, may be diminished, and the carbide, whilst increasing the amount of light, acts like the chromite in restraining the consumption of the electrode and the tendency to "puddling."—B. N.

Filaments ; Process of making ——. R. E. Myers, East Orange, N.J., Assignor to Westinghouse Lamp Co. U.S. Pat. 1,180,066, Apr. 18, 1916. Date of appl., Dec. 5, 1910.

The ductility of a wire of refractory conducting material is increased by successively drawing the wire through a die, and heating it in an oxidising atmosphere, such as air, to an annealing temperature, until a product of the desired diameter is obtained.—B. N.

Incandescence [tungsten] electric lamp. I. Langmuir, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,180,159, Apr. 18, 1916. Date of appl., Apr. 19, 1913.

The lamp is provided with a tungsten filament of large effective diameter, and a globe filled with dry nitrogen, of heat-conductivity less than that of hydrogen, at a pressure as high as or higher than 300 mm. of mercury. The filament is thereby adapted for operation at a temperature higher than it would have in a vacuum at an efficiency of one watt per candle.—B. N.

Incandescence body for electric lamps. A. Lederer, Vienna. U.S. Pat. 1,180,261, Apr. 18, 1916. Date of appl., Dec. 20, 1906.

See Fr. Pat. 371,557 of 1906 ; this J., 1907, 401.

Preparing intermediate products from hydrocarbon and other distillates. Eng. Pat. 6450. *See* III.

Manufacture and use of luminous radiations for therapeutical purposes. Eng. Pat. 1480. *See* XX.

III.—TAR AND TAR PRODUCTS.

Nitro-compounds ; Investigation of the chemical processes involved in the technical reduction of aromatic —— to amino-compounds. P. N. Raikow. Z. angew. Chem., 1916, **29**, 196—199.

None of the theories offered at various times to explain the mechanism of the reduction of aromatic nitro-compounds to amines by means of iron and only $\frac{1}{40}$ of the theoretical quantity of hydrochloric acid, is in accordance with the facts except that of Muspratt, which was declared by Wohl (this J., 1891, 876) to be erroneous, but which has now been experimentally proved in all its stages. The amino-compound, *e.g.*, aniline, plays an active part in the process, in that it converts the ferrous chloride into ferrous hydroxide, and the aniline hydrochloride thereby formed then reacts with the free iron with the generation of hydrogen and ferrous chloride, and so the process is repeated : $2C_6H_5.NH_2+FeCl_2+2H_2O=2C_6H_5.NH_2.HCl+Fe(OH)_2$, and $2C_6H_5.NH_2.HCl+Fe=2C_6H_5NH_2+FeCl_2+2H$.—G. F. M.

Anilines ; Acetylation of [substituted] —— by acetic anhydride in presence of catalysts. Transformation of aromatic nitroamines and allied substances and its relation to substitution in benzene derivatives. F. S. Kipping, K. J. P. Orton, S. Ruhemann, J. T. Hewitt, and W. H. Gray. Report Brit. Assoc., Australia, 1914, 105—107.

Smith and Orton (this J., 1909, 678) showed that negatively di-ortho-substituted anilines, such as *sym*-tribromoaniline, though reacting very slowly with acetic anhydride at the ordinary temperature, can be acetylated very rapidly in presence of sulphuric and other acids ; the monoacetyl derivative is formed, whereas at higher temperatures, without a catalyst, the chief product is the diacetyl derivative. Various salts, especially ferric salts, also act as catalysts in the acetylation of amines. To follow analytically the acetylation in presence of acids, the reaction was stopped by adding anhydrous sodium acetate, equivalent to the acid catalyst, and then excess of an acetic acid solution of nitric acid, which converted the unchanged amine rapidly and quantitatively into a nitroamine. The latter was extracted from the diluted solution by shaking three times with chloroform, and determined by titration of its alcoholic solution with baryta. Experiments on the acetylation of *sym*-tribromoaniline in presence of sulphuric acid showed that the reaction is of the second order, and that the velocity constant is approximately halved by doubling the dilution. When the concentrations of the amine and anhydride are constant, the speed of the reaction is approximately proportional to the concentration of the catalyst. When the anhydride and catalyst are kept constant, the speed decreases with increasing concentration of the amine, whilst it is practically unaffected if the concentration of both acid and amine be reduced simultaneously ; this is probably due to the acid catalyst being partly combined with the amine.—A. S.

Nitration of toluene. Hoffman. *See* XXII.

Patents.

Anthraquinone ; Manufacture of ——. A. Heinemann, Birmingham. Eng. Pat. 5514, Apr. 12, 1915.

Anthracene is suspended in water, dilute sulphuric acid, cold acetic acid, or acetone, or in a mixture of acetone with water or dilute sulphuric acid, or dissolved in hot acetic acid or acetone, and ozonised air passed into the suspension or solution until the oxidation to anthraquinone is complete. *Example.* 60 grms. of anthracene is suspended in 1 kilo. of sulphuric acid (sp.gr. 1·5—1·6) and the mixture heated to 100° C. Ozonised air, sufficient to supply 4 grms. of ozone per hour, is passed into the mixture for about 12 hrs., then 1 litre of boiling water is added to the liquid, which is neutralised with sodium carbonate, filtered hot, and allowed to stand until crystallisation of the anthraquinone takes place, which occurs in 24 hrs.—F. W. A.

Hydrocarbon and other distillates; Preparing intermediate products from ——. G. P. Lewis, London. Eng. Pat. 6450, Apr. 30, 1915.

A carbonaceous material such as lignite, peat, sawdust, megass, etc., is destructively distilled, and the distillation products are mixed with the vapour from a tar oil or other hydrocarbon oil, the mixing chamber being preferably heated to about 300° C. The vapours from the mixing chamber are condensed. In alternative forms of the process (1) the hydrocarbon oil in the liquid form is treated with the distillation products in a scrubber, and (2) the distillation products are condensed, and the condensed liquid mixed with the liquid hydrocarbon oil. It is stated that by treating 4 lb. of coal tar oil of b.pt. 250°—300° C. with 1 lb. of distillate from an Australian brown coal, a product containing 55% of oils distilling below 250° C. was obtained.—A. S.

Synthetic chemical process. [*Preparation of phenols.*] C. Ellis, Montclair, N.J. U.S. Pat. 1,179,415, Apr. 18, 1916. Date of appl., May 18, 1915.

An alkali salt of an aromatic sulphonic acid is made by heating a volatile aromatic hydrocarbon with an excess of strong sulphuric acid, and treating the mixture with a solution of an alkali sulphate. The precipitated sulphonate is separated, dried, and fused with caustic alkali, the melt dissolved in water, and the solution neutralised by the addition of a suitable quantity of the mother liquor, which contains the bisulphate of the alkali metal.—C. A. M.

Chlorobenzene: Process of manufacturing ——. V. E. Auger, Paris. U.S. Pat. 1,180,964, Apr. 25, 1916. Date of appl., Feb. 29, 1916.

A solution of chlorine in benzene, obtained by the counter-current method, is brought into contact with iron, and the chlorobenzene separated by fractionation.—F. W. A.

Liquid hydrocarbon consisting of a solution of naphthalene in hydronaphthalenes; Manufacture of a ——. P. Sabatier and A. Mailhe. Fr. Pat. 477,212, June 3, 1914.

Naphthalene vapour is decomposed into carbon and hydrogen by passing over catalysts, *e.g.*, metallic powders on an inert substratum not containing silica, at 500° to 1000° C., and the mixture of hydrogen and naphthalene vapour is passed over a second catalyst, *e.g.*, a metallic powder or alloy on a suitable substratum, when a mixture of the tetra- to deca-hydronaphthalenes with unchanged naphthalene is produced. The carbon is removed from the first catalyst by the action of steam; the water-gas obtained may be mixed with the hydrogen used for reduction. —F. W. A.

Cracking of oils. Eng. Pat. 1594. *See* IIa.

IV.—COLOURING MATTERS AND DYES.

Indigo-yielding glucosides; Physiology of ——. F. R. Parnell. Mem. Dept. Agric., India, Bot. Ser., 1915, **7**, 195—212. Bull. Agric. Intell., 1916, **7**, 70.

The roots and seeds of *Wrightia tinctoria* Br. and of *W. tomentosa* R. and S., contain an indigo-yielding glucoside. The glucoside and enzyme of the former are distinct from those of *Indigofera arrecta* and *I. Sumatrana*, but the enzyme has some action on *Indigofera* glucoside and *vice versa*. When the seed of *W. tinctoria* is germinated and grown without nitrogen, the glucoside content increases until it becomes nearly trebled in about 40 days; as nitrogen starvation begins the amount decreases but is still appreciable when the seedlings are nearly dead. These changes were not observed with *W. tomentosa*. The glucoside in cuttings of *Polygonum tinctorium* and *Strobilanthes flaccidifolius* partly disappears when they are grown without nitrogen. The percentage of glucoside present in *W. tinctoria* and *I. arrecta* is at a maximum at a very early stage in the leaf development, but the absolute amount in a leaf increases during growth, reaches a maximum at maturity, and then remains constant till the leaf falls. Indican is formed in etiolated leaves of *I. arrecta* when they are kept in the dark, but neither the indican content of this plant nor that of *I. Sumatrana* varies between night and day.—E. H. T.

Chloric acid as a reagent in organic chemistry. R. L. Datta and J. K. Choudhury. J. Amer. Chem. Soc., 1916, **38**, 1079—1086.

The regulated action of chloric acid on organic bases, or of silver chlorate on their hydrochlorides, resulted in the formation of the chlorates of the bases. They were isolated in most cases as white crystalline substances, which either exploded or rapidly decomposed on heating. The aromatic chlorates particularly are unstable, and gradually darken at ordinary temperatures owing to oxidation of the base; with excess of chloric acid oxidation to chloroquinones or black dyestuffs took place as the result of a vigorous reaction. The dyestuff from *o*-toluidine is quite distinct from *o*-Toluidine Black. Iodo-hydrocarbons were oxidised by excess of concentrated chloric acid, at the ordinary temperature, in the course of a few days, to iodoxy-compounds.—G. F. M.

Patents.

Gallocyanine series; Manufacture of halogen derivatives of ——. O. Imray, London. From Soc. Chem. Ind. Basle, Switzerland. Eng. Pat. 14,159, Oct. 6, 1915.

Gallocyanine dyestuffs, other than the product obtained by condensing nitrosodimethylaniline hydrochloride and tannin anilide, are treated with a halogen, preferably in presence of a suitable solvent or diluent. The halogen derivatives obtained, or better their easily soluble leuco-compounds, give bluer and faster tints than the parent dyestuffs when applied by the methods usual for printing and dyeing gallocyanine dyestuffs. —F. W. A.

Tetrakisazo dyes; Blue ——. J. Dedichen and W. Lange, Assignors to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,180,985, Apr. 25, 1916. Date of appl., Nov. 2, 1915.

See Eng. Pat. 14,789 of 1915; this J., 1916, 171.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Lignone reactions and constitution [*of lignocelluloses*]. C. F. Cross and E. J. Bevan. J. Soc. Dyers and Col., 1916, **32**, 135—141.

The study of the reactions of lignocelluloses with aromatic amines and phenols (Cross, Bevan and Briggs, this J., 1907, 941, 942) has been developed and extended. With hydroxylamine, the maximum combination in the case of jute lignocellulose corresponds to 0·18% of nitrogen fixed. With phloroglucinol and hydrochloric acid, it is confirmed that the colour reaction only accounts for a fraction of the total combination. The major reaction is attributed to a diketo-cyclohexene group in the lignone complex, while the colour reaction is accounted for by the presence of a

fractional quantity of an aldehydic group, probably a derivative of hydroxyfurfural. In the quantitative study of the phloroglucinol reaction a considerable time is required to reach maximum combination, and the period of about 16 hours (overnight) prescribed in the original description of the method (*loc. cit.*) must be regarded as the minimum duration permissible. Still higher results than are afforded by the standard method are obtained by drying down an excess of a solution of phloroglucinol in dilute hydrochloric acid in presence of the lignocellulose, exposed to the air for a period of four days. Both the phenol and the acid are thereby concentrated on the fibre; in this way a figure of 8·9% was obtained with a specimen of wood meal showing 6·84% after 16 hours by the standard method. Determinations were also made with pyrogallol by the air-drying process and the fixation of 7·6% on the wood lignocellulose was recorded. Jute digested with strong (33%) hydrochloric acid for six days at ordinary temperature lost 17% by weight; this was mainly confined to the furfural-yielding constituent (β-cellulose) which passed into the acid solution with a loss of about one-third of its furfural yield. The hydrolysed solution contained 3% of acetic acid on the original fibre, and the fibre residue after oxidation with chromic acid in presence of dilute sulphuric acid yielded 6% more; thus the effect of the treatment was a considerable increase in the total yield of volatile acid. The action of ethereal hydrogen chloride on the jute fibre was also mainly confined to the β-cellulose, but no volatile acid was obtained in the extract. Oxidation of the lignone complex in the lignocellulose by chromic acid in presence of dilute sulphuric acid, yields for the main part simple acids, acetic, oxalic, and carbonic, in proportions varying with the quantity of chromic acid and the strength of the sulphuric acid. By the incipient roasting of lignocellulose and cellulose he authors have isolated maltol (methylhydroxypyrone) and suggest from this that the pyrone onfiguration is represented in some portion of he constitutional structure of these bodies.
—J. F. B.

Paper: Ash tests for percentage of filler in ——. J. E. Plumstead. Chem. Eng., **23**, No. 2. Chem. News. 1916, **113**, 209—210.

THE percentage retention of any kind of filler on he paper machine is generally expressed by the ormula $\frac{P}{F-V}$, where P is the percentage of ash n the paper, F the number of lb. of filler added er 100 lb. of paper produced by the machine, and the volatile matter in the weight F. The reten- on is influenced by the quality of the filler, the ubstance of the paper, the degree of beating, he consistence of the pulp, the speed of the achine, and length of wire. Any factor which ecessitates the rapid and forcible removal of he water on the wire causes a poor retention of he filler. In making control determinations amples of pulp of 50 c.c. each are taken from the eater or chest and the breast-box and a sample f paper from the reel. The wet and dry samples re dried in the oven, ignited, and the ratio of ash o dry fibre noted. These should show steady elationships for each particular grade and subance of paper. Variations may be caused by ariations in the quantity and quality of "broke" rnished to the beaters. A rational utilisation the filler presupposes an arrangement for turning the whole of the solids of the white ckwaters to the stuff flowing on to the machine. nder these conditions the approximate average tention of the best English china clay is as follows: th 10 lb. of clay per 100 of paper, the retention is about 50%; with 15 lb., about 90%; and with 20 lb., about 85%.—J. F. B.

PATENTS.

Drying paper; Process of ——. J. D. Tompkins, Valatie, N.Y. U.S. Pat. 1,178,556, Apr. 11, 1916. Date of appl., May 25, 1908.

A WEB of paper is passed between heated rollers, one of which is heated to a higher temperature than the other, and is then separated from the rollers to allow escape of moisture and free lateral shrinkage.—F. W. A.

Rosin-size for paper-making; Manufacture of ——. J. M. Scrymgeour, Newcastle-on-Tyne. Eng. Pat. 5009, Mar. 31, 1915.

A ROSIN size which can be readily pulverised in the dry state, is prepared by heating rosin with about 7·9% of its weight of alkali (calculated as Na_2O) in presence of water equal to 4—5 times the weight of the sodium oxide, and continuing the saponification until a large proportion of the total rosin is in the combined state, so that the product, after drying, will dissolve in water at 200° F. (93° C.) without precipitation of free rosin. The product is strained, evaporated to dryness, and pulverised; if desired, an inert filling material, such as kaolin, may be added to the solid residue before pulverising.—J. F. B.

Plastics; Process of producing —— *and products of same.* W. T. Bonner, Washington, N.C., Assignor to K. P. McElroy and R. F. Steward, Washington, D.C., and M. C. Massie, New York. U.S. Pat. 1,180,902, Apr. 25, 1916. Date of appl., Aug. 24. 1908. Renewed Nov. 13, 1913.

A MATERIAL comprising an oleaginous body or fatty oil and cellulose, is treated with caustic alkali and carbon bisulphide to form a colloid solution, which is then coagulated to form a pliable plastic mass.—E. W. L.

Cellulose acetates; Manufacture of ——. H. Dreyfus, Basle, Switzerland. Eng. Pats. 6463, Apr. 30, 1915, and 100,009, Apr. 30, 1915 (Appl. No. 420 of 1916). Under Int. Conv., Apr. 4, 1914.

SEE Fr. Pat. 475,160 of 1914; this J., 1916, 40.

Filter- or press-plate for the dehydration of pulp, paper, peat, or the like. Ger. Pat. 291,010. *See* I.

Process of binding roads and road beds and composition from waste sulphite-cellulose lyes therefor. U.S. Pat. 1,178,979. *See* IX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Madder and market bleached goods; Distinction between ——. M. Freiberger. Färber-Zeit., 1915, **26**, 319—321; 1916, **27**, 26—27.

ATTEMPTS have been made to standardise the white obtained in bleached goods by preparing a series of patterns. Suitable dyestuffs for tinting the white patterns could not be found, and eventually waste bowking liquor diluted to known strengths was used for tinting the samples, which were then dried at the ordinary temperature. A range of standards from pure white to grey, unbleached material was obtained in this manner, by means of which it was easy to distinguish a difference of 5% in the extent of bleaching.
—F. W. A.

Madder and market bleached goods: Distinction between ——. R. Haller. Färber-Zeit., 1916, 27, 6—8.

The process suggested by Freiberger (preceding abstract) for the standardisation of bleached goods, is considered to be applicable only if the same system of bleaching and the same bowking and fulling materials are used in practice as were used in the preparation of the standards.—F. W. A.

Weighting of silk. E. Aumann. Färber-Zeit., 1915, 26, 301—303.

The amount of weighting introduced into silk without damage to the fibre by different manufacturers varies enormously, the limit attained being 180%. The factors influencing the degree of weighting are the nature, origin, and diameter of the silk thread, and the binding materials used. Japanese silks are most readily weighted, followed by Italian, Shantung, and Canton silks. To prevent tendering during storage, silk should contain at least 11% of water and should be kept in a humid atmosphere.—F. W. A.

Titanium tanno-oxalate; Application of —— to textiles. J. Barnes. J. Soc. Dyers and Col., 1916, 32, 141—142.

Titanium tannate is capable of useful application in the dyeing industry, not only for producing yellow and golden shades, particularly on mercerised cotton, but also as a mordant for basic dyestuffs, for which purpose titanium salts are as efficient as those of antimony in fixing tannic acid on the fibre. The compound is best applied in the form of a solution in oxalic acid (tanno-oxalate), and the dipped yarn is wrung, passed through a 5% solution of common salt at 110° F. (43° C.), which fixes the titanium tannate in an insoluble form, and finally washed and turned in a warm soap bath. Methylene Blue or other basic dyestuff may be added to the soap bath and the goods again dipped in the tanno-oxalate. The titanium tannate colour may be modified by mixing certain alizarin or allied colours with a tannin "prepare," passing through a titanium bath, and developing the shade by boiling in water or steaming, a portion of the titanic oxide in this case acting as a mordant for the alizarin colour. Cotton already dyed with the titanium tannate may be dyed with alizarin colours and, if the dyeing is carried on for a sufficient length of time, practically the whole of the tannic acid becomes replaced by the alizarin dye; an addition of calcium acetate may in some cases be advisable. A good scarlet may be produced on wool mordanted with titanic oxide by dyeing with Alizarin Orange. The materials must be free from iron, and care must be taken to avoid the change of the titanic oxide to the meta condition. Sufficient oxalic or, preferably, tartaric acid must be used in the mordanting bath and prolonged boiling avoided.—J. F. B.

Pack dyeing machines. F. Smith. J. Soc. Dyers and Col., 1916, 32, 128—135.

A systematic description of the various types of dyeing machine is given, with illustrations. In the older type, various forms of circulation by vomiting passages and steam injectors were adopted. In more modern designs the aim is to dye larger quantities of material in each operation with even results. In these types the material is packed tightly into a receptacle and the dye liquor forced through it under pressure supplied generally by a centrifugal pump. The chief point in these machines is to avoid the defect of "channelling," *i.e.*, the free passage of the liquor through localised paths, but all the commercial machines are capable of giving satisfactory results, provided the dyestuffs be carefully selected and exhaustion of the bath be suitably retarded. The forced circulatio machines may be classified as horizontal flo machines and vertical flow machines. In all thes machines two factors are of great importance, viz the thickness of material between the inlet fc the dye liquor and the outer casing where the partl spent liquor escapes for recirculation, and secondl the speed at which the liquor travels through th mass. The relation of these factors to eac other, together with the exhaustion speeds (the dyestuffs used, determines the evenness of tl results. In dyeing wool less trouble is experience than with cotton, as wool colours exhaust mo slowly than cotton colours when the latter a applied under the most economical condition Particularly since the war, the sulphur dyestuf available have shown considerable difficulties regards the production of level shades. Th author has designed an experimental machine f the testing of dyestuffs, consisting of a horizont tube in which 500—700 grms. of cotton may packed and compressed by a screw on the en plate; the other end of the tube is connected the delivery pipe of a pump. Speed of penetr tion, pressure, etc., could thus be noted an regulated, and the best conditions for the comp sition of the dyebath and prior treatment of th cotton established.—J. F. B.

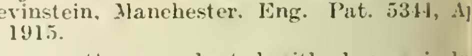
Catechu in black silk dyeings; Detection of —— P. Weyrich. Färber-Zeit., 1915, 26, 317—319.

Richer and somewhat faster shades of black a obtained if catechu is used with Monopol so in the dyeing of weighted silk. To detect t catechu, the sample is treated as suggested Ristenpart (Färber-Zeit., 1907, 273); after imme sion in 10% hydrochloric acid for 1 hr., it is plac in *N*/1 caustic potash for 5 mins. The alkali solution is acidified with a considerable excess hydrochloric acid, the resulting solution boiled a filtered. On boiling the filtrate with formaldehy a yellow flocculent precipitate is obtained catechu is present —F. W. A.

Patents.

Dyeings on wool and cotton; Fast blue ——. Levinstein, Manchester. Eng. Pat. 5344, A 9, 1915.

Wool or cotton, mordanted with chrome, is dy with a dyestuff of the type,



$$\begin{matrix}(2)\ HO-\\(3)\ HOOC\end{matrix}\!>C_{10}H_5(1)N{:}N(4).R.(1)N<\begin{matrix}X\\Y,\end{matrix}$$

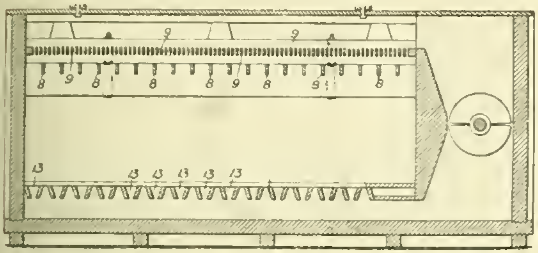
in which R is a benzene residue and X and Y hydrogen atoms or alkyl groups. 4-*p*-Ami benzene-azo-2-hydroxy-3-naphthoic acid gives fast bright blue on chrome-mordanted wool. —F. W. A

Dyeing of silk by means of a foam bath; Proc for the ——. Gebr. Schmid, Basle, Switzerla Eng. Pat. 100,336, Jan. 24, 1916. Under I Conv., July 19, 1915. (Appl. No. 1109 of 191)

Instead of using soap for producing the foa silk-worm chrysalides or silk wastes contain such chrysalides (Ital., *galettamini*; Fr., *pelet*) are added to the dye-bath, which is then hea until it foams, and the silk on reels is introdu into the foam and left for 10—30 mins. with being moved. The product possesses very h lustre, strength, and elasticity.—F. W. A.

Yarn dyeing apparatus. J. J. Fearon, Assigno C. J. Fox, Philadelphia, Pa. U.S. Pat. 1,170,4 Feb. 1, 1916. Date of appl., June 4, 1915.

The dyeing apparatus described in U.S. P 1,079,753 and 1,113,765 (this J., 1914, 1085) been modified to provide better circulation of dye liquor and to facilitate the handling of yarn. The former is effected by providing passages, 13, in the grid of the form shown in the diagram, so that yarn resting on the grid does not close the passages to the same extent as if the grid were composed of vertical strips. The yarn-supporting strips, 8, and the slats, 9, forming a screen, are supported by the cage, which is made in two parts to facilitate charging the yarn into the dye vat and its subsequent removal.—F. W. A.



Amino-compounds for use in mordanting or, after purifying, as foodstuffs; Manufacture of ——. G. Eberle et Cie. Fr. Pat. 476,693. Dec. 8, 1914.

Animal or vegetable products containing proteolytic or peptolytic enzymes and albuminoid substances, and carbohydrates are allowed to ferment, and when fermentation is complete, or later, the enzymes are destroyed. *Example.* Chloroform or another bactericide is added to finely divided pancreas: when fermentation is complete, the mass is heated to 65°—70° C. The product consists of two portions which separate on cooling, a liquid rich in amino-compounds under a mass composed of a mixture of undecomposed albuminoids and fatty acids which is of value in mordanting, particularly for silk goods. —F. W. A.

Weighting silk. Gebr. Schmid, Basle, Switzerland. Eng. Pat. 100,033, Jan. 21, 1916. Under Int. Conv., Jan. 25, 1915. (Appl. No. 1003 of 1916.)

See Ger. Pat. 291,009 of 1915; this J., 1916, 596.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric acid from ammonia by the Ostwald process; Production of ——. G. Schüphaus. Metall und Erz, 1916, **13**, 21. Met. and Chem. Eng., 1916, **14**, 425—426.

Impure ammonia liquor is mixed with milk of lime, and the liquid treated with steam in a separating column, the gas being cooled to condense the steam and the ammonia afterwards washed in caustic soda solution of 30° B. (1·26 sp. gr.). If ammonium chloride solution is used, the purification of the gas may be omitted. The ammonia gas is thoroughly mixed with a suitable quantity of air, and the mixture passed over a platinum gauze catalyst heated to about 700° C., thus forming nitric oxide and water. The lower half of the casing surrounding the gauze is cooled by water to prevent, as far as possible, decomposition of the ammonia before it reaches the catalyst. The nitric oxide is led off through a conical iron hood lined with aluminium, and an aluminium elbow, to a sulphuric acid plant, an iron plate trap being provided to prevent the possible passage of chamber gases back to the platinum catalyst.—B. N.

Potash in certain copper and gold ores. B. S. Butler. *Muscovite [; Extraction of potash from* ——]. G. Steiger. U.S. Geol. Survey, Bull. 620—J, Nov. 15, 1915. 10 pages.

The potash present in the tailings from certain copper and gold ores (see this J., 1915, 1246) is mostly in the form of muscovite. Clarke and Steiger (U.S. Geol. Survey, 1902, Bull. 207, 16) have shown that the potash of leucite is converted completely into chloride if the mineral be heated with ammonium chloride in a sealed tube; if an open vessel be used and the heating prolonged unduly, the potassium is re-converted into an insoluble form. If finely ground muscovite be heated with ammonium chloride in a sealed tube at 350° C., more than 25% of its potassium is rendered soluble, and the conversion is quantitative if the muscovite be fused before heating it with ammonium chloride. Nearly one-third of the potash can be extracted from muscovite by boiling for 5 mins. with dilute (1 : 10) hydrochloric acid. —A. S.

Hydrogen bromide; Absolute density of ——. E. Moles. Comptes rend., 1916, **162**, 686—688.

The density of hydrogen bromide prepared by the action of water on phosphorus tribromide and also by the action of bromine on hydrogen sulphide, was determined after elaborate purification of the gas by refrigeration, washing, drying over phosphorus pentoxide or fused calcium bromide, liquefaction, and fractional distillation. As a mean value of eight series of weighings the weight of a normal litre of hydrogen bromide is given as 3·6444 grms.—G. F. M.

Iodine and iodides; Titration of —— *with arsenious acid.* A. Thiel and E. Meyer. Z. anal. Chem., 1916, **55**, 177—185.

The titration of iodine by arsenious acid solution as described by Müller and Wegelin (this J., 1914, 21) presents no difficulty provided that the hydrogen ion concentration of the solution to be titrated lies between $10^{-6·5}N$ and $10^{-7·5}N$. The end-point of the titration is quite sharp. The authors agree with other observers that the use of borates or phosphate mixtures is preferable to that of bicarbonates for reducing the acidity of the solution to the desired degree.—W. P. S.

Osmosis of some solutions of electrolytes with porcelain membranes, and the relation of osmosis to membrane potential. F. E. Bartell and C. D. Hocker. J. Amer. Chem. Soc., 1916, **38**, 1036—1050.

The osmosis of solutions of various electrolytes, comprising nitrates of univalent, divalent, and multivalent metals, several potassium salts, and hydrochloric acid and sodium hydroxide, was studied in cells constructed with porcelain membranes of various degrees of porosity. Some of the electrolytes behaved normally and gave positive effects which increased with the concentration, whilst others gave positive effects which decreased with the concentration, eventually inverting to a negative osmosis. In other cases, again, maximum or minimum positive osmosis was observed at certain concentrations. All the nitrates investigated except aluminium and thorium nitrates gave zero effects at specific concentrations, namely potassium nitrate about molar, for sodium nitrate 0·1 molar, lithium nitrate 0·05 molar, and barium nitrate 0·02 molar solutions. It is suggested that the osmosis is related to the electrical orientation of the membrane and to the potential difference existing between the solutions on each face, and that it is due to the passage of a charged liquid layer along the capillary tubes of the membrane under the driving force of this potential difference.—G. F. M.

Obsidian and pumice; Synthesis of ——. W. Hempel. Z. angew. Chem., 1916, 29, 173—175.

When obsidian is heated to the softening point, it emits large quantities of steam and of other gases, and is transformed into a porous mass. A mixture of 6·602 grms. felspar, 1·983 grms. powdered quartz, 0·197 grm. spathic iron ore, and 0·17 grm. sodium carbonate was heated in a small electric furnace in presence of steam at a pressure of 85 atmospheres. When the molten mass was cooled normally, a glass-like substance exactly resembling obsidian was obtained; but when it was cooled and the pressure reduced suddenly, pumice resulted. The composition of the above mixture was deduced from analyses of specimens of obsidian and pumice found on Lipari. The iron ingredient must be in the ferrous state. The amount of water taken up is proportional to the pressure, but independent of the composition of the silicate; the absorption of carbon dioxide, when this is used instead of steam, follows the same law, but less of it is absorbed than of water. The furnace used, which could be heated to 1600° C. and could withstand an internal pressure of about 100 atm., consisted essentially of an inverted, cast-iron autoclave tightly sealed with a copper cover, and containing a small hollow cylinder of magnesia lined with thick platinum foil to receive the mixture. Between this cylinder and the autoclave were two cylindrical cells of fireclay. An iridium band wound spirally round the magnesia cylinder served to connect it to the source of electricity. The furnace was evacuated through a pipe fitted with a valve, and water subsequently admitted through the same channel.—E. H. T.

Silica; Determination of ——. V. Lenher and E. Truog. J. Amer. Chem. Soc., 1916, 38, 1050—1063.

The following method was devised to overcome sources of error due to incomplete dehydration of the silica, formation of non-volatile silicates in the residue, etc., and to render the process more expeditious:—The silicate mixed with about 5 times its weight of sodium carbonate is fused, the cold product treated with 60 c.c. of hydrochloric acid (sp.gr. 1·07), and the liquid evaporated on a steam bath until the residue becomes crumbly. It is then treated with 15 c.c. of hydrochloric acid (sp.gr. 1·1) and heated for 10 mins. on the water bath. After diluting with 10 c.c. of water, filtering immediately, and washing the residue of silica with dilute hydrochloric acid (5 c.c. of sp.gr. 1·2 to 95 c.c. of water), the filtrate and washings are evaporated to dryness and the residue dehydrated at 110° C. for 2 hours. A higher temperature than this tends to the formation of compounds of silica with the bases present. The dehydrated residue is treated with 8 c.c. of hydrochloric acid (sp.gr. 1·1), heated for 5—10 mins., diluted to 50 c.c., and filtered. This second silica residue after washing as before is added to the first, and ignited to constant weight. Finally the silica is volatilised with hydrofluoric and sulphuric acids, and the non-volatile residue, which with the above procedure is rarely more than 1 mgrm., weighed, and the weight deducted from the initial weight. The amount of silica which is recovered by a third dehydration never amounts to more than 0·1—0·3 mgrm., and hence the two dehydrations are sufficient.—G. F. M.

Hydrogen peroxide; Catalysis of —— *by platinum.* G. Lemoine. Comptes rend., 1916, 162, 657—663. (See also this J., 1916, 599.)

Experiments were made with platinum black and spongy platinum, using hydrogen peroxide purified by distillation in a vacuum before use, and having a concentration of 30 vol. The peroxide was heated with the platinum in tubes about 16 mm. in diameter, maintained at a constant temperature in a water-bath, the gas disengaged being collected and measured. The decomposition of the peroxide and liberation of oxygen was regular, and the speed of the reaction increased with the weight of the platinum used and also with the fineness of the state of division of the platinum sponge. An increase in the volume of hydrogen peroxide in relation to the catalytic agent, all other conditions being the same, produced some increase in the volume of gas liberated, but not a proportionate one. This proves that the action of the catalyst is limited to the field immediately around it. The comparison of the activity of platinum black and of spongy platinum in the same state of subdivision, proved that the former was much more energetic in its action, and possessed special properties as a catalyst, due probably to the presence of hydrogen compounds of platinum, since heating to 400°—500° C. caused it to lose this superiority over spongy platinum.—J. B. C. K.

Hydrogen peroxide; Catalysis of —— *by various oxides.* G. Lemoine. Comptes rend., 1916, 162, 702—708. (See preceding abstract.)

Ferric oxides. The catalytic action varied greatly according to the physical condition and state of subdivision of the oxide. Ferric oxide freshly precipitated by ammonia and dried, after washing, at 180° C. possesses a remarkably rapid catalytic action, which is greater in the cold than at 69·5° C. The same oxide, after heating to a red heat, has its efficiency as a catalyst enormously reduced. Colcothar, the brown-red oxide, is a less efficient catalyst than either of the above, the reduction being partly due to its greater density. Its action increases with the weight of oxide employed, but not proportionately. *Aluminium oxide.* Experiments with alumina freshly precipitated and dried at 120° C. proved that the oxide possessed a retarding action on the decomposition of the peroxide, *i.e.*, it is a negative catalyst. *Cerium oxide* is a good catalytic agent, its efficiency being no doubt due to its fine state of sub-division. *Silica* was prepared by decomposing a silicate with hydrochloric acid, and evaporating twice to dryness. The dried oxide proved an efficient catalyst, its activity increasing rapidly with increase of the weight used. Some experiments were also made with this oxide after heating to redness, and this was found to be a more efficient catalytic agent than the dried oxide, the efficiency being rather more than doubled. *Thorium oxide* was found to be only a moderately good catalyst; in small quantities it acted as a negative catalyst. Only when the weight of oxide used exceeded 3 grms. with 30 c.c. of 30 vol. peroxide was the decomposition much accelerated. —J. B. C. K.

Hydrogen peroxide; Catalysis by various agents of —— *in a heterogeneous medium. IV. Experiments with carbon.* G. Lemoine. Comptes rend., 1916, 162, 725—731. (See this J., 1916, 599; also preceding abstracts.)

Coconut charcoal is more active as a catalyst than any other form of carbon, though less efficient than spongy platinum. The relative times required for the liberation of the same volume of gas from the peroxide, using one grm. of the catalyst in each case, were as follows:—Hydrogen peroxide alone, 240 hrs.; coconut charcoal, 15 hrs. 4 min.; wood-charcoal, 212 hrs.; sugar-carbon, 142 hrs. The efficiency of charcoal as a catalyst seems to be measured by its absorptive power for gases, and in many respects catalysis by charcoal resembles that by spongy platinum.

The following general conclusions are drawn from the results of the whole investigation:—

(1) The temperature required to produce a given rate of decomposition is lower when a catalyst is present; without a catalyst decomposition occurs very slowly. (2) The rate of decomposition increases with the weight of the catalyst, but not proportionately. (3) It also increases with the fineness of subdivision of the catalyst, *i.e.*, with the active surface presented. (4) Diffusion and the mixing of the solution due to the liberation of the gas are the chief agents in renewing the surface of the liquid in contact with the catalyst.

The catalysts studied may be divided into two groups. Those in the first owe their power to the formation of an unstable combination with oxygen; mercury and the iron oxides and possibly platinum black are examples of this class. The other catalysts, *e.g.*, charcoal and spongy platinum, owe their power to the physical property which they possess of absorbing gases in their pores. Their catalytic action is due to the attractive force exercised by the occluded gas upon the oxygen, loosely held in the hydrogen peroxide molecule, and their efficiency is dependent upon the gas surface which the catalyst presents to the liquid by which it is surrounded. The attractive force brought into play is physical and not chemical, since it is independent of the nature of the gas with which the pores of the catalytic agent are charged.
—J. B. C. K.

Hydrogen peroxide; Determination of ——. J. von Bertalan. Chem.-Zeit., 1916, **40**, 373—374.

An accurate method for the volumetric determination of hydrogen peroxide, which is available in the presence of organic matter, depends on the oxidation of stannous chloride, and the titration of the excess of stannous tin by standard iodine solution, according to the equations:— $SnCl_2+H_2O_2+2HCl=SnCl_4+2H_2O$, and $SnCl_2+2HCl+I_2=SnCl_4+2HI$. The stannous chloride solution if preserved in an oxygen-free atmosphere is sufficiently stable, but it is desirable to perform a blank titration with standard iodine before each determination. In order further to exclude oxidation by molecular oxygen, the peroxide solutions are acidified with sulphuric acid and about 2 grms. of potassium bicarbonate added immediately before running in the known excess of tin solution. A direct titration of hydrogen peroxide by stannous chloride is also suggested, using 1% methylene blue solution as indicator.
—G. F. M.

Modified plant for manufacture of ammonium sulphate in small gas-works. Fukuda. *See* IIa.

Determination of nitrogen by Kjeldahl's method. Nolte. *See* XXIII.

Patents.

Nitric acid or nitrates; Manufacture of —— from nitrogen oxides. A. Classen, Aachen, Germany. U.S. Pat. 1,178,440, Apr. 4, 1916. Date of appl., Feb. 14, 1916.

A mixture of nitrogen oxides, oxygen, and ozone, containing less than 74% oxygen, is brought into contact with an oxidising catalyst containing nickel. The nitrogen pentoxide produced by the reaction is absorbed by an aqueous alkaline solution.—J. B. C. K.

Oxides of nitrogen; Device for producing ——. J. S. Island, Toronto, Canada. U.S. Pat. 1,179,927, Apr. 18, 1916. Date of appl., Oct. 4, 1913. (See also Eng. Pat. 11,363 of 1912; this J., 1913, 909.)

A pair of hollow ring-shaped electrodes, of triangular cross-section, is arranged in a suitable casing, with the flat outer sides of the electrodes abutting on the interior sides of the casing. Each electrode has a number of small openings along its V-shaped edge, and through these openings jets of oxy-nitrogen gas are projected inwards towards the middle of the chamber. A circular electrode with its plane equidistant from each of the ring-shaped electrodes, and having its rim arranged in the plane of the discharge of gas, is rotated in the centre of the chamber, and by its rotation an annular sheet of flame is formed on each side of the rotary electrode, in the plane of the discharge of the oxy-nitrogen gas. The rim of the rotary electrode is bevelled, and the outer angular edges are in alinement with the V-shaped edges of the hollow electrodes.—J. B. C. K.

Aluminium nitride; Process of producing ——. G. Giulini, Lazzago, Italy. U.S. Pat. 1,180,840, Apr. 25, 1916. Date of appl., Dec. 26, 1912.

See Fr. Pat. 451,405 of 1912; this J., 1913, 600. The mixture of aluminium compound, carbon, and alkali carbonates is arranged in vertical columns, to which fresh material is added at the top, whilst aluminium nitride is withdrawn at the bottom, heated gases containing nitrogen being passed upwards through the columns.

Nitrides [especially aluminium nitride]; Electric furnace principally for the manufacture of —— and its mode of utilisation. G. Coutagne. First Addition, dated May 22, 1914, to Fr. Pat. 469,551, May 23, 1913 (this J., 1915, 80).

The alloy containing aluminium, iron, silicon, and aluminium carbide, produced, together with aluminium nitride, by treating a mixture of carbon and bauxite as described in the principal patent, readily absorbs nitrogen at a high temperature, after disintegration has been effected by exposure to moist air, and may itself serve for the production of aluminium nitride. If nitrogen be omitted in the process described previously, the alloy is obtained without accompanying nitride.—F. Sodn.

Nitrogen; Process of fixing —— by means of ferro-aluminium. Soc. Gén. des Nitrures. First Addition, dated Apr. 21, 1914, to Fr. Pat. 474,322, Nov. 19, 1913 (this J., 1915, 1054).

The necessary initial temperature is reached by heating the material in the presence of an oxidising agent, such as air or a chlorate, which may be applied locally.—F. Sodn.

Nitrogen; Process of fixing atmospheric ——. Soc. Gén. des Nitrures. First Addition, dated Apr. 21, 1914, to Fr. Pat. 474,365, Nov. 21, 1913 (see Eng. Pat. 22,586 of 1914; this J., 1915, 353).

Part only, preferably the upper part, of the reaction mass is moistened with water, and, to accelerate heating, oxidising agents, such as chlorates, peroxides, etc., or a little material already in a state of reaction, are added.—F. Sodn.

Ammonia; Manufacture of ——. G. Coutagne. Fr. Pat. 477,746, June 27, 1914.

Aluminium nitride is crushed and vigorously triturated with hot water, so that the resulting coating of alumina is removed, as produced, from each particle; or the nitride may be triturated and agitated with boiling water alternately. Acids or bases may be dissolved or suspended in the water used.—F. Sodn.

Sodium silicate and hydrogen; Process for producing ——. G. Baillio, Niagara Falls, N.Y., Assignor to Castner Electrolytic Alkali Co. U.S Pat. 1,178,205, Apr. 4, 1916. Date of appl., May 21, 1915.

Caustic soda and water are caused to react in a closed vessel with silicon, the latter being present in an amount in excess of that required to convert the whole of the caustic soda into sodium silicate. The reaction produces hydrogen gas, which is drawn off and collected.—J. B. C. K.

Aluminium salts; Process for producing soluble——. M. F. Coolbaugh, Rapid City, and E. H. Quinney, Pierre, S.D. U.S. Pat. 1,178,384, Apr. 4, 1916. Date of appl., July 7, 1914.

Rocks, earths, or minerals containing insoluble compounds of aluminium are reduced to powder, and mixed with gypsum in the proportion of 2·8 parts gypsum by weight to each 1 part of silica present in the original rock or earth. The mixture is heated to incipient fusion, cooled quickly, leached with dilute sulphuric acid, and aluminium sulphate separated from the resulting solution by crystallisation.—J. B. C. K.

Chalk; Light precipitated —— and process of making. N. Statham, Boonton, N.J., Assignor to Industrial Chemical Co., New York. U.S. Pat. 1,178,962, Apr. 11, 1916. Date of appl., Dec. 23, 1915.

Lime and carbon dioxide are produced by calcining calcareous material. The lime is hydrated and the lime water freed from insoluble foreign matter. The carbon dioxide is also washed to free it from impurities. The lime water is then sprayed through the carbon dioxide, and this process is repeated several times, with constant circulation and agitation of the liquor, in order to keep the precipitated carbonate in a finely-divided form. The precipitated chalk is finally collected and dried.—J. B. C. K.

Limestone; Process of calcining——. R. Hart, Assignor to Hart and Page, Rockford, Ill. U.S. Pat. 1,179,180, Apr. 11, 1916. Date of appl., Feb. 17, 1916.

A wet combustible gas, made in a producer of the Mond type, is mixed with steam so that the total amount of water present is raised to about 30% by volume. The limestone is calcined by contact with the combustion products of this gas mixture.—J. B. C. K.

Lime; Process of burning——. A. E. Truesdel, Adams, Mass. U.S. Pat. 1,180,455, Apr. 25, 1916. Date of appl., July 31, 1912.

Uncrushed limestone as it comes from the quarry is heated in a vertical kiln, by the waste gases from a rotary kiln, to a temperature which causes disintegration of the lumps, but is not sufficiently high to effect the dissociation of the carbonate. The heated limestone is then crushed and passed through an inclined rotary kiln in which it is subjected to a higher temperature and the carbon dioxide expelled.—J. B. C. K.

Titanium tetrachloride; Method and means for producing——. L. E. Barton, Niagara Falls, N.Y., Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,179,394, Apr. 18, 1916. Date of appl., June 24, 1914.

Titanic oxide, or material containing it, is mixed with a carbonaceous material, such as bituminous coal, which will produce volatile hydrocarbons, and the whole is heated until all the volatile matter has been expelled. The residue is then subjected to the action of chlorine at a temperature not exceeding 750° C.—J. B. C. K.

Hydrogen peroxide; Manufacture of——. Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude). Fr. Pat. 476,816, May 11, 1914.

An alkali persulphate, *e.g.*, ammonium persulphate, produced by electrolysis, is separated from accompanying electrolyte by simple suction and heated under reduced pressure, in a current of steam, the evolved hydrogen peroxide being condensed. The residual bisulphate is then dissolved in water and returned to the electrolyti cell.—F. Sodn.

Radioactive salt and its process of manufacture T. T. Baker. Fr. Pat. 477,129, Jan. 28, 1915 Under Int. Conv., May 8, 1914.

Finely divided radioactive material is dissolve in the molten salt, at about 700° C., preferabl in the presence of a small quantity of a sulphate such as calcium sulphate, which maintains th radioactive substance in suspension when th product is dissolved in water. About 3 mgrms of radium per ton of salt is recommended. —F. Sodn.

Magnesium chloride liquors of the potash industry Utilisation of waste——. Chem. Fabr. Buckau Magdeburg. Ger. Pat. 290,876, Feb. 24, 1914 Addition to Ger. Pat. 283,096.

The liquor is treated with a mixture of sulphu dioxide and oxygen in presence of water or steam, whereby the magnesium chloride is decomposed with formation of hydrochloric acid and magnesiun sulphate. The hot liquor may be allowed t trickle down a plate-tower or the like, meetin an ascending current of sulphur dioxide and air the hydrochloric acid escaping is condensed, an magnesium sulphate solution is drawn off at th lower end of the tower.—A. S.

Zirconium dioxide or pure zirconium preparations Process for obtaining —— from natural zirconi earth. H. Herzfeld, Berlin. Ger. Pat. 290,87 May 29, 1914.

Natural zirconia earth is heated with excess lime and a quantity of carbon insufficient for th complete reduction of the lime, the product treated with hydrochloric acid, the gelatinou silicic acid which separates is removed, and th zirconium oxychloride present in the solution purified in the usual way. Calcium carbide ma be used in place of carbon, and halogen compound of alkali, alkaline-earth, or earth metals may added to the original mixture.—A. S.

Formaldehyde-sulphurous acid; Manufacture [aluminium] salts of——. L. Bleekwenn, Hanover. Ger. Pat. 290,909, Oct. 26, 1913.

Aluminium, alumina, or aluminium hydroxide dissolved in formaldehyde-sulphurous acid treated with a solution containing formaldehyd and sulphurous acid, and the resulting solution evaporated. Either the neutral salt or bas salts may be prepared. They are soluble i water and are superior in stability and activity aluminium acetate for medicinal purposes. Th basic salt, $HO.CH_2.OSO_2.Al(OH)_2$, is not affecte by exposure to air, but salts of lower basicity a hygroscopic.—A. S.

Silicic acid; Production of a porous mass of — for fixing and removing acids and metallic compounds from solutions. F. H. Bröcking, Barme Ger. Pat. 291,163, Dec. 22, 1914.

Silicic acid is precipitated by sulphuric hydrochloric acid from an alkali silicate soluti to which a soluble alkali salt, such as sodiu sulphate, chloride, nitrate, phosphate, or acetat has been added, and the precipitate is washe and dried. Before use the product is saturat with an alkaline solution, *e.g.*, a solution of sodiu hydroxide or carbonate, or calcium or bariu hydroxide. It is used as a filtering medium f the neutralisation of acid solutions and th separation of compounds of metals from solution —A. S.

Carbon: Process of treating the surface of articles made of "cured" ——. J. L. K. Snyder. Assignor to National Carbon Co., Cleveland. Ohio. U.S. Pat. 1,178,546, Apr. 11, 1916. Date of appl., Sep. 23, 1910.

The articles are dipped in a liquid, such as an acid or alkali, to open the pores, then heated, and a coating applied.—A. B. S.

Silicon: Process of purifying ——. C. J. Brockbank, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,180,968, Apr. 25, 1916. Date of appl., Sep. 18, 1912.

Impurities are removed from silicon by melting it under a layer of a fused silicate, *e.g.*, a double alkali-calcium silicate.—F. W. A.

Hydrogen; Process and apparatus for the commercial production of ——. G. F. Jaubert. Fr. Pat. 476,901, May 14, 1914.

Steam is decomposed by metallic iron, and the resulting iron oxide is reduced again to the metal by purified water-gas (free especially from sulphur compounds) which effects the reduction, at a relatively low temperature, chiefly at the expense of the carbon monoxide present, so that the reaction is almost entirely exothermic. The material to be treated is contained in a series of (preferably three) vertical retorts, which are provided with pipes at either end; the pipes at one end communicate through four-way taps with supplies of steam or purified water-gas, and those at the other end of the retorts with the hydrogen receiver or with a residual gas chamber, from which the spent reducing gas (still rich in hydrogen) is distributed to burners projecting within the masonry jackets of the respective retorts. Further external heating is unnecessary.—F. Sodn.

Formic acid, acetic acid, and like volatile acids; Process for distilling ——. E. C. R. Marks, London. From Chem. Fabr. Grünau. Landshoff u. Meyer, Grünau, Germany. Eng. Pat. 16,215, Nov. 17, 1915.

See U.S. Pat. 1,174,663 of 1916; this J., 1916, 468. The specifically heavy acid vapours are drawn off by means of a fan, so that distillation is effected substantially under atmospheric pressure. The process is applicable to acetic acid and other volatile acids as well as to formic acid.

Nitric acid; Process of concentrating ——. N. Titlestad, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,178,888, Apr. 11, 1916. Date of appl., Sept. 8, 1914.

See Eng. Pat. 19,792 of 1914; this J., 1915, 1053.

Nitric acid: Process of preparing highly concentrated ——. M. Moest, Höchst, Germany, Assignor to Nitrum A.-G., Zürich, Switzerland. U.S. Pat. 1,180,061, Apr. 18, 1916. Date of appl., Apr. 3, 1915.

See Eng. Pat. 4345 of 1915; this J., 1916, 537.

Acetic acid; Manufacture of organic acids, especially ——. E. Galitzenstein and M. Mugdan, Assignors to Consortium für Elektrochem. Ind. Ges., Nuremberg, Germany. U.S. Pat. 1,179,420, Apr. 18, 1916. Date of appl., July 25, 1913.

See Fr. Pat. 460,971 of 1913; this J., 1914, 42.

Process for binding roads and road beds and composition therefor. U.S. Pat. 1,178,979. *See* IX.

VIII.—GLASS; CERAMICS.

Patents.

Lehr [annealing furnace]. L. Steelman, Millville, N.J. U.S. Pat. 1,178,549, Apr. 11, 1916. Date of appl., Nov. 19, 1914.

A series of flues formed of interlocking tiles is located in part within and in part surrounding the greater portion of the annealing chamber. Portions of the flues are formed of regenerative tiles and the air for combustion is preheated by passing it around these tiles before delivering it to the flues where it mixes with the fuel. The products of combustion are passed through adjacent flues in opposite directions.—A. S.

Annealing furnace, or lehr. L. Steelman, Millville, N.J. U.S. Pat. 1,178,550, Apr. 11, 1916. Date of appl., Dec. 6, 1915.

In a continuous annealing furnace the articles are carried on an endless belt-conveyor. Recuperators and flues are provided in the lower part of the structure for the supply of hot air; the returning portion of the conveyor passes below these.—A. B. S.

Enamel and kindred coatings; Method of applying —— *to iron.* H. G. Higley, Tampico, Mexico. U.S. Pat. 1,178,469, Apr. 4, 1916. Date of appl., Mar. 31, 1914.

The iron is immersed in a bath of dilute sulphuric acid containing iron oxide and enamel composition. The enamel is then applied to the iron, which is afterwards fired in the usual manner.—A. B. S.

Furnace [; Calcining —— *for bricks, cement, ores, etc.] and method of operating same.* Metallbank und Metallurgische Ges., Frankfort, Germany. Eng. Pat. 5871, Apr. 19, 1915. Under Int Conv., Apr. 17, 1914.

The furnace consists of an annular series of removable and fixed chambers, arranged alternately. The removable chambers contain the material to be heated (arranged so that gases can pass through it) and the fixed ones are each connected with an air and a gas main and a flue for the products of combustion. One of the removable chambers is heated by a flame formed within it from a mixture of the gas and air supplied from the preceding fixed chamber, the products of combustion being passed successively through the other chambers and then through the flue to the chimney. When the heating of the chamber is completed the gas and air supply to it are cut off, and the succeeding removable chamber is heated in a similar manner. When a finished chamber is cool, it is withdrawn from the circuit transversely to the main axis of the furnace, and a freshly filled one is inserted.—A. B. S.

IX.—BUILDING MATERIALS.

Patents.

Kiln for burning cement, lime, etc. K. H. Johansson, Säfsjö, Sweden. U.S. Pat. 1,177,865, Apr. 4, 1916. Date of appl., Nov. 30, 1915.

The burner at the end of a gas-fired rotary kiln is supported so that it may be moved angularly in a vertical or horizontal plane and also horizontally towards or away from the kiln.
—A. B. S.

Heat-insulating material; Process of producing ——. J. A. Scharwath, Elizabeth, N.J. U.S. Pat. 1,178,027, Apr. 4, 1916. Date of appl., Aug. 20, 1914.

A core of suitable shape is coated with a solution of alkali silicates and then heated sufficiently to dry and harden the coating. This treatment is repeated until a sufficiently thick coating is obtained, by mechanically passing the core through a series of coating machines and furnaces arranged alternately.—A. B. S.

Roads and road beds; Process of binding —— and composition [from waste sulphite-cellulose lyes] therefor. J. P. Walsh. Boston, Mass. U.S. Pat. 1,178,979, Apr. 11, 1916. Date of appl., Nov. 20, 1914.

A highly hygroscopic road-binder is made of a comminuted solid obtained from waste sulphite liquor and an insoluble carbonaceous filler, *e.g.*, the waste product from the manufacture of soda-ash. The binder and filler are applied to the road-bed and the whole is then treated with water.—A. B. S.

Plastering-mortar: Method of improving the permeability to air of dry ——. C. A. Kapferer and J. Weber. Elbart, Germany. U.S. Pat. 1,180,775, Apr. 25, 1916. Date of appl., Aug. 15, 1911.

See Fr. Pat. 433,321 of 1911; this J., 1912, 131.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Carbon [in steel]: Determination of —— by the Eggertz method. H. Le Chatelier and F. Bogitch. Comptes rend., 1916, **162**, 709—714.

The Eggertz colorimetric method is the simplest for the determination of the carbon in steel, and the authors have carried out an investigation to determine the conditions for increasing its accuracy and reducing the time required. They recommend that the method should be carried out as follows:—1 grm. of the steel in the form of turnings or filings is placed in an Erlenmeyer flask of 250 c.c. capacity, and 20 c.c. of cold nitric acid of sp.gr. 1·16 is added. The liquid is heated to boiling in one minute, kept boiling for another minute, then treated with 30 c.c. of boiling nitric acid of sp.gr. 1·33, and ebullition continued for a further three minutes. The solution is then quickly cooled by plunging the flask into a pan full of water, and after one minute's immersion, during which the liquid is kept agitated, the colorimetric comparison is made with the standard solutions of steel or caramel employed for this test. The object of using acid of different strengths is to expedite the solution of the steel, for it has been found that while acid of sp.gr. 1·15—1·18 has the most rapid action on the metal, acid of a much higher strength is required to decompose the carbides.—J. B. C. K.

Carbon in steel: Determination of —— by the Eggertz method. H. Le Chatelier and F. Bogitch. Comptes rend., 1916, **162**, 731—735. (See preceding abstract.)

The authors have studied the effects of various percentages of carbon, manganese, nickel, and silicon, and of the thermal treatment of the steel upon the accuracy of the modified method. The percentage of carbon within the limits 0·09 to 1·20 %, has no influence on the results. The presence of manganese causes somewhat low results, but the effect is negligible when the Mn does not exceed 1 %. Nickel acts in a similar manner to manganese, but the effect is more pronounced. A steel containing 1 % Ni and 0·41 % C gave 0·32 % C when tested by the modified Eggertz method, and a steel containing 3 % Ni gave a solution coloured green, which rendered comparison with the standards very difficult. Silicon in small amounts does not affect the method, but in amounts exceeding 1 %, as in the steel used for dynamos and springs, a green liquid is obtained. The thermal treatment which the steel has received is also of importance, for alterations in the rate of cooling produce considerable variations in the colour due to carbon. The authors recommend, therefore, in order to obtain reliable results, that the test pieces should be cooled slowly, and that a steel containing the same percentage of manganese as the steel to be tested, should be used for the preparation of the standard series of colours.
—J. B. C. K.

Iron; Behaviour of —— towards water and aqueous solutions in the steam boiler. E. Bosshard and K. Pfenninger. Chem.-Zeit., 1916, **40**, 5—6, 46—48, 63—64, 91—92.

Experiments were made under normal working conditions, at a pressure of 15 atmospheres, in an experimental boiler of about 30 litres capacity, using test plates of mild steel of 400—500 grms. weight suspended from the cover of the boiler. The electrolytic method of removing rust, described by Jakob and Käsbohrer (this J., 1911, 1063), proved useful for determining the amount of corrosion. Freshly-boiled distilled water, free from carbonic acid, produced the least corrosion. Sodium carbonate in small concentrations caused rusting, but in concentrations above 1 % showed a pronounced protective effect. Zürich tap water corroded the iron to a greater extent than ordinary distilled water. Sodium hydroxide showed a protective action even at a concentration of only 0·01 %, whilst at 0·1 % it prevented corrosion entirely. Sodium hydroxide is formed slowly from sodium carbonate in the steam boiler, and this accounts for the fact that small proportions of sodium carbonate, which produce corrosion at first, exert a protective action after some time. Of the salts which may occur in boiler feed water, chlorides and magnesium salts are specially active in causing corrosion; sodium carbonate at a concentration of at least 1 % is an effective protective agent. Sodium hydrosulphite exerts a protective action when added in small quantities, but at a concentration of 1 % causes pronounced corrosion of boiler plate even in presence of sodium carbonate.—A. S.

Aluminium; Changes in physical properties of —— with mechanical work. II.—Specific heats of hard and soft aluminium. F. J. Brislee. Faraday Soc., May 9, 1916. [Advance proof.] 6 pages.

The mean specific heat of annealed aluminium (99·6 % Al) was found to be 0·2354 ± 0·00033 in the range 300°—20° C. and 0·2240 ± 0·0004 in the range 200°—20° C., these values being in agreement with those obtained by Tilden (Roy. Soc. Proc., 1903, 71, 220; Phil. Trans., 1903, A201, 37), but considerably higher than the results of Harker and Greenwood (Nat. Phys. Lab. Report, 1911, 54), for which the cast metal was employed. The mean specific heat of fresh, hard worked aluminium (hard drawn wire) was 0·2220 in the range 100°—20° C., but decreased when the metal was heated, the value after 10 days at 100° C. varying in four experiments between 0·2150 and 0·2193. As the result of heating hard, brittle wires 0·084 and 0·010 in. in diameter for 10 weeks at 100° C., the tensile strengths were reduced from 18·7 and 18·4 to 14·4 and 13·2 tons per sq. in. respectively, and the wires became soft and serviceable; no change occurred in the same time at atmospheric temperature. Since the specific heat of aluminium varies with the physical condition to an easily measurable degree, determinations should be made upon metal of which the history is definitely known; the greater number of the specific heats hitherto recorded are fortuitous. The values now given for worked aluminium represent metal composed of the crystalline and amorphous phases in unknown proportions, and further investigation is necessary before a definite specific heat can be assigned to the amorphous phase: but from the results obtained it is concluded, tentatively, that under the influence of cold work, aluminium is transformed into an amorphous variety. The most definite condition of the metal is obtained by long annealing, cast aluminium being greatly influenced by the casting temperature and rate of cooling.—W. E. F. P

Aluminium; Annealing of ——. R. Seligman and P. Williams. Faraday Soc., May 9, 1916. [Advance proof.] 2 pages.

The rate of solution of hard worked aluminium in concentrated nitric acid, per unit of surface exposed, was decreased by 30, 5·3, and 3% when the metal was annealed at 500° C., heated for 10 hrs. at 125° C., and heated for 10 hrs. at 100° C., respectively. The rate of solution increased as the time of heating at 125° C. was prolonged, and was completely restored after 80 hours; but a similar reversal was not effected in the case of samples heated at 100° C. Aluminium annealed at 440° C. and allowed to stand for several days had a higher rate of solution than metal freshly annealed at the same temperature.—W. E. F. P.

Copper in copper-manganese; Electrolytic determination of ——. E. D. Koepping. Met. and Chem. Eng., 1916, **14**, 441—442.

The estimation of copper, electrolytically, in the presence of manganese, has been carried out by using (1) soluble anodes, or (2) special electrolytes, and experiments have been made with iron, nickel, zinc, aluminium, and cadmium anodes, and with stationary or rotating platinum or copper gauze cathodes. The special electrolytes were prepared by neutralising the acid solution of the metals with ammonia, and then acidifying with 1 c.c. of sulphuric acid, 2 c.c. of nitric acid, and 1—2 c.c. of hydrofluoric acid (48%) per 125 c.c., or in place of the latter 5 c.c. of phosphoric acid. These electrolytes, combined with the use of nickel anodes, have given results sufficiently accurate for rapid control work. Glass vessels may be used with the dilute hydrofluoric acid electrolyte.—B. N.

Vanadium; Alloys of —— *with silicon, copper, nickel, and silver, and of nickel with boron.* H. Giebelhausen. Z. anorg. Chem., 1915, **91**, 251. Chem.-Zeit., 1916, **40**, Rep. 156.

Vanadium and silicon are miscible in all proportions in the liquid state, within the range 0—60% V. A compound, Si_2V, is formed and separates in long needles which easily scratch pure silicon. Vanadium and nickel in the liquid state are miscible in all proportions within the range 0—36% V. Up to 20% V the solid alloys appear to be homogeneous, but those richer in vanadium consist of two kinds of crystals. Vanadium forms no compounds with silver or with copper. Nickel and boron, within the range 0—23% B, form four stable compounds, Ni_2B, Ni_3B_2, NiB, and Ni_2B_3 respectively. These compounds are not ferromagnetic. In alloys containing 8·6 to 15·8% B, there is a transformation of a less stable α-form of Ni_3B_2 into a more stable β-form at 1050 °C. Amorphous boron is insoluble in molten copper, silver, thallium, bismuth, lead, tin, and zinc, but soluble in aluminium, manganese, and chromium. It dissolves in molten calcium fluoride and separates in the crystalline form. It reacts vigorously with fused cadmium fluoride, yielding boron trifluoride and cadmium.—A. S.

Rare minerals [uranium, columbium, tantalum] in Madagascar. T. P. Waites. J. Chem., Met., and Min. Soc., S. Africa, 1916, **16**, 187—189.

Rich deposits of rare minerals occur in the pegmatite of the volcanic districts of Antsirabe and Betafo, Central Madagascar. Of the more important uranium, columbium [niobium], and tantalum minerals found, blomstrandite contains Cb_2O_5 23·3, Ta_2O_5 28·5, TiO_2 10·9, and UO_3 18·1%; betafite Cb_2O_5 34·8, TiO_2 18·3, and UO_3 26·6%; samiresite Cb_2O_5 45·8, Ta_2O_5 3·7, TiO_2 6·7, UO_3 21·2%; and ampangabeite Cb_2O_5 34·8, Ta_2O_5 8·9, TiO_2 4·9, and UO_3 19·4%. All the constituents of the pegmatite are radioactive, the felspar containing 1% UO_3. Uranium ores also occur over a very considerable portion of the archaean region which constitutes two-thirds of the area of the island and is mainly composed of gneiss. Uranium phosphate occurs, in the form of thin layers on decomposed vegetation, at Vinaninkarenena near Antsirabe, and also in the district of Analalava. Concretionary forms of uranium ore ("pea-stones") are found near the mineral springs of the Infanja Marsh, north of Itasy.—W. E. F. P.

Niobium [columbium]-titanium minerals; Analysis of ——, *with some new tests for niobium, tantalum, and titanium.* J. Moir. J. Chem., Met., and Min. Soc., S. Africa, 1916, **16**, 189—191.

To avoid the difficulty of separating titanium from columbium [niobium] in solution, the ore is fused with potassium hydroxide, the melt dissolved in water (20 parts), and the solution filtered immediately under reduced pressure. Practically all the titanium is retained as K_2TiO_3 in the insoluble residue, and the solution contains the silica, tantalum, columbium, tin, and manganese as potassium salts. For the identification of columbium and tantalum, the filtrate is treated with a strong solution of sodium hydroxide: needle-shaped crystals of sodium tantalate separate in the course of a minute, and, on decanting the supernatant liquid and allowing it to stand for several hours, sodium columbate crystallises in hexagonal plates; this method, although very decisive, is not quantitative. The following new reactions for columbium, tantalum, and titanium are given:—(1) By treating sodium columbate with ammonium oxalate and then with acid and zinc, a deep brown coloration unaffected by hydrogen peroxide or thiocyanates is obtained; the colour fades to yellow on prolonged reduction. With the same treatment titanium gives a dull yellow colour changing to orange-red with hydrogen peroxide. (2) By substituting Rochelle salt or other tartrate for ammonium oxalate in (1), a permanent brown coloration is obtained. (3) By the addition of potassium hydrosulphite (from zinc dust and potassium metasulphite) to an acid solution of columbic acid (obtained by rapidly adding excess of hydrochloric acid to a solution of sodium columbate), a curdy, yellow precipitate is produced which oxidises to white columbic acid on standing. With this reagent titanium solutions give a reddish-orange coloration. (4) In the absence of mineral acid in excess, pyrogallol and allied substances give an orange precipitate with solutions of columbic acid: this is analogons to the known tannin test, but the colour is more characteristic and less liable to be confused with that from titanium. Tantalum gives pale yellow precipitates with these reagents. (5) Thymol, quinol, pyrogallol, and catechol give blood-red colorations with solutions of columbium in concentrated sulphuric acid; on dilution and treatment with zinc, dirty greenish reduction colours are produced. Under similar conditions phenol and morphine at first give orange and pink colorations which by dilution and reduction become dirty violet and yellowish-green, respectively. Titanium gives a garnet-red coloration with thymol and sulphuric acid, but the subsequent reduction colour with zinc is barely perceptible and does not interfere with that of columbium. (6) The violet coloration obtained by reducing titanium solutions with zinc and hydrochloric acid is much intensified by the addition of a thiocyanate.—W. E. F. P.

Joplin lead and zinc ores: Flotation tests on ——. C. A. Wright, O. C. Ralston, and G. L. Allen. Min. and Eng. World, 1916, **44**, 737—738.

EXPERIMENTS by the U.S. Bureau of Mines, in conjunction with the Missouri State Geological Survey, indicate that the sulphides of the Joplin lead-zinc ores can be separated from the gangue satisfactorily by flotation, using a combination of "rougher" and "cleaner" cells. The best results were obtained by the use of wood creosote and pine oil. Tests on slimes showed that the sphalerite can be floated from the gangue by using warm solutions and about 1 lb. of a suitable oil per ton; addition of acid is not essential but facilitates the separation of froth and tailings. In treating slimes it would be necessary to use some form of thickener in order to ensure a supply of pulp of uniform character to the flotation apparatus.—A. S.

[Ore] flotation: Recent progress in ——. R. J. Anderson. J. Franklin Inst., 1916, **181**, 643—657.

A BRIEF review is given of recent progress in the concentration of ores by flotation in Australia and the United States, including a discussion of the suitability of various oils (see this J., 1916, 312). Air-agitation processes possess the advantages over those in which mechanical agitation is used, of being simpler in operation, requiring less oil, and giving a higher recovery.—A. S.

Ore slimes: Control of ——. O. C. Ralston. U.S. Bureau of Mines. Eng. and Min. J., 1916, **101**, 763—769.

VARIOUS processes in use or proposed for the treatment of ores and clays (*e.g.*, those of Lockwood, Schwerin, and Bleininger) are considered on the basis of known colloidal chemical phenomena. By applying the principles of colloid chemistry it was found possible in most cases to alter the rate of settling of ore slimes, and in a few instances to effect differential settling. Ore and water suspensions of various concentrations were allowed to settle in similar graduated cylinders, about 10 in. deep and of 200 c.c. capacity. Three types of settling, termed "subsidence," "consolidation," and "compacting," were observed. Ordinary dilute suspensions were found to settle by subsidence until the thickened material contained 10—20% solids, when the surface of the settling material became suddenly clear-cut and consolidation settling commenced; the latter continued until a concentration of about 40% solids was attained, after which the compacting phase (closer packing of the settled particles) set in. The rate of settling decreased slightly from the subsidence to the consolidation stage, and considerably from the latter to the compacting phase. Compacting settling was found not to occur when a 36 in. tube was employed, and comparatively little subsidence settling occurred at the concentrations employed commercially unless the slimes had been previously deflocculated. The transition points of the various phases were altered by the addition of electrolytes and colloids to the slimes.—W. E. F. P.

Metals; Grain-size measurements in ——, *and importance of such information.* Z. Jeffries. Faraday Soc., May 9, 1916. [Advance proof.] 14 pages.

OWING to lack of data correlating the grain size of metals and alloys with their physical properties and behaviour in actual use, measurements of grain-size can only be interpreted in comparatively few instances at the present time; but in these cases the grain-size method of control appears to be more sensitive than mechanical testing and has the additional advantage that the measurements are made on the metal in the state in which it is actually used. The methods in use for determining grain size are: (1) the planimeter method, in which the number of grains in an irregularly bounded area is counted and the area determined by means of a planimeter; (2) Heyn's method, depending on the assumption that the intercepts of a straight line intersecting a number of grains are proportional to the square roots of the areas of the grains; (3) the intercept method, based on the same assumption as Heyn's, but in which the readings are not confined to a series of parallel lines; and (4) the method of comparison with known samples. In the method now recommended, the equivalent number of whole grains contained within a given circle is ascertained by adding to the number of grains completely included, 0·6 of those intersected by the circle. For rapid determinations the equivalent number of whole grains contained within a circle 79·8 mm. in diameter is multiplied by a factor corresponding to the magnification used, a list of such factors being given for magnifications from 25 to 2,000. Compared with the planimeter method, the author's method has an average percentage error of only 2·4, as against 13·05 and 11·2 in methods (2) and (3). Hints on apparatus and manipulation, sampling, and interpretation of results are also given.—W. E. F. P.

Metals; Annealing of ——. F. C. Thompson. Faraday Soc., May 9, 1916. [Advance proof.] 8 pages.

THE subject is considered more particularly in relation to the annealing of cold-worked copper-zinc and copper-zinc-nickel alloys, the object of which is essentially different from that sought in annealing steel, etc. With the alloys in question, annealing is only effective when it allows of a further reduction of the material in the rolls, etc., and this end is only attained by reheating above the minimum temperature at which recrystallisation occurs, with the result that the high limit of elasticity characteristic of hard worked metals is considerably reduced. Alloys generally have higher annealing temperatures than pure metals, and softening occurs over a much longer range; it is probable that this difference in the rapidity of recrystallisation is intimately connected with the finer crystallisation of alloys as compared with pure metals. The results of Charpy's work on the annealing of cold-worked brasses (this J., 1896, 117) are shown diagrammatically and their chief features discussed. The available range of temperature for annealing is much smaller for brasses of higher than for those of lower zinc content; and high nickel content has a similar effect on the annealing of copper-zinc nickel alloys. Although, as indicated by Le Chatelier, Charpy, and others, time is almost without effect on the annealing of the alloys considered for commercial purposes, the time factor is important at comparatively low temperatures when recrystallisation is commencing.—W. E. F. P.

Metals; Properties of solid solutions of —— *and of inter-metallic compounds.* F. C. Thompson. Faraday Soc., May 9, 1916. [Advance proof.] 7 pages.

ON the assumption, supported by investigation, that the hardness and high electrical resistivity of solid solutions of metals are caused by crystalline distortion similar to that produced by cold work, the theory is advanced that the process of crystallisation of such solutions causes an equalisation of the atomic volumes of the constituents, thus creating elastic stresses which, by increasing the resistance to further stresses, raise the hardness of the mass. On this theory, the relation of the hardness to the concentration throughout the series would be expressed by a parabolic curve with a maximum at 50 atomic per cent. of each metal. Such a curve would correspond absolutely with those observed for simple series such as the silver-gold alloys, and the same theory would also explain the hardness and fragility of inter-metallic compounds.—W. E. F. P.

Diffusion of solids: Preliminary report on ——. C. E. van Orstrand and F. P. Dewey. U.S. Geol. Survey. 1915. Professional Paper 95—G. (14 pages.)

The mean coefficients of diffusion of solid gold into solid lead at 100° and 150° C., determined by a similar method to that used by Roberts-Austen (this J., 1896, 596; 1900, 1117), were found to be 0·0002 + and 0·0043, respectively, a cylinder of lead being employed in conjunction with a gold plate 0·5 mm. thick. At 197° C. the value of the coefficient was 0·0076 when a gold cylinder was used and 0·0060 when electro-plated metal was employed. These results agree well with the theoretical values, and confirm those obtained by Roberts-Austen except at 100° C., for which temperature the present coefficient is ten times that previously found. The bearing of the results, and the diffusion of solids generally, on geophysical and geochemical phenomena is briefly discussed.—W. E. F. P.

Potash in certain copper and gold ores. Butler. *See* XII.

New methods of testing for molybdenum. Moir. *See* XXIII.

Patents.

Wrought-iron: Manufacture of ——. E. L. Ford, Youngstown, Ohio. U.S. Pat. 1,180,994, Apr. 25, 1916. Date of appl., July 23, 1914.

Pig iron is mixed with the calculated quantity of oxidising and slag-forming materials and converted into wrought iron in a tilting puddling furnace lined with a material which is neutral to the charge at the puddling temperature. Either the pig iron or the other constituents of the charge, or both, are preheated so that the reactions take place in the puddling furnace without the need of external heat, and oxygen, free or combined, except that present in the charge, is excluded from the furnace during the reaction period. Ferrous oxide is used preferably as oxidising agent, thereby increasing the yield of wrought iron.—A. S.

Tin and other metals: Recovery of ——. J. B. Letcher, Redruth, Cornwall. Eng. Pat. 5256, Apr. 7, 1915.

In an apparatus of the kind in which a travelling nclined band is employed for recovering tin, etc., rom aqueous mixtures of the latter with sand or lime, the band is composed of corduroy the ridges and furrows of which are at right angles to the direction of travel.—W. E. F. P.

Tin: Apparatus for use in the process for the recovery of —— from tinplate scrap and the recovery of zinc from galvanised iron. D. M. Callander, West Drayton, Middlesex. Eng. Pat. 9094, June 21, 1915.

A slate tank containing acid is placed inside a larger tank containing water, which is heated in any convenient way, as by steam coils. The metal scrap is placed in a container made entirely of slate, which is perforated to allow of the ready access of the acid to the metal.—T. St.

[Lead-zinc] sulphide ores; Separation of mixed ——. Minerals Separation, Ltd., London, Assignees of Minerals Separation and de Bavay's Processes Australia Proprietary Ltd., Melbourne. Eng. Pat. 5650, Apr. 14, 1915. Under Int. Conv., May 1, 1914.

In the treatment of lead-zinc sulphide ores by froth flotation, powdered coke, charcoal, or other carbonaceous material is used in addition to the frothing agent, in neutral or alkaline circuit-water, to produce a float concentrate relatively rich in galena.—W. E. F. P.

Ores; Process and apparatus for separation of —— by flotation. A. W. Thompson, Assignor to G. M. Parks Co., Fitchburg, Mass., and D. Cole, El Paso, Tex. U.S. Pat. 1,180,089, Apr. 18, 1916. Date of appl., Jan. 13, 1916.

The froth produced in the flotation separation of ores is broken down by the action of a whirling jet of gaseous fluid containing globules of liquid in suspension. The jet is made to impinge on the froth at such an angle that the flow of the froth is retarded until substantially all the bubbles are broken down.—T. St.

Flotation of minerals. R. F. Bacon, Pittsburgh, Pa., Assignor to Metals Recovery Co. U.S. Pat. 1,180,816, Apr. 25, 1916. Date of appl., Aug. 14, 1914.

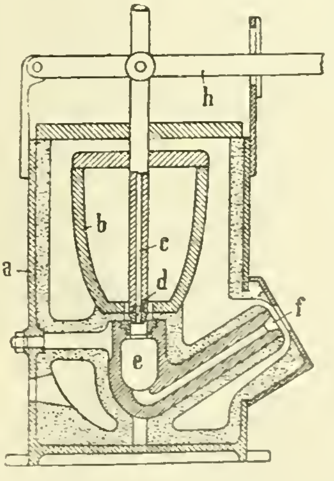
Finely divided oxidised ore is treated with hydrogen sulphide under a pressure of 20 lb. per sq. in., and then subjected to flotation.—A. S.

Alloy. F. La Roche, London. Eng. Pat. 6061, Apr. 22, 1915.

An alloy having properties similar to those of Delta metal, is prepared by melting together copper 55, zinc 38, aluminium 2, and nickel 5 parts by weight, casting the melt into blocks, drawing the latter into bars, heating the bars to cherry-redness and allowing them to cool on an insulated table while an electric current is passed through them in a longitudinal direction.—W. E. F. P.

Metal and other fusible substances; Process and apparatus for casting —— in moulds. Präzisionsgusswerke System Schmidt-Reichhardt, G.m.b.H., Frankfort, Germany. Eng. Pat. 7466, May 18, 1915. Under Int. Conv., May 25, 1914.

The molten material is forced into the mould by the pressure of an explosion, preferably of gunpowder. The apparatus (see fig.) consists of a melting furnace, *a*, in which the crucible, *b*, communicates with a charging chamber, *e*, and has a shut-off valve, *d*, attached to a hollow rod, *c*, which is actuated by a lever, *h*. At the bottom of the chamber, *e*, is a channel, *f*, to the end of which the charging nozzle of the mould is attached. The explosion is produced by charging gun-powder through the hollow rod, *c*.—W. E. F. P.



[*Alloy.*] *Composition of matter.* H. W. Gaskill, Assignor to C. F. Johnson, Cleveland, Ohio. U.S. Pat. 1,180,996, Apr. 25, 1916. Date of appl., May 8, 1915.

THE claim is for an alloy containing copper, nickel, zinc, manganese, aluminium, magnesium, and phosphor-tin.—A. S.

Metal : Combined apparatus for melting and casting ——. I. Hall, Birmingham. Eng. Pat. 10,281, July 15, 1915. Addition to Eng. Pat. 2220, Feb. 11, 1915 (this J., 1915, 837).

THE melting pot is mounted on anti-friction bearings and is rotatable with respect to the furnace body.—W. E. F. P.

Furnace ; Oil fired metal melting ——. A. D. Hunter and H. W. Cullum, London. Eng. Pat. 16,729, Nov. 26, 1915.

THE furnace is cylindrical and is mounted in a horizontal position on trunnions so that it may be turned about its axis. One of the trunnions is hollow to allow of the admission into the furnace of a reducing flame produced by burning liquid fuel in a chamber or jacket situated in line with the opening into the furnace. Water is sprayed into the flame before or just as the latter enters the furnace, whereby hydrogen is liberated and passes into the furnace in a highly heated condition.—T. St.

Cyaniding : Process of ——. H. R. Layng, San Francisco, Cal. U.S. Pat. 1,178,081, Apr. 4, 1916. Date of appl., Mar. 19, 1913.

THE ore is treated with cyanide, the solution filtered and conveyed to a sealed receptacle, and a reagent added to liberate hydrocyanic acid and precipitate salts of the metals. A gas is passed through the liquid to carry off the hydrogen cyanide, which is recovered from the mixture by bringing it into contact with zinc hydroxide and boiling the resulting zinc cyanide with water. The precipitated salts of the metals are recovered by filtration.—W. F. F.

Ores ; Apparatus for treating ——. E. R. Holden, Los Angeles, Cal. U.S. Pat. 1,179,313, Apr. 11, 1916. Date of appl., July 21, 1915.

A CYLINDRICAL tank has a lining of copper coated with mercury and is provided with a series of outlet holes extending from near the bottom to near the top of the tank, each outlet hole being separately controlled. The lining forms the cathode of an electrolytic system, the anode consisting of metal plates secured to the lower surfaces of horizontal blades mounted on and rotated by a central vertical shaft. The upper surface of each blade is substantially level with the bottom edge of the adjacent outlet opening, so that there is a set of anode plates between each pair of outlet openings.—T. St.

Precious metals : Process of treating ores bearing ——. E. R. Holden, Los Angeles, Cal. U.S. Pat. 1,181,077, Apr. 25, 1916. Date of appl., Aug. 10, 1915.

ORES containing gold and silver are treated with a solvent solution in a vessel provided with means for imparting a rotary motion to the solution and for electrolysing it, a cathode coated with mercury being used. The mixture of ore and liquid is drawn off gradually from the top downwards to a predetermined level, whilst the rotary motion is continued.—A. S.

Tungsten or tungsten alloys ; Method of producing malleable and ductile bodies of ——. A. Just, Budapest, Austria-Hungary, Assignor to General Electric Co. U.S. Pat. 1,179,009, Apr. 11, 1916. Date of appl., Aug. 5, 1915.

A MIXTURE of non-malleable and non-ductile tungsten with not more than 2 % of boron nitride is heated until a regulus of malleable and ductile metal is produced.—W. E. F. P.

Sintering-machine. J. F. Austin, Monterey, Mexico, Assignor to The American Smelting and Refining Co., New York. U.S. Pat. 1,179,390, Apr. 18, 1916. Date of appl., June 18, 1913 ; renewed Sept. 17, 1915.

A CONTINUOUS layer of the material to be sintered is ignited from above at a fixed point while travelling in an endless trough above a suction chamber. The ignition device, consisting of a mixing and a combustion chamber, has one or more openings at the bottom for the emergence of the flame and is supported resiliently above and across the trough and recessed to receive the latter, so that the portion of the charge immediately below is practically enclosed during heating.—W. E. F. P.

Metals [*e.g., copper*] *from their ores : Extraction of* ——. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,179,522, Apr. 18, 1916. Date of appl., Sept. 30, 1912.

THE ore is leached with dilute sulphuric acid, the solution separated, and the residue washed with water. The sulphate solution and the wash water are then electrolysed, the former in the cathode and the latter in the anode compartment of the electrolyser. The metal of the sulphate, *e.g.*, copper, is deposited at the cathode, and the anolyte becomes enriched in acid. The spent cathode solution is discarded, and the acid anode solution is used for leaching the ore, the cycle of operations being repeated as often as is necessary. Both the sulphate solution and the wash wate may be treated with sulphur dioxide befor electrolysis.—A. S.

Copper from its ores ; Process of extracting ——. W. E. Greenawalt, Denver, Colo. U.S. Pat 1,180,844, Apr.25, 1916. Date of appl., Sep.30, 1912

THE ore is treated with a chloride solution to dissolve the copper, and the solution treated firs with sulphur dioxide to reduce cupric to cuprou chloride, and then with hydrogen sulphide t precipitate the copper as sulphide. After separating the precipitate, the solution is used agai for leaching the ore, if necessary after treating i to raise the valency of the divalent element present.—A. S.

Metals ; Furnace for the distillation of ——. R. H Engle, Trenton, N.J. U.S. Pat. 1,180,118 Apr. 18, 1916. Date of appl., Nov. 26, 1915.

THE apparatus consists of a series of fireplace or combustion chambers arranged about a centra stack and communicating with the lower part o the latter by means of a descending flue at th back of each. Each chamber contains an incline retort which extends across the fireplace and int the corresponding descending flue.—W. E. F. P.

Metal bodies ; Process of producing compound —— *Compound metal body.* O. H. de Lapotterie, Ne Brighton, Pa. U.S. Pats. (A) 1,180,248 an (B) 1,180,249, Apr. 18, 1916. Dates of appl. Apr. 7, 1914, and Mar. 22, 1915.

(A) THE basis metal is coated with a film of metal or alloy having a melting point belo 900° F. (480° C.), and then with a film of a de oxidised metal having a melting point abo 900° F., the latter film being applied in a sem molten state. A substantial body of anoth metal is then brought into contact with th deoxidised film and caused to unite with i (B) The body consists of a ferrous base metal coate with tin, a coating of an alloy containing a de oxidising metal and copper upon the tin, and a lay of copper upon the alloy.—T. St.

[*Aluminium.*] *Metals ; Process of recovering* ——. C. S. Robison, Assignor to The Metallic Smelting and Refining Co., Chicago, Ill. U.S. Pat. 1,180,435, Apr. 25, 1916. Date of appl., Feb. 12, 1912.

Material containing metallic aluminium is mixed with cryolite, and the mixture charged into a bath of molten sodium chloride ; the metal is melted by the heat of the bath and is allowed to settle out.—W. E. F. P.

Furnace : Electric ——*for the preparation of zinc and similar metals.* H. Specketer, Griesheim. Ger. Pat. 290,643, Oct. 17, 1914. Addition to Ger. Pat. 283,965.

Longitudinal partitions in the furnace are provided with openings, or the middle portions are cut away, thus leaving an undivided middle chamber, into which, on the furnace being rotated, the charge passes from the subdivisions, is mixed, and again distributes itself among the different subdivisions.—T. St.

Muffles [*for distillation of zinc*] ; *Process for improving the durability of* ——. A. Zavelberg, Hohenlohehütte. Ger. Pat. 291,043, Apr. 3, 1914.

A pair of muffles, one fitting loosely inside the other, with the intermediate space packed with finely ground silica or washed sea-sand, is used. —A. S.

Zinc furnaces ; Clean-out apparatus for ——. F. A. Hinkey, Springfield, Ill. U.S. Pat. 1,178,518, Apr. 11, 1916. Date of appl., June 16, 1913.

Blast-furnaces ; Charging bell for ——. J. Kennedy, Pittsburgh, Pa. U.S. Pat. 1,178,522, Apr. 11, 1916. Date of appl., Sept. 10, 1915.

Ore and coal washing ; Table for ——. *Ore concentrator.* (a) C. E. Thompson, and (b) C. E. Thompson and H. Nelson, Denver, Colo., Assignors to The Mine and Smelter Supply Co., New York. U.S. Pats. (a) 1,180,209 and (b) 1,180,210, Apr. 18, 1916. Dates of appl., May 31, 1913, and May 29, 1914.

Iron and steel articles ; Cementation and hardening of ——. G. Stolle and A. Hocks, Kiel, Germany. U.S. Pat. 1,178,551, Apr. 11, 1916. Date of appl., July 31, 1915.

See Eng. Pat. 8889 of 1915 ; this J., 1916, 183.

Ore or fuel briquettes or the like ; Process of making ——. D. H. Bibb, New York. Eng. Pat. 13,375, Sept. 20, 1915.

See U.S. Pat. 1,158,364 of 1915 ; this J., 1915, 1199.

Precipitation device for metal-bearing solutions. Koering Cyaniding Process Co., and B. R. Koering, Detroit, Mich., U.S.A. Eng. Pat. 12,136, Aug. 23, 1915.

See U.S. Pat. 1,163,829 of 1915 ; this J., 1916, 184.

Aluminium ; Method for producing bands of ——. E. R. Lauber and R. V. Neher, Emmishofen, Switzerland. U.S. Pat. 1,178,863, Apr. 11, 1916. Date of appl., Sept. 21, 1911.

See Eng. Pat. 20,445 and Fr. Pat. 434,400 of 1911 ; this J., 1912, 192, 288.

Tantalum and its alloys ; Highly-refractory article of ——. O. A. Simpson, Charlottenburg, Assignor to Siemens und Halske A.-G., Berlin, Germany. U.S. Pat. 1,180,614, Apr. 25, 1916. Date of appl., Oct. 17, 1912.

See Eng. Pat. 23,050 of 1912 ; this J., 1913, 795.

Zinc ; Extraction of —— *from its ores or products.* H. T. Durant, Assignor to The Metals Extraction Corporation, Ltd., London. U.S. Pat. 1,180,765, Apr. 25, 1916. Date of appl., May 4, 1914.

See Eng. Pats. 21,581 and 22,761 of 1913 ; this J., 1914, 1058.

Calcining furnace for bricks, cement, ores, etc. Eng. Pat. 5871. *See* IX.

XI.—ELECTRO-CHEMISTRY.

Insulating oils. Report of Sub-Committee of Inst. of Electrical Engineers. See 11a.

Patents.

Furnace ; Electric ——. J. W. Brown, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,177,680, Apr. 4, 1916. Date of appl., Jan. 8, 1912.

The furnace comprises an upper electrode, with a chamber above it, and a lower electrode with a chamber below it. The charge of granular material is fed into the upper chamber and passes after treatment into the lower chamber. Means are provided for the passage of a combustible gas through the lower chamber to cool the treated material, and for the admission of air to the upper chamber in order to burn the combustible gas and so preheat the charge.—E. W. L.

Electrolytic cell. F. J. Metzger, Assignor to H. T. Beans and M. C. Whitaker, New York. U.S. Pat. 1,178,591, Apr. 11, 1916. Date of appl., Oct. 16, 1908.

A diaphragm, composed of fibrous material or wood, such as birchwood, is cut so as to present the ends of the fibres or the grain to the electrolyte, and is arranged across substantially the entire effective path of the current to and from the electrodes.—B. N.

Cell ; Galvanic ——. M. L. Kaplan, Brooklyn, N.Y., Assignor to Beacon Miniature Electric Co., Inc., New York. U.S. Pat. 1,178,927, Apr. 11, 1916. Date of appl., Aug. 14, 1913.

Depolarising material, of a dense but highly active character, suitable for use in miniature dry batteries, is prepared by exposing a basic compound of manganese, such as the carbonate, to a gaseous oxidising agent, such as air, and then subjecting the partially-oxidised material to the action of a strong oxidising agent in aqueous solution.—B. N.

Battery [*depolariser*] ; *Electric* ——. F. S. Bandeira de Mello, Rio de Janeiro, Brazil. U.S. Pat. 1,179,903, Apr. 18, 1916. Date of appl., Feb. 23, 1916.

The depolariser consists of artificial cuprous sulphide.—B. N.

Electrolytic cell. H. M. Du Bois, Detroit, Mich., Assignor to Pennsylvania Salt Manufacturing Co. U.S. Pat. 1,178,501, Apr. 11, 1916. Date of appl., Apr. 11, 1910.

See Eng. Pat. 1439 of 1913 ; this J., 1913, 873.

Electric furnace principally for the manufacture of nitrides. Addition to Fr. Pat. 469,554. *See* VII.

Manufacture of hydrogen peroxide. Fr. Pat. 476,816. *See* VII.

XII.—FATS ; OILS ; WAXES.

Fats ; Hydrogenation of ——. W. Normann. Chem.-Zeit., 1916, 40, 381—383.

As a proof that the absence of electrical conductivity does not necessarily indicate the absence of metallic nickel, the author cites an experiment in which a contact material prepared from purified kieselguhr with about 20 % of nickel, reduced for an hour at 500° C. in hydrogen, showed no conductivity. On the other hand, the same kieselguhr mixed with 5 % of nickel, prepared by the reduction of nickel oxide at 280° C., showed pronounced conductivity. In answer to Erdmann's assertion that the reduction of nickel oxide during hydrogenation was due to impurities in the oil, the author describes an experiment in which 100 grms. of synthetic triolein was mixed with 1 grm. of pure nickel oxide and hydrogenated at 250° C. Within a few minutes a pronounced carbonyl reaction was obtained, and the mixture was strongly electrically conductive. Notwithstanding Erdmann's hypothetical assertions, the author repeats his conclusion that without free metal there can be no hydrogenation of fats (see this J., 1915, 237, 969; 1916, 262).—C. A. M.

Fat in powders; Determination of ——. S. B. Phillips. Analyst, 1916, **41**, 122—123.

A quantity of the powder containing from 1·5 to 3·5 grms. of fat is shaken for a few seconds in a 6 oz. wide-mouthed stoppered bottle, with 100 c.c. of trichloroethylene, allowed to stand for 15 mins. and again shaken. The stopper is then replaced by a bung through which are passed a 20 c.c. pipette and a short piece of tubing bent outside at an angle. The delivery end of the pipette passes into a perforated cork over which are tied two filter-papers which have been folded so as to resemble a Soxhlet thimble. Air-pressure is applied to the tube so that the solution of fat is forced up into the pipette through the filtering device, the measured quantity is evaporated in a weighed flask, and the residue dried in an oil-bath at 150° C. and subsequently for an hour in a water-bath, with occasional blowing with the bellows. As the volume of the solvent is increased on dissolving the fat, it is necessary to find a factor for the particular fat in question from which the percentage in the powder may be calculated.
—C. A. M.

Sulphonated castor oil; Behaviour of sodium soaps prepared from —— towards acids and calcium and magnesium salts. H. Pomeranz. Monats. Text.-Ind., 1916, **31**, 33—34. Z. angew. Chem., 1916, **29**, Ref., 232.

According to Ger. Pat. 128,691 (see Eng. Pat. 24,868 of 1897; this J., 1898, 162), the separation of insoluble calcium and magnesium soaps in soap baths prepared with water containing calcium and magnesium salts, can be prevented by addition of soap prepared by saponifying highly sulphonated castor oil with caustic soda. The author finds, however, that the calcium soap forms an emulsion from which it separates as a heavy oily layer after standing for a long time. The magnesium salt of sulphoricinoleic acid is soluble in water, but a mixture of sulphonated and unsulphonated sodium ricinoleate is precipitated completely on addition of magnesium salts. Sulphoricinoleic acid and its acid sodium salt are precipitated by strong mineral acids from solutions of soap prepared as described above, but remain dissolved in presence of very dilute mineral acids. Organic acids have no salting-out action on acid solutions of sulphonated castor oil soap.
—A. S.

Determination of stearic acid in butter fat. Holland and others. *See* XIXa.

Patents.

Oils and fats; Apparatus for hydrogenising ——. H. Lane, Ashford. Eng. Pat. 968, Jan. 21, 1915.

The oil is hydrogenated in a vertical cylindrical vessel which is heated by means of a steam jacket or otherwise. Beaters rotating horizontally round a central vertical shaft alternate with annular sloping shelves on the sides of the vessel, so that the oil entering at the top is alternately sprayed outwards to the sides and guided to the centre of the beaters next below, and so on until it reaches the bottom; it is then pumped again to the top of the vessel.—C. A. M.

Catalyst [for hydrogenating oils] and process of preparing same. A. Schwarcman, Assignor to S. Kellogg and Sons, Buffalo, N.Y. U.S. Pat. 1,172,062, Feb. 15, 1916. Date of appl., Apr. 22, 1914.

A composite precipitate of basic character (*e.g.* containing aluminium hydroxide or carbonate) is produced in a solution of a salt of a catalytic metal (nickel) and of a salt of a metal not readily reducible (barium nitrate or chloride), by the addition of an alkali solution containing a dissolved colloid (*e.g.* wool, glue, etc.). The precipitate is washed, dried, and reduced by hydrogen.
—C. A. M.

Oils or fats; Process of hydrogenating ——. W. D. Richardson, Assignor to Swift and Co., Chicago, Ill. U.S. Pat. 1,177,896, Apr. 4, 1916. Date of appl., Nov. 11, 1912.

An electric arc is produced between metallic (nickel) electrodes, which are immersed in the oil, so that part of the metal is disintegrated and becomes incorporated with the oil. After hydrogenation to the desired extent the disintegrated metal is removed from the oil.—C. A. M.

Fats; Process of refining hydrogenised —— for producing edible fats. M. Wilbuschewitsch, Nischninovgorod, Russia. U.S. Pat. 1,177,911, Apr. 4, 1916. Date of appl., Sept. 29, 1911.

The bulk (up to 90 %) of the free fatty acids in the oil, is neutralised with a concentrated solution of sodium carbonate, and the oil then treated with strong caustic soda solution of about the same alkalinity as the first solution, the resulting soaps are washed out, and volatile constituents distilled in an atmosphere of carbon dioxide. Powdered sodium carbonate may be added to the strong solution used for neutralising the fatty acids, so as to form a pulp-like mass.—C. A. M.

Oils; Process of thickening ——. Process of making a thickened oil product. C. Ellis, Montclair, N.J. U.S. Pats. (a) 1,179,414 and (b) 1,180,025, Apr. 18, 1916. Dates of appl., Oct. 4 and Sept. 9, 1913.

(a) A fatty oil is exposed in thick layers to ultraviolet light in the absence of oxidising gases (*e.g.* in a current of non-oxidising gas) to obtain a plastic mass without substantial oxidation of the material. (b) Fatty oils, substantially free from petroleum, are exposed in thin films to ultra-violet radiations to obtain products with increased viscosity.—C. A. M.

Sweating wax; System for ——. W. Murphy, New York. U.S. Pat. 1,180,599, Apr. 25, 1916. Date of appl., Apr. 27, 1915.

Wax is sweated by depositing it on a meshed endless belt on which it is conveyed through an oven at a temperature above its melting-point, raked, and then immersed in a bath of boiling water.
—F. W. A.

Soap; Polymerised-oil ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,178,142, Apr. 4, 1916. Date of appl., Feb. 15, 1915.

Oils, such as fish and whale oils, are polymerised at about 250° C. in a non-oxidising atmosphere and the products saponified.—C. A. M.

Lubricant and process of making the same. A. Dinsley, Manchester. Eng. Pats. 11,129, July 31, and 14,520, Oct. 14, 1915.

Fifteen parts of melted tallow is stirred into a solution of 5 parts of casein in 10 parts of water and 10 parts of caustic soda, and the mixture is allowed to solidify. One part of the above solid mixture is powdered and mixed with one part of castor oil and 7 parts of mineral lubricating oil or petroleum jelly and heated until homogeneous. It is then poured into moulds and allowed to set. Substances such as graphite may be added to the mixture.—W. H. C.

Oils, liquefied greases and fats, or any other liquids ; Apparatus for treating —— with nascent ozone. A. Breydel, Brussels. U.S. Pat. 1,180,372, Apr. 25, 1916. Date of appl., Apr. 3, 1914.

See Eng. Pat. 8772 of 1913 ; this J., 1914, 556.

Process of reconditioning bone-black. U.S. Pat. 1,177,725. *See* I.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Patents.

Paint for protecting metals from rusting. H. Grünwald, Griesborn, Germany. U.S. Pat. 1,179,176, Apr. 11, 1916. Date of appl., Aug. 4, 1914.

A solution of the condensation products of oil, resin, and sulphur—which can, at a certain temperature, be drawn out into threads—is intimately mixed with a tarry liquid consisting of a solution of asphalt in an equal quantity of varnish.—E.W.L.

Paints' and enamels ; Process for ensuring the adhesion of —— to metallic and other surfaces. G. Halavan. Fr. Pat. 477,293, June 9, 1914.

The surface of the metal—*e.g.* zinc—is first treated ith a solution of hydrochloric acid, 50 grms., nd sulphuric acid, 50 grms., in water, 900 grms. priming, consisting of equal parts by weight f potassium silicate and zinc white, is then pplied, and to this, after standing for 24 ours, any paint can be applied in the usual ay. The silicate used consists preferably f potassium silicate of 14° B. (sp.gr. 1·11), iluted with half its weight of water. To coat ther materials such as stone, wood, plaster, it is referable to increase the proportion of silicate. —E. W. L.

urpentine condenser. A. H. Baker, Jacksonville, Fla. U.S. Pat. 1,179,791, Apr. 18, 1916. Date of appl., Dec. 4, 1915.

N auxiliary condenser, for use with the ordinary ndenser of a turpentine distilling apparatus, nsists of a number of vessels, each having a ome-shaped portion extending upwards from the se to a point about half-way up the vessel, gether with a partition which divides the vessel to a lower space for receiving the condensed quid and an upper vapour space. The upper d lower spaces of all the vessels are connected means of "flat" connecting tubes, and there e outlets from the last receiving vessel for the scharge of the liquid and air respectively. —E. W. L.

aterproof coatings ; Method of producing —— on objects which are influenced by humidity. M. Dickert, Werne, Germany. U.S. Pat. 1,180,704, Apr. 25, 1916. Date of appl., July 30, 1915.

E object—such as a gun-cartridge provided th a cardboard casing—is coated first with lata and then with cellulose acetate, and is then ated above the melting-point of the balata, to able the latter to flow and fill up the pores of e under layer.—E. W. L.

nufacture of rosin size for paper making. Eng. Pat. 5009. *See* V.

Process of thickening oils. Process of making a thickened oil product. U.S. Pats. 1,179,414 and 1,180,025. *See* XII.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

[Rubber] coagulum : Alkali treatment of ——. C. Beadle and H. P. Stevens. India-Rubber J., 1916, **51**, 713—714.

Eaton has shown recently (this J., 1916, 264) that by treating rubber coagulum with caustic soda, sodium carbonate, or lime, a product having a very rapid rate of cure can be obtained. Tests by the authors have shown that the vulcanised material prepared from rubber which has been so treated deteriorates on keeping and, sooner or later, "perishes."—A. S.

Vulcanisation ; Rate of —— and rate of output. G. D. Kratz. India Rubber Rev., 1916. India-Rubber J., 1916, **51**, 661—662.

The author gives the results of experiments on accelerating vulcanisation by increasing the temperature, using the following mixing :—First latex plantation rubber, 100 ; zinc oxide, 100 ; sulphur 5 parts, with the addition of a small amount of an "accelerator." Samples were vulcanised at various steam pressures from 36 to 85 lb., and the time required for a "correct cure"—as judged by the "thumb and tooth test"—was determined. Subsequently, tensile strength and elongation tests were made on the samples with the results shown in the table.

Cure.		Tensile strength. Pounds per sq. in.	Elongation. %
Time in minutes.	Steam pressure in lb.		
120	36	2896	750
90	43	2747	725
60	50	2755	725
43	55	3064	725
30	60	2947	775
22	65	2854	800
18	70	2563	750
14	75	2656	725
11	80	2545	750
8	85	2970	800

By plotting a curve the "correct cure" at any intermediate pressure can be ascertained. Ageing tests extended over 4 months confirmed the view that if a compound is correctly vulcanised the temperature at which it is vulcanised in no way affects its ageing properties, and the author concludes that it is therefore safe to increase the temperature of vulcanisation (within reasonable limits) for the purpose of increasing output, provided that the highest temperature which may be employed corresponds with the shortest time capable of definite measurement under the conditions of vulcanisation.—E. W. L.

Vulcanisation ; Substances which facilitate —— (vulcanisation catalysts). R. Ditmar. Gummi-Zeit., 1915, **29**, 424—426. Chem.-Zeit., 1916, **40**, Rep., 148.

A considerable number of vulcanisation catalysts, enabling vulcanisation to be carried out in shorter time and/or at lower temperatures, are known. The presence of two or more of these, or of one in considerable quantity, does not produce an additive result ; in the former case the activity of the mixture is as a rule greater than the sum of the activities of the constituents ; in the latter the activity frequently changes its sign, and a retarding effect is produced. Besides the well-known accelerators litharge and magnesia, which when used together give particularly good results. iron oxide, manganese dioxide, and cuprous oxide are mentioned, although there are objections to the use of the last two. Nickel oxide retards vulcanisation. Amongst organic compounds, piperidine and methylenepiperidine accelerate vulcanisation, pyridine, quinoline, and dimethylaniline do not. Other aliphatic, open and closed chain amines, as well as derivatives of readily volatile bases—such as their urea derivatives or addition products with carbon bisulphide—may also be used. Tetramethylenediamine and the addition compound of carbon bisulphide and pyrrolidine work well. In general any organic base with a dissociation constant greater than about 1×10^{-8} acts as an accelerator. Organic and inorganic ammonia compounds, such as ammonium carbonate and sodamide, give the same result. Dihydroxyquinoline sulphate, especially in conjunction with litharge, is extremely active, as is also anthraquinone; and sulphoxyquinoline and quinoline sulphate are also good catalysts.—E. W. L.

Patents.

Latex; Process and apparatus for coagulating——. W. G. ten Houte de Lange, jun., Bandoery, Java, and C. Bosman, Haarlem, Holland. Eng. Pat. 10,382, July 16, 1915.

Latex is supplied to tubes provided with longitudinal slots, arranged at the top of a chamber into which a coagulating vapour or gas, such as carbon dioxide or smoke, is admitted. The latex flows from the slots on to a series of inclined glass or other plates, arranged vertically one below the other, in such a way that the uncoagulated latex from the top plate is received by the second plate of the series, and so on. The plates are in parallel pairs, pivoted about a horizontal shaft, so that when a layer of sufficient thickness has been formed on the upper plate of a pair, the pair can be rotated through 180° to enable the under-plate to receive the latex. By this method it is possible to separate the rubber from a given latex into different grades or qualities.—E. W. L.

Rubber latex; Process and apparatus for the treatment of——. F. Ripeau. Fr. Pat. 477,238, June 5, 1914.

Latex is placed in shallow aluminium trays (about 50 × 20 × 0·3 cm.) to a depth of at most 2 cm., and the trays are packed on shelves in a chamber, a charge consisting of about 350 trays. Smoke, previously cooled, is passed through the chamber from a smoke generator for about 20 minutes, after which communication between the chamber and the chimney is closed, and the passage of smoke into the chamber continued for about an hour and a half. The course of the coagulation is observed through a glass window, and the chamber is kept closed for half an hour after the coagulum has shrunk away from the sides of the trays. The smoke is then allowed to escape, the chamber opened, the trays allowed to stand for two hours, and the serum poured off. The coagulum is transferred to a large tank of water, in which it is left one night, the sheets of rubber are washed further with changes of water, and each sheet is then exposed to sunlight for 1 to 2 hours, after which it is lightly pressed in an iron or wooden mould and allowed to dry in the air for 5 to 6 days.—E. W. L.

Raw rubber; Apparatus for [smoke] coagulation of ——. T. L. A. Runge, Hanover. Ger. Pat. 290,856, Dec. 28, 1913.

Smoke passes into a closed chamber in which two horizontal rollers revolve one above the other. Latex from a container outside the chamber is introduced, at intervals, by means of a tipping vessel, through a door in the top of the chamber which opens to allow the latex to be introduced. The latex falls on to the upper roller, and any not coagulated falls from there to the lower roller, a sheet of rubber being gradually built up on the rollers, which can be taken out of the apparatus for removal of the rubber.—E. W. L.

Vulcanisable materials [rubber]; Process of treating ——. J. M. Bierer, Boston, Mass., Assignor to Boston Woven Hose and Rubber Co., Cambridge, Mass. U.S. Pat. 1,177,678, Apr. 4, 1916. Date of appl., Jan. 14, 1914.

The material (*e.g.*, an unvulcanised rubber tube) is placed in a vulcanising chamber, and a fluid, other than steam, is admitted to the chamber under pressure; the rubber is then vulcanised by the admission of steam under pressure, whilst it is still under the external pressure of the fluid other than steam. When vulcanisation is complete the steam is shut off and a liquid cooling medium is admitted, the tube still remaining under the external fluid pressure.—E. W. L.

Rubber solutions; Process and apparatus for vulcanising —— by means of ultra-violet rays. H. Olivier. Fr. Pat. 477,204, June 3, 1914.

Rubber solution containing free sulphur with or without certain inorganic or organic sulphides which are decomposed by ultra-violet rays—such as carbon bisulphide, allyl sulphide, or antimony sulphide—passes from a hopper on to an endless steel band, which is carried by guide rollers round the greater part of the periphery of a mercury vapour lamp. The lamp is surrounded by a double, hemicylindrical water-jacket of quartz, in order to cut off heat rays. The time of exposure is quite short, in order to avoid the deleterious effect on the rubber of prolonged exposure to ultra-violet radiation. As an example a layer of solution a fraction of a millimetre thick at a distance of 5 cm. from the lamp, which is operated at 220 volts and 3 ampères, requires an exposure of about 40 secs. After passing the lamp the solution is removed from the endless band to a receiving vessel by means of a scraper —E. W. L.

Rubber; Process of devulcanising——. S. E Allen, Akron, Ohio, Assignor to The Empire Rubber Co. U.S. Pat. 1,178,483, Apr. 11, 1916 Date of appl., Dec. 7, 1911. Renewed, Dec. 22, 1914

Rubber is devulcanised by heating it with oil having a sp.gr. 0·88—0·96, preferably 0·93—0·95 distilled from long leaf pine wood. Heat is applied by means of a bath of liquid having a boiling point above 200° C.—E. W. L.

Rubberising machines. A. Olier et Cie., Clermont Ferrand, France. Eng. Pat. 8757, June 14, 1915 Under Int. Conv., July 4, 1914.

In a double spreading machine the fabric afte being spread on one side with rubber dough passes under a series of hot plates to evaporat the solvent, then over rollers which reverse i and pass it under the second spreading gauge or knife, where it receives a coating on the othe side, finally passing again over the hot plates t complete the drying of the dough.—E. W. L.

Caoutchouc substances; Process of producing —— F. Hofmann, K. Delbrück, and K. Meisenburg Assignors to Farbenfabr. vorm. F. Bayer un Co., Elberfeld, Germany. U.S. Pat. 1,178,72 Apr. 11, 1916. Date of appl., Nov. 25, 1911.

See Eng. Pat. 27,361 of 1911; this J., 1912, 59

XV.—LEATHER ; BONE ; HORN ; GLUE.

Acid-gelatin equilibrium. H. R. Procter and J. A. Wilson. Chem. Soc. Trans., 1916, **109**, 307—319. (See also Procter and Burton, this J., 1916, 404.)

Gelatin combines with acids forming highly ionisable salts, in a manner analogous to the combination of ammonia with acids. The fact that the jelly is completely permeable to all diffusible molecules and ions concerned in the equilibria necessitates that the product of the concentrations of any pair of diffusible and oppositely-charged ions must be equal in the jelly and in the surrounding acid medium, which further requires that the concentrations of diffusible ions in the jelly must always be greater than that in the external solution, so long as the two phases remain distinct. Since the concentration of non-ionised acid is equal in both phases, this excess of ionic concentration of the jelly, *c*, is the measure of the difference of osmotic pressure between the two phases. Since the anion of the gelatin salt cannot be separated from its colloid cation, this force *e* exerts upon the jelly mass an outward pull, which being uniform in all directions produces according to Hooke's law an increase in the volume of jelly proportional to the intensity of the pull. The force *e* is expressed as a function of the concentration of the acid in the outer solution and of that of the gelatin salt, giving an equation which explains the peculiarities of the curves of swelling of gelatin in acids of different concentrations and degrees of ionisation. Other formulæ explain the difference in action between strong and weak acids, as well as the repressive action of neutral salts on the acid-swollen gelatin. All equations given are quantitative and the authors believe them to be applicable to the swelling and contracting actions of electrolytes on colloid jellies in general. —F. C. T.

Limed hide ; Analysis of ——. H. G. Bennett. Collegium (London), 1916, 125—127.

Total alkalinity is determined by shaking about 10 grms. of pelt (previously cut into small pieces) with 50 c.c. of 3% boric acid solution, and neutralising from time to time with *N*/10 hydrochloric acid using methyl orange as indicator. The shaking is continued until the methyl orange remains permanently red. The neutralised liquor from this determination is distilled with a few fragments of granulated zinc and about 20 grms. of caustic soda. Ammonia, which distils over, is collected in 50 c.c. of 3% boric acid solution and titrated with *N*/10 hydrochloric acid and methyl orange. Sulphur is estimated by leaving 50 grms. of pelt in 300 c.c. of 10% hydrochloric acid overnight, heating almost to boiling for half an hour and then boiling for 20 mins., collecting the distillate in 10 c.c. of *N*/1 caustic soda. The sulphide is determined by the sodium arsenite method. To determine soda, the pelt is incinerated, the ash carbonated with ammonium carbonate, and reheated to a dull red heat, and the sodium carbonate extracted with water. Total lime is determined by dissolving the ash of the pelt in hydrochloric acid, precipitating as oxalate, dissolving the oxalate in sulphuric acid, and titrating with *N*/10 permanganate. If lime alone has been used for unhairing, the simple weight of the ash will give sufficiently exact result. There is no satisfactory method of estimating caustic lime. The method of Payne, by which the alkali diffusing into water is neutralised with *N*/10 hydrochloric acid, is inexact in presence of ammonia, soda, or sulphides, and is very slow.—F. C. T.

Tannery liquors ; Acidity of ——. H. G. Bennett. Collegium (London), 1916, 106—113.

Acid constituents of tannery liquors are classified in three groups as tannins, volatile acids, and acids contained in non-volatile non-tannins. The total acidity of the liquor is first estimated by titrating 10 c.c. of the diluted liquor with *N*/10 caustic soda, using 5 drops of phenolphthalein solution as indicator. Next, 10 c.c. of the filtered and diluted liquor is evaporated with 5 c.c. of 0·5% tartaric acid solution, dried in the steam oven, and the residue redissolved in water and titrated with *N*/10 caustic soda as above. The amount of alkali required for the tartaric acid must be deducted. Finally 11 c.c. of the non-tannin filtrate obtained in the gravimetric process of analysis is evaporated with tartaric acid, and the residue titrated as above. The subtraction of the result of the third titration from that of the second gives the tannin acidity, and subtraction of the result of the second from that of the first gives the acidity due to volatile acids. The third titration gives the acidity due to non-volatile non-tannins. This is sometimes a negative quantity owing to the presence of bases in the non-tannins, and in returning results it is assumed that the excess of bases was neutralised by volatile acids, the value for which is corrected accordingly. All acidities are expressed as c.c. of *N*/10 caustic soda required for 10 c.c. of tan liquor. The author proposes tannic acid and non-tannin acid values for various materials, calculated as centigrams of caustic soda required to neutralise the acids of 1 grm. of tannin or non-tannins. These figures are claimed as characteristic though not very constant.—F. C. T.

Preparation of frozen and dried eggs. Pennington and others. *See* XIXa.

Patents.

Fur skins ; Manufacture of ——. M. C. Lamb, London. Eng. Pat. 4910, Mar. 30, 1915.

To enable a fur skin to be used as a waterproof garment otherwise than as a lining to a garment made of textile or other waterproof material, the leather, or flesh side of the skin is coated with a mucilaginous mixture of gelatin or isinglass, rendered insoluble in water by formaldehyde. For example, the skin is tanned (without removal of wool, fur, or hair) by a chrome, aldehyde, oil, or vegetable tanning process, and smoothed by buffing. A solution of gelatin or isinglass (5 parts) in water (100 parts), mixed with, for instance, china clay, 10 ; burnt umber, 3 ; Paris green, 2 ; and, immediately before using, 40% formaldehyde 50 parts, with or without 2—5 parts of castor or other suitable oil, is then applied to the leather side of the skin.—E. W. L.

Artificial leather or the like ; Production of a skin-like mass of micro-organisms for the manufacture of ——. Deutsche Gasglühlicht A.-G. (Auerges.). Ger. Pat. 290,985, Apr. 17, 1914.

A suitable material is sprayed with a nutrient liquid containing micro-organisms. (See also Ger. Pats. 256,407 and 256,408 ; this J., 1913, 438.) —A. S.

Fibrous material to be used as a substitute for leather and other purposes. K. Haring, Assignor to Anhydat-Leder-Werke A.-G., Hersfeld, Germany. U.S. Pat. 1,179,357, Apr. 11, 1916. Date of appl., June 16, 1914.

See Ger. Pats. 258,992 and 258,993 of 1911, and Fr. Pat. 452,380 of 1912 ; this J., 1913, 668.

XVI.—SOILS ; FERTILISERS.

Nitrogen of soil ; Soluble non-protein ——. R. S. Potter and R. S. Snyder. J. Agric. Res., 1916, 6, 61—64.

A silt loam soil was ground, sifted, extracted with 1% hydrochloric acid until all the calcium was removed, and after being air-dried, treated with a 1·5% solution of sodium hydroxide. The mixture was shaken for 2 hours, centrifuged for 5 mins., and then the nitrogen in two portions of 25 c.c. of the clear but dark liquid was determined by the Gunning-Arnold method. Another two 25 c.c. portions were neutralised with sulphuric acid, and then the soluble protein in them was precipitated by adding sufficient trichloroacetic acid to give a 2·5% solution of the acid and a total volume of 30 c.c. After centrifuging, the soluble non-protein nitrogen was found in 10 c.c. portions by the Bock-Benedict modification of the Folin-Denis method (this J., 1915, 200). The same procedure was adopted to determine the nitrogen when the soil had been previously treated with an organic nitrogen compound. Twenty-six such compounds were used, including a few, *e.g.*, guanine, hypoxanthine, nucleic acid, peptone, and creatine, which are known to occur in some soils. When pure proteins, which are soluble in dilute alkali, were added, the proportions extracted were not constant; hence it is probable that the alkali extract does not represent a definite class of nitrogenous compounds. Of the simpler compounds added, the "more acid and the more closely neutral substances" were completely extracted and remained in the soluble non-protein fraction; nucleic acid was, however, an exception. The more basic the compound the less was the quantity recovered. The determination of the soluble non-protein fraction would provide an index of the degree of decomposition of organic matter in the soil.—E. H. T.

Soil inoculation. J. Golding and H. B. Hutchinson. Report Brit. Assoc., Australia, 1914, 668.

Much of the earlier field experimental work on the inoculation of soil with nodule bacteria gave unsatisfactory results, and it is only within the past few years that the requisite conditions have been determined. It is not sufficient to have a pure and active culture of the bacteria, but the soil must be suitable for the growth of the organism and the supply of mineral nutrients must not be the limiting factor in the growth of the plant; in many cases dressing with lime is required. In the majority of cases inoculation by means of soil has given better results than the use of pure cultures, and soil media or the soil itself have been used latterly for cultivation of the organism in the laboratory. Pure cultures possess advantages in regard to cheapness and convenience, and their use avoids the danger of transference of plant diseases which may occur when soil is used for inoculation.—A. S.

Carbon bisulphide; Relation of —— to soil organisms and plant growth. E. B. Fred. J. Agric. Res., 1916, **6**, 1—20.

Silt-loam soil from the Miami River valley was potted and treated with (a) 2% carbon bisulphide; in set (b) the bisulphide was allowed to evaporate after 24 hours by spreading out the soil, and in a third set (c) after evaporation of the bisulphide the treated soil was re-inoculated with 5% of the original soil. Plate counts of the bacteria, dilution counts of the active protozoa, and ammonia and nitrate determinations were made at regular intervals. The bisulphide treatment greatly depressed the number of bacteria at first; after about 5 days an increase set in, and thereafter the numbers far exceeded those in the control pots, even after 60 days. During the period of depression the soil (a) contained many more bacteria than soil (b). After 13 days (c) contained far fewer bacteria than (a) or (b). At this stage the ammonifying power of the soils was found by measuring the rate at which casein was decomposed. In every case the bisulphide treatment favoured ammonification, the rates found for (a), (b), (c), and the control being as 154 : 212 : 190 : 100. Counts of the protozoa after 14 days showed that these organisms had not been affected to any extent. The ammonia and nitrate in (a) and (b) after 60 days was about twice that in the control, but there was less in (c), and except in the last case the amount of nitrate showed no increase, indicating that the nitrifying organisms do not recover so quickly as the ammonifying. The total soluble nitrogen was much increased by the treatment with bisulphide. Mustard was greatly benefited by the presence of carbon bisulphide in the soil, in all the concentrations used, but corn (maize) was injured, except when 2% was applied. Grown in a 2-course rotation, buckwheat, oats, and mustard all improved under a 2% application, but corn was unaffected. The same crops were grown in pots in different soils, viz., Miami silt-loam, the same with 50% of sand, and in sand alone, all of which had been treated with 2% of bisulphide three months previously. The initial reduction in the number of bacteria was greatest in the silt-loam and least in the sand; the increase took place in the second month. Mustard gave the best result, buckwheat and oats improved, and corn was not influenced. Similar experiments to find the effects of bisulphide on five distinct soil types ranging from a very compact red clay to an open sandy soil, showed a maximum bacterial activity in the first soil and a minimum activity in the last. Three months after treatment, buckwheat was sown; increased yields were obtained on each soil, except the sandy, and the results on the clay soil were particularly good. When rape was grown after the buckwheat, the beneficial effect of the bisulphide application was still apparent. Tests on acid soils proved the bisulphide to favour enormously the growth of red clover in peat soil in both first and second crops; in Sparta sand a decreased yield was noted, and in Colby silt-loam the first crop was increased, the second decreased. A 0·3% application of flowers of sulphur to peat soil growing red clover led to a very poor yield. Mustard did not grow well in a treated acid soil. Excluding such soil, the order of response t carbon bisulphide treatment was: mustard, rape, red clover, buckwheat, oats, corn. To test th efficiency of bisulphide as a stimulant, plant were grown in pure sand containing nutrient inorganic substances. Buckwheat and oat responded very well, clover flourished, but mustar did not do well. Analyses of soils which ha been treated with the antiseptic showed that thei sulphate content had increased.—E. H. T.

Humification of plant constituents. A. Trousov Selskoie Khosiaistvo i Liesovodstvo, 1915, 248 409—437. Bull. Agric. Intell., 1916, **7**, 46—47 (See this J., 1915, 808; 1916, 132.)

Vegetable matter undergoes humification eithe by chemical action (oxidation and action of alkalis or by biological action (bacteria and fungi). Tanni and chlorophyll are humified in the former manner protein in the latter, and lignin in both ways Good aeration and, in particular, a favourabl temperature promote humification. Lignin doe not humify at 8°—10° C.; at 37°—38° C. th change is rapid, the amount transformed increasin with the temperature. Different plant consti tuents humify at different rates; thus ligni tannins, and chlorophyll change rapidly, protein slowly, and starch very slowly. The humificatio of those plant constituents which are washed int the soil by rain begins before their actual decom position, and the soluble constituents of the wood tissue are an important factor in the formation humus; they are formed from albumin, tannin and chlorophyll, but not from proteins, whil lignin give rise to humus only in presence of albumin.—E. H. T.

Sewage sludges; Manurial value of ——. G. Mumford. J. Bd. Agric., 1916, 23, 129-135. (See also Bartow and Hatfield, this J., 1916, 552).

The activated sludge obtained by the process of Ardern and Lockett (this J., 1914, 523, 1122; 1915, 937; 1916, 153), after ordinary settling, contains about 95% of moisture, but at Milwaukee, U.S.A., settlement in a deep pipe reduced this figure to 70—75%. Preliminary experiments on the manurial value have shown that this sludge gives better results than sodium nitrate, dried blood, fish meal, etc., when applied in amounts containing equivalent quantities of nitrogen. A sample obtained at Manchester from domestic sewage lost 69·8% on ignition, and contained 4·3% phosphoric acid and 5·5% of nitrogen. Some samples contained as much as 6—7% nitrogen; and the high nitrogen content is accounted for by assuming that the solid particles of sludge assimilate nitrogen from the liquid portion, the effluent holding very little matter in suspension. The nitrogen of the sludge is in a readily available condition. —E. H. T.

Phosphates difficultly soluble; Some factors affecting the efficiency of ——. H. G. Söderbaum. Kingl. Landbruks Akademiens Handlingar och Tidskrift, 1915, 50, 448—467. Bull. Agric. Intell., 1916, 7, 48—50.

The efficiency of insoluble phosphates (bone meal, phosphorite, etc.), depends not only upon the lime content of the soil, but upon the kind of nitrogenous fertiliser applied at the same time, and upon the amount of magnesia in the soil and its quantitative relation to the lime and phosphoric acid present. The influence of the nitrogen factor was investigated during 10 years by growing oats, barley, rye, and wheat in a sandy soil contained in glass vessels holding 52—66 lb. each. In the presence of a soluble phosphatic manure the substitution of ammonium nitrate or sulphate for sodium nitrate was practically without effect, but with insoluble phosphates the replacement gave much increased yields of oats, rye, and wheat. With barley there was usually a decrease, which was greatest when nitrate was completely absent. The same results were observed when sodium nitrate was replaced by organic nitrogen in the form of urea or of albumin. The effects of adding magnesium sulphate or carbonate in the presence of soluble phosphate, but in the absence of a nitrogenous fertiliser, were irregular or very small. When rye or wheat was treated with superphosphate and ammonium sulphate, the addition of magnesium carbonate in amount equivalent to the ammonium salt always resulted in an increased yield. In presence of insoluble phosphate, magnesium carbonate applied with ammonium sulphate always improved the yield of winter cereals; magnesium sulphate, on the other hand, acted irregularly.—E. H. T.

Calcium cyanamide; Investigation and valuation of crude ——. P. Liechti and E. Truninger. Chem.-Zeit., 1916, 40, 365—366. (See also this J., 1911, 23.)

In the determination of the nitrogen present as cyanamide, the sample should be extracted with dilute nitric acid and not with water, as recommended by Caro. 10 grms. is shaken with 800 c.c. of water in a litre flask, and the liquid is then neutralised with 10% nitric acid. After shaking for 2 hours, the flask is filled to the mark and the contents filtered; 50 c.c. of the filtrate is made alkaline with ammonia, and then completely precipitated with a 10% solution of ammoniacal silver nitrate, the precipitate being stirred to effect rapid sedimentation. The precipitate is filtered off and washed, and its nitrogen content determined by Kjeldahl's method. The determination by Caro's method of the dicyandiamide left in the filtrate from the above, yields low results owing to the prolonged boiling with alkali necessary to expel the ammonia. In six specimens of calcium cyanamide a maximum cyanamide-nitrogen content of 0·5% was found, whereas the element present as dicyandiamide ran to more than 7·0%. As the dicyandiamide can act as a plant poison under certain conditions, pot experiments on wheat were performed to compare the action of these abnormal specimens with that of the normal fertiliser. These showed that the former were distinctly injurious to the yield of grain and to a lesser extent, to the yield of straw. During a 3-months storage of calcium cyanamide in an atmosphere saturated with moisture, the original cyanamide present was almost completely converted into dicyandiamide. On the other hand, no such conversion occurs when the air is kept dry; one sample was preserved in a wooden box for 8 years without any deterioration taking place. The determination of the nitrogen present as cyanamide and as dicyandiamide is at least as important as the determination of total nitrogen. —E. H. T.

Study of plant enzymes, particularly with relation to oxidation. Hall and others. *See* XVII.

Patent.

Process for destroying plant pests by means of finely-divided sulphur. Ger. Pat. 290,610. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Starch-flour content of potatoes; Determination of ——. H. J. F. De Vries. Versl. van Landbouwk. Onderz. der Rijkslandbouwproefstat., 1915, [18]. Chem.-Zeit., 1916, 40, Rep., 153.

The most accurate values for the true starch content of potato flour are obtained indirectly, by subtracting from 100 the sum of the percentages of moisture (at 120° C.), ash, cellulose, ether extract, proteins, and pentosans. Values thus obtained are somewhat higher than those given by the Baumert-Bode method (this J., 1900, 1152; 1901, 623; 1909, 949) and Ewers' polarimetric method (this J., 1906, 139; 1908, 238), which are the best of the direct methods. The values ascertained from the table of Behrend, Märcker, and Morgen (compare Foth, this J., 1907, 705), after determining the specific gravity, are, on the average, 0·5% lower than those given by Ewers' method; for determining the specific gravity the use of the balance of Parow or of Reimann is preferable to Stohmann's method. From analytical results obtained with potatoes containing from 15 to 20% starch, the author has constructed a new table ("Groning's table"), which gives more accurate values than the Behrend-Märcker-Morgen table.—A. S.

Study of plant enzymes, particularly with relation to oxidation. [Test for distinguishing dextrose and lævulose.] Hall and others. *See* XVIII.

Use of the electric spark for pulverising solutions and for obtaining monochromatic light. Hirschel. *See* XXIII.

Patents.

Sugar-cane juices; Method of handling ——. H. S. Truscott, Makaweli, Hawaii. U.S. Pat. 1,177,832, Apr. 4, 1916. Date of appl., Mar. 22, 1915.

The diluted juices of low purity obtained from the second and later mills, are subjected to a purification process (liming, heating, and decantation from the deposit) before being mixed with the high-purity juice from the first mill.—J. H. L.

Filter-press, especially for the filtration of sugar juice and the like. E. Lehne, Klein Wanzleben. Ger. Pat. 291,316, June 19, 1914.

THE filter-elements are mounted in a rotary frame composed of end plates provided with wooden trunnions and connected by removable longitudinal rods. The filter-elements have a common central outflow channel and are separated from one another by rubber packing rings. After removing the longitudinal rods of the frame, the filter-elements can be easily removed or replaced. —A. S.

Inverted sugar syrup; Process of making ——. N. W. Taussig, New York. U.S. Pat. 1,181,086, Apr. 25, 1916. Date of appl., Feb. 7, 1916.

AN aqueous sugar solution is heated with an organic acid, *e.g.*, citric acid, for a considerable time at 210°—218° F. (99°—103·5° C.), then raised to a temperature just below that of caramelisation, *e.g.*, 232·5° F. (111·5° C.), and suddenly cooled.—J. P. O.

Adhesives; Method of producing vegetable ——. E. Stern and F. Sichel, Hanover, Germany. Eng. Pat. 3338, Mar. 2, 1915.

STARCH is modified by heating under pressure with water and less than 1 % of caustic alkali or a salt having an alkaline reaction, and the modified starch is partly converted into xanthate by the action of carbon bisulphide. The starch xanthate adhesive may be mixed if desired with 5—15 % of cellulose xanthate.—J. F. B.

Cane-sugar; Refining raw ——. H. F. Clark, Washington, D.C., Assignee of F. Murke, Fort Collins, Colo., U.S.A. Eng. Pat. 6661, May 4, 1915. Under Int. Conv., June 20, 1914.

SEE U.S. Pat. 1,132,868 of 1915; this J., 1915, 504.

Process of reconditioning bone-black. U.S. Pat. 1,177,725. *See* I.

XVIII.—FERMENTATION INDUSTRIES.

Hops; Bitter substances of ——. W. Wöllmer. Ber., 1916, **49**, 780—794, and Z. ges. Brauw., 1915, **38**, 394—395.

THE products of the action of alcoholic sodium hydroxide on the α-bitter acid, humulone, $C_{21}H_{30}O_5$, comprise the humulinic acid described by Schnell (cp. this J., 1904, 944), acetic acid, an unsaturated acid, $C_6H_{10}O_2$, isobutyraldehyde, and resinous matters. Humulinic acid, $C_{15}H_{22}O_4$, is unsaturated and is reduced by hydrogen, in presence of colloidal palladium, to a saturated compound, $C_{15}H_{24}O_4$. Both of these are only feebly acid and the presence of a carboxyl group is improbable, but they both contain a carbonyl group which reacts with phenylhydrazine. When oxidised with permanganate at 0° C., humulinic acid yields a saturated monobasic acid, $C_{15}H_{22}O_6$, which is acid but not bitter in flavour. Humulone, dissolved in alcohol containing some palladous chloride, and shaken in an atmosphere of hydrogen, yields ethyldimethylmethane and a yellow compound, $C_{16}H_{24}O_5$; $C_{21}H_{30}O_5+6H=C_{16}H_{24}O_5+C_5H_{12}$. The yellow compound forms a tetrabenzoyl derivative and therefore contains four hydroxyl groups; the fifth oxygen atom does not appear to be ketonic. This substance behaves as a monobasic acid in presence of phenolphthalein. In the air it slowly oxidises to a red compound, $C_{16}H_{22}O_5$, possessing the characters of a substituted dihydroxyquinone, which is reduced again to the tetrahydroxy-compound by sulphur dioxide. With *o*-phenylenediamine the tetrahydroxy-compound forms an azine. The β-bitter acid of hops, "lupulone," $C_{25}H_{36}O_5$, is also decomposed on hydrogenation.—J. H. L.

Plant enzymes; Study of —— particularly with relation to oxidation. [Test for distinguishing dextrose and lævulose.] A. D. Hall, E. F. and H. E. Armstrong, E. Keeble, and E. J. Russell. Report Brit. Assoc., Australia, 1914, 108—109.

IN certain white-flowered races of *Primula sinensis*, the oxydases (peroxydase) appear to be distributed in the flowers in definite zones, and it is probable that the zonal colour pattern in flowers of plants originating from crosses of white-flowered races of the plant with coloured forms is due to lack of uniformity in distribution of the peroxydase constituent of the colour-forming mechanism, not of the chromogen.

If a few drops of methylene blue be added to a freshly prepared solution containing 1 % of dextrose or lævulose and 0·5 % of sodium hydroxide solution, the blue colour is discharged almost immediately in presence of lævulose, but only after about 15 mins. in presence of dextrose. After standing, the dextrose solution acts much more rapidly, whereas lævulose is less active than at first. The active agent is probably the enolic form common to both sugars, and the method may be used to compare the relative rates of enolisation of carbohydrates. Indigo-blue solution, which changes from green to red, and finally to yellow, as it is reduced, may be used instead of methylene blue.

Urease has been detected in the root nodules from lupins and a number of other *Leguminosæ*, but attempts to detect it in organisms cultivated from the nodules gave negative results. The enzyme has also been detected by Benjamin in nodules from several Australian plants, including wattles, in tubercles derived from the Cycad, *Macrozamia spiralis*, and in the seeds of *Abrus precatorius*.—A. S.

PATENTS.

Distillery slop; Process of recovering by-products from ——. A. von Laszloffy, Peoria, Ill. U.S. Pat. 1,177,746, Apr. 4, 1916. Date of appl., July 3, 1913.

SUCCINIC acid is separated from lactic acid and other constituents of mixtures derived from distillery slop (see this J., 1915, 917), by treating the mixtures with an alkaline earth and extracting with a solvent, *e.g.*, water, in which the alkaline-earth succinates are less soluble than the other substances present.—J. H. L.

Fermentation preparations; Production of ——. M. Groll, Vienna. U.S. Pat. 1,179,625, Apr. 18, 1916. Date of appl., Sept. 20, 1913.

SEE Ger. Pat. 282,296 of 1913; this J., 1915, 730.

Solid combination of vitamines from brewers' yeast. U.S. Pat. 1,173,317. *See* XX.

XIXA.—FOODS.

Pasteurisation [of milk]; Effect of —— on mould spores. C. Thom and S. H. Ayers. J. Agric. Res., 1916, 6, 153—166. (See also this J., 1916, 323.)

To ascertain the effect of pasteurisation by the "holder," "flash," and dry heat methods upon the common saprophytic moulds, sterilised milk samples were inoculated with several specimens of *Penicillium*, *Aspergillus*, and of the mucors, with or without the addition of *Oidium* (*Oospora*) *lactis* and one strain of *Fusarium*. By the "holder" process of subjecting to a temperature of 62·8° C. for 30 mins., practically all the mould spores were destroyed. The common *Mucor racemosus* group and *Rhizopus nigricans* were killed at 54·5° C.; the common green species of *Penicillium* were also eliminated at the same temperature, but a few withstood 57·2° C., and two survived 60° C. for 30 mins. By the "flash" process of heating up to 73·9°—79·5° C. within 30 secs., maintaining at that temperature for another 30 secs., and cooling quickly, practically all the moulds that are found in milk were destroyed, only a few *Conidia* occasionally surviving. Very few of the organisms were affected at 62·8° C., but nearly all were killed at 68·3° C. When the pasteurisation was effected by heating in dry air for 30 secs. at 93·3° C., 31 out of 42 forms of *Penicillium* and 7 out of 24 forms of *Aspergillus* were destroyed, but the mucors were not affected. Heated at 121·1° C. for 30 mins., all the forms of *Penicillium* were exterminated; an occasional living spore of one species of *Aspergillus* and 3 out of 6 mucors, however, withstood the treatment. —E. H. T.

Butter fat; Determination of stearic acid in——. E. B. Holland, J. C. Reed, and J. P. Buckley, jun. J. Agric. Res., 1916, **6**, 101—113.

WHEN dealing with small quantities of stearic acid according to the method described by Hehner and Mitchell (Analyst, 1896, 21, 316), it was found that supersaturation nearly always occurred and a deposit of stearic acid crystals was not obtained. Further experiments showed that if the stearic acid content of the alcohol was sufficient, supersaturation did not take place and that, on cooling the mixture of butter fatty acids and alcoholic stearic acid solution, the stearic acid of the butter fat was deposited together with the excess quantity in the alcohol solution. It is recommended that the alcohol solution used should contain from 3 to 3·7 grms. of stearic acid per litre; 0·5 grm. of the insoluble fatty acids of butter is dissolved in 150 c.c. of the alcoholic stearic acid solution, and the mixture cooled in ice-water for about 24 hours, being gently agitated after the end of the first 18 hours; the liquid is then drawn off through a small filter, the residue dissolved in ether, the ethereal solution evaporated, and the residue weighed. A control experiment, using definite weight of stearic acid, is made at the same time. Narrow cylindrical bottles closed with rubber stoppers should be used for containing the mixtures whilst cooling. The insoluble fatty acids of butter fat were found to contain from to 22% of stearic acid, a quantity considerably n excess of that recorded by Hehner and Mitchell. The molecular weight of the stearic acid recovered rom the butter fat was 284·6. Relatively large amounts of lauric, myristic, and oleic acids do not affect the crystallisation of stearic acid from lcohol. Palmitic acid reduces the amount of tearic acid recovered in the test, but its solvent ction can be counteracted in a large measure, not entirely, by increasing the relative amount f stearic acid in the solution. With butter fatty cids of average palmitic acid content, the alcoholic tearic acid solution should contain at least the uantity of the acid mentioned.—W. P. S.

ggs; Study of the preparation of frozen and dried ——. M. E. Pennington, M. K. Jenkins, W. A. Stocking, S. H. Ross, E. Q. St. John, N. Hendrickson, and W. B. Hicks. U.S. Dept. Agric., Bull. No. 224, Apr. 28, 1916, pp. 1—99, with 17 plates.

STATEMENT is given of the results of an investigaon as to the conditions prevailing in egg-breaking ctories and of the quality of the products placed the market. All eggs should be subjected to the candle test before going to the breaking room and, in addition to this test, the eggs should be graded after removal from the shell, since the candle test sometimes fails to detect eggs which are unfit for food. It is quite possible to prepare a product containing less than 5,000,000 bacteria per grm., including less than 100,000 *B. coli*, provided strict cleanliness and careful grading have been observed. Eggs which are beginning to exhibit signs of decomposition may contain from 20,000,000 to 92,000,000 bacteria per grm. and are unfit for food. In the case of eggs rejected for food purposes but used for tanning leather, the number of bacteria may amount to 150,000,000 per grm. The amount of ammoniacal nitrogen in good eggs rarely exceeds 0·0024% (or 0·0087% on the dry substance) but increases rapidly as the eggs decompose. The amount of ammoniacal nitrogen in desiccated egg is not, however, a reliable index of the quality of the raw material from which it was prepared, as ammonia volatilises during the drying process.—W. P. S.

Wheat flour; Conditions which affect the activity of proteolytic enzymes in ——. C. O. Swanson and E. L. Tague. J. Amer. Chem. Soc., 1916, **38**, 1098—1109. (Cp. this J., 1913, 987.)

FILTERED aqueous extracts of wheat flour were maintained at a constant temperature, usually at 40° C., under aseptic conditions, and the rate of decomposition of the protein in the extract, consisting substantially of the water-soluble leucosin, was estimated from the increase in the amount of amino-acid nitrogen determined by the formaldehyde-titration method from week to week. Addition of small quantities of potassium sulphide or mono- or dipotassium phosphate to the extracts had no appreciable influence on the rate of protein cleavage, but partial or complete inhibition was produced by potassium hydroxide, tripotassium phosphate, or hydrochloric acid ($N/10$ or $N/1$). Ammonium and calcium chlorides, on the other hand, had a very pronounced accelerating influence. The rate of formation of amino-acid nitrogen, at 40° C., was increased by addition of desiccated egg albumin to the extracts, but not by addition of casein.—J. H. L.

Saccharin; Detection of —— in foods. M. Klostermann and K. Scholta. Z. Unters. Nahr. Genussm., 1916, **31**, 67—78. Z. angew. Chem., 1916, **29**, Ref., 222.

THE sample is extracted with a mixture of ether and petroleum spirit, the extract evaporated, the residue boiled for a few minutes with 10% hydrochloric acid, and the solution evaporated to dryness. If the presence of vanillin in the residue is indicated by the odour, it is removed by extraction with a mixture of ether and chloroform. A portion of the residue is treated with Nessler's reagent; if no reaction is obtained, saccharin is absent. If a positive result is obtained, the remainder of the residue is dissolved in phenol and the solution dropped on to phosphorus pentoxide in a porcelain crucible. If saccharin is present a red colouring matter is formed; this dissolves in water to a yellow solution, which becomes blue on addition of alkali.—A. S.

Determination of fat in powders. Phillips. *See* XII.

PATENTS.

Dry milk or cream powder and a process for its manufacture. S. A. Vasey and U. A. Cleeve, London. Eng. Pats. 2772, Feb. 20, 1915, and 7766, May 25, 1915.

THE particles of a milk or cream powder are coated with a layer of an odourless, liquid hydrocarbon which is non-volatile at ordinary temperature (*e.g.*, *Paraffinum liquidum*, B.P.) ; the product will keep unaltered for a considerable period. Such a powder is produced by projecting milk powder by means of an air-blast into an atomised spray of the hydrocarbon, or by mixing the milk, or partially evaporated milk, with the hydrocarbon and then drying the mixture. The finished product should contain not more than 5% of its weight of the hydrocarbon.—W. P. S.

Milk ; Method of treating ——. J. M. W. Kitchen, East Orange, N.J. U.S. Pat. 1,178,808, Apr. 11, 1916. Date of appl., Oct. 25, 1915.

Milk is aerated, heated nearly to 130° F. (55° C.), and then transferred to a bottle which has been washed, sterilised, and cooled to the temperature of the milk. The bottle is closed, heated to a pasteurising temperature, and cooled by transfer of its heat to water which is then used for preheating a fresh supply of milk.—W. F. F.

Egg substitute ; Manufacture of ——. T. S. Kelsey, London, J. W. V. Mason, Manchester, and H. E. Jüngjohann, London. Eng. Pat. 100,294, Jan. 7, 1916. (Appl. No. 327 of 1916.)

Eighty pints of skim milk is evaporated *in vacuo* at 100°—130° F. (38°—54° C.) until the volume is reduced to 62 pints, and 36½ pints of the mixed yolk and white of eggs is stirred in. 7 lb. of albumin or blood serum, 4 lb. of starch, 6½ oz. of ammonium carbonate, and 9 pints of fresh or concentrated milk are mixed together at 100° F. (38° C.) and added to the above egg mixture to form a viscous liquid, suitable as an egg substitute for bakers and confectioners. Where fat is not required, the eggs may be omitted, and a mixture of casein, syrup, sodium carbonate, and water substituted.—J. H. J.

Food product and method of preparing the same. Dry vegetable food products and process of producing the same. R. Wahl, Assignor to Wahl-Henius Research Laboratory, Chicago, Ill. U.S. Pats. (a) 1,178,039 and (b) 1,178,040, Apr. 4, 1916. Dates of appl., Sept. 9 and Oct. 29, 1915.

(a) Cereal matter of the character of bran is washed with water, the latter is separated, allowed to settle, and the clear liquid returned to the bran. The mixture is then maintained at above 40° C. to favour the development of lactic acid bacteria ; gelatinised starch is added during the process and is converted by the diastase present, insoluble nutrient substances in the bran being at the same time rendered soluble. (b) Ungerminated cereal substances containing translocation diastase and starch are moistened with water containing lactic acid, the mixture is kept at 45° to 60° C. for 1 hour, and then dried at a temperature between 80° and 200° C.—W. P. S.

Food product [*bread*] *and process of preparing same.* R. and A. S. Wahl, Chicago, Ill. U.S. Pat. 1,179,877, Apr. 18, 1916. Date of appl., July 6, 1915.

Lactic acid and malt peptase are added to the dough, the mixture is kept at a temperature favouring the activity of the enzyme, and then baked.—W. P. S.

Flour ; Method of preparing grains for the manufacture of ——. E. Simons, Cassel, Germany. U.S. Pat. 1,178,459, Apr. 4, 1916. Date of appl., Nov. 10, 1913.

The grain is subjected to the action of steam at less than 100° C., in order to preserve the diastase, then dried, and crushed.—W. P. S.

Edible pastes ; Process of drying ——. K. Gammel, Assignor to The Cleveland Macaroni Co., Cleveland, Ohio. U.S. Pat. 1,178,794, Apr. 11, 1916. Date of appl., Apr. 10, 1911. Renewed Sept. 9, 1915.

The tubes of paste (*e.g.*, macaroni) are subjected to currents of air of progressively higher temperatures, each temperature being maintained until the tubes begin to bend, and then to the action of air below the saturation point.—W. P. S.

Manufacture of amino-compounds for use in mordanting, or, after purifying, as foodstuffs. Fr. Pat. 476,693. *See* VI.

Process of refining hydrogenised fats for producing edible fats. U.S. Pat. 1,179,911. *See* XII.

XIXb.—WATER PURIFICATION ; SANITATION.

Filtration of water ; Theory and practice in the ——. W. Clemence. Inst. Mech. Eng., Apr. 14, 1916. Engineering, 1916, **101**, 391—393, 412—414, 425—426, 463—464.

There are only two classes of methods of filtration, the rapid and the slow, of which the rapid depends for its success upon the use of a coagulant film, so that the question of the " filtering film " is the real dividing line between the two. In slow sand filters on which a film is allowed to form, the efficacy of the filter is impaired if the film is broken, and more so if the film is removed. Recent work has thrown doubt on the usefulness of the film, and better results have been obtained in some cases without any film. Mechanical filters depend upon the artificial formation of a film, so that they can be worked at a high rate of speed, and any bacteriological purification takes place in the film On the other hand, in the process of multiple filtration no filtration film is formed, the water being passed through successive separate shallow layers of gravel of graded sizes, with a final fine sand filter. A short account is given of installation on this principle at Magdeburg, the Derwent Valley, and the Gold Coast, and a detailed description, with results of working, of that at Cawnpore, India, treating the water of the Ganges This installation consists of settling tanks (which the author does not consider necessary), strainer in three tiers, followed by pre-filters of coarse sand and finally slow sand filters with 2 ft. 6 in. of fin sand. The rate of filtration in the strainers wa 21, 12, and 7 ft. per hr. respectively, 1·1 ft. per hr in the pre-filters, and 0·33 ft. per hr. in the san filter. The strainers were cleaned by blowing ai through them, and the pre-filters were scraped b hand. No film formed on the slow sand filter, th purification being brought about by the bacteria especially the nitrifying bacteria, in the body the filter. Photomicrographs of the sand particl used in the filters, and of the silt particles in th raw water and in the water from the various part of the system are given.—J. H. J.

Chlorine ; Use of gaseous —— *for sterilising wat and effluents.* L. Zamkow. Z. angew. Chem 1916, **29**, 178—180.

Gaseous chlorine, obtained from the liquefie element, has been successfully used in America f sterilising water in place of bleaching powde The content of one cylinder, containing 45 kilo of liquid chlorine, suffices for the treatment 200,000 cub. metres of water. Such cylinders a easily handled, the installation is very simple, a the quality of the chloride is uniform. Th proposal of Ornstein to use chlorine water inste of the gas has greatly increased the use of th disinfectant. The solution is made by passi

the gas upwards through a tower packed with coke down which water percolates. By this method the action of the chlorine is supplemented by that of its reaction products with water, viz., hypochlorous acid, hydrochloric acid, and oxygen. The sterilised water acquires no taste of the disinfectant. In October, 1915, 150 such plants were in use; and tests in Philadelphia showed a reduction in the number of bacteria from 25,000 to 10—40 colonies per c.c. The process has not been adopted in Germany to any extent, but the preliminary trials have all proved satisfactory. The chlorine water is either pumped into the reservoir or passed directly into the main. The sterilising action is apparent at a distance of 50 metres from the point of application. The cost of a plant for treating 10,000 cub. metres daily is M. 6000 (£300), and the all-in working costs are only a small fraction of a pfennig per cub. metre. Chlorine water is also specially suitable for treating effluents, which should be first purified from the coarser suspended solids. The use of chlorine will probably supersede that of bleaching powder.
—E. H. T.

Chloramine group; Antiseptic action of substances of the ——. H. D. Dakin, J. B. Cohen, M. Daufresne, and J. Kenyon. Proc. Roy. Soc., 1916, B., **89**, 232—251. (Compare this J., 1915, 919, 977.)

Nearly all substances containing the $=NCl$ group possess very strong germicidal action, which, like that of sodium hypochlorite, seems to be due to their chlorinating action on the amino-acids and proteins of the living cells. Thus *p*-toluene sodium sulphochloramide gives, for example, with glycine, toluenesulphonamide and an unstable chloramino-acid, $CH_2(NHCl).CO_2Na$, which subsequently decomposes into an aldehyde, carbon dioxide, and ammonia. On the other hand their germicidal properties seem also to depend on the complex chloramine molecule as a whole, apart from the active halogen they contain, since molecule for molecule they are more actively germicidal than sodium hypochlorite. This may possibly be ascribed to selective chlorination of particular cell constituents. Whilst the bromamines and the chloramine derivatives of naphthalene, of halogenated or nitrated hydrocarbons, and of proteins all show strong germicidal action, the sulphochloramides of the benzene series, particularly *p*-toluenesulphochloramide, are best suited for practical use. *p*-Toluenesulphochloramide is readily prepared by the action of sodium hypochlorite (1·2 mols.) on *p*-toluenesulphonamide (1 mol.), and precipitation of the sodium salt, $CH_3.C_6H_4.SO_2Na : NCl$, by the addition of 1½ vols. of saturated brine. The yield is 90% of the theoretical. The salt has all the properties required of an antiseptic for wounds, being readily soluble in water, a non-coagulant of protein, very stable in aqueous solution, and of high germicidal activity both in water and in serum. Tested against *Staphylococci* (2 hours at 18°—20° C.) the following results were obtained: in water, 1 : 500,000, negative; 1 : 1,000,000, positive; in serum, 1 : 1500, negative; 1 : 2500, positive.
—G. F. M.

Manurial value of sewage sludge. Mumford. *See* XVI.

Patents.

Purifying water [*for the manufacture of ice*]; *Method for* ——. L. Block, Mamaroneck, N.Y. U.S. Pat. 1,178,901, Apr. 11, 1916. Date of appl., Oct. 30, 1913.

The water in a state of ebullition is passed slowly along an extended channel open to the atmosphere. Deleterious gases present are allowed to escape freely and the water is then distilled.—J. H. J.

Filtration apparatus [*for water*]. W. A. Stevenson, Florence, Mass. U.S. Pat. 1,180,616, Apr. 25, 1916. Date of appl., Nov. 11, 1913.

The apparatus consists of a filter bed provided with a pipe for collecting the filtered water, which serves also for washing the bed by reverse flow, a discharge pipe delivering below the level of the bed so as to produce a negative pressure during filtration, and a system of pipes by which air can be admitted to the bed during the reverse flow. This system comprises lateral pipes, free from dead ends, by which air can be admitted from either side, and blow-off pipes passing through the walls of the bed, by means of which foreign matters collecting in the air system may be expelled.—J. H. J.

Septic tank. W. J. Kearney, Assignor to J. M. Speed, Memphis, Tenn. U.S. Pat. 1,179,327, Apr 11, 1916 Date of appl., Aug. 24, 1915.

A rectangular tank, with inlet and outlet pipes at opposite ends, has a dividing wall in the middle, with a siphon passing over the wall to convey liquid from one side to the other. The inlet compartment has two partitions, spaced apart, suspended in the liquid. The outlet compartment has a partition from top to bottom, formed of spaced sheets of wire mesh with filtering material between.—J. H. J.

Chlorine or other poisonous gases; Absorbent for —— *for use in respirators.* E. J. Bevan and R. H. Davis, London. Eng. Pat. 7165, May 12, 1915. Addition to Eng. Pat. 22,719, Nov. 18, 1914 (this J., 1915, 448).

The absorbent described in the original patent can be used in a respirator for absorbing chlorine, or any other noxious gas which is rendered innocuous by alkalis. For this purpose, the absorbent is improved by adding sodium thiosulphate, sodium sulphite, or other reducing agent to the alkali with which the cellulose is ground.—J. H. J.

Plant pests; Process for destroying —— *by means of finely-divided sulphur.* M. Bruck, Berlin, and G. H. Lenart, Berlin-Wilmersdorf. Ger. Pat. 290,610, Apr. 10, 1915.

The plants are sprayed with a colloidal solution of sulphur, prepared, for example, by leading hydrogen sulphide and sulphur dioxide simultaneously into a solution of glue. The treatment is particularly effective against *Peronospora.*—A. S.

Insecticides; Preparation of ——. J. D. Riedel A.-G., Berlin-Britz. Ger. Pat. 290,611, Dec. 12, 1913.

Extracts prepared from insect powder (*e.g.*, from *Pyrethrum* flowers) by means of benzene, petroleum spirit, ether, etc., are distributed over a suitable medium, such as magnesium carbonate, and the solvent evaporated.—A. S.

[*Water softening.*] *Apparatus for adding predetermined quantities of substances to a uniform or variable flow of liquid.* B. C. Hinman, London, and E. W. Robey, South Woodford. U.S. Pat. 1,179,311, Apr. 11, 1916. Date of appl., Sep. 26, 1914.

See Eng. Pat. 4435 of 1914; this J., 1915, 375.

Method and apparatus for detecting pieces of foreign matter in the human body. Eng. Pat. 100,291. *See* XXIII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloidal reactions; Adhesion ——. J. U. Lloyd. Amer. J. Pharm., 1916, 88, 217—220.

Colloidal hydrated aluminium silicate possesses the property of completely removing alkaloids from solution in dilute aqueous acids. This property, which is ascribed to 'adhesion,' is only exhibited by the hydrated silicate, and so tenaciously are the alkaloids held by the colloid that even strychnine and berberine are quite tasteless. The liberation of the alkaloid from the colloid by an alkali, followed by its extraction with ether, etc., may be advantageously used in alkaloidal manipulations.—G. F. M.

Medicinal [opium] preparations; Production of —— by ultrafiltration. F. Mayer. Deutsche Med. Wochens., 1916, 42, 224—225. Z. angew. Chem., 1916, 29, Ref., 223—224.

By means of ultrafiltration it is possible to obtain from opium, by a purely physical method, a preparation containing the whole of the opium alkaloids, and free from colloidal impurities. The preparation is suitable for injection and has no irritant action.—A. S.

Elemol, a naturally occurring monocyclic sesquiterpene-alcohol, $C_{15}H_{26}O$. F. W. Semmler and F. Liao. Ber., 1916, **49**, 794—798.

An attempt by Schimmel und Co. to prepare elemicin (cp. this J., 1908, 641, 708, 875) from Manila elemi oil, yielded a product which the authors found to consist of a sesquiterpene-alcohol, "elemol," $C_{15}H_{26}O$, contaminated probably with elemicin. The alcohol, purified by benzoylation and subsequent hydrolysis, had b.pt. 152—156° C. under 17 mm.; sp.gr., 0·9411 at 20° C.; n_D = 1·5030; a_D = —5° in a 100 mm. tube. Its molecular refraction indicated two double linkages. Dehydration by formic acid yielded the corresponding sesquiterpene, "elemene," $C_{15}H_{24}$, containing three double linkages, and with b.pt., 115°—117° C. under 10 mm.; sp.gr., 0·8797 at 20° C.; n_D = 1·4971; the product, however, was probably not quite pure. Neither elemol nor elemene was reduced by sodium and alcohol, but reduction with hydrogen and platinum in ether gave rise to tetrahydroelemol and hexahydroelemene in the respective cases; the former product was converted into tetrahydroelemene by dehydration.—J. H. L.

Colloidal solutions and organic synthesis. M. Bakunin. Annali Chim. Appl., 1916, **5**, 243—251.

If phosphorus pentoxide be heated gently with acetic anhydride, or mixed with acetic anhydride dissolved in chloroform, a colloidal solution is obtained. Nearly theoretical yields of the nitrobenzylidene diacetates can be obtained by adding excess of such a colloidal solution to a chloroform solution of *o*-, *m*-, or *p*-nitrobenzaldehyde and heating for a few minutes. Cinnamylidene diacetate can be obtained in a similar manner from cinnamic aldehyde, and benzylidene diacetate from benzaldehyde, whilst *p*-hydroxybenzaldehyde and salicylaldehyde yield the acetic esters of the corresponding diacetates. Colloidal solutions can be prepared in a similar manner with sulphur trioxide, zinc chloride, phosphorus pentachloride, and ferric oxide instead of phosphorus pentoxide, and these act in the same way, although the ferric oxide sol is less active. Rebuffat (Gaz. Chim. Ital., 1840, 158) obtained a good yield of cinnamylidene acetate by the interaction of cinnamic aldehyde, acetic anhydride, and sodium phenylacetate, and the author finds that whilst sodium acetate or phenylacetate does not form a colloidal solution on warming with acetic anhydride, a colloidal solution is produced in presence of cinnamic aldehyde. It is considered probable that in many of the reactions used in organic syntheses, the formation of a colloidal solution is an essential stage.—A. S.

Acetone: Determination of —— when present in systems of methyl alcohol, water, and potassium fluoride, and equilibria in systems of methylethyl ketone, water, and inorganic salts. G. B. Frankforter and L. Cohen. J. Amer. Chem. Soc., 1916, 38, 1136—1141.

The method for the determination of acetone in aqueous solutions by salting out with potassium fluoride (see this J., 1914, 711) is applicable without modification to solutions containing not more than 5% of methyl alcohol; in presence of larger amounts of methyl alcohol the acetone can be determined only if its concentration does not exceed about 18%, but this condition can always be complied with by diluting with water. Methylethyl ketone may be salted out from pure aqueous solutions by sodium chloride, potassium fluoride, or potassium carbonate. Tables and binodal curves are given relating to the systems comprising sodium chloride and potassium fluoride respectively, and it is concluded that either of these salts might be used for the approximate determination of methylethyl ketone in aqueous solutions by methods similar to that described for acetone (*loc. cit.*).—J. H. L.

Alcohols and aqueous solutions of hydrochloric and hydrobromic acids; Reaction between ——. J. F. Norris, M. Watt, and R. Thomas. J. Amer. Chem. Soc., 1916, **38**, 1071—1079.

Experiments were made with allyl, tertiary amyl, heptyl, *n*-octyl, secondary octyl, cetyl, *o*-, *m*-, and *p*-nitrobenzoyl, phenylethyl, phenylpropyl, and cinnamyl alcohols. Hydrobromic acid reacted with all the alcohols, giving in most cases good yields of the bromides; the rate of the reaction decreased, in general, with increase of molecular weight, and increased in the order, primary, secondary, tertiary. Hydrochloric acid behaved very differently. With primary aliphatic alcohols no reaction was observed, but the introduction of a negative group such as phenyl, or vinyl, adjacent to the carbinol carbon atom, as exemplified in benzyl and allyl alcohols, determined the ready formation of the chlorides. The removal of the negative group to the β-position to the carbinol carbon destroyed its effect, hence primary phenylpropyl alcohol gave no chloride whilst cinnamyl alcohol gave an 80% yield. A further increase in the negative character of the phenyl group, as in the nitrobenzyl alcohols, likewise destroyed the effect of the phenyl group, and no chlorides were formed. As with hydrobromic acid, increase in molecular weight decreased the reactivity, so that whilst secondary butyl alcohol gave a chloride, secondary octyl alcohol did not. —G. F. M.

Magnesium glycerophosphate as a substitute for magnesium sulphate in the treatment of tetanus. G. Zuelzer. Berliner klin. Wochenschr., 1915, **52**, 689. Chem.-Zeit., 1916, **40**, Rep., 144.

Magnesium glycerophosphate (5 or 10 c.c. of a 25% solution) is superior to magnesium sulphate, or to magnesium sulphate in combination with a soporific, for the treatment of tetanus, and has the additional advantage of causing but very slight decrease in the blood pressure. The therapeutic effect is immediate.—G. F. M.

Thymol, wintergreen oil, and salicylic acid; Production of —— in India. Perf. and Essent. Oil Rec., May, 1916.

Experiments in the Forest Research Institute, Dehra Dun, having demonstrated the practicability of the manufacture of thymol, in April of last year the Dixon Chemical Co. established a factory at Dehra Dun, which is now producing regular supplies of thymol of good quality from ajowan seeds.

The Institute has also been studying the production of wintergreen oil and salicylic acid from the leaves of *Gaultheria fragrantissima*, and the results have been so promising that the same Company has decided to undertake the manufacture of these substances, as well as sodium salicylate and acetylsalicylic acid.

Chloric acid as a reagent in organic chemistry. Datta and Choudhury. *See* IV.

Antiseptic action of substances of the chloramine group. Dakin and others. *See* XIXb.

Determination of nitrogen by Kjeldahl's method. Nolte. *See* XXIII.

Patents.

Formaldehyde; Catalytic manufacture of ——. H. von Hochstetter, Konstanz, Germany. Eng. Pat. 464, Jan. 7, 1914.

See U.S. Pat. 1,000,076 of 1914; this J., 1914, 844. Couples composed of silver on which platinum, rhodium, or other metal of the platinum group has been precipitated, may be used. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 402 of 1887, 17,177 of 1896, 30,036 of 1897, and 19,569 of 1900.)

Luminous radiations for therapeutical purposes; Manufacture and use of ——. W. S. Simpson, London. Eng. Pat. 1480, Jan. 29, 1915.

Metallic tungsten or ferrotungsten is heated either electrically or by means of an oxyhydrogen blowpipe in a current of air, so that rapid combustion occurs. Active radiations or emanations are thus produced which are of value for therapeutic purposes, especially for the treatment of skin diseases and ailments due to bacteria, *e.g.*, lupus, rodent ulcer, etc. A tungstic oxide is also produced, in the form of vapour, which likewise has valuable therapeutic properties: the vapour may be applied with the radiations or emanations, or it may be inhaled, or absorbed in a suitable liquid, and the solution employed as a nasal douche or for injections.—A. S.

Acetic ester [ethyl acetate] from acetaldehyde; Preparation of ——. Consortium f. Elektrochem. Ind., Nürnberg, Germany. Eng. Pat. 4887, Mar. 30, 1915. Under Int. Conv., Mar. 30, 1914.

Instead of increasing the catalytic activity of aluminium alcoholate by treatment with substances containing a halogen, by melting with aluminium hydroxide, etc., as described in Eng. Pats. 26,825 and 26,826 of 1913 (this J., 1914, 666), this result may be brought about by dissolving the molten alcoholate in anhydrous potash alum or copper sulphate, camphor, etc., or by rapidly cooling the molten substance by pouring on to a cold metal plate or into a solvent. Ethyl acetate is a suitable solvent, giving solutions containing over 40% of the alcoholate. *Example.* 160 grms. of pure, chlorine-free, molten aluminium alcoholate (16·9% Al) is poured into 300 grms. of boiling ethyl acetate, and 2665 grms. of freshly distilled acetaldehyde is added rapidly with stirring; a vigorous reaction ensues immediately; the stirring is continued for several hours, and the product distilled, giving a yield of ethyl acetate equal to 90% of the theoretical. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 26,825 of 1913.)—F. W. A.

Hog cholera serum globulin; Preparations of —— *and process of producing same.* P. M. Justice, London. From H. K. Mulford Co., Philadelphia, U.S.A. Eng. Pat. 6604, May 3, 1915.

Preparations of hog cholera antitoxin practically free from serum albumin, living or dead germs, cellular débris (including white blood corpuscles), and fibrin, are obtained from serum or defibrinated blood containing the antitoxin by a process of fractional salting-out by means of ammonium sulphate, magnesium sulphate, or sodium sulphate, or other precipitant which does not form an insoluble metallic hydroxide. For example, the defibrinated blood or serum is treated with ammonium sulphate until the mixture contains about 33⅓% of the salt, then filtered, and ammonium sulphate added to the filtrate until the latter contains 50% of the salt. The precipitate produced contains a large percentage of hog cholera immune bodies and pseudo-globulins; it is filtered off, washed, dried, powdered, and dissolved in a solvent, and may be purified by dialysis. The precipitate produced by the first treatment with ammonium sulphate, is macerated with water, filtered, the filtrate saturated with sodium chloride, again filtered, and the solution treated with glacial acetic acid to obtain a further quantity of precipitate consisting of hog cholera immune bodies and pseudo-globulins.—A. S.

Methylene chloride [chloroform and carbon tetrachloride]; Manufacture of chlorinated ——. B. S. Lacy, Sewaren, N.J. Eng. Pat. 11,709, Oct. 18, 1915.

To maintain the temperature between suitable limits (350°—400° C.) during the reaction between methylene chloride and chlorine, a large excess (over 500%) of methylene chloride, is used to act as diluent; the products of the chlorination are cooled to about 200° C., and a further amount of chlorine introduced, the process being repeated several times. The products finally pass into a tower down which water is passed, and the lower layer of chlorohydrocarbons separated.—F. W. A.

Methyl chloride; Process of manufacturing —— B. S. Lacy, Perth Amboy, N.J., Assignor to The Roessler and Hasslacher Chemical Co. Re-issue No. 14,105, Apr. 11, 1916, of U.S. Pat. 1,111,842, Sept. 29, 1914. Date of appl., Feb. 19, 1916.

See this J., 1914, 1075. The volume of methane is at least ten times that of the chlorine, and the reaction vessel is heated to about 400° C. The reaction products are washed with water to remove hydrochloric acid, then dried, and the methyl chloride separated from unchanged methane by compressing to a pressure of about 150 lb. per sq. in. and cooling to about −80° C.

Vitamines [from brewers' yeast]; Solid combination of —— *and process of making same.* A. Seidell, Washington. U.S. Pat. 1,173,317, Feb. 29, 1916. Date of appl., Jan. 13, 1916.

Washed and pressed brewers' yeast is digested for 36 hours at 37·5° C., and the clear liquid from the resulting mass mixed with about 50 grms. per litre of finely divided fuller's earth. The mixture is shaken and treated with about 1% of *N*/1 hydrochloric acid to assist settling. The sediment is washed with dilute acid and with ethyl alcohol and then dried *in vacuo* over sulphuric acid. The vitamines contained in the yeast extract are almost completely adsorbed by the fuller's earth. The solid extract thus obtained can be taken either in liquid suspension or as capsules, about 5 grms. per day being an adult dose. The process is applicable to other sources of vitamines, such as fruit juices and meat extracts, and to other inert adsorptive agents.—B. V. S.

Leaf-tobacco; Method of treating ——. J. W. Gayle, Owenton, Ky. U.S. Pat. 1,180,137, Apr. 18, 1916. Date of appl., Apr. 7, 1915.

Damaged leaf tobacco is suspended in a steam-tight chamber, thoroughly moistened with steam, and then treated with sulphur dioxide for a period from 2 to 8 times as long as that of the moistening operation.—B. V. S.

Physiologically-active bases. H. Hoerlein, Elberfeld, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,178,720, Apr. 11, 1916. Date of appl., Oct. 29, 1915. (See also U.S. Pat. 1,166,206; this J., 1916, 275.)

A mixture of 1 part of β-iminazolylethylamine and 4—30 parts of *p*-hydroxyphenylethylamine.
—B. V. S.

Hydrocarbons of the erythrene series; Production of ——. K. Delbrück, H. Köhler, and K. Meisenburg, Assignors to Farbenfabr. vorm. F. Bayer und Co., Elberfeld, Germany. U.S. Pat. 1,179,408, Apr. 18, 1916. Date of appl., Dec. 6, 1912.

See Fr. Pat. 451,827 of 1912; this J., 1913, 672. Magnesium sulphate heated to 300°—400° C. is used as dehydrating agent.

Arsenic; Art of preparing organic compounds containing ——. L. Ach, Mannheim-Waldhof, A. Rothmann, Heidelberg, and H. Dieterich, Mannheim, Assignors to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,180,627, Apr. 25, 1916. Date of appl., June 22, 1914.

New arsenic compounds are obtained by nitrating an aromatic arsenic compound containing a halogen in the ortho position to the arsenic group and the group $\cdot NR(CH_3)$ in the para position.
—B. V. S.

Choline; Manufacture of a crystalline, non-hygroscopic salt of ——. Verein. Chem. Werke A.-G., Charlottenburg. Ger. Pat. 290,740, July 4, 1914.

A non-hygroscopic salt of choline, which crystallises well from water, is obtained by the interaction of 1 mol. of choline and at least 3 mols. of boric acid. Aqueous solutions of the salt can be boiled without decomposition.—A. S.

Acidyl derivatives of the xanthine series; Preparation of ——. E. Merck, Darmstadt. Ger Pat. 290,910, Aug 2, 1914.

By treating metallic salts of xanthines with derivatives of chlorocarbonic acid, or xanthine chlorocarbonates with suitable alcohols, phenols, or amines, derivatives of the general formulæ X.CO.R, X.CO.R.CO.X, or X.CO.X, are obtained, where X is a xanthine or a mono- or dialkyl substituted xanthine residue, and R is the radicle of a suitable compound, *e.g.*, an aclohol, phenol, or amine, containing active hydrogen. The products are of value for therapeutic purposes, as the diuretic action of xanthines may be combined with the antiseptic action of phenols, the antineuralgic action of salicylic acid, or the property of dissolving uric acid possessed by piperazine. They are sufficiently stable towards acids, but, for the most part, easily saponified by alkalis.—A. S.

Salicyloyltheobromine; Preparation of ——. E. Merck, Darmstadt. Ger. Pat. 291,077, Oct. 26, 1913. Addition to Ger. Pat. 290,205.

Salicyloyltheobromine is obtained by saponification of an acylsalicyl derivative of theobromine prepared as described in the chief patent (this J., 1916, 557). For example, 1 part of carbomethoxysalicyloyltheobromine is dissolved in 4 parts of cold hydrochloric acid of sp. gr. 1·19, the solution allowed to stand for 1—2 hours at the ordinary temperature, and then treated with ice to precipitate the salicyloyltheobromine. After recrystallising from alcohol, the product melts at 198°—200° C. with decomposition.—A. S.

Esters of silicic acid. L. Knorr, Jena, and H. Weyland, Berlin, Germany, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,178,731, Apr. 11, 1916. Date of appl., Dec. 29, 1914.

See Ger. Pat. 285,285 of 1914; this J., 1915, 1166.

Ethylene from acetylene; Process for producing ——. W. Traube, Berlin, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,179,051, Apr. 11, 1916. Date of appl., Dec. 1, 1915

See Ger. Pat. 287,565 of 1913; this J., 1916, 142.

N-Alkyl derivatives of organic bases; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co., Ger. Pat. 291,222, July 10, 1914. Addition to Ger. Pat. 287,802.

The method described in the principal patent (this J., 1916, 198) for the preparation of N-methyl derivatives can be used for the preparation of other N-alkyl derivatives if the formaldehyde be replaced by other aldehydes. By the action of phenylacetaldehyde on dimethylamine in presence of isopropyl alcohol, a quantitative yield of dimethylphenylethylamine is obtained.—A. S.

Ureas and thioureas of the aromatic series; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 291,351, June 12, 1914.

Aromatic aminoacidylated amino-acids containing a chain of two or more aminoacidyl residues in the molecule and not belonging to the naphthalene series, are treated with phosgene or thiophosgene or with substances capable of reacting in a similar manner. The products are of therapeutic value, whereas the carbonylurea of *p*-aminobenzoyl-*p*-phenylenediaminesulphonic acid, in which there is only one aminobenzoyl residue on either side of the carbonyl group, is almost inactive therapeutically.—A. S.

Dry bacteria preparations suitable for the production of liquids for injection; Process for obtaining ——. Farbwerke vorm. Meister, Lucius, u. Brüning. Ger. Pat. 291,405, July 8, 1914.

Liquid bacteria preparations, especially such as contain glycerin, are mixed with dehydrated sodium tetraborate. Dry products are thus obtained which, weight for weight, are equal or superior in activity to the original liquid bacteria preparations.—A. S.

Quinine derivatives and dialkylbarbituric acids; Preparation of compounds of ——. E. Merck, Darmstadt. Ger. Pat. 291,421, Apr. 28, 1914. Addition to Ger. Pat. 249,908.

Instead of using quinine or its salts as described in the chief patent (this J., 1912, 952), derivatives of quinine, such as hydroquinine, ethylhydrocupreine, or propylhydrocupreine, may be used. The products have a stronger narcotic action than those prepared from quinine, and many of them are much less toxic. Propylhydrocupreinedipropylbarbituric acid, for example, is practically non-poisonous.—A. S.

Nicotine and other products from tobacco; Apparatus for extraction of ——. F. T. Birdwood, London. U.S. Pat. 1,178,487, Apr. 11, 1916. Date of appl., July 1, 1915.

See Eng. Pat. 17,024 of 1914; this J., 1915, 923.

Pharmaceutical product containing arsenic. E. Fischer, Berlin, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,178,708, Apr. 11, 1916. Date of appl., Nov. 27, 1914.

See Eng. Pat. 295 of 1915; this J., 1915, 1072.

Terpenes and aromatic amines or their substitution products; Preparation of condensation products from ——. Chem. Fabr. auf Actien, vorm. E. Schering. Ger. Pat. 290,938, Feb. 4. 1914.

Condensation products which differ from those otherwise prepared in that they cannot be reconverted into terpenes of similar character and the salt of the aromatic base by heating alone or with dilute acids, are obtained by heating terpenes with aromatic bases or their substitution products in presence of an acid, or a medium readily yielding acid, or of a metallic salt.—E. W. L.

Peracids from aldehydes; Manufacture of ——. E. Galitzenstein and M. Mugdan, Assignors to Consortium für Elektrochem. Ind. Ges., Nuremberg, Germany. U.S. Pat. 1,179,421, Apr. 18, 1916. Date of appl., Aug. 2, 1913.

See Fr. Pat. 460,972 of 1913; this J., 1914, 42.

Glycerin; Process for the synthetic production of ——. A. Heinemann, London. U.S. Pat. 1,180,497. Apr. 25, 1916. Date of appl., May 28, 1913.

See Fr. Pat. 458,398 of 1913; this J., 1903, 1086.

Glucoside [from foxgloves] and process of making the same. F. Kraft, Brugg, Switzerland, Assignor to C. F. Boehringer und Söhne, Mannheim-Waldhof, Germany. U.S. Pat. 1,180,657, Apr. 25, 1916. Date of appl., Dec. 16, 1911.

See Eng. Pat. 28,739 of 1911; this J., 1912, 256.

Mercury preparation for therapeutic purposes, and process of producing the same. H. Buchtala, Gratz, Assignor to Dr. Bayer és Társa, Budapest, Austria-Hungary. U.S. Pat. 1,180,694, Apr. 25, 1916. Date of appl., June 5, 1913.

See Ger. Pats. 267,411 and 267,412 of 1912, and Eng. Pat. 11,302 of 1913; this J., 1914, 220, 767.

Manufacture of aluminium salts of formaldehyde-sulphurous acid. Ger. Pat. 290,909. *See* VII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

ilver chloride in light-sensitive photographic silver halide films; Rapid detection of ——. E. Valenta. Chem.-Zeit., 1916, **40**, 398.

F silver chloride is treated with a solution of otassium ferrocyanide, white insoluble silver errocyanide is formed. Silver bromide and dide do not give this reaction. The presence of lver ferrocyanide is easily shown, after thorough ashing to remove all soluble ferrocyanide, by eatment with nitric acid which forms the orange d ferricyanide. A more delicate test is to treat ith a mixed solution of ferric chloride and otassium bromide, or of uranium nitrate and otassium bromide, when by double decomposition silver bromide is formed along with Prussian ue or uranium ferrocyanide respectively. The st is easily applied to any light-sensitive film; is necessary to ensure the absence of soluble lver salts by a preliminary washing and to work weak daylight if the nitric acid test is employed, in artificial light if the other tests are used, ice the partial decomposition of silver bromide daylight causes the formation of slight amounts silver ferrocyanide in the treatment with tassium ferrocyanide and subsequent washing. ie reaction can also be used to detect chloride a mixture of halides, the mixed silver salts ing first precipitated.—B. V. S.

Patent.

Photographic papers, photographic film support and similar manufactures; Process for coating and drying ——. F. M. Cossitt and L. D. Castor. Assignors to Ansco Co., Binghampton, N.Y. U.S. Pat. 1,180,255, Apr. 18, 1916. Date of appl., May 14, 1914. (See also U.S. Pat. 1,171,321; this J., 1916, 386.)

Coating and drying are both effected in a vacuum chamber and the exhaust gases are passed into a condenser for recovery of the solvents.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

New permitted explosives. Home Office Order, No. 239, Apr. 14, 1916.

The following explosives have been added to the "Permitted List":—

Dynobel No. 3 (Nobel's Explosive Company, Ltd.), consisting of the following mixture:—

Ingredients.	Parts by weight.	
	Not more than	Not less than
Nitroglycerin	16	14
Nitrocotton	0·75	0·25
Trinitrotoluol Dinitrotoluol and Dinitrobenzol } together	2·5	0·5
Ammonium nitrate	54	51
Woodmeal (dried at 100° C.)	6	4
Sodium chloride	26	24
Magnesium carbonate	1	—
Moisture	2	—

Dynobel No. 4 (Nobel's Explosive Company, Ltd.), consisting of the following mixture:—

Nitroglycerin	16	14
Nitrocotton	0·75	0·25
Trinitrotoluol Dinitrotoluol and Dinitrobenzol } together	4	2
Ammonium nitrate	47	44
Woodmeal (dried at 100° C.)	6	4
Sodium chloride	31	28
Magnesium carbonate	1	—
Moisture	2	—

The usual conditions as to quality, packing, etc., are specified in each case.

Nitration of toluene. E. J. Hoffman. U.S. Bureau of Mines. Met. and Chem. Eng., 1916, **14**, 467—468.

The following method gave the most satisfactory results for the preparation of trinitrotoluene from toluene of about 99% purity, sp.gr. 0·8659 at 20°/4° C., and yielding 88·4% between 109·4° and 110·1° C., and about 97% between 108·4° and 110·1° C., when fractionated with the aid of a Hempel still-head. Fifty grms. of toluene is added gradually, with constant stirring, to a mixture of 73·4 grms. of nitric acid of sp.gr. 1·42 and 146·8 grms. of sulphuric acid of sp.gr. 1·84, the temperature not being allowed to rise above 30° C. When the temperature ceases to rise, after the addition of the whole of the toluene, the reaction is allowed to continue for about ½ hour, and after standing, the spent acid is drawn off. The crude mononitrotoluene (yield 80—83 grms., composed of about 60% of mono- and 40% of dinitrotoluene) is dissolved in 109·2 grms. of sulphuric acid of sp.gr. 1·84, the solution heated to 50° C., and a mixture of 54·6 grms. each of nitric acid of sp.gr. 1·5 and sulphuric acid of sp.gr. 1·84 is added gradually during a period of at least 1 hour, the temperature not being allowed to exceed 100° C. The mixture is then heated for

2 hours at 90°—100° C., after which it is cooled to 90° C., and 145·6 grms. of 15% oleum added slowly, followed by a mixture of 72·8 grms. each of 15% oleum and nitric acid of sp.gr. 1·5. During the addition of the acid (2 hours) the temperature is not allowed to exceed 115° C., and the mixture is heated subsequently at 90°—117° C. for 2 hours. After standing for at least 18 hours, the spent acid is drawn off, and the crude trinitrotoluene crushed, and washed first with cold water and then several times, in the molten state, with hot water. A yield of 75% of the theoretical quantity of trinitrotoluene (m.pt. 78°—80° C.) is obtained, and a further 8·5% (m.pt. 69°—75° C.) can be recovered from the spent acid. If the product be purified by recrystallising from, or washing with, a mixture of 9 vols. of 95% alcohol and 1 vol. of benzene, the yield is 69% of m.pt. 79°—81° C. and 7·5% of m.pt. 78°—81° C.—A. S.

PATENTS.

Nitrocellulose; Manufacture of ——. C. C. L. G. Budde, and The Hendon Paper Works Co., Ltd., Sunderland. Eng. Pat. 10,292, July 15, 1915.

CELLULOSES, and especially "natural oxycelluloses" such as wood, esparto, and straw celluloses, which may be in the form of moist sheets, are saturated with free chlorine or bromine, and washed and dried prior to nitration. The tendency of the temperature to rise and the formation of secondary products during nitration are reduced, and stable white products are obtained even from dark-coloured celluloses.—C. A. M.

Explosives. Powerite Explosive Co., Ltd., Sydney. Eng. Pat. 16,505, Nov. 23, 1915. Under Int. Conv., Dec. 1, 1914.

NITROGLYCERIN (say 64·53%) which has been washed in alkaline sugar solution and in water, is incorporated with nitrocellulose (32·46%), which has been boiled in a similar solution and then washed, and with calcium picrate (2%), and mineral jelly (1%). The resulting explosive is stable under storage conditions, leaves practically no residue after firing, and has much greater explosive force than cordite.—C. A. M.

XXIII.—ANALYSIS.

Metals; Alkalimetric determination of certain divalent —— as tertiary phosphates, with especial reference to cobalt and nickel. W. R. Schoeller and A. R. Powell. Analyst, 1916, **41**, 124—131.

Magnesium:—It is preferable, as suggested by Classen (Theorie und Praxis der Massanalyse, 1912, 214), to displace the ammoniacal solution used for washing the magnesium ammonium phosphate by 50% alcohol, and to prevent re-absorption of ammonia by the filter by having a flask of acidulated water beneath the funnel. The precipitated magnesium ammonium phosphate may be directly titrated with *N*/10 or *N*/5 acid with methyl orange (or preferably cochineal) as indicator. *Zinc:*—Zinc ammonium phosphate may be titrated in the same way, and the method gives more accurate results than those obtained by the usual methods. *Cadmium:*—On adding an excess of di-ammonium phosphate to a solution of cadmium sulphate a crystalline precipitate of cadmium ammonium phosphate is obtained. This may be dried at 105° C. and weighed as $CdNH_4PO_4+H_2O$; or it may be dissolved in excess of *N*/10 acid, and the excess titrated with *N*/10 alkali, with cochineal as indicator. Owing to the decolorising action of cadmium on cochineal the solution should not contain more than 0·1 grm. of the metal. *Manganese:*—Solutions of manganese salts are treated as described for cadmium, but the method is not satisfactory in the case of manganese ores. *Cobalt:*—The precipitate of cobalt ammonium phosphate varies in properties with its mode of preparation. In Clarke's method (Chem. News, 48, 262) ammonium phosphate is added in the proportion of 5 times the weight of nickel and cobalt and 5 parts of hydrochloric acid to each part of ammonium phosphate. Ammonia is then added to the boiling solution until the precipitate is redissolved, and the boiling continued to precipitate the cobalt. The precipitate is granular, deep lilac in colour, and generally free from nickel. It dissolves slowly in *N*/5 acid and is suitable for indirect titration. In Hope's method (Beringer, Textbook of "Assaying," 442) the same excess of ammonium phosphate is added, but no hydrochloric acid or ammonium chloride. The reagent is added, drop by drop, with constant stirring, to the boiling solution until the blue amorphous precipitate becomes pink. The resulting precipitate is crystalline, pale lilac in colour, and usually contains a trace of nickel. It is readily soluble in *N*/5 acid, and is suitable for direct titration. Indirect titration of the precipitate obtained by the first method, with cochineal as indicator, gives slightly high results owing to the difficulty of observing the end-point. The direct method is more accurate, the precipitate being titrated, without indicator, until a lilac colour is given to the liquid. Double precipitation is advisable to remove any nickel. The filtrate containing the nickel may be directly titrated with cyanide, with good results.—C. A. M

Molybdenum; New methods of testing for —— J. Moir. J. Chem., Met., and Min. Soc., S Africa, 1916, **16**, 191—192.

(1) A PERMANENT deep-blue coloration is produce when a solution containing a trace of alkal molybdate is acidified with acetic acid and boile with hydrazine sulphate or quinol. (2) When slightly acid solution of molybdic acid is treate with excess of potassium iodide and boiled fo some time, iodine is slowly liberated and th solution becomes blue. (3) By substituting pyrogallol or catechol for tannin in the well-know test, an orange coloration is produced. The tes is conducted in acetic acid solution and is ver sensitive.—W. E. F. P.

Nitrogen; Determination of —— by Kjeldahl' method. O. Nolte. Z. anal. Chem., 1916, 55 185—189. (See this J., 1915, 1032.)

THE use of mercury (13 grms.) in the determinatio of nitrogen in caffeine or in uric acid causes th results to be considerably too low, and this los of nitrogen also takes place when ammoniu sulphate is treated by the Kjeldahl process in th presence of mercury. If 7 grms. of copper foil used in place of the mercury, no loss occurs in th case of ammonium sulphate, but there is still slight loss of nitrogen with caffeine, uric acid, an silver cyanide; the results are, however, muc too low with antipyrine, tetramethylammoniu bromide, and methylindole.—W. P. S.

Monochromatic light: Use of the electric spark f pulverising solutions and for obtaining —— Hirschel. Rec. Trav. Chim. Pays-Bas, 191 **36**, 110—115.

IT has been frequently observed in the study spark spectra that the spark causes an inten pulverisation of certain solutions, but the effe has been regarded as peculiar to certain salt The author has found that the phenomenon is general one, the effect depending not upon t nature of the salt, but upon the relative positi of the electrodes, the frequency of the curre interrupter used, and the intensity of the curre By introducing a small quantity of a solution a salt into one of the known forms of sparking apparatus, *e.g.*, that of Delachanal and Marmet (Ann. Chim. Phys., 3e. serie, Tome 11.), provided with inlet and outlet tubes so that gas or air may be passed through, this property of the electric spark may be used to colour the flame of a Bunsen or oxyhydrogen burner for spectroscopic examination, and for producing an intense yellow (sodium) light for use in polarimetry. Using a concentrated solution of sodium chloride, light from 1½ times to twice as intense as that given by the Laurent-Mitscherlich lamp can be obtained in this way with a consumption of 2 ampères at 30 volts.—A. S.

A frequent source of error in analysis of producer gas. Hoffmann. *See* IIa.

Insulating oils. Report of Sub-committee of Inst. Electrical Engineers. *See* IIa.

Ash tests for percentage of filler in paper. Plumstead. *See* V.

Distinction between madder and market bleached goods. (1) Freiberger. (2) Haller. *See* VI.

Detection of catechu in black silk dyeings. Weyrich. *See* VI.

Titration of iodine and iodides with arsenious acid. Thiel and Meyer. *See* VII.

Determination of silica. Lenher and Truog. *See* VII.

Determination of hydrogen peroxide. Von Bertalan. *See* VII.

Determination of carbon in steel by the Eggertz method. Le Chatelier and Bogitch. *See* X.

Electrolytic determination of copper in copper-manganese. Koepping. *See* X.

Analysis of niobium-titanium minerals, with some new tests for niobium [columbium], tantalum, and titanium. Moir. *See* X.

Determination of fat in powders. Phillips. *See* XII.

Analysis of limed hide. Bennett. *See* XV.

Acidity of tannery liquors. Bennett. *See* XV.

Investigation and valuation of crude calcium cyanamide. Liechti and Truninger. *See* XVI.

Determination of the starch-flour content of potatoes. De Vries. *See* XVII.

Study of plant enzymes, particularly with relation to oxidation. [Test for distinguishing dextrose and lævulose.] Hall and others. *See* XVIII.

Determination of stearic acid in butter fat. Holland and others. *See* XIXa.

Detection of saccharin in foods. Klostermann and Scholta. *See* XIXa.

Adhesion alkaloidal reactions. Lloyd. *See* XX.

Determination of acetone in systems of methyl alcohol, water, and potassium fluoride, and equilibria in systems of methylethyl ketone, water, and inorganic salts. Frankforter and Cohen. *See* XX.

Rapid detection of silver chloride in light-sensitive photographic silver halide films. Valenta. *See* XXI.

Patent.

Foreign matter in the human body or the like; Method of and apparatus for detecting pieces of ——. The Cambridge Scientific Instrument Co., Ltd., H. Darwin, and W. H. Apthorpe, Cambridge. Eng. Pat. 100,291, Feb. 8, 1916. (Appl. No. 1865 of 1916.)

LECTRICALLY conductive foreign matter is detected by inserting into the body a conductor adapted, in conjunction with the foreign matter and with the blood or other fluid which is an electrolyte, to form an electrochemical system, from which a current may be produced on completing the circuit by bringing a conductive probe into contact with the material sought. The instrument comprises an electrode of different material from that of the foreign matter, a probe adapted not to form an electric current on contact with the electrode, and an indicator to show the formation of a current.—C. A. M.

XXIV.—MISCELLANEOUS ABSTRACTS.

Semipermeable membranes; Microscopic structure of ——, and the part played by surface forces in osmosis. F. Tinker. Proc. Roy. Soc., 1916, A, **92**, 357—372.

The common semipermeable membranes prepared by precipitation are composed of small particles, of the order of magnitude $0{\cdot}1\mu$ to $1{\cdot}0\mu$, closely packed together. Each of the particles is itself an aggregate formed by the flocculation of submicroscopic colloidal particles. The particles are the smallest in the case of copper ferrocyanide and Prussian blue. The order of a series of membranes in pore size is the same as that of their efficiency as semipermeable membranes, the two above-mentioned being the most efficient in this respect and having also the smallest pores, which with the copper ferrocyanide membrane range from 8 to 60 $\mu\mu$ in diameter, with an average of 15 to 20 $\mu\mu$. This size is too great for the membrane to act osmotically by a mere selective mechanical blocking action. Precipitation membranes show most of the properties of gels, though in their mechanical structure they are much more closely knit together than the gel proper. A close connection exists between the osmotic properties of a membrane and the extent to which its capillaries are under the control of surface forces. Osmotic effects are probably the result of selective adsorption phenomena occurring at the surface of the membrane and in the capillaries, the membrane being relatively impermeable to solutes which are negatively adsorbed, but permeable to solutes which are positively adsorbed.—G. F. M.

Iceland moss (Cetraria islandica) as a protective colloid. A. Gutbier, A. Irion, and E. Sauer. Kolloid-Zeits., 1916, **18**, 1—11. Z. angew. Chem., 1916, **29**, Ref., 223.

Many lichens contain protective colloids, relatively small quantities of which are capable of preventing the coagulation of inorganic colloids by electrolytes. They can be extracted from the lichens by water and precipitated by alcohol, and can then be kept for a long time without alteration. When used to protect inorganic colloids the latter are also precipitated on addition of alcohol, and products having a high concentration of solid colloid can be obtained by fractional precipitation, and can subsequently again be obtained as sols by treatment with water. An extract of Iceland moss possesses the properties described in a marked degree, and its activity is not destroyed by sodium chloride, $N/1$ hydrochloric acid, or $N/1$ sodium hydroxide.—A. S.

Trade Report.

Mineral production of the United Kingdom in 1915.

The following tables, showing the output of coal and certain other minerals in the United Kingdom at mines worked under the Coal and Metalliferous Mines Acts (the returns from quarries under the Quarries Act are not yet available) during the year 1915, with comparative figures for the preceding year, are extracted from an advance proof of tables prepared for the Mines and Quarries General Report and Statistics for 1915 :—

I.—Output of Minerals under the Coal Mines Act.

—	1914.	1915.
	Tons.	Tons.
Barium (compounds)	6,265	7,477
Coal	265,643,030	253,179,446
Clay and shale, other than fire-clay and oil shale	399,810	236,506
Fire-clay	2,374,068	1,839,746
Igneous rocks	634	79
Iron pyrites	9,359	9,255
Ironstone	7,241,481	6,080,218
Limestone	6,442	4,464
Oil shale	3,268,666	2,998,652
Sandstone (including "ganister"*)	135,718	141,420

* The quantity of ganister obtained was 121,168 tons in 1914, and 128,938 tons in 1915.

II.—Output of certain Minerals under the Metalliferous Mines Regulation Act.

—	1914.	1915.
	Tons.	Tons.
Arsenic	1,974	2,496
Barium (compounds)	39,645	53,324
Bauxite	8,286	11,723
Chert, flint, etc.	3,844	3,033
Clay and shale	131,190	86,202
Copper ore and copper precipitate	2,519	746
Fluorspar	24,688	25,577
Gold ore	47	5,086
Gypsum	220,096	204,574
Igneous rocks	44,299	43,010
Iron ore	1,743,011	1,795,887
Iron pyrites	2,295	1,280
Lead ore	25,988	20,698
Limestone†	328,337	283,216
Manganese ore	3,437	4,640
Ochre, umber, etc.	4,463	4,030
Rock salt	189,995	131,348
Sandstone‡	76,198	57,626
Slate	82,307	48,893
Tin ore, dressed§	6,635	6,420
Zinc ore	15,419	12,057

† Including 630 tons of calcspar in 1914 and 271 tons in 1915.
‡ Including 4297 tons of ganister in 1915.
§ In addition, 201 tons of undressed tin ore were obtained in 1914 and 385 tons in 1915.

The above figures do not in all cases represent the total production of the minerals for the year. Large quantities of several important minerals, such as iron ore, limestone, sandstone, slate, clay, etc., are obtained from quarries under the Quarries Act and from other open workings, the returns from which are not yet available. The totals for coal and for the ores of copper, lead, and zinc are, however, substantially complete.

Books Received.

CONCENTRATING ORES BY FLOTATION. BIBLIOGRAPHY. Bulletin of the School of Mines and Metallurgy, University of Missouri, Rolla, Mo., U.S.A. Vol. VIII., No. 1, Jan., 1916. 106 pages.

THE bibliography comprises 530 references to published literature on the concentration of ores by flotation, together with 146 references to works on colloids and surface tension, and abstracts of 226 English and United States patents on ore flotation, arranged in order of date. Literature up to the beginning of this year is reviewed, and the patent abstracts are also up to date. A comprehensive index concludes a most useful publication, credit for the compilation of which is due to Mr. Jesse Cunningham, Librarian of the School of Mines and Metallurgy. A few copies of this Bulletin are available for free distribution and may be obtained upon request to the Librarian at Rolla, Missouri.

THE CHEMISTS' YEAR BOOK, 1916. Edited by F. W. ATACK. Sherratt & Hughes, 34, Cross Street, Manchester. 990 pages, 6¼ × 4 in. In two volumes. Price 10s. 6d.

NEARLY eighty pages have been added to this edition of the Year Book, which made its first appearance in 1915 (see this J., 1915, 694). The whole of the matter in the first edition has been revised and many of the constants recalculated according to the International Atomic Weights for 1916. The sections on hydrometry, carbohydrates, brewing materials, tanning materials, and pharmaceutical synonyms, amongst others, have been completely rewritten, and sections have been added on "Cellulose and paper" and "Milk and butter," which add materially to the usefulness of the work. It is gratifying to read that the Editor's enterprise has been rewarded by success, and it is certain that when the Year Book becomes more widely known it will meet with the appreciation it deserves.

A CLASS BOOK OF CHEMISTRY. Part IV. METALS. By G. C. DONINGTON. Macmillan & Co., Ltd., St. Martin's Street, London. 134 pages, 7½ × 5 in. Price 2s.

IN the author's well-known "Class-book of Chemistry," the metals were dealt with in the course of two short chapters, and in order to meet the needs of elementary students, these chapters have been expanded by Dr. T. M. Lowry, in collaboration with Dr. P. C. Austin, to form the present volume. The whole work now covers the requirements of those preparing for such examinations as the Senior Oxford and Cambridge Local Examinations in Chemistry.

A MANUAL OF EXPLOSIVES. By A. R. J. RAMSEY and H. C. WESTON. G. Routledge & Sons, Ltd., London. 116 pages, 7½ × 5 in. Price 1s.

THIS little book is intended to provide thos unacquainted with the subject, with concis information on the nature and manufacture o explosives, as well as their use in modern engineering. Chapters on industrial poisoning amon explosives workers and its prevention, and legislation on explosives, are included. The book i well illustrated and written in simple language and should serve the purpose for which it wa prepared.

REPRESENTATIVE PROCEDURES IN QUANTITATIV CHEMICAL ANALYSIS. By F. A. GOOCH. Yal University. J. Wiley & Sons, New York Chapman & Hall, Ltd., 11, Henrietta Stree London, W.C. x. + 262 pages. 9¼ × 6 in Price 8s. 6d.

THIS book is divided into five chapters as follows I. Processes of analysis. II. Processes of weighing and measuring. III. Procedures in grav metric analysis: processes depending on the formation of volatile products, electrolytic processe processes dependent on differences in respect t solubility. IV. Procedures in volumetric analysis neutralisation processes, oxidation processe iodometric processes (which are fully dealt with precipitation processes, gasometric processe colorimetric processes. V. Systematic analysi including schemes for the analysis of brass, limestone, silicates, halides, nitrates and nitrites, e

Journal of the Society of Chemical Industry.

No. 12, Vol. XXXV. JUNE 30, 1916. No. 12, Vol. XXXV.

THE SOCIETY OF CHEMICAL INDUSTRY.

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDING 31st DECEMBER, 1915.

1914. £ s. d.	£ s. d.	EXPENDITURE.	£ s. d.	£ s. d
		To Journal—Editorial and Sundry expenses—		
674 2 0		Editor's Salary including indexing Journal	550 0 0	
32 11 3		Do. Expenses	60 0 0	
156 0 0		Do. Assistant	180 0 0	
628 8 9		Abstractors	545 2 6	
150 0 0		Sub-Editor's Salary	150 0 0	
30 18 4		Foreign Journals	18 13 0	
2 14 9		Sundry Journals............	10 12 7	
42 1 9		French and U.S.A. Patent Specifications.............	13 0 2	
6 18 0		Insurance of Stock	7 3 0	
£1723 14 10			£1534 11 3	
		Publishing expenses—		
		General 1821 19 1		
		Postage on Copies 752 11 10		
2548 15 6			2574 10 11	
	4272 10 4			4109 2 2
		„ Sectional expenses—		
10 0 0		Boston	—	
42 4 2		Birmingham and Midland ...	40 0 0	
42 3 7		Canada	59 11 6	
85 14 3		Liverpool	42 17 5	
101 17 3		London	117 1 10	
83 2 11		Manchester	82 18 3	
0 10 0		Newcastle-on-Tyne	30 1 7	
100 0 0		New York	100 0 0	
26 19 4		Nottingham	29 5 10	
15 15 0		Scotland	51 1 8	
16 16 4		Sydney	13 2 2	
23 1 4		Yorkshire	28 8 8	
	548 4 2			594 8 11
	161 2 9	„ Annual Meeting expenses		169 14 0
		„ Superannuation (late Editor)	315 0 0	
		„ Working expenses—		
300 0 0		Secretary's Salary	300 0 0	
250 0 0		Clerk in Secretary's Office ..	62 5 6	
77 10 0		Honorarium to Treasurer's Assistant and for Clerical Assistance	77 10 0	
208 9 1		Rent, Lighting, and Cleaning	209 2 2	
59 10 0		Stationery and Binding......	111 4 1	
167 14 0		Postages, Bank Charges, Telephone and Sundry expenses	151 14 6	
31 5 6				
	1094 8 7			914 16 3
	6076 5 10			6103 1 4
	891 15 2	„ Excess of Income over Expenditure		997 14 5
	£6971 1 0			£7100 15 9

1914. £ s. d.	INCOME.		£ s. d.	£ s. d
164 17 0	By Entrance Fees			221 11 0
37 10 0	„ Life Composition Fees			58 16 9
4852 15 0	„ Annual Subscriptions............			4692 6 9
	„ Journal Advertisements		532 5 6	
	„ Sales		884 17 10	
1203 9 8				1417 3 4
6 19 0	„ Collective Index—Subscriptions ..			2 1 0
12 10 0	„ Decennial Index—Sales..........			2 10 0
	„ Dividends and Interest on Investments—			
		£ s. d.		
126 0 10	Metropolitan 3% Consolidated	4476 9 2	115 2 7	
28 3 9	New Zealand 3% (1945)	1000 0 0	26 11 3	
36 0 1	New South Wales 3% (1935)	1277 4 8	33 18 8	
28 17 8	Consols 2½%	1231 0 10	27 5 0	
16 18 3	Gas Light and Coke Co. 3% Debentures	600 0 0	16 4 9	
30 11 7	North British 3% Consolidated	1084 13 4	29 7 7	
39 17 8	Midland Rly. 2½%..	1696 0 0	37 19 8	
56 15 5	Great Eastern Rly. 4% Irredeemable .	1509 0 0	54 7 9	
28 9 1	South Eastern Rly. 4½% Preference ..	673 0 0	27 6 4	
28 3 9	Metropolitan Water Board 3% "B" Debentures	1000 0 0	26 11 3	
5 12 11	Nottingham Joint Station 3%	200 0 0	5 8 2	
58 15 10	Great Western Rly. 5% Guaranteed ..	1250 0 0	56 6 4	
22 11 6	Great Northern Rly. 3% Debentures ..	800 0 0	21 12 6	
17 5 5	Nottingham and Grantham Canal 4½% Consolidated	450 0 0	16 9 2	
23 16 0	India 3½%	724 8 0	22 9 0	
23 10 1	India 3%	834 9 2	22 3 6	
45 18 9	Dominion of Canada —Canadian Pacific Rly. 3½% Land Grant Bonds 1938	1400 0 0	43 7 9	
26 6 2	Canada 4% (1940—1960)	700 0 0	24 15 10	
13 2 7	Western Australian Government 4% ..	703 8 5	24 18 3	
36 3 0	War Stock 3½% ..	700 0 0	10 18 4	
	War Stock 4½% (Bearer)........	1700 0 0	32 10 3	
	War Stock 4½% (Converted from Consols)	820 13 10	15 13 11	
	Interest on Deposit		14 19 1	
693 0 4				706 6 11
£6971 1 0				£7100 15 9

BALANCE SHEET, 31st DECEMBER, 1915.

1914. £ s. d.	1914. £ s. d.		£ s. d.	£ s. d.
	755 15 0	To Sundry Creditors		773 9 3
	61 4 9	„ Subscriptions received in advance		87 10 0
		„ Overdraft—London City and Midland Bank		345 0 4
		„ Accumulated Fund—		
20,314 1 7		Balance 31st December, 1914 .	21,238 19 9	
894 15 2	21,238 19 9	Add—Excess of Income over Expenditure, 1915	997 14 5	22,236 14 2
	£22,056 0 11			£23,442 13 9

1914. £ s. d.	1914. £ s. d.		£ s. d.		£ s. d.	£ s. d.
	461 18 0	By Sundry Debtors (Publishers &c.) ..				678 8 11
	35 0 0	„ Arrears of Subscriptions (received up to 23rd March, 1916)				65 0 0
100 0 0		„ Cash at Bank			—	
138 1 3						
9 17 7		„ Cash in hand (Secretary)			6 5	
—	518 1 10				—	6 5
		„ Investments as last year—				
1163 2 1			4176 9 2	Metropolitan 3% Consolidated	1163 2 1	
870 0 0			1000 0 0	New Zealand 3% (1945)	870 0 0	
1122 3 1			1277 4 8	New South Wales 3% (1935)	1122 3 1	
1031 15 4			820 13 10	War Stock 4½% in lieu of £1231 0 10 Consols which were valued at ..	1031 15 4	
507 0 0			600 0 0	Gas Light and Coke Co. 3% Debentures	507 0 0	
900 5 6			1084 13 4	North British 3% Consolidated	900 5 6	
			736 0 0	Midland Rly. 2½% Perpetual		
1187 4 0			960 0 0	Midland Rly. 2½% Guaranteed Preference	1187 4 0	
1629 14 5			1509 0 0	Great Eastern Rly. 4% Irredeemable	1629 14 5	
747 0 7			673 0 0	South Eastern Rly. 4½% Preference ..	747 0 7	
922 10 0			1000 0 0	Metropolitan Water Board 3% "B" Debentures	922 10 0	
166 0 0			200 0 0	Nottingham Joint Station 3%	166 0 0	
1762 10 0			1250 0 0	Great Western Rly. 5% Guaranteed ..	1762 10 0	
696 0 0			800 0 0	Great Northern Rly. 3% Debentures .	696 0 0	
495 0 0			450 0 0	Nottingham and Grantham Canal 4½% Consolidated	495 0 0	
700 0 0			724 8 0	India 3½%	700 0 0	
700 0 0			834 9 2	India 3%	700 0 0	
1372 4 0			1100 0 0	Dominion of Canada (Canadian Pacific 3½% Land Grant Bonds 1938)	1372 4 0	
676 8 1			700 0 0	Canada 4% (1910-1960)......	676 8 1	
698 3 0			703 8 5	West Australian Government 4%	698 3 0	
661 0 2			700 0 0	War Loan 3½% ..	661 0 2	
					21,008 0 3	
		Add—Purchased during 1915—				
			1700 0 0	War Stock 4½% ..	1690 18 2	
	21,008 0 3					22,698 18 5
	£22,056 0 1					£23,442 13 9

1914: Valuation £18,693 4 8
Depreciation £2,314 15 7 = 11%

1915: Valuation .. £19,755 18 1
Depreciation £2,943 0 4 = 13%

We have examined the above Balance Sheet, dated 31st December, 1915, and have verified the Investments and the balances at the Bank. In our opinion the Balance Sheet shows

[illegible] all Street, London, E.C.

Chartered Accountants.

Birmingham Section.

Meeting held at Birmingham University on Thursday, March 2nd, 1916.

MR. W. J. REES IN THE CHAIR.

EMISSION SPECTRA IN CHEMICAL INDUSTRY.

BY S. JUDD LEWIS, D.SC. (TUBINGEN), B.SC. (LONDON), F.I.C.

Emission spectra are produced on allowing the light emitted by the incandescence of the body under examination to pass through a spectroscope. The light may be obtained in several ways. First, there is the *Flame spectrum*, commonly produced by feeding the substance into a Bunsen or blowpipe flame and passing the light emitted through a spectroscope. This method succeeds with the alkalis, alkaline earths, and a few other elements. Secondly, the *Arc spectrum* results on striking an arc between two poles, or pieces, of the substance under review, or the material to be analysed is placed on one of the poles used to form the arc, and passing the light into the instrument as before, when a spectrum is projected composed of the spectrum of the material of the poles together with that of the substance whose composition is to be ascertained. All metallic and certain non-metallic elements are subject to this method. In the third place there is the *Spark spectrum*. This is an equal rival of the arc spectrum for utility, and cannot easily be dispensed with, for its application is in numerous cases different. The arc is very convenient when the substance can be deposited on the electrode in the solid state, especially when it is insoluble. When the inquiry relates to a solution the spark is almost indispensable.

It follows that the methods of emission spectroscopy are not applicable to the identification of organic compounds, for these would be destroyed at the temperature of incandescence, nor indeed of inorganic compounds as such, for the majority of these also are decomposed, hence the results are usually limited to the ultimate analysis of the substance. Every element can be identified by the spectroscope under some conditions.

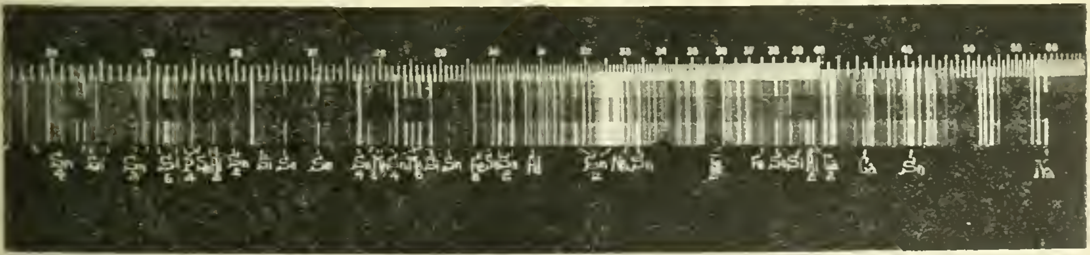


FIG. 1.

Figure 1 exhibits the spectrum of the ash of a silk (M). The middle band is the spectrum of the electrodes on which the ash was deposited; the outer bands are similar and are the combined spectra of the electrodes and of the elements contained in the ash. As signified by the inscribed symbols the extra lines seen in the outer bands reveal the composition of the substance. The electrode lines which pass through all three bands rarely cause confusion; on the other hand they are extremely useful, for, their wave-lengths being known, they serve as guide-lines and so assist in the recognition of the lines in question.

Having regard to the fact that the boundary between the visible and ultra-violet regions has a wave-length of about 3970, it is evident, from the wave-length scale in the figure, that a far larger amount of information is acquired by a study of the ultra-violet spectrum than by observing the visible spectrum alone.

Minute quantities suffice for a complete analysis. Ten or twenty milligrams answers all requirements. Provided the portion applied to the electrode contains 0·01 mgrm. of a given element its presence will usually be discovered; 0·001 or even 0·0001 mgrm. may be recognised in some instances.

A few examples may now be considered to illustrate some of the cases in which spectrography facilitates the work of the analyst or the works chemist.

Water occurs as one of the first things to be examined critically by every means available, since the presence of even minute quantities of an unusual element may be of the highest physiological and economic importance. The historic spectroscopic work of Bunsen and others on the waters of the Continental spas has not only assumed classic renown by reason of their finding in them certain new elements, but has, doubtless, contributed largely to inspiring the popular favour which has so long been accorded them. If the elemental contents of many of these waters are so active biologically as to render them medicinal with regard to certain diseases, it is reasonable to suppose that the continued drinking of waters carrying minute quantities of elements known to possess pronounced physiological properties should have an influence on public health which cannot be overlooked. In the residues from several waters which have been examined by this method, boron is frequent; indeed, boron is very widely distributed throughout the animal and vegetable kingdoms (Year Book of Pharmacy, 1914, 362), and the origin of this distribution is probably to be found associated with the natural water supplies. It would be interesting to compare the health of districts served with boron-charged waters with that of districts where the supply is free from boron. Manganese is not uncommon, and cases are known where its presence has been found to be prejudicial to public health. The action of very small quantities of it on vegetable life has been investigated by several workers. Barium occurs occasionally, and strontium frequently. Traces of the less exceptional elements such as lithium, potassium, aluminium, lead, zinc, also contribute their quota to the spectrum.

Technically the complete analysis of the mineral constituents of a water is of interest wherever living organisms are concerned, as in public water supplies, agriculture, stock-raising, brewing, and the fermentation industries generally. Knowing that the application of spectrography in the last-named had been prosecuted for several years by

Messrs. Murphy and Lonsdale, I asked whether they could contribute to the present paper by giving any particulars in regard to the position of their research, and they have very kindly replied in the following terms :—

Spectrum Analysis and the Fermentation Industries.

"We made our first spectrographic analysis in this connection in 1908. Fermentation is largely, if not entirely, a question of enzyme action, and it appeared probable that many of the puzzling abnormal results met with in brewery practice might be explained by the presence of traces of elements which had not previously been suspected.

"We have obtained unmistakeable evidence that both in the mashing process and in the fermentation itself, these elements do exert a very definite influence, and we are justified in recommending that the analysis of every brewing water should include a record of *all* the constituents present, not merely of those which it is assumed may, or ought to, be present.

"Usually the air of a manufacturing town is biologically cleaner than that of the surrounding country. In general this has been ascribed to the presence of sulphurous or nitrous fumes, etc., but a much more common cause of the difference is to be found in the presence of certain heavy, non-metallic and even rare constituents which have been discharged into the atmosphere from foundries, smelting works, and such establishments. We have found this to be notably the case in at least one West Riding town ; and in our ordinary practice we are no longer satisfied with a mere biological analysis of the air. Having regard to the custom of aeration in the brewery and the ever-present layers of air over the fermenting tuns, it is clearly desirable to know as much about the chemical composition of the air as of its biological features.

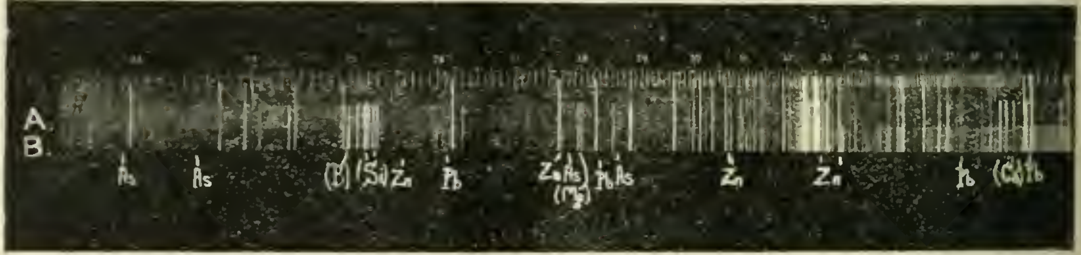


FIG. 2.

"In both water analysis and air analysis the spectroscope affords the only ready means of determining whether such constituents are present or not. There is also the further advantage that if a photograph of the spectrum be made we secure an infallible record of any variations in the water supply or conditions of atmosphere with lapse of time."

Similar analyses of soils and the like follow as a natural corollary. The inorganic constituents of plants, drugs, foods, etc., are also amenable to a similar study, and this branch of the subject has already been dealt with in a paper read at the Chester meeting of the British Pharmaceutical Conference, entitled "The Mineral Constituents of Certain Tinctures and Drugs" (Year Book of Pharmacy, 1914, p. 361).

Minerals, ores, clays, building materials, glass, and the like are equally ready to reveal their constituent elements.

The components of an alloy are easily discovered, whatever their nature. The elements which occur in small quantities and impart peculiar properties, such as hardness, to the metal, disclose their identity, and give some idea of the proportions in which they are present.

One of the most significant applications of spectrography, where it shows peculiar advantage over chemical methods, is in the comparison of the composition of two samples of similar material. Two pieces of metal, intended to be the same, may possess different properties, and it is required to know the cause of the variation. On placing together their two spectra, their elemental differences, if any, are at once made evident and, if none appear, the absence of other elements in either may be considered established. For example, commercial zinc was compared with the purest metal obtainable for analysis. The lines present in the spectrum of the commercial metal, but not in that of the pure metal, signify and identify the impurities. Incidentally it became evident from some very faint lines in the spectrogram of the pure metal which coincide with the thickest of the lead lines in the spectrogram of the commercial metal, that the pure specimen contained minute traces of lead, but how small these traces were is shown by the very slight intensity of these lines as compared with that of those associated with the commercial specimen, where indeed the proportion of lead was small.

Similarly two glasses, A and B, were compared (Fig. 2). Glass B contained a notable quantity of zinc and minute quantities of lead and arsenic which did not occur in the glass A. The relative intensities of the lines indicate that A contains more calcium and silicon, but less magnesium and boron than B does.

The comparison method is equally applicable to other classes of material. For instance, the ash of *Baptisia* root was compared with the ash of a tincture prepared from the same specimen of root, and it was seen that barium, strontium and silicon had disappeared owing to their insolubility, and that aluminium, manganese, and boron were proportionately much feebler, while magnesium was decidedly stronger. The method thus becomes an aid to the proximate analysis of drugs and foods.

It is to be observed that in the method of comparison it is not necessary to track out the entire composition of either substance examined. The differences alone need be determined. Two silks, marked M and O, were examined primarily with a view to ascertaining the mineral constituents of the dressing in the one. A considerable amount of comparative information was easily derived as follows :—Tin, much in both ; silicon, much in both, but more in M ; phosphorus, a little in both, more in O ; aluminium, much in M, none in O ; boron, a little in O, none in M ; calcium, a little only, but more in O ; magnesium, a trace in both ; sodium, a little only. Chemical tests showed that ammonia and sulphates accompanied the aluminium in M.

It is thus seen that the spectrographic method possesses great advantage in certain particulars. First, the completeness of the qualitative analysis follows from the fact that the lines of unsuspected elements appear with the same regularity as those of the elements which are expected, even in the most complex mixtures, and provided all the lines are identified, which is done in a general search, all the corresponding elements are discovered. Secondly, very small quantities suffice for the examination. With a few milligrams the work proceeds quite easily and without restriction, and very small proportions of constituent elements are discovered. Traces of impurity are not only found, but their nature is identified with certainty. Thirdly, it is rarely necessary to prepare the material in any way for the analysis.

The one desideratum is to make the work quantitative. No accurate method of determination has yet been devised, but adopting constant conditions of experiment and preparing proper standards for comparison, the proportions below one per cent. may be estimated with a very fair approximation to the truth. Considerably greater accuracy is attainable by taking much care, as exemplified by the following figures, which were obtained in testing the method for the determination of small quantities of nickel in the soda residues obtained on igniting soap, to ascertain the proportion of nickel in the fat. The quantities of nickel named were added to a solution of 20 grms. of soda crystals and then estimated spectroscopically with the undermentioned results.

Introduced.	Found.	
	A.	B.
0·1 mgrm. Ni	——	about 0·1 mgrm. Ni
0·05 „	0·04 mgrm. Ni	0·045 „
0·025 „	0·03 „	0·025 „
0·01 „	0·01 „	——

In actual practice, the following figures were obtained. The results in the first column record those by a chemical method of estimation carried out in another laboratory; those in the second and third columns are spectrographic determinations. The spectrum figures agree well between themselves and are of the same order as the chemical ones.

	1	2	3
	%Ni.	%Ni.	%Ni.
A.	0·00001	0·00004	0·00004
B.	0·00002	0·00002	0·000035
C.	0·00006	absent or v. little	0·00001
D.	0·00005	0·000005	0·000005
E.	0·00005	0·00004	0·00005

There is little hope that quantitative spectroscopy will ever attain that order of precision associated with gravimetric work, but as the foregoing and numerous other figures show, a degree of accuracy favourably comparable with that of many of the processes on which chemists are wont o rely is within the range of common practice. Each element, however, calls for individual attention and careful study, just as it has done n becoming amenable to chemical methods. Thus the order of experiment which succeeded with zinc so well as to give with three dilute olutions of different quality results which differed rom one another by only 5%, failed completely with nickel.

The foregoing instances of the application of mission spectroscopy to the purposes of chemical dustry are taken from a large number of such ases, and illustrate the capability of the spectroraph to solve many a problem not easily tractable by more ordinary means. It is necessary, however, that the operator should have studied the subject somewhat widely and have acquired some considerable experience. The results are then complete and unimpeachable.

The best thanks of the author are due to Messrs. Adam Hilger, Ltd., for kindly exhibiting a large quartz spectrograph with its accessories at the meeting, and for providing for the practical demonstration.

Glasgow Section.

Meeting held at Glasgow on Tuesday, May 2nd, 1916.

MR. ROBERT HAMILTON IN THE CHAIR.

RECOVERY OF BY-PRODUCTS FROM BLAST FURNACE GASES.

BY ROBERT HAMILTON.

The first record of the presence of ammonia in blast furnace gases seems to be that in the report of the research carried out by Bunsen and Playfair on the gases of a furnace at Alfreton in Derbyshire, published in the reports of the British Association in 1845. At the suggestion of the West of Scotland Iron and Steel Institute, this interesting report was reprinted separately by the Iron and Steel Institute in 1903. To render this account of the progress of the recovery of by-products from blast-furnace gases as complete as possible I have gone over the patent records for the last sixty years (from 1855) and taken note of any specifications having a bearing on the subject. I do not claim that everything has been included, but the list is as complete as I could make it without spending an amount of time searching the records which would be out of proportion to the value of the results to be reasonably expected.

The first patent I found was No. 580 of 2nd March, 1865. This specification is remarkable for its completeness and for being in advance of some patents taken out at subsequent dates. The applicants were Thomas Horton of Priors Lee Hall, Salop. and David Simpson Price, 26, Great George Street, Westminster. The official abstract states: " The condensible hydrocarbons and other products contained in the waste gases from blast furnaces are separated by passing the gases through a wrought iron tube connected with vertical condensing mains communicating with an air-tight box or cistern in which the condensed products are collected. The tube may be cooled by injecting a spray of water, or by surrounding it by a water trough, or by water falling from a perforated pipe. Scrubbers or cooling towers through which water passes, or like devices, may be added to the plant: the ammoniacal products are more completely collected by using acidified water."

The next specifications I found went on lines completely contrary to the foregoing. In No. 2454 of 17th August, 1872, William Ferrie states that the deposition of tar, etc., in the tubes from blast furnaces gives rise to obstructions, and he proposes to prevent the deposition of tar by heating the gas; part of the gas may be burned to heat the remainder of the gas. In No. 2369 of 9th October, 1873, David Blacker, of Thornhill Lees, near Wakefield, claims as follows: " The noxious gases evolved when coal-gas is used in blast furnaces are absorbed by discharging water in the form of spray or steam into the flues: or an open or perforated vessel or vessels containing hydrochloric acid or sulphuric acid diluted with water may be placed in the flues."

In No. 576 of 16th February, 1871. Henry Aitken claimed as follows: " . . . The combustion products from blast furnaces are passed through a condenser to remove the tar. ammoniacal liquor. etc.. and the gases. after being purified. are . . . " utilised. Scrubbers, filters. washers, etc., are mentioned. Further on I shall refer again to Aitken's claims.

The first practical attempt to recover by-products from blast furnace gases was made by the Scottish firm of William Baird and Co. In 1879 Messrs. Alexander and M'Cosh, two of the partners of the firm, commenced experiments at Gartsherrie Ironworks and soon convinced themselves that the recovery was worth attempting. In those days many data that are now common knowledge were not available and had to be worked out by the pioneers. They began with tests on a laboratory scale, but satisfactory results were not obtained. (I shall allude to this fact later on.) Instead of being discouraged, experiments on a larger scale were ordered and encouraging results were obtained The next step was to put down a small plant which produced a few cwt. per day of sulphate of ammonia and from which figures for further development were obtained. This was followed by the installation of a complete plant to take the gases from two furnaces. It was started to work in October. 1882, and was extended gradually until completed in 1886, and since the latter date has dealt with the gases from twelve blast furnaces.

In 1884 Messrs. Baird started plant to recover all the by-products from the gases of their Muirkirk and Lugar Ironworks in Ayrshire.

Alexander and M'Cosh's patents in this connection are: 1879, 11th October, No. 4117; 1880. 8th April, No. 1433; 1881. 31st August, No. 3785; 1882. 31st July, No. 3610.

The methods employed by Alexander and M'Cosh consisted in simply cooling and washing the gases with water. and events have proved that they were on the right lines from the first. At that time. however. a market had not yet been created for the tar products obtained from the furnace gases and there was at times difficulty in getting rid of them. This fact, together with the great cost of the plant for complete cooling and recovery and, possibly, the existence of Alexander and M'Cosh's patents, led to the introduction of two interesting processes. Taking them in the order of the dates of application, the first was known as the "Summerlee" process, stated to have been set to work on the large scale in 1884 under George Neilson's patent No. 440. Jan. 28, 1882 (this J., 1882. 365). In this process the gases. without much cooling. were washed first with water and then in a lead-lined scrubber with sulphuric acid till the acid liquor attained a sufficient strength, when it was run off and boiled down. The sulphate of ammonia produced was discoloured and the portion of the tar that was recovered was contaminated with sulphates and sulphuric acid. In the course of time a market arose for blast furnace tar products and it became profitable to recover the whole of them. In 1901 the Summerlee Iron Co. changed over to the ordinary method of cooling the gases and washing them with liquor and, finally, with plain water.

The second of the afore-mentioned processes was that known as the "Langloan" process patented by J. and J. Addie. No. 4758. Oct. 6. 1882 (this J., 1883. 264). In this process the ammonia was extracted from the hot gases by blowing into them sulphurous acid gas generated by blowing air through pyritic "blaes" and then washing out the resultant sulphite of ammonia with a minimum of water. This process continued to work from the summer of 1885. till the furnaces were blown out at the beginning of 1893. Many attempts were made to oxidise the ammonium sulphite liquors to sulphate but these were not successful owing. principally, to the fact that a considerable proportion of the ammonia was in combination with thiosulphuric acid, an acid requiring very strong oxidising agents to convert it to sulphuric acid. In practice. the liquors were treated with lime and the ammonia distilled into sulphuric acid.

The following patents bearing on the subject have a certain amount of interest although they do not appear to have been worked. Gavin Chapman took out four patents, all with the same object, viz., to expose blast furnace gases to water or acid solutions in thin films by means of discs set at short distances apart on rotating horizontal shafts; he also claims the pumping of acids over surfaces exposed to the gases. Chapman's patents are as follows:—1881, Dec. 17, No. 5523; 1882, Jan. 27, No. 410; 1883, Oct. 17, No. 4941; 1884, Apr. 16, No. 6106.

On 21st June. 1883. No. 3084 was granted to J. H. Darby; according to this patent: "The waste gases of furnaces, or coke-oven or coal gas, are brought into contact with sulphurous acid, gaseous oxides of nitrogen, steam, and air. within a flue leading to a scrubber tower down which water or weak liquors are showered. Sulphuric acid is thus formed which combines with the ammonia present," etc., etc.

At a meeting of the Iron and Steel Institute held in Glasgow in September, 1885, Mr. William Jones, then chemist at Langloan Iron Works, read a paper—the first on the subject—on the recovery of by-products from blast furnace gases. He described the Gartsherrie, Summerlee, Addie, Dempster and Henderson processes. I have already mentioned the first three. The Messrs. Dempster being gas plant engineers, the process designed by them follows gas works practice and comprises an efficient combination of apparatus well adapted for the purpose for which it was designed. From the list of installations of plant at the end of this paper, it will be seen that almost half of the existing plants are of Dempsters' erection. Of the Henderson process I have been unable to discover any particulars; no plants seem to have been erected on this system. The apparatus described in No. 3708 of 1883 (this J., 1884, 233) does not seem well suited for dealing with blast furnace gases.

Lunge, in his work on "Coal Tar and Ammonia" in the section on blast furnace products, mention the processes I have referred to and also tw others, viz., those of Mackay and Imray.

The former was patented in 1889, 6th Sept. No. 14,060, by F. N. Mackay of Freshfield. Count of Lancaster. The special feature of this claim i the use of jackets and heat exchangers to coo and utilise the sensible heat of the incoming gase after cooling, the gases are washed first with oi and then with water (see this J., 1890, 1120).

The patent in Imray's name is No. 10,589 o 31st May, 1891*, and is a communication fron Paul Gredt of Esch-sur-Abzette, Luxemburg, an relates to the recovery of salts (iodides are speciall mentioned) from the gases of coke-fed furnace In this connection I may mention that ten year earlier, a patent, No. 3198 of 18th Feb., 1884 was taken out by Hugh Barclay and Rober Simpson of Harrington Ironworks, Cumberlan for the recovery of salts, especially potash salt from coke-fed blast furnaces (see this J., 1885, 351

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* See this Journal, 1894, 816.

An interesting plant with several special features was designed by the late Wm. Young for the Coltness Iron Co. and a patent applied for in their joint names on 6th Nov., 1889, No. 17,673.[†] From it was derived, by a process of simplification, the excellent type of plant associated with the name of Gillespie, which has been installed at a number of iron works in Scotland. It has been described in papers by the late A. Gillespie to the Institute of Engineers and Shipbuilders in Scotland, vol. 1895/6, p. 187, and by J. Gillespie to the West of Scotland Iron and Steel Institute, vol. 12, p. 49. The washing and scrubbing treatment to which blast furnace gas is subjected is not sufficient to remove the last traces of tar and the small amount left in the gas interferes with its use in internal combustion engines. G. Neilson's patent No. 28,508 of 1904 (see this J., 1906, 115) covers apparatus designed to remove and recover the last traces of tar and render the gas suitable for use in engines. Reference may also be made to W. C. Neilson's patent No. 28,462 of 1908 (this J., 1909, 1079).

The following is a chronological table of the order in which recovery plants were erected at blast furnace works. As far as possible the dates refer to the time of completion of erection. For these I am indebted to Mr. M'Cosh, Messrs. R. and J. Dempster, Ltd., Mr. John Gillespie, and others.

obtained from the coal when distilled in gasworks. The gases themselves do not seem to have been tested before the recovery plant was erected, but when satisfactory results were not obtained scientific advice was got and the gases tested and a satisfactory report obtained, so it was assumed that the plant was to blame; but that was not correct, as it has since been transferred to another works, where it gives good results. I am afraid that the tests which gave satisfactory results cannot have been correct; at any rate, I am able to say that many subsequent tests all gave consistently lower results.

In conclusion, I should like to refer once more to the need for a thorough chemical investigation of blast furnace tar. I mentioned this in the paper read before the West of Scotland Iron and Steel Institute in 1902, but little advance has been made in the way of obtaining products from the oil except that there has been an increase in the quantity of phenoloids extracted from blast furnace oil for the manufacture of disinfectants. It would be a small matter for the makers of blast furnace by-products to establish a central research laboratory for the express purpose of investigating the tar and finding if there are not in it substances the preparation of which, or derivatives thereof, would be more profitable than the selling of crude tar and oil.

Works.	Owners.	Design.	Erection completed.
Gartsherrie	Wm. Baird and Co.	Alexander and M'Cosh	Oct. 1882/86
Muirkirk	Wm. Baird and Co.	Alexander and M'Cosh	1884
Lugar	Wm. Baird and Co.	Alexander and M'Cosh	1884
Summerlee, original	Summerlee Iron Co.	Neilson	1884
Summerlee, altered	Summerlee Iron Co.	Gillespie	Sept. 1901
Langloan, original	R. Addie and Sons	Addie	1885
Langloan, altered	Langloan Iron and Chemical Co., Ltd.	Dempster	May 1900
Norton Green	R. Heath and Sons, Ltd.	Dempster	1885
Govan	Wm. Dixon, Ltd.	Dempster	1890
Coltness	Coltness Iron Co., Ltd.	Young	April 1891
Shotts	Furnace Gases Co., Ltd.	Dempster	June 1891
Calder	Wm. Dixon, Ltd.	Dempster	Dec. 1891
Carnbrae	Carnbrae Chemical Co., Ltd.	Dempster	Sept. 1892
Dalmellington	Dalmellington Iron Co., Ltd.	Gillespie	Jan. 1893
Glengarnock	Glengarnock Chemical Co., Ltd.	Dempster	Nov. 1893
Clyde	James Dunlop and Co., Ltd.	Gillespie	April 1894
Wishaw	Glasgow Iron and Steel Co., Ltd.	Gillespie	Dec. 1894
Eglinton	Wm. Baird and Co., Ltd.	Gillespie	Aug. 1896
Fenton	Stafford Coal and Iron Co., Ltd.	Dempster	Feb. 1902
Ardeer	Glengarnock Iron and Steel Co., Ltd.	Gillespie	Mar. 1903

It is of interest to observe the importance of correct analytical estimations as illustrated by instances which I have touched on in this paper. In the discussion on Mr. Jones' paper read at the Glasgow meeting of the Iron and Steel Institute in 1885, the late Mr. Henry Aitken referred to his efforts to get the ironmasters to go in for the recovery of by-products from their gases. He said: "Twelve years ago, Mr. William Ferrie, managing director of the Monkland Iron Co. employed two scientific experts who reported little tar and no ammonia." Aitken himself was not satisfied that this report was correct but stated that, in the face of the scientific report, he found it impossible to make further progress.

At Gartsherrie I understand the first tests were not encouraging, and it was only the certainty in the minds of Alexander and M'Cosh that caused them to persevere with their experiments.

In a paper read before the West of Scotland Iron and Steel Institute in 1902, vol. 9, p. 125, I gave an account of the difficulties encountered in the case of a plant put down in the Midlands about 1896. In this case there was a considerable amount of salt in the coal, the chlorine of which acted detrimentally on the tar and possibly on the ammonia also, as the yield of ammonia from the furnace gases was much lower than that

London Section.

Meeting held at Burlington House, on Monday, June 5th, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

THE ACTION OF NITRIC ACID ON ALUMINIUM.

BY R. SELIGMAN AND P. WILLIAMS.

In recent years the use of aluminium in factories making nitric acid and explosives has grown to large proportions, the chief directions in which the metal has found application being the following:—1. For the conveyance of nitric acid in tanks or by pipe lines. 2. For storage and blending in tanks. 3. For carrying off fumes by means of hoods, domes, and vapour pipes. 4. For the covers of vessels, themselves not made of aluminium. 5. For the gigantic pipe systems used in the manufacture of nitric acid from the atmosphere. 6. For many small utensils.

It is therefore essential that the interaction of aluminium and nitric acid on the one hand and of aluminium and nitrating mixtures on the other should be fully understood, and as moreover the experience of different factories which have used aluminium has varied within wide limits, it has become a matter of urgent importance to establish as far as possible the causes of these divergencies. The great differences which have appeared in practice are a reflection of the conflicting results obtained by the large number of chemists who have investigated this subject. Thus for instance the following divergent statements may be found in the literature of this subject. (i) "Dilute sulphuric acid and nitric acid, both dilute and concentrated, have no effect upon aluminium." (H. E. Roscoe, Proc. Royal Inst., 1889, **12**, 451); (ii.) Sulphuric acid and nitric acid act immediately upon aluminium (G. A. Le Roy, Chem.-Zeit., **15**, Rep., 276); (iii.) Aluminium is not attacked by boiling nitric acid whether dilute or concentrated (Deville, Comptes rend., **38**, 279). (iv) 100 c.c. of 1·35 nitric acid at 100° C. will dissolve 1 grm. of aluminium in 30 mins. (Stillman, J. Amer. Chem. Soc., **19**, 711). Of all the work done on this subject the most accurate appears to be that of Lunge and Schmidt (Z. angew. Chem., 1892, 7), whose results so far as they refer to similar conditions, are confirmed by the present work. Lunge and Schmidt, however, conclude that aluminium "cannot be used in the manufacture of nitric acid." Acworth and Armstrong also seem to have correctly interpreted the facts in their communication to the Chemical Society in 1877 (J. Chem. Soc., 1877, 54).

[†] This J., 1890, 1120.

Whilst in the work described in the present communication the practical bearing of the subject has been continually kept in mind, attention has been concentrated on eliminating the sources of error which have made so much of the earlier work done on this subject misleading, and it is therefore hoped that a true picture of the conditions has been obtained. As in all similar investigations, the complexity of the subject has grown rapidly as the problem has been faced and many conditions influencing the rate of attack have been disclosed which were not contemplated at the outset of the experiments. Some of these minor factors have not been completely elucidated, but as they are of comparatively small practical importance and not likely to influence to any appreciable extent the main conclusions arrived at, it has been thought unwise to defer publication of the results obtained.

During the concluding stages of this investigation there appeared an article by A. Trillat (Bull. Soc. d'Encouragement, **122**, No. 3, p. 547) on the same subject. Many of Trillat's conclusions are identical with those of the present authors. In some cases, however, notable differences occur, whilst the basis for a comparison is frequently missing, so that it seemed desirable to bring forward the results obtained in spite of Trillat's publication.

The main conclusions reached were the following:—

A. Effect of temperature. The most important condition affecting the rate of dissolution of aluminium in nitric acid is temperature. Over a considerable range of temperature an increase of 10° C. is sufficient to increase the rate of dissolution by 100 %. The practical importance of this factor, to which no reference has heretofore been made, is very great. The life of aluminium vessels used for the storage or transport of nitric acid can be greatly increased where it is possible to keep the temperature down.

B. Effect of concentration.—Next to temperature, concentration plays the most prominent part in determining the rate of dissolution of aluminium in nitric acid. The most active solvents are mixtures containing between 20 % and 40 % by volume of nitric acid of 1·42 sp. gr., whilst on the other hand some acids made from the atmosphere and containing 94·7 % of true nitric acid were found to be almost without effect on aluminium. A sample of the metal suspended in this acid for 71 days lost only 0·0004 grm., equivalent to a rate of dissolution of 0·015 mgrm. of aluminium per 100 sq. cm. per 24 hours. The extreme inactivity of acid of this strength is held to account for the great success which has attended the use of aluminium transport vessels by the Norwegian makers of nitric acid.

C. Impurities in the nitric acid.—Contrary to statements made by other investigators (*e.g.*, Trillat, *loc. cit.*, p. 553), the presence of up to 0·05 % chlorine in nitric acid was not found to affect the rate of attack of the latter upon aluminium. Similarly no acceleration could be noted on the addition of up to 0·01 % of iodine. On the other hand the presence of traces of sulphuric acid was found to promote the rate of attack, 0·04 % of sulphuric acid being sufficient to raise the rate of dissolution from 36 to 62 mgrms. per 100 sq. cm. per 24 hours.

D. Effect of oxides of nitrogen.—The rate of attack is increased by the presence of the lower oxides of nitrogen. If the acid be kept free from such lower oxides the rate of attack on aluminium can be reduced considerably. The effect of the oxides of nitrogen produced by the interaction of nitric acid and aluminium in stimulating the attack is held to account for the fact often observed in practice that dissolution is most rapid in crevices or corners where the acid cannot circulate freely and where such products therefore accumulate.

E. The effect of physical state of the metal.—The effect of the physical state of the aluminium is considerable, the metal being attacked very much more readily when amorphous than when crystalline.

F. The composition of the metal.—The composition of the metal is of very much smaller importance than has heretofore been assumed to be the case. Nevertheless the purer metal is generally the most resistant to the attack of nitric acid.

G. Mixed acids.—Mixed nitric and sulphuric acids attack aluminium very much more readily than pure nitric acid, and the statements to the contrary to be found in the literature of the subject are erroneous (cf. Guttmann, this Journal, 1896, **15**, 850).

H. Uniformity of the action.—The attack by nitric acid on aluminium sheet of high quality is absolutely uniform and during the present investigation no instance of local action or "pitting" has been observed.

In addition to the conclusions recited above and which are all of technical importance, certain observations have been made which are less of practical than of scientific interest. Only very short reference will be made to these observations here as they will form the subject of separate communications.

I.—It has been stated that in the crystalline form brought about by annealing aluminium is more resistant to attack by nitric acid than in the amorphous or unannealed form. The observation has been made that a partial change to the more resistant form is brought about by exposure for a few hours to a temperature of 125° C., but that by a longer exposure to this temperature metal loses its comparative immunity from attack. A similar change to the more resistant form has been observed to commence at a temperature as low as 100° C. Moreover, it has also been noticed that metal which has been freshly annealed at 540° C. is more resistant to attack than metal which has been allowed to stand for about ten days after annealing. These observations cast some doubt upon the sufficiency of the accepted explanations of the changes which take place on annealing.

J.—During the course of the experiments made the existence has been established of a number of hydrates of aluminium nitrate heretofore unrecorded. The solubilities of these hydrates in nitric acid of 1·42 and 1·5 sp.gr. have been determined and found to be extremely small.

Experimental.

The metal used for the experiments was, unless otherwise stated, in the form of thin rolled strips 0·5 mm. thick, 70 × 25 mm. in size. In order to eliminate any discrepancies due to the physical state of the metal all the samples were in the earlier stages of the work carefully annealed at 410° C. Later on it was found that this was not sufficient to ensure uniformity owing to changes which were observed to take place in the metal after annealing. In the majority of cases the differences due to this property are not large enough to affect the results obtained. Where this is not the case special precautions were subsequently taken.

After being annealed, unless otherwise stated, the samples were cleaned by immersion in warm 5% caustic soda, washed with water, plunged into warm nitric acid (1 vol. of acid of sp.gr. 1·42 to 1 vol. of water), again washed, and finally dried in an air bath at 100° to 120° C.

The numerical results are all given as milligrammes of aluminium dissolved per 24 hours per 100 sq. cm. This is termed the "Rate of dissolution" (R.D.) throughout. Owing to the many causes of variation the figures given must not be taken too literally. They are, however, considered to represent with sufficient accuracy for practical purposes the effect of conditions in connection with which they are used. In most cases the figures are arrived at by averaging a large number of determinations.

The density of each sample of nitric acid used in the experiments was determined and the percentage of true HNO_3 calculated from the tables of Lunge and Rey, due allowance being made for the N_2O_4 present.

In view of the importance of concentration and the fact that the stronger acids are very hygroscopic, the experiments, unless otherwise stated, were carried out in glass stoppered bottles. Sometimes even this precaution was not sufficient to prevent dilution of the acid and in such cases the experiments were conducted in sealed tubes.

The numerical results at first obtained were almost always very irregular, but, as the experiments proceeded, the rates of dissolution became more uniform and better agreement was noted between duplicate samples. This was ascribed o irregularities of surface which tend to disappear as dissolution proceeds. From the practical point of view the initial effect of an acid upon a surface is of no consequence, so that where it was of mportance to simulate practical conditions the course adopted was to continue the weighings until regular conditions obtained and then to replace the samples in fresh acid. By this means onditions similar to those met with in practice were attained.

The capacity of the bottles used was 165 c.c., he amount of acid used being about 130 c.c. As oon as the importance of small variations of emperature had been established it became ssential to work in a thermostat, and as it was esired to carry out the experiments at not more han 20° C. whilst the use of ice was impracticable, water cooled thermostat was constructed. The rrangement, which appears to be novel in some espects, is shewn in Fig. I.

The thermostat consists essentially of an outer essel, A, and of an inner vessel, B, which contains he usual form of gas regulator and stirrer and erforated tray on which the bottles, etc., rest. The outer vessel is itself formed of an inner and an outer wall and is closed at the top. Water from the main is allowed to run into the vessel, A, by the funnel, C, and to escape by the overflow, D. In addition to the overflow, D, a number of small holes are punched in the outer casing of A by which water escapes and flows over the outer surface, which is encased in some fabric such as butter muslin. In hot weather evaporation of the film of water thus produced assists in keeping down the temperature of the water in A. The whole apparatus stands in a tray, E, provided with an overflow. Between A and B an air space is provided in order to avoid sudden fluctuations of temperature. B may therefore be considered as standing in a room of approximately constant temperature. A small piece of tube, F, is sweated into the bottom of A through which the heating pipe, G, passes loosely. G is sweated into the bottom of B and rises above the water level. It carries the products of combustion of the controlled pinhole burner, H. This apparatus gives very satisfactory results, and it was found practicable to keep the temperature within 0·1° C. of 20° C. except on three or four days in 1914 and with no exception in 1915. The temperature can be maintained within 3° C. of the temperature of the water in the mains so long as the room temperature does not exceed the thermostat temperature by more than 2° or 3°. Even a higher room temperature would not be injurious if a suitable cover to the thermostat were used.

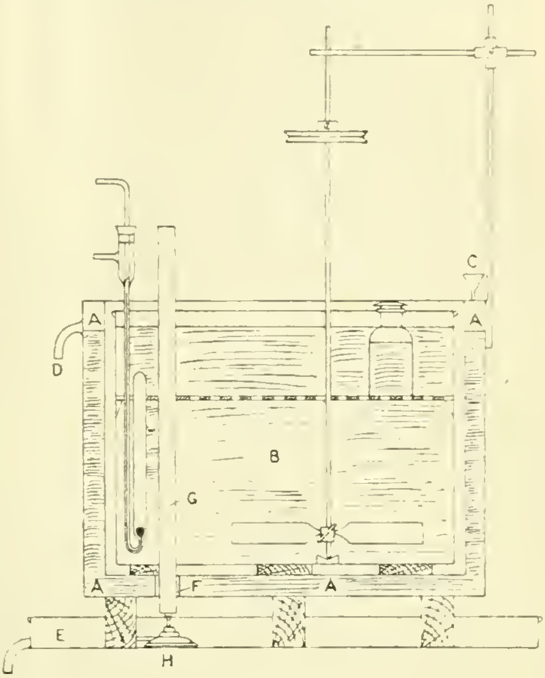


Fig. I.

Series A.

The effect of temperature.—The experiments in this series were carried out with annealed metal having the following composition: Si, 0·45; Fe, 0·45; Cu, 0·00; Al (by diff.), 99·10%. The acid used was a commercial sample having a density of 1·4193. (N.B.—This and all subsequent densities are referred to 15°/4° *in vacuo.*) Up to a temperature of 20° C. the experiments were made in stoppered bottles. From 30° C. upwards the time of exposure was very much reduced so that the experiments could be made without danger of dilution in a flask containing about 1 litre of the acid. The same acid was used throughout. The results are given in Table I.

TABLE I.

Temp.	Time of exposure.	Rate of dissolution.
0° C.	41 hours	5·5
8 ,,	216 ,,	13
20 ,,	24 ,,	48
30 ,,	2 ,,	110
40 ,,	2 ,,	206
50 ,,	2 ,,	453
60 ,,	1 ,,	927
70 ,,	1 ,,	1770
80 ,,	1 ,,	3450
90 ,,	¼ ,,	6300
100 ,,	¼ ,,	10750
110 ,,	¼ ,,	15800
120 ,,	1 5 ,,	21000

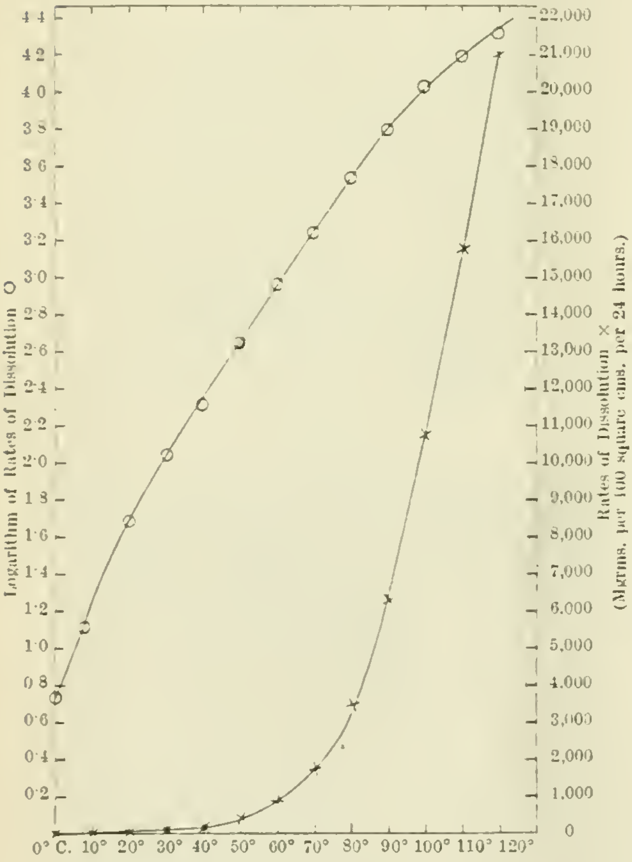


FIG. II.

Visible evolution of gas first occurred at 80° C. The rates of dissolution and their logarithms have been plotted in Fig. II., from which it will be seen that between 20° C. and 90° C. the latter lie practically in a straight line. At the highest temperatures the curve changes, possibly owing to the very rapid evolution of gas from the surface of the metal. A similar experiment made with metal containing 0·21 % of silicon and 0·19 % of iron gave exactly analogous results. Moreover, similar conditions were found to obtain with acid of 1·5 sp.gr. and dilute acid containing 22 % HNO_3. In the latter case, however, there was one anomalous factor which is still the subject of investigation.

SERIES B.

Effect of concentration.—The experiments of this series were carried out with annealed metal containing 0·21 % Si, 0·19 % Fe, 0·00 % Cu. The temperature was 20° C. throughout. The numerical results are given in Table II.

TABLE II.

Composition of acid.			Remarks.	R D.
Δ	% HNO_3.	Approximate % by vol. of 1·42 acid.		
1·5245	99—100		Acid prepared by distilling fuming acid under reduced pressure on to aluminium contained in a tube which was subsequently sealed.	0·11
1·5047	96·1		Acid prepared from the atmosphere containing 0·22 % N_2O_4 & 0·007 % H_2SO_4.	0·4
1·508	90·8		Commercial fuming containing 2·65 % N_2O_4 & no H_2SO_4.	3
1·496	89·0		Another sample of coml. fuming containing 0·009 % H_2SO_4 & 1·65 % N_2O_4.	10
1·4193	69·6		Coml. 1·42 acid containing 0·007 % H_2SO_4.	30
1·350	55·8	75		40
1·256	40·7	50		55
1·133	22·2	25		70
1·052	9·3	10		30
1·024	4·4	5		20

From these figures it will be seen that the action of cold nitric acid on aluminium is at a maximum when the acid contains about 22 % of true nitric acid, equivalent to one volume of 1·42 sp.gr. acid to three volumes of water. Experiments showed that this maximum is by no means a sharp one but that it extends from about 13 % to 27 % of true nitric acid.

The results obtained with acids of higher concentration call for some remark. This part of the table shows a good deal of irregularity, and therefore a short series of experiments was made to determine the effect of change in concentration by adding small quantities of water to an acid of known composition. The acid used was a sample prepared from the atmosphere and containing 94·7 % HNO_3. 0·37 % N_2O_4 and 0·008 % H_2SO_4 The following figures were obtained :—

TABLE IIA.

% HNO_3.	R.D.
94·7	1·5
92	7·2
90	12·6
88	16·6

It will be seen that with acid of such high con centration the effect of the addition of even ver small quantities of water is very great indeed but the figures in Table IIA. do not at first sigh agree with those in the previous table. I however, it is borne in mind that it is the pe centage of water which is the determining fact and if the rate of dissolution is therefore plotte against the percentage of water in the variou mixtures, the smooth curve shown in Fig. III. i obtained.

It will be noted that acid prepared from th atmosphere and containing 96·1 % of true HNO a sample of which was obtained by the courte of The Norsk Hydro Elektrisk Kvaelstofakti selskab, is extraordinarily inactive with respect to its solvent action on aluminium. Small though the rate of dissolution of the metal in this acid is, the figure given does not fully represent the facts. After immersion in such acid for about three days a brown film forms on the surface of the metal and thereafter the rate of dissolution falls away to 1/8th of its former value. In fact if care be taken to prevent dilution of the acid the reaction may be said to cease. A strip of aluminium containing 0·45% Si and 0·45% Fe which was exposed for 71 days at 20° C. to the action of "atmospheric" nitric acid, the density of which was 1·5019, and which contained 0·37% N_2O_4, 94·7% true HNO_3, and 0·008% H_2SO_4, lost only 0·0004 grm. during the whole period. This is equivalent to a loss of 0·015 mgrm. per 100 sq. cm. per 24 hours. At the end of the experiment the metal was covered with a well-marked iridescent film. As to the nature of this film, it may be suggested that it consists of silicon left exposed by the solution of the aluminium in the early stages of the interaction, or of a film of passive iron derived from the same source. Its formation has been observed in samples of nitric acid of 1·5 sp.gr. containing 0·05% of H_2SO_4. Dilution of these acids not only prevents the formation of the film but also causes its disappearance if already formed. The film also disappears if the acid containing H_2SO_4 is replaced by acid of the same strength which is free from this impurity.

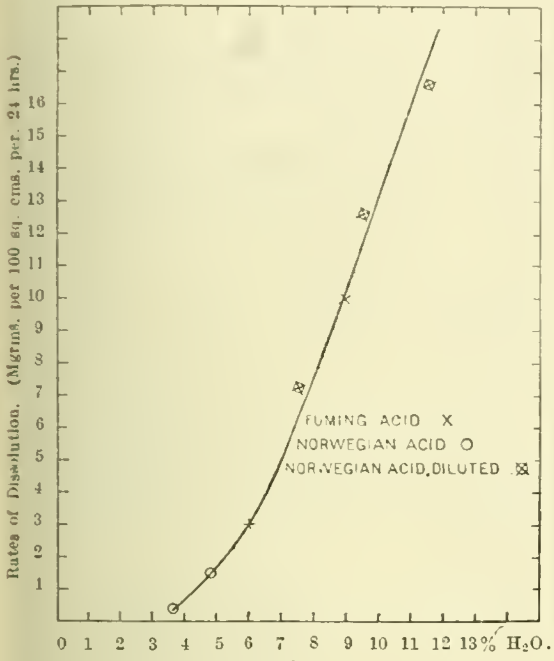


Fig. III.

Series C.

Influence of impurities in the nitric acid.—The influence of the presence of small quantities of chlorine, iodine, and sulphuric acid was examined. The effect of the dissolved oxides of nitrogen appeared from the experiments of series D.

The method adopted was to add to the nitric acid weighed quantities of the potassium salt of the acid under investigation. By this means it was possible to add the very small quantities required with sufficient accuracy and without dilution of the nitric acid. The numerical results are given in the following tables :—

Table III.

Chlorine.

Metal used. Si 0·45% Fe 0·45% Cu 0·00. Annealed.
Acid used. Commercial acid, sp. gr. 1·42.
Temp. 20° C.

Chlorine added as percentage of acid	R.D.
0	42
0·0005	40
0·005	42·6
0·05	42·1

Table IV.

Iodine.

Metal used. Si 0·21% Fe 0·19% Cu 0·00. Hard.
Acid used. Commercial acid sp.gr. 1·42.
Temp. 20·0° C.

Iodine added as percentage of acid	R.D.
·0	64
0·01	64

Table V.

Sulphuric acid.

Metal used. Si 0·21% Fe 0·19% Cu 0·00.
Acid used. Pure redistilled sp.gr. = 1·426. H_2SO_4 = 0·0006%.
HNO_3 = 71·2%. Temp. 20° C.

H_2SO_4 as percentage of acid.	Metal hard R.D.*	Metal annealed R.D.
0·0006	35	27
0·01	48	38
0·02	55	41
0·04	66	47

* The metal was cleaned and dried at temperatures not exceeding 40° C.

From these tables it is apparent that no accerleration in the rate of attack can be ascribed to the presence of chlorine or iodine in the quantities in which they may normally occur in nitric acid, but that traces of sulphuric acid may readily double the rate of attack by nitric acid of 1·42 specific gravity upon both hard and annealed aluminium.

In the case of acid of 1·5 sp. gr. a similar increase due to the addition of 0·05 % of sulphuric acid has not been observed. This fact may, however, be connected with the formation of a film on the surface of the metal as described above.

Series D.

Effect of products of the interaction.—If a sample of aluminium be immersed in a limited amount of nitric acid in a closed vessel and removed periodically for weighing, it will be found that the rate of dissolution gradually increases, although the rise is not always uniform and in some cases appears to be preceded by a slight decline. The increase in the rate of dissolution can only be due to accumulation of the products of the reduction of the nitric acid, because experiments have shown that the aluminium nitrate formed at the same time is without effect upon the rate of dissolution. The following experiment demonstrates the accuracy of this statement.

The metal used contained 0·45% Si, 0·45% Fe, and was free from copper.

Three samples of nitric acid were used :—

(*a*) Commercial 1·42 acid sp.gr. 1·4244. N_2O_4 a trace.

(*b*) The above into which had been passed N_2O_4 prepared by heating lead nitrate: sp. gr. 1·4255. N_2O_4 0·57%.

(c) "*a*" which had been freed from N_2O_4 by the addition of 0·5 grm. urea to 150 c.c. of acid. The results are shown in Table VI.

TABLE VI.

Duration of experiment in days.	A. Ordinary acid.	B. Acid containing additional N_2O_4.	C. Acid free from N_2O_4.	Remarks.
1	R.D. = 48	R.D. = 60	R.D. = 40	
2	51	61	41	
3	52	61	40	
4	55	—	38	
8	59	63	39	Acid colourless
10	62	63	40	
13	62	63	41	
14	63	62	40	
17	63	61	41	
23	62	60	52	Acid yellow

It will be noted that in the first case the rate of dissolution was only 75% of that in the second case but that it rose rapidly, whilst in case B only a slight rise took place.

After about 13 days the rate of dissolution was practically identical in both cases. The subsequent small decline in case B has not been explained. After the experiment acid A contained 0·95% of N_2O_4 whilst acid B contained 1·3%. In the case of C the rate of dissolution remained constant and low until the urea was exhausted when rapid increase commenced.

SERIES E.

Physical state.—The rate of dissolution of hard worked aluminium was found to be considerably greater than that of the same sample when annealed. This is in agreement with the general rule according to which amorphous forms of metals are more readily soluble than crystalline forms. The following figures illustrate this point :

TABLE VII.

Composition of metal	Si 0·21%. Fe 0·19%. Cu 0·00.
Density of acid	1·4244
Time of exposure	23 days
Rate of dissolution of hard-worked metal	55·25 *
Ditto after annealing at 440° C.	40·9

* The metal was cleaned and dried at temperatures not exceeding 40° C.

As stated above, various minor factors were observed during the experiments on this subject which influence the rate of dissolution, but as they are not of such magnitude as to be of any practical importance no further reference will be made to them here.

In connection with these experiments some determinations were made of the rate of dissolution of cast aluminium. Plates cut from an ingot of similar composition to the sample used for the previous experiment, showed a higher rate of attack and it was especially noticeable that the rate increased continuously for a long period. This is ascribed to the open structure of cast aluminium compared with wrought.

SERIES F.

Composition of the metal.—In order to determine the effect of the composition of the aluminium upon its rate of dissolution in nitric acid, a series of experiments was made upon different samples chosen so that their composition should correspond as closely as possible to the various grades found in commerce. Whilst very little difference in the rate of attack was found in the case of high purity metal of varying composition, such differences as were found were irregular and could not be simply explained. Thus for instance the rate of dissolution of metal containing 0·16% Si and 0·29% Fe was always found to be lower when the metal was annealed than that of metal containing 0·21% Si and 0·19% Fe, but when both samples were hard this relation was reversed.

In general the effect of purity was found to be far smaller than was anticipated, even a metal containing 1·1% Si, 1·3% Fe, and 0·3% Cu only showing a rate of dissolution about double that of the purest sample examined. Table VIII. gives the numerical results obtained with concentrated acid.

TABLE VIII.

Acid used. Commercial 1·42. Sp. gr. 1·4191. HNO_3 69·6% H_2SO_4 0·023%. N_2O_4 less than 0·01%. Time of exposure 120 hours. Temperature 20° C.

Composition of metal.			R.D.	
Si %	Fe %	Cu %	Metal annealed at 450° C. for 6 hours.	Metal hard rolled.*
0·13	0·14	0·00	37·5	60
0·21	0·19	0·00	45·7	61·5
0·16	0·29	0·00	38·4	64·5
0·45	0·45	0·00	50·3	66·8
1·4	1·3	0·30	81·0	——

* The metal was cleaned and dried at temperatures not exceeding 40° C.

A similar series of experiments conducted with dilute nitric acid gave analogous results. Here also very small differences were observed in the case of the purer samples of metal although the results were more regular.

Table No. IX. gives the numerical results obtained.

TABLE IX.

Composition of metal.			Composition of acid.	Length of exposure.	Rate of dissolution
Si %	Fe %	Cu %			
0·13	0·14	0·00	1 vol. 1·42 acid to 2 vols. water ; sp. gr. 1·1765. HNO_3 = 28·8%	69 hours	71·6
0·21	0·19	0·00			71·2
0·16	0·29	0·00		72 ,,	75·7
0·45	0·45	0·00			84·5
1·4	1·3	0·30			127

Finally a series of experiments was made in order to determine the effect of copper present as an impurity in the aluminium. The results are shown in Table X.

TABLE X.

Acid used, sp. gr. 1·4198. Exposure 120 hours.

Composition of sample.			Rate of dissolution.
Si %	Fe %	Cu %	
0·13	0·14	0·00	42
0·14	0·14	0·02	42·5
0·13	0·13	0·90	43

It will be seen that nearly 1% of copper has practically no effect upon the rate of dissolution of aluminium in concentrated nitric acid.

On repeating this experiment with dilute acid the results shown in Table XI. were obtained.

TABLE XI.

Composition of sample.			Composition of acid.	Length of exposure.	Rate of dissolution
Si %	Fe %	Cu %			
0·13	0·14	0·00	1 vol. 1·42 to 2 vols. water. sp. gr. 1·7775 29% HNO_3	72 hours	62·5
0·14	0·14	0·02			87
0·13	0·13	0·90			127·5

From these figures it will be seen that the presence of copper as an impurity in the aluminium is much more injurious where the metal has to resist the action of dilute nitric acid than in cases where it is only exposed to attack by concentrated acid.

SERIES G.

Mixed acids.—A series of experiments was made with mixtures of nitric and sulphuric acids varying from 100 % of the former to 100 % of the latter. In addition a few typical nitrating mixtures were examined with reference to their action on aluminium. These experiments were not carried out in the thermostat as no great refinement appeared to be necessary. Therefore the results obtained, whilst strictly comparable with one another in each series, are not directly comparable with those given for nitric acid alone in other parts of this paper. The experiments were made with nitric acid of 1·42 sp.gr. and also with fuming acid.

TABLE XII.

Aluminium used, Si 0·15, Fe 0·14, Cu 0·02%. Nitric acid used, sp.gr. 1·42. Sulphuric acid used, commercial 98%. Duration of experiment, 20 hours. Temperature, about 11° C.

H_2SO_4% by vol.	HNO_3% by vol.	Rate of dissolution.
100	—	122
90	10	174
80	20	176
70	30	179
60	40	179
50	50	176
40	60	169
30	70	154
20	80	116
10	90	74
—	100	15·5

TABLE XIII.

Aluminium used, Si 0·15, Fe 0·14, Cu 0·02%. Nitric acid used, sp.gr. 1·5. Sulphuric acid used, commercial 98%. Duration of experiment, 20 hours. Temperature, about 11° C.

H_2SO_4% by vol.	HNO_3% by vol.	Rate of dissolution.
100	—	92
90	10	126
80	20	125
70	30	120
60	40	117
50	50	114
40	60	109
30	70	95
20	80	73
10	90	29
—	100	4

It will be seen that both in the case of nitric acid of 1·42 sp.gr. as with acid of 1·5 sp.gr. the addition of 10 % of sulphuric acid, far from reducing the rate of dissolution, augments it very largely. Similarly the addition of 10 % of nitric acid is seen to increase the action of the sulphuric acid. Earlier views expressed in literature on this subject according to which the action of mixed acids on aluminium was smaller than that of either component of the mixture, must therefore be discarded.

TABLE XIV.

Aluminium used, Si 0·21, Fe 0·19, Cu 0·00% annealed. Nitric acid used, sp.gr. 1·508. HNO_3 90·8%. N_2O_4 2·6%. Sulphuric acid used, sp.gr. 1·8415. H_2SO_4 97·7%. Temperature, 20° C.

Composition of mixture.			Rate of dissolution.
H_2SO_4. %	HNO_3. %	H_2O. %	
70	21	9	360
72·2	17·3	10·5	380
61	17·4	21·6	440

Finally experiments were made with three mixtures representing a nitrating acid, a spent acid, and the washings from the latter. The results are given in Table XIV.

Conclusion.

The practical conclusion to be drawn from the experiments described in this communication is that, as the authors have frequently pointed out, aluminium can be used with great advantage for dealing with strong nitric acid provided that the latter be cold and provided that the plant or apparatus be suitably designed. For hot nitric acid of any concentration aluminium can have but a very limited life. Dilute nitric acid if cold could in many cases be handled in aluminium with success, although the life of the aluminium will not be so long as where the metal is exposed only to the action of the strong acid. Owing to the higher rate of attack by dilute nitric acid, storage and transport tanks after being emptied should either be thoroughly washed out or so sealed that moisture cannot get in and so dilute the acid which remains in the tank. Finally aluminium should only be used with great caution for handling mixed acids, and where aluminium covers and domes are used above vessels containing such mixtures care should be taken to prevent splashing of the contents upon the aluminium.

The writers desire to express their thanks to Mr. English of Messrs. Spencer Chapman and Messel, Ltd., and to the Norsk Hydro-Elektrisk Kvaelstofaktieselskab of Kristiania for assisting them to secure suitable samples of nitric acid, and to Messrs. Brislee, Jack, and Murray-Morrison for valuable help in the selection and preparation of the aluminium used in these experiments.

DISCUSSION.

Prof. HODGKINSON said that he had also noticed the brown deposit formed by the action of nitric acid on aluminium. The same kind of deposit was obtained by the action of caustic soda, say 20 % sodium hydroxide solution. Its formation practically stopped the evolution of hydrogen. It contained silicon and also iron.

Professor H. E. ARMSTRONG asked what was Dr. Seligman's view with regard to the protection of aluminium from the action of nitric acid. He supposed that aluminium was really very attackable by nitric acid. The figures showed clearly enough that adding an extra quantity of nitrogen peroxide produced an effect; but he did not think the figures in the C column should be taken as showing what the effect was in the absence of nitrous compounds. The acid Dr. Seligman used presumably always contained a small amount of nitrous compounds, because there was a low rate of action until all the urea was used up. Therefore nitrous compounds were being produced throughout and were present throughout, though in less quantity when urea was there. In the absence of nitrous compounds there would probably be no action. He was inclined to think there was protection afforded by some coating of oxide, particularly in view of what had been said as to the way copper interfered and promoted action. If Dr. Seligman continued the experiments, he hoped he would investigate the action of caustic soda on aluminium and the behaviour of aluminium couples; also what the effect would be of coupling up aluminium under different conditions with a negative metal such as platinum. It was a great pity that they could not use aluminium with the nitrating mixtures, because at the present time there was not a single vessel known which could be used safely except with a mixture of nitric and sulphuric acid containing certainly not more than 30% of water. Aluminium was most disappointing in that way, and it was therefore very difficult to deal with weak nitric acid mixtures.

Prof. **Hodgkinson** asked whether Dr. Seligman had tried hydrazine to remove the lower oxides of nitrogen from nitric acid. It was a far better destroyer of nitrous acid than urea. He had kept copper in 20% nitric acid containing a small quantity of hydrazine for six months, and there had been practically no action on the copper, except that there was a little black-brown film formed which could be rubbed off. There was no copper in solution.

Mr. W. F. **Reid** said that the first use of aluminium was assisted by the French Government for the purposes of warfare. Deville had funds granted to him for the investigation of aluminium, because it was proposed to make cuirasses for the French soldiers out of that metal. The earlier experiments were made on aluminium obtained by the sodium process, and this doubtless accounted for some of the discrepancies between Deville's results and the author's. They ought to consider whether it was not possible to cover the vessels at the commencement with a film of oxide which would be useful in resisting the action of the acids to which they were subjected. In one of the large establishments where they made nitric acid from the air, aluminium treated in that way had resisted the fumes in a wonderful way.

Dr. **Seligman**, in reply, said that Professor Hodgkinson had pointed out that the film produced by the action of caustic soda on aluminium consisted largely of silicon. He thought the nitric acid film did also. He had not tried hydrazine, but it struck him as a most valuable agent. With regard to urea his point was that the nitrogen peroxide began to be formed and accumulated the moment the urea was used up.

Professor **Armstrong** said that nitrous acid must be present all through, but in small quantity when urea was present.

Dr. **Seligman** agreed, and said it was commercially pure. He had not made himself clear with regard to copper. He was of opinion that a film played a large part in stopping reaction, but he did not think copper was a good proof of that, because in dealing with strong nitric acid, copper had little or practically no effect. Nevertheless, he thought the film was the chief point.

Nottingham Section.

Meeting held at Nottingham on Wednesday, February 23rd, 1916.

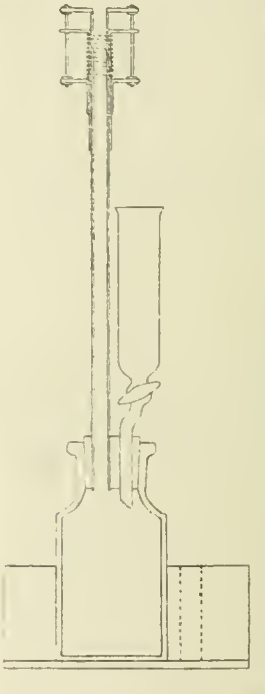
MR. JOHN WHITE IN THE CHAIR.

A NEW FORM OF ARSENIC APPARATUS.

BY JOHN CHARLES HIBBERT.

The particular form of apparatus described is the result of a continuation of some earlier work carried on in the analytical laboratory of Messrs. Boots' Pure Drug Co. (*vide Chemist and Druggist*, 1905, 168. The detection and estimation of arsenic by the Gutzeit test. By T. F. Harvey).

In the earliest apparatus there was a cap and sleeve cemented together with Canada balsam ground on to a tube of 5 mm. bore. This dimension has been retained, as it has been found convenient in practice. A disc of mercuric chloride paper was gripped between the top of the tube and the shoulder formed by the lower end of the sleeve. Finding the method of securing the paper was not wholly satisfactory, the modified form of cap described in the paper referred to (*loc. cit.*) was devised. This has been used continuously for over ten years: its drawbacks are inherent to its mechanical design, the securing of the glass cap requiring a certain amount of dexterity which is only acquired by experience. During the first month or two even the careful worker may have more breakages than is desirable, as the correct grinding and fitting of the cap and tube absorbs considerable time. In the latest form I have not only eliminated these sources of weakness but have greatly simplified the apparatus whilst retaining its essential features. One specific dimension, a 5 mm. bore tube, persists against the three dimensions necessary in the superseded form. The head of the apparatus consists of a simple spring clamp securely holding a *strip* of mercuric chloride paper between the orifice of the tube and a celluloid (vulcanised fibre or ebonite) plate perforated by a 5 mm. hole concentric with the bore of the tube and somewhat countersunk on the underside to ensure a gas-tight seal. The practical advantages of a paper strip over the circular discs of the older apparatus are self-evident. The strip may be moved along should an unexpected amount of arsenic be present, and, if suitable intervals be chosen, a series of stains obtained whose indications may then be summed when otherwise a spoiled experiment would have resulted. The apparatus is conveniently set up in battery form in a frame or block and the requisite temperature, 50 to 60° C., maintained either by electrical or steam heating—internally or by placing the block on a steam bath, a metal bottom providing sufficiently rapid conduction.

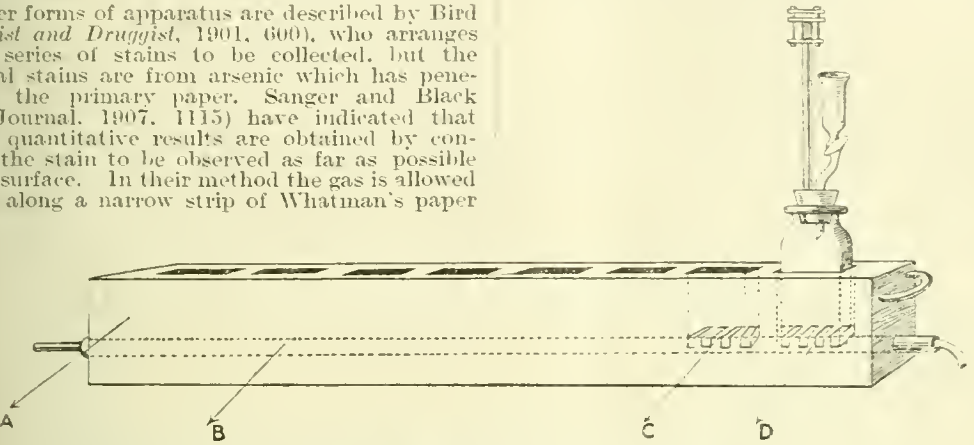


As to purity of materials, the zinc used is freed from arsenic by fusion and treatment with metallic sodium as originally recommended by Hehner, and described in greater detail by Thorne and Jeffers (*Analyst*, 1906, 101). The zinc must be well baked and skimmed to remove all sodium, and it is preferable to use a zinc which is fairly free from foreign metals: for, as Chapman and Law, in a paper on "The reducing action of hydrogen" (*Analyst*, Jan. 1906, 3), point out, such metals as platinum, silver, copper, nickel and iron have the effect of lowering the potential at which the hydrogen is liberated, and such hydrogen apparently is not so active in reducing arsenious or arsenic oxide to arseniuretted hydrogen; so that there is a certain retentive effect and complete recovery of the arsenic is not possible under these conditions. The addition of cadmium, tin, or lead removes the effect of most of these impurities, and insensitive zinc may be thereby sensitised. Hydrochloric acid is obtained free from arsenic by Allen's method of treatment. A fairly pure acid diluted to a specific gravity of 1·1 is treated with 0·5 grm. of potassium permanganate to the litre and distilled from a sand-bath, the first small portion being rejected. The distillation is continued with the periodical addition of more acid treated with permanganate. The distilled acid is finally air-blown and boiled or otherwise dechlorinated by hydroxylamine hydrochloride.

Other forms of apparatus are described by Bird (*Chemist and Druggist*, 1901, 600), who arranges for a series of stains to be collected, but the residual stains are from arsenic which has penetrated the primary paper. Sanger and Black (this Journal, 1907, 1115) have indicated that better quantitative results are obtained by confining the stain to be observed as far as possible to the surface. In their method the gas is allowed to act along a narrow strip of Whatman's paper treated with mercuric chloride held in a horizontal tube. It seems somewhat difficult to support such a method of developing the arsenic stain. A horizontal disc upon which the whole of the liberated arsenic hydride impinges gives greater certainty. Hill and Collins (*Chemist and Druggist*, 1905, 548) describe an apparatus in which mercuric chloride paper is held to the tube by a rubber band. Any such method leads to neven stains due to crinkling of the paper and ocal abrasion. Exact area of exposed surface s necessary to uniform results.

Penetrating stains, except in case of large mounts of arsenic, point to the presence of ntimony. Usually the stains influenced by the resence of antimony are of a redder colour, and hen the ratio of antimony to arsenic is high, he stain will be perhaps even denser on the back f the paper than on its face. The nature of the tain is readily identified by Bird's method.

As a rule a pure arsenic stain will show signs of enetration when 0·005 mgrm. has been deposited. nd as this tint is about the limit of the colour cale in use, it will be found convenient to move he strip along at the first appearance of a yellowish oloration on its back.



A.—Wood block with "nests" to take arsenic apparatus (any convenient number .
B.—Steam pipe, tinned outside, passing throughout length of A.
C. and D —Metal floors, made by pouring in melted lead until a flat base is obtained to give good heating contact to bottom of apparatus.

DISCUSSION.

Mr. **Gill** said that he had long since abandoned he idea of generating hydrogen by zinc because e had found all the so-called arsenic-free zinc o contain arsenic, some German zinc being xceedingly bad in this respect. He had therefore iven up this method and now used the electrolytic pparatus.

Mr. **Hibbert** replied that the best zinc they had een able to buy showed 0·0005 mgrm. of arsenious xide when run for half an hour. When treated the Hehner method the zinc showed no arsenic the test paper when run for ¾ hour. In that ay they got the zinc perfectly free from arsenic. he great difficulty seemed to be in the treatment of the zinc with sodium. The method adopted for a good many years in Messrs. Boots' laboratory was to start with as pure a zinc as possible, add the sodium at a moderate temperature and then raise the whole to a low red heat, maintaining this higher temperature for as long a time as dross rises and can be skimmed off the surface of the melt; then a final heating was given to expel traces of sodium. Thorne and Jeffers suggested that after the addition of sodium the zinc should stand to allow the arsenical portions to rise to the surface; when somewhat cooled this was broken and the still molten zinc poured away from the solidified arsenical alloy. He (the speaker) had always skimmed off visible impurities without allowing a pellicle to remain more than a short time: then, after the half hour's baking, a zinc was obtained which answered the most critical requirements. Since the first publication of Hehner's method he had treated many hundreds of pounds and had not yet come across a batch of insensitive zinc. In no case had treatment with cadmium or tin liberated arsenic previously latent. That was certainly not in agreement with the experience of many other workers, but possibly in his own case a successful technique had been developed.

Mr. **Gill** said that taking into consideration all the freeing of zinc and acid from arsenic, this apparatus had very little advantage, if any, over the electrolytic method.

Mr. J. M. **Wilkie** said that the success or failure of such an apparatus largely depended upon the means adopted for securing the paper on which the stain was to be developed. In the pharmacopœial method the paper was simply held to the tube by means of a rubber ring. That involved bending and creasing the paper and so grave risk was run of a serious loss of arsenic owing to development of unavoidable breaks. The Gutzeit method offered many advantages over the electrolytic method, where great numbers of arsenic determinations had to be carried out; whereas the purification of zinc and acid was now on firm ground and an apparatus of the type described was available, the advantages seemed more distinct than ever. There was nothing to prevent this apparatus being used in conjunction with an electrolytic generator as an alternative to the ordinary Marsh mirror readings. He also referred to the papers read before the Nottingham Section by Trotman and by Sand and Hackford on the electrolytic method.

Meeting held at Nottingham, on Wednesday, March 29th, 1916.

MR. JOHN WHITE IN THE CHAIR.

THE PROBLEM OF FUEL ECONOMY.

In the unavoidable absence of Prof. Bone, Mr. J. M. **Wilkie** gave a summary of the paper on fuel economy (see this J., 1916, 389).

Professor **Bulleid** said that in fuel economy there were sometimes economies that were not worth while. In many small plants, for example, by putting down an expensive addition, a small amount of working expenses might be saved but not enough to pay the interest on the capital laid down, and a great deal of our coal at the present time was being burned in small fires where it would not pay to do very much more than was being done at present. Professor Bone had mentioned the domestic hearth and the kitchen fire, which were probably the two worst sinners. In small plants where the efficiency was low, the coal bill, although large compared with the horse-power developed, was small compared with other expenses of the industry, and it was not worth while going to any further elaboration. Especially was that the case with small portable plants, such as cranes. A great deal of coal must be wasted on small blacksmiths' hearths. Nor in small brass smelting fires were they going to save very much. The possibilities of economies began when they were dealing with large units. He had one case in mind where a very big economy had been effected in a large blacksmith's shop, by incorporating with every one of the furnaces an old boiler; not only did they burn no coal for raising steam to drive hammers, but they had a great deal of steam to spare which they were able to use for generating power. Similarly in large works they often found distributed about the premises a number of boilers, each one serving a small engine for driving that particular shop. A great deal was being done by piping up all these engines and using the steam in some centralised low-pressure steam turbine. The proper way to deal with a large collection of shops spread over a large area was to obtain the driving from a central plant and, by putting down a system of boilers, steam turbine, and condensers, a good deal of economy was effected. The development of blast furnaces and steel-making plant might be taken as illustrations of economy. Professor Bone had mentioned the Newcastle Electric Supply Company—an enormous undertaking that extended from Morpeth to Middlesbrough and covered the whole of Durham. That undertaking, he thought he might say, had almost every type of generating station dotted all over the district. They had steam plant, waste heat plant (using gas from coke ovens), and gas power plant (using waste gas from blast furnaces), and the result was that people were able to get power at ¾d. a unit. Plant like that was possible in a large industrial district, but not in a small town. It had been suggested at one time that a similar plant could be put down in the Nottingham and Derby district, and he believed that such a scheme would have been very successful if it had been carried out.

Mr. H. **Senior** said that there was no doubt that the production of power from gas was the cheapest method of obtaining the power unit. He understood that both Professor Bone and Professor Armstrong wished that our bituminous coal in this country could be conserved, that it should be used more economically; and the method they wished to employ was to have large power stations erected on the coal fields, or in the vicinity of the coal fields, which would utilise the bituminous coal and extract the by-products. They would produce gas which would drive gas engines and in turn drive electric dynamos for distribution, the same as at Newcastle, and in that way we should have large centres on all the coal fields distributing power and also extracting the by-products. The difficulty of the house fire would be overcome by the use of gas or electric fires. The speaker then referred to Prof. Bone's surface combustion boiler, and said that he had been very disappointed to find that it had not been taken up in this country as well as one would have expected. He sincerely looked forward to the re-imposition of the duty on exported coal as one of the first results of this movement. When in Denmark eight years ago he had bought anthracite coal for less than it could be bought in Lincoln. The reason was that it was shipped very cheaply on account of the ship having to bring back a cargo. That ought to be stopped.

Mr. **Percy** said that he was of opinion that greater economies might be effected in the underground workings of the mines than could possibly be effected eventually in engineering methods. The development of our coal seams was in the hands of private individuals, and the colliery companies who developed the mines had only one object in front of them, and that was to pay large dividends. Such an arrangement would not attain the full output of the whole of the workable seam. Coal was very inconsistent in its composition and character, even in the narrow limits of a single colliery. There were frequently two or three seams of coal separated by thin horizontal layers of clay or shale, and frequently one of the seams of coal would be used merely for the support of the higher rocks so that the coal so used was broken and wasted. He believed that in many of the coal fields of England, particularly the older fields, the loss approached 20% of the entire contents of the coal bed. It was thrown back into the waste places and there lost. As collieries were in private hands, vast quantities of coal were left merely for the protection of one colliery from its neighbour so that inundation should not occur. Now if these barriers, which must be left for such reasons, were only laid out in straight lines and followed the natural lines or faults in the strata, there would be very great economy; and probably if the working of collieries were subject to Government control in this matter one half of the coal, which was at present left in the pit, might be brought to the pit bank. At the same time, he did not advocate that we should have too much legislation, but we ought so to develop and work our collieries at the present time as to protect the interests of posterity.

Dr. R. M. **Caven** said that the proper way to develop our resources was to look at the subject from an entirely scientific point of view and to trust our scientific men, They had lost much in this country in the past through failing to learn that most important lesson. If they were going to economise coal, they could at the same time carry out on an extensive scale the development of the by-products.

Mr. **Rushworth** pointed out that if 10% of the amount of coal raised in the United Kingdom could be saved there would be a further 3,000,000 tons to dispose of. Ten per cent. was a very small item, considering that in a big industrial plant a saving of 25% could be effected. He mentioned the instance of one colliery where there were 13 or 14 boilers all in a row: there were no economisers and the amount of coal consumed was enormously excessive compared with the amount of steam raised. If that plant had been used in the proper way he ventured to say that a saving of 35% would have been effected.

Mr. F. H. **Carr** said that quite apart from whether it paid or whether it did not pay to put in economisers to save coal, every pound of coal saved postponed the date when the industrial supremacy of this nation would be on the wane. That was an important aspect of the question that affected every one in this country and by which the future of Great Britain in the end must be in some degree affected. The coal of Great Britain was more capable of producing valuable chemical products than most other coal in the world. It was thus of the greatest importance that as much of the coal should be consumed in a way which would give to them those chemical products. So it was not merely a question as to whether or not it paid to burn coal direct: they had got to make it pay better, to use it in such a way as would give by-products.

Mr. **Edgcombe** said that he was connected with a railway company that had been trying to do something in the matter of conserving the coal supply. The difficulty of fuel economy seemed to him up to the present to be one of cost. If they were going to conserve coal by adopting gas fires and had to pay more for gas, the cost of their heating was going to be much heavier. They had been trying to use exhaust gas on gas engines, but had found it too poor to be useful. Chemists could help engineers in many ways: one was by a proper classification of coals.

Mr. **Duncalfe** said that there were many thousands of plants which had the old type of boiler and for many years to come the firms would not be prepared to scrap the plants. Probably a point would be gained by the education of the comparatively small power user, showing how the coal could be burnt better in the appliances at his disposal, either by a small alteration or by no alteration at all. There was no public authority they could refer to as to the best type of furnace for various fuels. Then, again, it would also interest many people to know whether they could gain better results by the use of combustion recorders, also economisers.

Mr. J. T. **Wood** referred to the enormous importance of the by-products and said that engineers as a rule only looked to the production of steam. If coal users knew the immense variety of things for which they were dependent upon coal and coal products, they would use all their influence to support a scheme which would economise coal in every way.

Mr. **Carlton** mentioned the important effect of less smoke in the towns. If there were to be fuel economy the health of the community would be greatly enhanced. If chemists would think more of the disastrous results due to the excessive use of coal it would be a great advantage.

Mr. **Goodchild** suggested the preparation of a report showing the amount of coal used in these various industries and for power purposes. He understood that domestic fires in this country onsumed, perhaps, 30,000,000 tons. If that were o the domestic fireplace was worth considering.

Mr **Chambers** said that up to now in this ountry fuel had been far too cheap and that was why it had been wasted. Conditions had changed uring the past few years and there had not been ufficient time to adapt things to the changed onditions. At one colliery they burned 10,000 ons of coal a year, but that was because it was of o marketable value. At that time they were upplying a railway company with the best steam oal at 9s per ton. He thought that colliery wners were now wide enough awake to utilise o the full the fuel at their disposal. Much of he coal used at the present time could be replaced y coke, especially that obtained by low-temperaure carbonisation, but coke often cost more than oal.

Meeting held at Nottingham on Friday, May 3rd, 1916.

MR. JOHN WHITE IN THE CHAIR.

THE SWELLING OF GELATINOUS TISSUES.

BY PROFESSOR H. R. PROCTER AND DONALD BURTON.

(See this Journal, 1916, 404-409.)

Discussion.

Dr. E. B. R. **Prideaux** showed how the Donnan theory of ionic distribution at a surface would account for swellings which are not satisfactorily explained by ordinary conceptions of osmotic pressure. In the equations (a) and (b) of the paper the gelatin was naturally treated as a basic substance. The second equation represented the combination of the gelatin with the positive charge of the hydrogen ion, and the absorption of the hydrogen with formation of gelatin cation. While no doubt this basic function of gelatin alone came into play in the case of the strongly acid systems with which the paper was mainly concerned, it appeared necessary to take more fully into account the amphoteric character (already noticed by Professor Procter in a previous paper) when the effect of nearly neutral solutions was being considered. If that were done, it was seen that neither the minimum acid swelling nor the minimum alkali swelling should occur at the hypothetical zero $(H^{\cdot})$ or (OH'), or at the neutral point. But the minimum swelling (on the side of low concentrations, of course), would be determined by the acid and basic constants of the amphoteric molecule.

As $(H^{\cdot})$ or (OH') in an acid or alkaline solution was continuously decreased a point would be reached, on one or the other side of the neutral point, at which the amphoteric molecule would change its electrochemical function and the acid equilibrium became an alkaline, or *vice versa*. The $(H^{\cdot})$ at which that took place was commonly called the isoelectric point, and was associated with the maximum amount of electrically neutral protein, etc., the minimum amount of gelatin ion. That point was also the optimum for the coagulation of a colloidal sol. It would be in accord, then, with amphoteric theory to expect to find the minimum swelling at the isoelectric point, which in the case of gelatin had been given as $p_H' = 4{\cdot}6 [H^{\cdot}] = 2{\cdot}5 \times 10^{-5}$.

Two minima of swelling for gelatin had been stated by W. Ostwald to occur at about $(H^{\cdot}) = 5 \times 10^{-3}$ and $(H^{\cdot}) = 1 \times 10^{-12}$, but the matter evidently required further investigation. Neither the predicted value of $(H^{\cdot})$ nor those found by Ostwald for gelatin agreed with that which produced the minimum swelling in the case of hides, *i.e.*, slightly on the alkaline side (see Mr. Wood's remarks). Thus while in the case of hides the basic function appeared to predominate $(K_B > K_A)$, in the case of gelatin $K_A > K_B$.

The numerical values of both those constants could be determined from that of the first basic constant K_B, which in a previous paper by Professor Procter (J. Chem. Soc., 1914, **105**, 313) had been given as $0{\cdot}5 \times 10^{-11}$. The acid constant K_A would now be determined from the laws of amphoteric equilibrium. At the isoelectric point or

$$(H^{\cdot})^2 = \frac{K_W K_A}{K_B}$$

Putting in the numerical values $K_W = 1 \times 10^{-14}$ and $(H^{\cdot}) = 2{\cdot}5 \times 10^{-5}$, K_A is found to be $3{\cdot}14 \times 10^{-7}$.

If the data were correct the acid properties of gelatin were considerably stronger than the basic.

The gelatin molecule in pure water should therefore be negatively charged, and actually, as noted by Professor Procter (*loc. cit.*), it had been shown by Pauli (Koll. Zeitsch., 1913, **12**, 222), that gelatin when placed in an electric field moved towards the positive pole. There might also be mentioned in support of this conclusion the behaviour of gelatin in preventing the coagulation of the electro-negative colloidal gold.

The value of $K_A \times K_B = 1{\cdot}5 \times 10^{-18}$ would lead one to suppose that gelatin and animal tissues, in so far as they behaved like gelatin, possessed a fairly wide isoelectric zone within which the minimum swelling should be produced, which was fortunate in view of the conclusion stated by Mr. Wood, that the $(H^{\cdot})$ should be chosen so as to coincide with the optimum for bacterial action.

Mr. J. T. Wood made some remarks on the application of the theory to the process of bating and puering. The simplest case, of course, occurred in deliming with dilute acids, but as the authors remarked: "It is recognised by manufacturers that the depletion produced by the most careful deliming is less thorough than that obtained by the use of ferments, dung bates, or puers." Where these were used, the case was far too complicated to be treated mathematically. There was first the gradual reduction of the alkaline swelling, due to the neutralisation of the lime in the skin by the reaction with ammonium salts and amines contained in the bate; simultaneously there was the action of the proteolytic enzymes contained in the bate. The hydrogen ion concentration was of the utmost importance for the right action of these enzymes, as had been shown by Sorensen and others. From numerous experiments which he (the speaker) had carried out, in which the hydrogen ion concentration was measured electrometrically by means of a hydrogen electrode, he had come to the conclusion that in the case of the dog dung bate, the point of minimum swelling, or of greatest falling, was about 10^{-6}, which was in good agreement with the authors' prediction. The change of hydrogen ion concentration during the course of the puering poess ranged from $10^{-5{\cdot}2}$ to $10^{-7{\cdot}6}$, the former figure being that of a freshly made bate, which had not had any skins in it.

For the enzyme reactions, the optimum concentration of hydrogen ion depended upon a number of causes: the temperature, quantity of enzyme present, and on the dissociation of the protein, and of the enzyme. At the temperature employed in puering, namely, 38° C., the optimum, according to Palitzsch and Walbum (Comptes rend. Lab. Carlsberg, 1912, 232), was $10^{-9{\cdot}5}$. If the temperature rose, the optimum was displaced from the alkaline side towards the neutral point. It was seen, therefore, that the two things, viz., point of minimum swelling, and optimum of hydrogen ion concentration for enzyme activity, did not correspond, and a compromise had to be effected. In the case of the dung bate, the best working concentration seemed to be about $10^{-7{\cdot}3}$ to $10^{-7{\cdot}6}$. With the bacterial enzyme bate "Erodin," it was $10^{-7{\cdot}3}$, with the artificial enzyme bate "Oropon," it was $10^{-7{\cdot}9}$, *i.e.*, that bate had a somewhat more alkaline reaction than a puer.

In the hydrolysis of proteins by trypsin, a number of amino acids were set free, which would considerably reduce the hydrogen ion concentration. In that connection the phosphates in the bate played the part of "buffers" in preventing brusque changes of the hydrogen ion concentration during the bating process. That had been pointed out by Sorensen. If no "buffers" were present, the potential of the hydrogen electrode fell during the process, indicating the production of acid bodies. (See Wood and Law, this Journal, 1912, 1105.)

Dr. Caven said that it occurred to him, especially when Professor Procter referred to the influence of salt outside in diminishing swelling, that there was a distinct analogy between the influence of salt solution in causing shrinkage of gelatin and in effecting the plasmolysis of a vegetable cell. He supposed the two things were quite connected?

Professor Procter replied that that was so. He hardly felt capable at the moment of fully considering all the points which Dr. Prideaux had raised, but hoped to do so when his remarks were printed, and he did not think that there would prove to be much difference of opinion between them. With regard to some of the figures given in earlier papers, there was no doubt that revision might be required. Their own work on the whole was a strong confirmation of Donnan's theory of membrane-potential, and some on that side of the problem which they hoped shortly to publish, brought forward proof of its correctness which, so far as he knew, Donnan had not been able completely to obtain.

New York Section.

Meeting held at Rumford Hall, Chemists' Building, on Friday, April 21st, 1916.

DR. WM. M. GROSVENOR IN THE CHAIR.

THE APPLICATION OF CENTRIFUGAL FORCE TO SUSPENSIONS AND EMULSIONS.

BY EUGENE E. AYRES, JR.

During the last generation centrifugal force has been applied in a variety of useful fields. Centrifugal pumps, fans, filters, and hydro-extractors are known everywhere. It is not strange that the application that should eventually prove of the greatest value should have been developed more recently than all the rest. The principle of separation by differentiation of mass and of velocity of motion is even yet only meagrely understood.

A most general impression prevails that the maximum degree of centrifugal force capable of being safely exerted by a machine is limited chiefly by the strength of materials. There can be no greater fallacy. A steel tube can be readily made to withstand a force exceeding 100,000 times the force of gravity, but such a machine has not yet been built. If a bowl of this strength were put in any existing type of centrifuge, and the driving power were gradually increased to bring the number of revolutions per minute up to the required figure, a point would at last be reached where an increase in driving power is accompanied no longer by an increase in speed. As a rule the speed will begin to decrease, for if the gravity axis does not coincide with the axis of rotation, the rotating element will be subject to more or less severe lateral vibration and may even tend to change the direction of the axis of rotation. As long as these disturbing effects are produced the speed cannot increase.

In practice "balance" is only a relative term. A high speed bowl should be as nearly "in balance" as is humanly possible, and the inevitable error must be automatically neutralised in some such manner as entirely to eliminate vibration. Recently, big strides have been taken toward this ideal, and an immensely higher centrifugal force is possible to-day than was even contemplated a few years ago.

Another fundamental principle to be observed in the manufacture of high speed centrifugals is that high peripheral speed and large diameter are wholly subordinate to the number of revolutions per minute.

The experimental results mentioned in the following pages were all obtained with a small centrifuge having an internal diameter of 1¾ in. and working at 700 revs. per second. Aside from the great centrifugal force generated, it possessed several other features without which any experiments on emulsions or suspensions would have been impossible. If an emulsion is passed through the ordinary continuous "separator," the two liquids discharged will be at best a concentrated and a dilute emulsion. The concentration of the heaviest emulsion can be varied by an adjustment of the bowl, but the most favourable adjustment will not permit a complete separation in any case. The bowl of the centrifuge with which we worked is capable without adjustment of delivering the two liquids consistently and separately, no matter what the ratio of the one phase to the other. Any separated solid matter, whether heavier or lighter than the liquid, will be retained in the bowl.

There are very few references to centrifugal force in our chemical literature. Most of the work hitherto done has been on the concentration of certain ions and the separation of electrolytes from solution. The apparatus used has been the large diameter type of centrifugal, exerting necessarily a comparatively low centrifugal force. The most that has been accomplished has been the proof of the fact that certain difficult separations are possible by centrifugal force. All the factors that are necessary intelligently to define and correlate the data from the various researches are completely lacking. Our own work has been only incidental to a number of commercial filtration, settling, and separation problems that have interested us recently, and as a rule no attempt has been made to follow these experiments through to a conclusive end. But our experiments should help to formulate a general method of attack and should moreover furnish considerable suggestive material for research.

Our experimental procedure has generally been as follows:—About one litre of solution was poured into the bowl of the small centrifuge mentioned, which exerts a peripheral force 40,000 times that of gravity. The solution was passed in at a known rate and remained under the influence of the force for a period of time depending upon the rate of supply. The discharge began only after 250 c.c. had been supplied. When the rate of flow was 100 c.c. per minute, each c.c. of liquid herefore remained in the bowl two and one half minutes. The total depth of the layer of liquid was ½ inch. The average distance the particles had to move before coming in contact with the periphery of the bowl was therefore ¼ inch. If wo liquids were to be separated, the average distance traversed by either liquid varied from nearly zero to nearly ¼ inch, depending upon the elative percentages of the liquids.

The extreme importance of these dimensional ata will be fully realised after consideration of he following theoretical treatment.

A disperse phase, whether solid or liquid, will move through its dispersion medium at a velocity hat must depend upon all of the following factors greater or less degree:—1. Centrifugal force xerted. 2. Viscosity of the dispersion medium. . Temperature of the dispersion medium. . Difference in specific gravity of disperse phase nd dispersion medium. 5. Relation between the mass and the surface area of the particles. . Chemical nature of the continuous and disperse hases.

The distance the particle will travel in a given period of time will, of course, depend on the velocity of motion. The small diameter of our bowl means three things: A short distance for the particle to travel, the possibility of safely generating a great centrifugal force, and a consequent reduction of time necessary to move the particle a given distance.

Perhaps it is still an open question as to whether any separation that can be effected by a force 40,000 times gravity can be effected also by a much lower centrifugal force or even by gravity alone if the force is applied long enough. The solution of this theoretical point would involve certain ideal conditions hard to maintain. The convection currents caused by differences in temperature are greatly increased in volume and velocity by centrifugal force. The apparatus must therefore never be warmer than the liquid. The slightest tremor or vibration in the rapidly revolving bowl must inevitably cause a disturbance to interfere with the motion of small particles. The determination of the ratio between time and force necessary to move a particle a given distance is complicated by the fact that a very high centrifugal force will easily more than counterbalance any disturbing effects, while the lower force may not do so.

Temperature and viscosity, although relative functions, are apparently independent in their effect upon the velocity at which a particle can be moved. As long as the viscosity of a liquid is greatly reduced by a comparatively slight increase of temperature, the velocity of particles is increased by rise of temperature. This effect is seen very strikingly in the case of highly viscous lubricating oils. Usually a rise of a few degrees in temperature will shorten the time of separation of small particles quite appreciably. But there are strong indications that for some liquids, or perhaps at some point for every liquid, an increase of temperature will diminish the velocity imparted by centrifugal force. This statement seems to be especially true of melted waxes or fats where the viscosity is not so decidedly affected by temperature. The proof of the general verity, however, of our assumption is complicated by the fact that most organic liquids cannot be heated above a critical temperature without chemical change. A low temperature has sometimes been found advantageous for gravity settling of certain emulsions, a most natural result in view of the effect of heat to increase the solubility of a solute or to subdivide a colloid. The fact that this phenomenon is so infrequently observed is, in our opinion, due to the very great part viscosity usually plays in centrifugal separation.

The difference in specific gravity naturally exerts an important influence on the separation of a particle from a liquid, but this effect is relatively diminished where the size of the particle has been reduced beyond a certain point. This statement can be better understood when we consider the behaviour of certain colloids under the influence of gravity. Particles of gold need be no smaller than particles of aluminium hydroxide to exhibit colloidal characteristics. A somewhat vague explanation of this has been offered in the balancing effect of mass energy *versus* surface energy. But even for particles that are large enough for microscopic observation, the difference in specific gravity is often overshadowed by some of the other factors, because in the little centrifuge, although a very small difference is magnified 40,000 times, often a heavy particle will move more slowly than a light one.

The sixth factor, the function of chemical composition, brings up a most interesting question, one that we feel has not been conclusively demonstrated by our own experiments. If we are given three liquids—one an oil, another an aqueous solution of an electrolyte, the third an alcoholic solution of a carbohydrate, each liquid having the same specific gravity, the same viscosity, and handled at the same temperature, will the velocities of identical particles be the same? We believe not. Further on a number of special cases will be cited in support of our assumption.

We have not mentioned osmotic pressure as a factor affecting centrifugal separation for the reason that this discussion does not relate to true solutions. Colloidal solutions have very small osmotic pressures, and the comparatively crude emulsions and suspensions with which we have mostly to do have none. It may be found that the high osmotic pressure of a crystalloid in the dispersion medium may affect the ease of separation of the emulsoid or suspensoid. This proposition is easily capable of proof.

Once the considerable mechanical difficulties of generating a great centrifugal force have been overcome, and the general principles of centrifugal separation are understood, the science of its application to suspensions and emulsions is for the most part related directly to the science of the suspensions and emulsions themselves. The scarcity of published data on these things is always a source of surprise to one who is looking for improved processes or who is working up a new manufacturing industry. Most of the publications on colloids, though of great value in themselves, give an idea of the behaviour of true colloidal suspensoids and emulsoids under purely theoretical conditions. The particles in an emulsoid are supposed to be usually amicrons, particles too small for ultramicroscopic observation and yet larger than molecules. Therefore, except for true solutions, the emulsoid presents the hardest possible problem for centrifugal separation. Every true emulsoid can be completely separated by a very high centrifugal force. But as the maximum practical multiplication of gravity will usually move the particles of the two phases an average distance of ¼ inch in five minutes, the application of centrifugal force to true emulsoids is rarely commercial. This fact is not so discouraging as it might appear, for in practice a pure emulsoid is a rare phenomenon, and furthermore there are many ways of destroying the emulsoid state.

The effect of various reagents to "precipitate" a colloid is well known. By precipitation is meant the bringing together of the fine particles to form larger particles that will eventually settle by gravity. The larger particles have no greater specific gravity than the colloids, but their surface area has decreased with respect to their mass, and the effect may be roughly compared to the formation of rain-drops from the clouds. The reagents and conditions that increase the size of the particles of the disperse phase will naturally make centrifugal separation much easier. From a commercial point of view, it is usually practicable to "break" an emulsoid in this way with only a trace of reagent. A trace is nearly always sufficient to increase the particle to the micron stage, but a comparatively large excess of reagent is required to effect the precipitation still further, for emulsions and suspensions are much less sensitive to electrolytes and other precipitating agents than emulsoids or suspensoids. For a practical separation of the amicron the centrifuge must be applied when the particle is still so small as to be just visible under the microscope. Even here a very great centrifugal force is necessary to bring the rate of flow up to a point at which the liquid can be profitably handled, but the modern commercial centrifuge is fully equal to the problem. We are speaking now of the emulsion or suspension obtained from the pure colloidal condition.

Electrolytes are not always the only or the best precipitating agents.[*] Centrifugal separation of some colloids is greatly expedited by a trace of some other colloid, such as, for instance, albumin. A patent was recently taken out for the acceleration of gravity settling by the addition of a trace of formaldehyde. Unfortunately we have not yet come across the emulsion that will separate by this means. An old and effective expedient has been the addition of some inert substance to absorb one of the phases. A recent process for cotton-seed oil soap emulsions is based on this principle. A certain organic liquid is emulsified with mixed acid, the separation of which is greatly accelerated by the addition of two reagents which act together with the acid to form minute bubbles of gas. As one of the reagents is itself a colloid, it is difficult to determine the correct theory. This same emulsion can also be broken by a mild electrolysis. The effect of bubbles of gas or of electrolysis on centrifugal separation has not yet been noted.

A very peculiar phenomenon is the effect of a continuous mechanical vibration or jarring. Certain emulsions have been broken by attaching an electric vibrator to the tank, and we have had instances where an apparently hopeless emulsion was broken by a long journey in an express train.[†]

In practice difficult suspensoids are being agglomerated in a variety of ways, perhaps the most interesting of which has been a change in the vapour tension of the liquid by applying pressure or vacuum.

All these procedures represent mere gropings after the fundamental laws of colloidal and physical chemistry, and chemists will be very grateful to the man who can get together some reliable data and then hypothecate some workable rules.

A few of the methods for increasing the size of a colloidal particle have been mentioned. Concentration and heat should be added to the list. Occasionally we meet with cases that can be handled commercially by centrifugal force only after being maintained at an elevated temperature for several hours. A gradual concentration by spontaneous evaporation will sometimes change an amicron to a submicron, but what should we expect from an instantaneous increase in concentration such as can be secured from a continuous centrifuge? Unless precautions are taken to avoid this effect, the liquid is delivered from the continuous centrifuge in a tiny stream at a velocity exceeding three miles a minute, and striking the walls of the covers is immediately broken into infinitesimal particles. The resultant sudden volatilisation can be easily stopped by arranging a circulation of a limited volume of saturated air through the covers and the receiving vessel, but there seems to be no way of avoiding the mechanical impact in a machine of this type. Fortunately the latter effect gives rise to a condition that is usually very beneficial for the separation of colloidal or colloidogenic substances. For example, when a suspensoid of tricalcium phosphate is passed through the centrifuge at too fast a rate to secure complete separation of the colloid, the discharged solution will in a few minutes contain only tricalcium phosphate in a completely flocculated state, and a second passage through the bowl, observing certain precautions, will easily remove the rest. This phenomenon has been found to apply to quite a number of things, among which may be mentioned fruit juices and suspensoids of alumina and ferric hydroxide.

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[*] In general, any substance that is effective in mechanically carrying down suspended particles will aid centrifugal separation. A few typical examples are—kieselguhr, magnesia, finely divided wood pulp, cotton linters, and kaolin. Each particular problem can be best handled by using one or another of such substances, but as the loss of liquid in each case increases with the amount of foreign solid matter, it is gratifying to note that centrifugal separation requires at most a much smaller percentage of precipitating agent than gravity settling.

[†] It has been suggested that certain suspensions might be precipitated by taking advantage of the electrical properties of the colloid. Every colloid has an electric charge. The phase with the greater dielectric constant is charged positively. Except for certain substances, such as oxides, hydroxides, and carbonates, all solid suspended particles are negative to water. By properly charging the continuous phase, the attraction for the disperse phase can be diminished, and agglomeration will be correspondingly more rapid.

The reversibility of certain colloids is well illustrated by the effect of the rapidly revolving bowl on a precipitated colloid. As the liquid enters the bowl, the tremendous impact on the flocculent agglomerations will tend to break them up again into very small particles, and the centrifugal force is given a correspondingly harder task to accomplish. We have observed a wide difference in the behaviour of various electrolytes under such conditions. Some, particularly those of high valence in the ion of opposite potential to the disperse phase, seem to exert a physical stabilising power, toughening the agglomerates to such an extent that they are not broken up.* A little work was recently done on the centrifugal separation of suspended hydroxides of iron and aluminium from a saturated solution of a sodium salt electrolyte. The concentration of the electrolyte was too great to get a maximum precipitating effect, but after about twelve hours the impurities had become flocculent. When the suspension in this state was passed through the centrifuge where it was subjected to a force quite competent to quickly remove the suspended particles, the latter were so broken up by the initial impact of the revolving bowl as to require a long continued application of force to separate them. It was found that a trace of aluminium sulphate dissolved in the solution made the centrifugal clarification commercially successful. A peculiar fact is that when these same precipitates are in a much more dilute solution of sodium electrolyte, centrifugal separation is very rapid and complete without the addition of aluminium sulphate.

A certain pyroxylin lacquer contained a fine cloud of cellulose impurities. A suspension of this type can rarely be clarified by filtration, but will usually respond to centrifugal force. In this case, however, no reasonable amount of force would effect clarification, and yet on long standing the impurity flocculated and settled by gravity. The flocks were so unstable that the slight motion of a stirring rod was sufficient to destroy them. Very little is known of suspensoids in organic media, and no expedient we have tried was effective in precipitating the impurity. The problem was finally solved, however, by adding a fractional percentage of tricalcium phosphate precipitated in alcohol. The filter press in this way produces an absolutely clear lacquer, whereas other filtering agents, such as kieselguhr, fullers' earth, bone black, barium sulphate, etc., were entirely without effect.

We come now to a discussion of emulsifying agents, a subject more important than all the rest to practical chemists. Though a thorough study of these agents would be of considerable value, no one seems yet to have undertaken any systematic investigation of their variety and effects.

Emulsoids may be enormously stabilised by the presence of certain substances. We would roughly divide the emulsifying agents into three classes: First, those whose presence in the minutest proportion will lead to a stable emulsion. Characteristic members of this class are the salts of the sulphonic acids of the naphthene hydrocarbons, and certain complex ethereal esters. One drop of an oil containing the merest trace of these substances will cause a large volume of pure oil to become highly emulsifiable. We have mentioned these particular groups because they are at the heart of a big problem before the refiners of petroleum oil, but there are many others fully as interesting and troublesome, though of more theoretical value.* It is characteristic of these compounds that their emulsifying properties depend upon their presence in the aqueous phase. We do not make a distinction here between the disperse phase and the dispersion medium, for it is believed that emulsoids may have no phase that is not continuous. The condition has been described as an intricate net-work of one liquid within another. If the emulsifying agent is thrown out of solution in the water to the oleaginous phase, the emulsion is no longer stable, but can be separated by a very moderate application of force. For naphthenic agents, this interchange may be brought about either by salting out or by any reaction that will substitute a sulphonic salt more soluble in oil and less soluble in water. The emulsion can be easily broken also by decomposition of the salt with strong sulphuric acid. The resultant separated oil will, of course, be highly emulsifiable because of the presence of the transposed agents.

Emulsions caused by the presence of ethereal esters can always be broken by distilling over caustic soda—sometimes in no other way.

A very high centrifugal force can cope successfully with this first class of emulsifying agents. The so-called "milk water," a weak emulsion thrown away by some of our oil refineries, can be completely freed from its oil without the addition of chemical reagents, but this procedure can hardly yet be called commercial. A certain lubricating oil contained a trace of an ammonium sulphonate. When emulsified with water, the very highest centrifugal force generated was unable to separate it at commercial capacities. A slight dilution with a light oil, however, reduced its viscosity to such a point as to make centrifugal separation easy. The oil thus obtained was of course free from the emulsifying impurity and was not emulsifiable.

The second class of emulsifying agents must always be present in "excess" of the aqueous phase. The commonest examples of this group are the soaps of the ordinary fatty acids, the products of hydrolysis of albumin, and certain saponins. Nearly all of the cutting oils of trade are made of oil, alcohol, water, and soap, and the stability of such emulsions is well illustrated by an analysis made of a standard product that was found to contain 82% water. The principle underlying the action of soap in stabilising the emulsoid appears to be its property of colloidogenesis, especially when in dilute aqueous solution. If an aqueous soap solution is agitated with a pure oil, the oil will extract the soap nearly completely, and the emulsion will be quite unstable. But the function of the alcohol is to increase the relative solubility of the soap in the aqueous phase, and it is clear that the reason for the excess of this emulsifying agent lies in the fact that the relative solubility in the oil is high, and that accordingly, even when the concentration of alcohol is great, much of the emulsifying efficiency of the soap is lost. The soaps of calcium, aluminium, or magnesium, prove much less efficient than those of sodium or ammonium. This class of emulsifying agents can be neutralised by liming, by salting, or by acid treatment, but rarely by caustic alkalis. In fact alkali will usually act as a stabiliser.

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* It has been stated that the relative precipitating powers of the sulphates of univalent, divalent, and trivalent radicles are as 1 · 35 : 1023.

* The naphthene hydrocarbons are supposed to be cycloparaffins, chiefly cyclopentanes, occurring with traces of aromatic hydrides, such as hexahydroxylene and hexahydromesitylene.

We have in no instance found an emulsion of this type that cannot be easily separated by centrifugal force alone, and this is perhaps the most general field for centrifugal machinery.

Occasionally what appears to be a pure soap emulsion proves to be in reality an emulsion of the first class. For instance, a number of attempts have been made to purify the crude dégras recovered from wool by saponifying the fatty acids with soda ash, and separating the neutral wool fat by centrifugal force. The separation has been found difficult to accomplish in this way, but this is not due to the soap. As any emulsion of *purified* neutral wool fat with aqueous soap can be readily separated, the real emulsifying agent in the case of dégras must be an unidentified ester present as an impurity. Proceeding on this assumption, we find that the difficult centrifugal separation of the dégras emulsion can be safely aided by such a reaction that will precipitate some of the soap without throwing the ester into solution in the fat. A little salt will answer the purpose. Lime will of course produce a poor fat because of the solubility of calcium soaps.

Centrifugal separation of such emulsions is invariably made easier by dilution with water, not so much because of a reduction of viscosity, for this is not always the case, but because of the colloidal properties of soap solutions of high dispersity.*

The third class of emulsifying agents appears to have a more or less mechanical function. A good example is finely divided or colloidal carbon. Each particle of carbon retains a film of water exceedingly difficult to remove. Our experiments have shown also that the film of water is enveloped by a tenacious film of oil. No chemical treatment, except, of course, the use of some hygroscopic agent such as anhydrous calcium chloride, will break up such a condition.

The effect of centrifugal force on carbon emulsions is very interesting. If the liquid is passed through the centrifuge at a low rate, the carbon is thrown completely to the periphery of the bowl and the oil and water separately discharged. If on the other hand the rate is increased, so that the separating influence is exerted for a shorter interval of time, some of the carbon will be deposited in the bowl, while some will form a layer between the oil and the water and can be discharged with either. The ratio of "floating carbon" to that deposited in the bowl has been found to be as high as 50% in some cases.

This phenomenon would naturally lead to a discussion of the continuous discharge of separated sludges, but the subject is so large that it must be omitted from this paper.

In conclusion we would point out that practical operatives thoroughly realise the futility of any purely chemical means for breaking down their emulsions, for in nine cases out of ten the object is to obtain an oil as free as possible from the impurities that cause emulsification; and in these days of rapid production, very few industries can afford to wait for the gravity settling of a suspension even if it is practicable to precipitate by reagents. We hope, therefore, that our industries will not only investigate centrifugal force, but will make public their investigations, for any such data will be of immediate practical interest.

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* A hint as to the proper direction in which to look for a theory to account for the emulsifying agent may be seen in the frothing effect capable of being produced in an aqueous solution of any of these substances. Frothing is a phenomenon related to surface tension. We believe that the properties of these artificial emulsions can be accurately gauged by a measurement of interfacial surface tension.

Sydney Section.

THE COMMERCIAL UTILISATION OF THE GRASS TREE (XANTHORRHŒA) AND ZAMIA (MACROZAMIA) IN WESTERN AUSTRALIA.

BY H. ROWLEY.

(See this J., March 15, 1916, 290—292.)

ADDENDUM TO DISCUSSION.

The AUTHOR, who could not be present when the paper was read, wrote saying that with regard to size of retorts he preferred to begin with the smaller size, which was also the German practice when destructively distilling for tar as a primary product. (See Von Klar's *Technologie der Holzverkohlung*, 1910.)

As to the work of other investigators, he was not so much concerned with the history of what had been written and proposed, as with the practical utilisation of the material, for which he was now erecting plant.

He thought the amount of ammonia obtainable was too small to have a commercial value, and that the proportion of potassium oxalate could not be serious, or calves and pigs would not thrive on the fodder, as they are now proved to do.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

Boiler scale preventives; Method for testing the efficiency of——. H. K. Benson and O. A. Hougen. J. Ind. Eng. Chem., 1916, **8**, 435—436.

It is considered that the function of boiler scale preventives is to form, with the impurities in the feed water, precipitates which remain suspended in a colloidal or flocculent condition, and it is suggested that the relative efficiency of such preparations may be compared by measuring the rates of settling of the precipitates formed on adding them to the feed water.—A. S.

Capacity and economy of multiple-effect evaporators [for sugar juices]. Kerr. *See* XVII.

PATENTS.

Furnaces. A. Smallwood, London. Eng. Pat. 6323, Apr. 28, 1915.

The hot gases pass from the fire through a horizontal combustion chamber, then back through flues on either side of the combustion chamber, which communicate with the interior of the hollow floor of the heating chamber; the connecting passages can be controlled individually. The heating chamber communicates also with other heating flues in its side walls and roof.—W. F. F.

Cement or other material: Means for grinding or disintegrating ——. A. Smallwood, London. Eng. Pat. 6329, Apr. 28, 1915.

THE apparatus, *e.g.*, a tube mill, contains one or more hollow, cylindrical members each of which has a longitudinal slit or opening extending from end to end, and is case-hardened on the outer surface only, in order to obviate fracture in the event of excessive stress.—W. E. F. P.

Smoke and fumes; Means of washing —— from furnace or boiler flues. J. Shaw, Gateshead, and W. R. Lowrison, Morpeth. Eng. Pat. 6429, Apr. 30, 1915.

THE patent comprises the same subject matter as that of specification No. 15,788 of 1913, on which the grant of a patent was refused, on the ground that the invention had been obtained from J. Shaw. Smoke passes from the furnace or boiler flue through a chamber fitted with water spraying nozzles at the top, and with hinged plates which can be arranged to form vertical baffles to force the smoke to take a zigzag path. An exhaust fan is fixed at the outlet of the chamber to the chimney. When the apparatus is not required, the hinged plates can be turned so as to cut out the washing chamber and form a continuous passage from the flue to the chimney. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 18,488 of 1904, 7962 of 1905, and 15,172 of 1907; this J., 1905, 982; 1906, 332; 1908, 742.)—W. F. F.

Distilling and concentrating apparatus. W. Anderson, Helensburgh, and J. Meikle, Glasgow. Eng. Pat. 6854, May 7, 1915.

SEVERAL distilling or concentrating units are connected in series so that the liquid flows through them at a gradually increasing temperature. All the units are heated by a common furnace, the temperature of each being regulated by a damper in its flue. Each unit comprises two superposed drums, the lower of which is traversed by fire tubes.—W. F. F.

Evaporating frothing liquids; Apparatus for ——. F. Seeger, Magdeburg, Germany. U.S. Pat. 1,182,220, May 9, 1916. Date of appl., Apr. 24, 1914.

A FROTH chamber is arranged above an evaporator chamber and is provided with an outlet tube which communicates with a third chamber above, by means of a series of tangential nozzles. Baffles are provided to reverse the direction of the vapour as it issues from the nozzles.—W. H. C.

Volatile solvents diluted with air or other gases; Recovery of ——. H. Frischer, Cologne, Germany. Eng. Pat. 7098, May 11, 1915.

VOLATILE solvents other than naphtha, such as alcohol, wood spirit, acetone oil, acetone and its homologues, chloroform, ethyl acetate, ether, benzol, etc., are recovered by passing air or gases containing them through liquids having entirely or partly the same composition. The last traces are condensed by passing the gases through emulsions of vegetable or animal oils with water. —W. F. F.

Grain drying apparatus. E. Djandiery and S. Shapow, Petrograd. Eng. Pat. 9971, July 8, 1915.

GRAIN is charged into a chamber which can be rotated on a horizontal axis and is constructed of fine net mounted on a framework, the shape being that of two cones or pyramids with their bases in contact and their axes in the axis of rotation. The frame is connected to the shaft by radial spokes which assist in stirring the grain. This chamber is mounted in a hermetically closed vessel and surrounded by heating pipes. The grain is charged and discharged through valves in the periphery of the chamber and the air is rarefied and vapour withdrawn by a vacuum apparatus connected to the closed vessel.—W. F. F.

Transporting materials in bulk; Art of ——. T. W. McNeill, Assignor to Reid, Murdoch and Co., Chicago, Ill. U.S. Pat. 1,181,677, May 2, 1916. Date of appl., Sept. 8, 1913.

SMALL solid bodies, *e.g.*, pickles, sauerkraut, and the like, are immersed in a protecting liquid in an open vessel. The liquid and the small solid bodies are then drawn through a pipe, which is immersed in the open vessel, into a chamber by means of a vacuum which is created therein. —W. H. C.

Filtering-press. G. Brown, Bayonne, N.J. U.S. Pat. 1,181,729, May 2, 1916. Date of appl., July 3, 1915.

A LONG shallow horizontal chamber is divided by a horizontal grooved plate carrying a perforated plate which supports a filtering fabric. The liquid enters at the top at one end and is forced to flow in a stream along the fabric by a series of transverse ribs attached to the roof and nearly touching the fabric. The filtrate is withdrawn from the lower chamber at a point immediately below the inlet. The apparatus may be heated. —W. F. F.

Filter. H. T. Evans, El Centro, Cal. U.S. Pat. 1,182,465, May 9, 1916. Date of appl., Nov. 6, 1913.

ONE half of a horizontal cylinder is divided by transverse partitions into a series of filter chambers, and the other half into a storage chamber, a settling chamber, and a chamber to receive the filtered liquid from the filter chambers. The liquid flows from this receiving chamber into the settling chamber through a central opening in the division wall, covered by filtering material, and then overflows from the settling chamber into the storage chamber.—W. H. C.

Mixing apparatus. F. Tyson, Canton, Ohio. U.S. Pat. 1,181,973, May 2, 1916. Date of appl., July 7, 1911.

THE mixing vessel is provided with a central, vertical, hollow shaft which is rotated by suitable means from below. An arm carrying rabbles is attached to the shaft near the bottom. Stirrers are attached to and rotated with the arm above the rabbles, and also receive a vertical, reciprocating motion, which is transmitted to them from mechanism located below the shaft, by means of independent bars, which pass through the hollow shaft.—W. H. C.

Lubricating-oil; Fireproof ——. R. R. Graf, Baltimore, Md. U.S. Pat. 1,181,976, May 2, 1916. Date of appl., Mar. 8, 1916.

SIX oz. sodium tungstate, 5 oz. ammonium chloride, 6 oz. ammonium phosphate, 16 oz. sal soda, 5 oz. graphite, ½ oz. alum, and 6 oz. ammonium sulphate are mixed with one gallon of lubricating oil and boiled for half an hour. —W. H. C.

Fires; Process for quenching —— by means of non-combustible gases. F. Arledter, Hamburg. Ger. Pat. 291,380, Mar. 21, 1914.

A GASEOUS mixture, holding particles of liquid in suspension, suitable for extinguishing fires, is obtained by subjecting superheated steam to the simultaneous action of atomised water and flame-extinguishing gases (carbon dioxide, sulphur dioxide).—A. S.

Separating solids from liquids: [Apparatus for] continuously ——. J. Van N. Dorr, Denver, Colo., U.S.A. Eng. Pat. 6985, May 10, 1915.

SEE U.S. Pat. 1,140,131 of 1915; this J., 1915, 703.

Evaporation of solutions, salts and the like to dryness. Eng. Pat. 6482. *See* VII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Gases, Ignition of —— *by impulsive electrical discharge.* W. M. Thornton. Proc. Roy. Soc., 1916, A., **92**, 381—401.

THE ignition of gases by impulsive discharge or "jump sparks" (this J., 1915, 1044) is considered as a function of sparking distance: the shorter the distance the greater is the sectional area of the spark, so that the volumes of the sparks which just cause ignition are, in a typical case, the same for all spark lengths. The impulsive discharge was produced by a powerful induction coil of the usual X-ray type. The vibrating contact of the primary electric circuit was locked, and the current made or broken by a separate quick-break switch. The sparking points were set to a convenient distance apart, 0·5 mm. for hydrogen, and 2 mm. for methane, and the current was adjusted until a spark was obtained which just caused ignition. The igniting sparks were made between the flat end of a platinum rod and a platinum wire, and the vessel was thoroughly dried by exhaustion after each explosion. The gases examined were mixtures with air of hydrogen, methane, propane, and pentane; ethylene and acetylene; carbon monoxide and cyanogen; coal gas, and a mixture of equal volumes of hydrogen and methane. With the hydrogen, propane, pentane, and carbon monoxide mixtures the difficulty of ignition increases gradually as the percentage of oxygen is reduced. In the case of inflammable methane-air mixtures, ease of ignition is independent of the percentage of methane in the mixture. With the acetylene and cyanogen mixtures the curves showing the relation between the strength of the current producing the igniting spark and the percentage of inflammable gas in the mixture, advance in steps in which the atomic groupings caused by the initial ionisation, but preceding the self ignition, are made visible as if by the spark itself. A mixture of hydrogen and methane in equal volumes behaves like methane in regard to ease of ignition, *i.e.*, the hydrogen influences the magnitude but not the type of the reaction. The upper limit of inflammability of the paraffins is reached when the volume of combustible gas is twice that in the mixture for perfect combustion, the lower limit when the volume of oxygen is twice that required for perfect combustion less one atom to the molecule. The curve for the ignition of coal gas is the same as that for methane, showing that the ignition of coal gas is through methane. Ethylene is unique amongst the gases examined, since the richer mixtures are easier to ignite. Evidence is given by these experiments that ignition begins by ionisation of the oxygen of the mixture.
—W. G. C.

Methane and air and hydrogen and air; Ignition of mixtures of —— *by means of the impulsive electric discharge.* S. G. Sastry. Chem. Soc. Trans., 1916, **109**, 523—529.

EXPERIMENTS were carried out to confirm the statement of Thornton (see preceding abstract) that continuous alteration of the proportions of an explosive mixture of gases may be accompanied by discontinuous alterations in the spark energy required for ignition. Ignition was effected by an impulsive electric discharge from the secondary of an induction coil, and the measure of the ignition spark energy was the magnitude of the current that had to be broken in the primary to produce a spark at the spark gap in the explosion vessel which would ignite the mixture. Mixtures of methane and air, and hydrogen and air were used, with spark gaps of 0·5 and 0·25 mm. respectively, and no indications whatever of "step" ignition could be obtained, a normal smooth type of curve being obtained on plotting the relative igniting currents against the percentage of methane or hydrogen in the mixture.—G. F. M.

Toluol and benzol [from coal gas]; Oil washing for the absorption of ——. T. Glover. J. Gas Lighting, 1916, **134**, 387—389.

TAR washing has proved in many respects unsatisfactory for recovering toluol and benzol from coal gas; only a small portion of the benzol and toluol is absorbed by the tar, and naphthalene may be carried forward and cause trouble in the mains. Heavy creosote and green oil give much better results, as the following table shows, and at the same time absorb naphthalene from the gas.

	Lb. per ton of coal, laboratory test.	Lb. extracted per ton of coal carbonised.	
		Tar process.	Oil washing process.
Benzol........	14	1·5	10·032
Toluol........	4	0·75	3·65

Illustrations showing the general arrangement of plant suitable for small works are given.—W. H. C.

Oil-shales, with especial reference to those of the Dorsetshire Kimmeridgian Series. W. H. Manfield. J. Inst. Petrol. Techn., 1916, **2**, 162—190.

THE geological and geographical distribution of oil-shales throughout the world is briefly outlined and a short history given of the origin and development of the British shale-oil industry. Details are given of the geology of the Kimmeridge shales in Dorsetshire and of the methods adopted for proving and working these deposits. By distilling the shale at the lowest possible temperature, a higher yield and better quality of oil is obtained than in the Scotch method of retorting, but the yield of ammonia is poor unless the temperature is increased considerably towards the end of the distillation. Several methods of low-temperature distillation have been devised, for one of which (the Del Monte process) an average yield of 80 galls. of oil per ton of shale is claimed. The oil obtained by ordinary methods contains 5—8% of sulphur, as against less than 1% in that from most other shales worked. Although many processes have been devised for the removal of sulphur from the oil or from the shale direct, none is yet commercially available, and this difficulty has hitherto prevented any large extension of the shale-oil industry in this country. A bibliography of British oil-shales (including torbanite) is appended.
—W. E. F. P.

Paraffins; Effects of temperature on the structure of ——. T. Peczalski. Comptes rend., 1916, **162**, 784—788.

THE specific gravity of the different pure paraffins varies from 0·848 to 0·875, but the author has come across paraffins with a specific gravity over 0·900. Experiments on the effect of temperature upon the structure and density of the paraffins showed that in certain cases when the sample was maintained for 16, 48, or 50 hours in closed tubes at 40° to 45° C. (that is well below the melting point), hollows appeared in the mass near the bottoms of the tubes, and the specific gravity increased appreciably, the increase in one case being from 0·875 to 0·900. The physical appearance of the wax also changed, a sample that was opaque before heating becoming transparent after the heat treatment. The electrical conductivity diminished rapidly as the heating proceeded. On examining very thin films of the wax, microscopically, with the aid of polarized light, it was found that the mass before heating was composed of two portions, one crystalline and the other amorphous. The effect of the heating was to cause an increase in the size and number of the crystals at the expense of the non-crystalline portion of the sample. A fresh orientation of the individual crystals probably accompanies this change, and this would explain not only the increase of specific gravity and diminution of electrical conductivity noted in the earlier experiments, but also the changes in transparency of the mass that accompanies the heating.

—J. B. C. K.

Formolite reaction of Nastukoff as applied to oil residuals and natural asphalts. C. Richardson. J. Ind. Eng. Chem., 1916, **8**, 319—321.

MODIFICATION of Nastukoff's formolite reaction this J., 1904, 1082) was applied to a number of etroleum residuals and natural asphalts. The esults, confirming those obtained by treatment vith concentrated or fuming sulphuric acid, show hat natural Trinidad and Bermudez asphalts consist largely of unsaturated hydrocarbons, followed y Trinidad residual pitch, Mexican petroleum esidual, California petroleum residual, and Texas etroleum residual, arranged in order of decreasing ercentages of unsaturated hydrocarbons. It ppears, therefore, that the smaller the content of nsaturated hydrocarbons, the more pronounced s the asphaltic character of a bitumen.—A. S.

aphthenic acid. Radcliffe and Pollitt. *See* XII.

Patents.

oal ; Mode of and apparatus for extracting water from ——. C. Burnett, Bath. Eng. Pat. 6944, May 10, 1915.

HE coal is fed under pressure through a perforated ylinder and then between heated rolls, an interediate heated chamber being inserted between he cylinder and the rolls, when the water content f the coal is exceptionally high. —J. B. C. K.

on-coking coals ; Process of making —— *coking.* J. Becker, Chicago, Ill., Assignor to H. Koppers Co. U.S. Pat. 1,182,738, May 9, 1916. Date of appl., Dec. 8, 1913.

RUSHED non-coking coal is mixed with 2—10% f crushed, solidified pitch, substantially free from r, and the mixture is then coked.—W. H. C.

vens for the production of gas and coke ; Method of charging ——. H. Koppers, Essen. Ger. Pat. 291,053, July 17, 1914.

HE oven is provided with a relatively large number charging openings widening towards the base, that the entire charge of coal can be introduced om the closed feed hoppers, without it being ecessary to level the coal during the charging eration. When the initial strong evolution gas is at an end, the charge is levelled through a or in the side of the oven, escape of gas and flow of air being prevented as far as possible by aintaining the pressure in the oven approximately equal to the atmospheric pressure. An ert gas, *e.g.*, flue-gas, is supplied to the feed ppers while these are being emptied, in order to aintain therein a flame-extinguishing atmosphere.

—A. S.

Acetylene and hydrogen ; Method of separating ——. G. O. Curme, jun., Pittsburgh, Pa., Assignor to The Prest-O-Lite Co., Inc., Indianapolis, Ind. U.S. Pat. 1,181,116, May 2, 1916. Date of appl., July 20, 1915.

A MIXTURE containing acetylene, ethylene, hydrogen, and traces of other gases is passed through a vessel containing charcoal at or below ordinary temperatures. Acetylene and catalytic "poisons" are absorbed and hydrogen and other gases pass through. The acetylene may be recovered afterwards by heating the charcoal.—W. F. F.

Gas-producer. W. B. Chapman, Assignor to Chapman Engineering Co., New York. U.S. Pat. 1,182,640, May 9, 1916. Date of appl., Feb. 13, 1912.

THE producer is provided with a rotating head carrying eccentrically a coal hopper with its lower end open at the level of the fuel bed. The following wall of the hopper projects downwards slightly below the leading wall, and is provided with a chamber through which a cooling medium is circulated, while its lower edge, in contact with the fuel bed, is bevelled upwards close to the wall of the producer.—W. F. F.

Gas producer. H. Koppers, Essen. Ger. Pat. 291,423, July 4, 1914. Addition to Ger. Pat. 289,590.

IN a gas producer of the type described in the chief patent (see U.S. Pat. 1,146,627 of 1915 ; this J., 1915, 896), in which the clinker is removed in a molten condition, the intermediate chamber, into which the clinker and gases are discharged from the producer, is in the form of a bell dipping into water.—A. S.

Gas-purifying process and apparatus. Gas-purifying, cooling, and by-product-recovery apparatus. B. M. Ferguson, Chicago, Ill. U.S. Pats. (A) 1,182,543 and (B) 1,182,544, May 9, 1916. Dates of appl., Oct. 17, 1914 and Mar. 4, 1915.

(A) GAS from the retorts or ovens is heated by intimate contact with sprayed liquid (*e.g.*, gas liquor) so as to raise its vapour content. It is then forced through adjustable, perforated baffle plates over which a cooling liquid is sprayed, to remove the tar and other impurities. (B) The gas is passed from a common supply reservoir through a battery of scrubbers of different sizes, provided with sprays of cold gas liquor. Grid plates are provided in each scrubber, which are adjusted automatically by the gas, to vary the flow through the scrubber, and any of the scrubbers may be cut out of action by valves connecting them to the supply reservoir and to the outlet main.—W. F. F.

Ammonia in the condensed liquors and wash liquors of gas works and coking installations : Process for recovering the combined ——. Deutsche Continental-Gas-Ges., Dessau, and K. Fritz, Darmstadt. Ger. Pat. 291,038, Dec. 10, 1913.

THE liquor is passed through a layer of cinders or ashes from the fuel or through a layer of coke breeze, either in the distilling column or in a separate vessel ; or the liquor may be treated with an aqueous extract of the cinders, ashes, or coke breeze. The liberation of ammonia is probably caused largely by the action of calcium, magnesium, and iron silicates or aluminates : an aqueous extract of the cinders liberates only from $\frac{1}{16}$ to $\frac{1}{15}$ of the quantity of ammonia liberated by using the solid cinders.—A. S.

Oil ; Method of treating crude [hydrocarbon] ——. C. B. Forward, Urbana, Ohio. U.S. Pat. 1,181,301, May 2, 1916. Date of appl., Sept. 8, 1914.

VAPORISED hydrocarbon oils are passed through a connected series of separating condensers, and the uncondensed portion is heated in one of the condensers to a temperature in excess of that in the last preceding condenser, and then passed through the remaining condensers.—C. A. M.

Asphaltum; Process and apparatus for making ——. M. J. Trumble, Artesia, Cal., Assignor to Simplex Refining Co. U.S. Pat. 1,182,601, May 9, 1916. Date of appl., Sept. 16, 1912.

A constant supply of asphaltic material is introduced into a heater, and is thence conveyed to an evaporator provided with an outlet for the vapours. The concentrated material is then conveyed in a stream into a "reducer," which may be heated by the material itself, and is treated with a reducing agent, which is subsequently removed, together with volatile products of the reaction.—C. A. M.

Carbon monoxide in a gaseous mixture: Process of replacing —— by hydrogen. P. Siedler and K. Henke, Griesheim, Assignors to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,181,264, May 2, 1916. Date of appl., June 13, 1912.

See Eng. Pat. 13,049 of 1912; this J., 1913, 278.

Gas: Manufacture of ——. J. Bueb, Dessau, Germany. U.S. Pat. 1,181,131, May 2, 1916. Date of appl., Aug. 29, 1913.

See Ger. Pat. 280,746 of 1913; this J., 1915, 540.

Fireproof lubricating oil. U.S. Pat. 1,181,976. *See* I.

Manufacture of bituminous compounds. Eng. Pat. 6283. *See* IX.

Briquetting machines [for metal borings, etc.]. Eng. Pat. 1816. *See* X.

Process and apparatus for decomposing light hydrocarbons for the production of carbon black. Ger. Pat. 290,883. *See* XIII.

Gas analysing apparatus. U.S. Pat. 1,182,851. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Surface combustion furnace; Test of a ——. E. Schramm and J. R. Cain. J. Ind. Eng. Chem., 1916, 8, 361—365.

The furnace used was a crucible furnace similar to that described by Lucke (this J., 1913, 1001), but the walls of the muffle were composed of a mixture of 80% of white alundum and 20% of kaolin, which is more refractory than the alundum cement originally used, and were made in sections so that damaged parts could be easily replaced. The furnace temperature was observed by means of a Holborn-Kurlbaum optical pyrometer. It was found that complete combustion could be attained without excess of air, and that a 20% excess of air caused a lowering of the furnace temperature by 100° C. The highest temperature attained was 1675° C. A temperature of 1650° C. could be attained in a little over ½ hour, and then maintained with a gas consumption of 3 cb. ft. per minute. Some of the results obtained are shown in the following table:—

Furnace temp., ° C.	Supply in cb. ft. per min. of:		Gas pressure, in. of water.	Mixture pressure, in. of water.	Flue gas tmp., ° C.	Composition of flue gas, vol. percentages.		
	Air.	Gas.				CO_2	O_2	CO
1530	16·0	2·95	—	—	690	—	—	—
1565	16·4	2·40	—	—	610	—	—	—
1585	15·5	2·40	3·0	11·0	680	—	—	—
1670	13·7	2·90	—	—	710	12·8	0·0	2·4
1675	15·0	3·00	—	—	740	—	—	—
1660	13·5	3·20	2·9	11·0	760	12·1	0·0	2·3

Total heating value of gas, 687 B.Th.U. per cb. ft.; net heating value, 634 B.Th.U. per cb. ft. (gas saturated at 60° F. and 30 in. Hg).—A. S.

Patents.

Heating cartridge. A. Lang, Karlsruhe. Ger Pat. 290,908, Dec. 5, 1914.

The cartridge contains mixtures of metals an metallic oxides, sulphides, sulphur, or the like which give rise to an exothermic reaction whe ignited at one part. The mixtures are arrange in layers so that the quantity of heat develope increases progressively, starting from the poin of ignition. For example, the layers near th point of ignition may be composed of mixture containing heavy metals, whilst those more remot may be formed of mixtures containing ligh metals: or mixtures containing a heavy meta and progressively increasing proportions of a ligh metal may be used, or, similar effects may b obtained by using different oxides or sulphides etc., in the different layers. The cartridges ar intended specially for heating and melting feebl conducting materials such as snow, fats, etc.—A. S

Cobalt-nickel-manganese alloy. Eng. Pat. 13,207 *See* X.

III.—TAR AND TAR PRODUCTS.

Benzene, toluene, and solvent naphtha in light oils etc.: Determination of ——. D. Wilson an I. Roberts. Gas Record (Chicago). J. Ga Lighting, 1916, 134, 225—227.

The apparatus used by the authors consists of 2200 c.c. copper flask, provided with a Hemp column, one inch diam. and 40 in. long, and fille with ¼ in. glass beads. A Liebig condenser tub 21 in. long and ½ in. diam., with an open to jacket, 14 in. long and 1 in. diam., is fitted wit the wide end uppermost to the top of the Hemp column, and a sealed tube, 16 in. long and ⅜ in outside diam., is fixed by means of wires or pr jections concentrically within the condenser tub The Liebig condenser serves as a dephlegmator c constant temperature still-head and is provide with a thermometer. The top of the dephlegmat is attached by a side-neck connecting tube wit a Liebig condenser having a 30-in. jacket, an inclined as steeply as possible. The connectin tube carries a thermometer, graduated from 7 to 150° C., divided into fifths. The thermomet is calibrated for 3 in. immersion in the vapou 2100 c.c. of the crude oil is washed successivel with sulphuric acid and caustic soda, and the either steam distilled or fractionated directl The rate of distillation is regulated to one dr per second and the first fraction is collected up 79° C. This may contain benzene owing to th presence of water. The rate is now increased 5 c.c. per minute and the water leaving th dephlegmator jacket is kept below 80° C. Di tillation is continued until 81° C. is reached, wh the receiver is changed, the fraction being benzen The rate of distillation is now reduced again one drop per second, the supply of water to th dephlegmator is shut off, and as soon as th contents boil, the hot water is run off and at on replaced by a hot solution of calcium chlori having a boiling point of 105° C. The rate distillation is maintained until 109° C. is reach when the receiver is changed, the fraction bei the benzene-toluene intermediate. The rate distillation is again increased to 5 c.c. per minu the Hempel column is wrapped around wi asbestos paper and the temperature becom constant at about 110·5° to 111° C. As soon a starts to rise, the rate is decreased again to o drop per second, and the receiver changed at 111·5° C., the fraction being toluene. The calcium chloride solution is now run out of the dephlegmator and the distillation continued until a temperature of 137° C. is reached, when it is stopped, the last fraction being the toluene-xylene intermediate. The composition of the intermediate fractions is ascertained approximately by distillation from a small flask, the results being judged by comparison with the distillation of similar quantities of known mixtures of benzene and toluene and toluene and xylene. Corrections for variation of atmospheric pressure are made by adding to or subtracting from the thermometer reading the following fractional degrees for each mm. of pressure above or below 760 mm.:—81°, 0·013; 109° and 111·5°, 0·047; 137° C., 0·052; benzene-toluene intermediate, 0·045; toluene-xylene intermediate, 0·05. The process is stated to give benzene and toluene which distil within 1·5° C.; the intermediates are very small in quantity and one fractional distillation will give the percentages present within a few tenths of one per cent. A mixture of 500 c.c. pure benzene with 400 c.c. pure toluene and some solvent naphtha gave benzene 498 c.c. and toluene 398 c.c. Paraffins are tested for by treating 10 c.c. of the sample in a 110 c.c. flask (having the neck graduated for 10 c.c. in tenths) with 25 c.c. of a mixture of two parts of sulphuric acid of sp.gr. 1·84 with one part of fuming sulphuric acid (20% SO_3). The mixture is shaken and allowed to cool and the volume made up to nearly 110 c.c. by pouring strong sulphuric acid into the flask. The volume of the paraffins is then read off.—W. H. C.

Oil washing for the absorption of toluol and benzol. Glover. *See* IIa.

New form of distilling flask, and a note on benzoyl benzoate. Earl of Berkeley. *See* XXIII.

Patents.

Car distillation; Process for preventing formation of coke in ——. M. Melamid and L. Grötzinger, Freiburg. Ger. Pat. 291,164, Mar. 27, 1914.

3oric acid or a borate is added to the tar, and .n inert gas, such as nitrogen, or steam, is preferbly led through it during distillation.—A. S.

-Nitro- and 3-aminocarbazole-monosulphonic acids and their derivatives alkylated at the pyrrole nitrogen atom. Farbwerke vorm. Meister, Lucius, und Brüning. Ger. Pat. 291,023, Sept. 7, 1913.

-Nitrocarbazole or its N-alkyl derivatives are ulphonated, preferably in presence of an inert olvent, under such conditions that the formation f di- and polysulphonic acids is almost or comletely prevented. The resulting nitromonoulphonic acids may be reduced to the correspondig amino-compounds. *Example.* A solution of hlorosulphonic acid in nitrobenzene is added radually, with stirring, to a solution or suspension f 3-nitrocarbazole in nitrobenzene at 0°—5° C., ne temperature is allowed to rise slowly to 20° C., nd after standing for some time at this temperaure, the mixture is poured into water. The itrobenzene layer is separated, and nitrocarbazoleionosulphonic acid is recovered from the aqueous olution by salting out in the form of its sodium alt.—A. S.

hlorobenzene; Manufacture of ——. V. E. Auger, Paris. Eng. Pat. 100,105, Feb. 16, 1916. Under Int.Conv., Feb. 23, 1915. (Appl. No. 2332 of 1916.)

ee U.S. Pat. 1,180,964 of 1916; this J., 1916, 628.

IV.—COLOURING MATTERS AND DYES.

Dyes: Adsorption of —— by colloidal clay, etc P. Rohland. Kolloid. Zeits., 1915, **16**, 16—18. J. Chem. Soc., 1916, **110**, ii., 226—227.

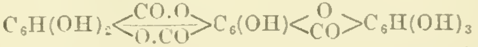
In general, the adsorption of dyes by colloidal silicates increases with increase in the colloidal nature of the dye. The constitution of the dye also seems to have an influence on the phenomenon. Dyes derived from triphenylmethane are in general readily adsorbed, whilst those containing nitro- or azo-groups are adsorbed with greater difficulty. The differences exhibited by colloidal silicates towards dyes may be utilised in separating dyes from their mixtures.

Polyhydroxyanthraquinone dyes; The colour of ——. D. B. Meek and E. R. Watson. Chem. Soc. Trans., 1916, **109**, 544—561. (See this J., 1915, 1243.)

By observing their behaviour in alcohol. potassium hydroxide, and on different mordants, the effect on the absorption spectra of polyhydroxyanthraquinone dyes of changing the end groups of the conjugate chains has been studied in the light of the colour theory previously advanced, and the effect of varying the number and position of the attached auxochromes throughout the chains was likewise observed. The experiments embraced alizarin, quinizarin, purpurin, anthragallol, Alizarin Bordeaux, Alizarin Cyanine, Anthracene Blue, and rufigallol. It was concluded that the more electro-positive the nature of the radicle attached to the conjugate chain, the longer is the wave length of the maximum absorption band. In respect of the number and position of the auxochromes no simple relationship could be traced between them and the absorption spectra of the dyes but the following generalisations are put forward:—Two *o*- or *p*-hydroxyl-groups in one benzene nucleus are necessary to produce a deep colour. The colour is still further deepened if both nuclei have such hydroxyl-groups or by three hydroxyl-groups in the 1.2.4-positions in one nucleus. Three hydroxyl-groups in the 1.2.3-positions produce a brown colour.—G. F. M.

Gallic acid; An oxidation product of ——. H. Bleuler and A. G. Perkin. Chem. Soc. Trans., 1916, **109**, 529—543.

The oxidation of gallic acid by arsenic acid in presence of dilute sulphuric acid at 120° C. gives rise to a crude product which readily dyes mordanted fabrics yellow and yellowish brown shades, and from which, by purification through its acetyl derivative, a canary yellow colouring matter, $C_{21}H_8O_{12}$, for which the name flavogallol is proposed, was isolated in fine needles. It forms a tripotassium salt, an anhydrosulphate of the oxonium type, and hexa-acetyl and -benzoyl derivatives melting at 278°—280° C. and 326°—328° C. respectively. Boiling potassium hydroxide solution converts it into flavogallonic acid, $C_{21}H_{10}O_{13}$, and flavogallone, $C_{20}H_{10}O_{11}$, the former by the opening of a lactone group, and the latter by the elimination of a carboxyl group, the behaviour in this respect resembling that of ellagic acid, from which, however, flavogallol differs in its yellow colour and dyeing properties. On methylation with methyl sulphate and alkali, and hydrolysis of the ester, a dibasic acid was obtained which was produced from flavogallol by the addition of 3 mols. of water and subsequent methylation of ten hydroxyl groups. It has the composition $C_{21}H_4O_5(OCH_3)_{10}$ and melts at 206°—208° C. An isomeric acid melting at 238°—240° C. was also isolated. It is suggested, on the basis of these results, that flavogallol has the formula



$$C_6H(OH)_2<\genfrac{}{}{0pt}{}{CO.O}{O.CO}>C_6(OH)<\genfrac{}{}{0pt}{}{O}{CO}>C_6H(OH)_3$$

and is formed by the oxidation of gallic acid to tetrahydroxybenzoic acid and its subsequent condensation with ellagic acid with the formation of a γ-pyrone ring.—G. F. M.

PATENTS.

Mordant [azo] dyestuffs : Manufacture of ——. Akt.-Ges. f. Anilinfabr., Berlin. Eng. Pat. 16,592 Nov. 24, 1915. Under Int. Conv., Dec. 18, 1914.

BY combining a 4-acylaminophenol, or a substitution product having a free 2-position, with diazotised picramic acid, valuable mordant dyestuffs are obtained, which produce shades of excellent fastness to washing, milling, potting, and light. Olive to brown shades are obtained on chrome mordant.—F. W. A.

Production of colour lakes. Eng. Pat. 28,741. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton groundwork for lace manufacture : Treatment of ——. W. Thomson. J. Soc. Dyers and Col., 1916, 32, 166—167.

THE fabric is treated with a solution of barium chlorate and dried. The salt, being non-deliquescent, does not injure the needles used for the embroidery, as is the case with fabrics treated with magnesium chloride. Subsequently by heating the fabric for a short time at 320° F. it becomes disintegrated and can be brushed out of the lace. In the discussion E. Knecht stated that a process devised by him had been commercially successful. The bleached cotton fabric was nitrated so as to render it soluble in sodium hydroxide solution, and then partially denitrated so as to leave a product which, while retaining its solubility in the alkali solution, was not more inflammable than ordinary cotton. The final product, which was afterwards made by direct nitration with a suitable mixture of acids, contained somewhat more nitrogen than would correspond to a mononitro-cellulose (on the C_6 formula). The prepared fabric did not attack the needles and could be readily dissolved without causing discoloration of the lace.—C. A. M.

Calcium bisulphite solutions ; Analysis of acid ——. E. Hägglund. Chem.-Zeit., 1916, 40, 433—434.

THE usual method employed for the analysis of the fresh "acid" in the pulp mill is that of Winkler, *viz.*, titration of the total sulphur dioxide by iodine and of the "free" acid by sodium hydroxide in presence of phenolphthalein. In the latter titration errors are caused by the presence of carbonic acid derived from the limestone and of volatile organic acids in the recovered gases blown off from the digesters. The end point with phenolphthalein also is not sharp. Any satisfactory method must be readily applicable to mill routine and must indicate the percentage of calcium oxide in the liquor with an error not exceeding —10% or +5%. It is more dangerous to employ too little than too much calcium oxide in the digestion. A method for which greater accuracy is claimed was proposed by Oman, consisting in precipitating the calcium as normal sulphite by adding to 100 c.c. of the "acid," 30 c.c. of strong ammonia solution, filtering after 15 mins., and washing the precipitate three times with 50 c.c. of 15% ammonia each time. The precipitate is transferred to a 500 c.c. flask, acidified with 10 c.c. of strong hydrochloric acid, the solution made up to the mark and titrated into 10 c.c. of iodine solution. Owing to the lesser solubility of calcium sulphite, practically the whole of the calcium sulphate is precipitated as sulphite, and a correction may be applied for this. The author has compared the Winkler and Oman methods with the results obtained by standard analytical methods and found that both are liable to equally large errors, both frequently giving too low results for calcium oxide. The Oman method offers no advantage: apparently the calcium sulphite tends to oxidise on the filter and possibly sulphur dioxide escapes during the acidification. A modification of the method is therefore proposed: 10 c.c. of clear sulphite "acid" is added to about 50 c.c. of water and 3 c.c. of strong ammonia. The liquid is made up to 100 c.c., the precipitate allowed to settle for 15 mins., and 10 c.c. of the clear supernatant solution drawn off and titrated with iodine. A correction based on the average percentage of calcium sulphate in the liquors, $= +0{\cdot}13\%$ SO_2, is applied. The maximum divergences recorded in a series of twelve analyses were equivalent to—1 and +4·1% of CaO.—J. F. B.

PATENTS.

Cork articles : Manufacture of ——. L. L. Bentley, Beaver Falls, Pa., U.S.A. Eng. Pat. 16,935, Dec. 1, 1915.

GRANULATED cork is heated to a temperature sufficient to expel the more inflammable volatile matter, *e.g.*, above 400° F. (204° C.), and to cause the particles of cork to expand so that the increase in volume amounts to over 35%. The hot cork is then compressed in moulds in which it is baked under pressure at a still higher temperature, *e.g.*, above 600° F. (315° C.), so that the further expansion which tends to take place on baking binds the particles together in a solid mass. Cork board manufactured in this way has a weight of less than 7·8 lb. per cub. ft. and a tensile strength of not less than 5 lb. per sq. in. of cross section. —J. F. B.

Paper-pulp ; Process of manufacturing ——. C. M. Taylor and H. K. Cook, Camden, N.J. U.S. Pat. 1,181,553, May 2, 1916. Date of appl., Mar. 16, 1912.

BANANA fibre, for use in paper-making, is prepared by crushing and squeezing the stalks in lines parallel to the length, except for a short portion at one end, whereby the long fibres remain connected to a solid portion of the stalk. The stalk is held at the solid portion, and the fibres brushed in a direction away from it to loosen them and remove deleterious associated materials. The fibre is then boiled with an alkaline solution under pressure to dissolve the natural resinous and gummy substances, but the action is stopped when about 10% of these remain undissolved, and the fibre is finally washed and bleached. The resinous matters remaining in the fibre act as a binding material in the preparation of the pulp.—B. N.

[Wood] pulp laps ; Reconversion of —— *into thinned stock.* A. Curtis, New York, and A. H. White, Brooklyn, N.Y. U.S. Pat. 1,181,067, May 2, 1916. Date of appl., July 29, 1910.

PULP in the form of dry or frozen laps is torn and pulled apart into fragments, which are then shredded in the dry or frozen state into a fine fluffy mass; the product is worked into thin pulp and formed into paper.—J. F. B.

Cellulose acetates and process of making same. H. Dreyfus, Basel, Switzerland. U.S. Pat. 1,181,857, May 2, 1916. Date of appl., Oct. 2, 1911.

SEE Fr. Pat. 432,046 of 1911 and Addition thereto; this J., 1912, 24, 329.

Celluloid substitute ; Uninflammable —— *and method of making the same.* H. Dreyfus, Basel, Switzerland. U.S. Pat. 1,181,858, May 2, 1916. Date of appl., Oct. 2, 1911. Renewed Dec. 11, 1915.

SEE Fr. Pat. 432,047 of 1911 ; this J., 1912, 21.

Celluloid : Substitute for —— and method of making same. Uninflammable celluloid substitute. H. Dreyfus, Basel, Switzerland. U.S. Pats. 1,181,859 and 1,181,860, May 2, 1916. Dates of appl., Oct. 2, 1911, and Nov. 12, 1911.

See Fr. Pat. 432,264 of 1911 ; this J., 1912, 24.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cotton cloth : Removal of the natural impurities of —— by the action of bacteria. B. S. Levine. J. Ind. Eng. Chem., 1916, **8**, 298—302.

According to Hebden (this J., 1914, 959) the yellowing of bleached cotton cloth on steaming or during storage is due to imperfect removal of alcohol-soluble and nitrogenous impurities. The author confirms Hebden with regard to the importance of the nitrogenous impurities, but finds that the ether-soluble impurities have an equally injurious action, whereas the yellowing is not connected in any way with the presence of the alcohol-soluble constituents. Laboratory experiments with different species of bacteria (*Bac. mylolyticus, Bact. fimi, Bac. bibulus, Bac. arotovorus*, and *Bac. subtilis*, Ehrenberg) in a nutrient solution containing 1 grm. each of ipotassium phosphate and magnesium sulphate nd 2 grms. each of sodium chloride, ammonium ulphate, and calcium hydroxide per litre, showed hat the nitrogenous substances and ether-soluble npurities of cotton can be efficiently removed by acterial action. The bacteria mentioned conerted starch sizing only to dextrins and had little ction on the alcohol-soluble impurities. Samples f cotton cloth purified by bacterial action and then leached, showed no yellow coloration when ubjected to steam at a pressure of 10 lb. per sq. in. or 45 mins. Preliminary trials on a large scale or the purification of paper-making stock, cotton arn, and cotton cloth by bacterial treatment, revious to bleaching, have given promising results, he material being incubated with the bacteria ulture for periods ranging from 72 down to 24 ours.—A. S.

yeing ; Rapid methods of ——. G. Tagliani. Färber-Zeit., 1915, **26**, 225—228.

Lop padding is much cheaper than most ethods employed in dyeing, for example, than yeing by means of a padding roller in a printing achine or by the hot flue method, but it has only und limited application up to the present for yeing light and medium shades which need not be ery level or fast. By using a concentrated dye-ath and an oil in the dye-bath to assist the etting-out of the fabric, it has been found ossible to obtain deeper shades : for example, suitable dye-bath for 100 grms. of cotton fabric ntains 10 grms. of dyestuff, 100—120 grms. of ater, 10—20 grms. of dextrin, 2—5 grms. of salts ich as sodium sulphate, phosphate, etc., and —20 grms. of oil (*e.g.* Monopol oil, Turkey-red l, or Para soap). Treatment of the fabric in such dye-bath frequently renders a subsequent ishing operation unnecessary.—F. W. A.

lphur black dyeings ; Production of sulphuric acid in ——. W. Zänker and P. Weyrich. Färber-Zeit., 1915, 26, 337—341. (See this J., 1915, 659.)

y heating to 140° C., all the readily oxidisable lphur in black sulphur dyestuffs is oxidised to lphuric acid. To find whether material dyed ith Sulphur Black may be stored with safety, is therefore sufficient to heat a sample twice r one hour at 140° C. The authors conclude that is only satisfactory to employ black sulphur dyestuffs which contain the least possible amount of readily oxidisable sulphur. (Compare Vlies, this J., 1910, 558, and Gardner and Hodgson, *ibid.*, 672).—F. W. A.

Naphthenic acid. Radcliffe and Pollitt. *See* XII.

Patents.

Woollen goods ; Process for producing white ——. A. E. Garrett, St. Albans. Eng. Pat. 13,215, Sept. 15, 1915.

The material is immersed in a solution containing less than 1% of hydrogen peroxide, below 50° C., squeezed out, passed through dilute ammonia solution (*e.g.*, a 0·15% solution at 50° C.) to which soap (*e.g.* 0·5%) may have been added, again squeezed out, and allowed to dry for one to two hours. A permanent bleach results, subsequent washing improving, if anything, the whiteness of the goods. By stoving in sulphur dioxide before the final scouring, drying, and finishing, a somewhat brighter white is obtained than by the peroxide bleaching alone, but this will probably not be so permanent.—F. W. A.

Sizing and dyeing ; Method of ——. M. N. Aisen, Chicago. U.S. Pat. 1,181,202, May 2, 1916. Date of appl., May 15, 1914.

The material is sized and dyed by treatment with a bath which tends to prevent shrinkage and contains a stiffening substance, *e.g.*, a solution of glue in alcohol, and a dyestuff.—F. W. A.

Dyeing machine. R. D. Booth, Philadelphia, Pa., Assignor to The Psarski Dyeing Machine Co., Cleveland, Ohio. U.S. Pat. 1,181,286, May 2, 1916. Date of appl., June 7, 1912.

See Addition of July 30, 1912, to Fr. Pat. 436,936 of 1911 ; this J., 1912, 134.

Dyeing machine. W. Inman, Milwaukee, Wis., Assignor to The Psarski Dyeing Machine Co., Cleveland, Ohio. U.S. Pat. 1,181,314, May 2, 1916. Date of appl., June 13, 1913.

See Eng. Pat. 18,303 of 1913 ; this J., 1914, 73.

Dyeing ; Process of ——. E. Lodge and J. M. Evans, Huddersfield, Assignors to Lodge-Evans New York Corporation, New York. U.S. Pat. 1,181,905, May 2, 1916. Date of appl., Dec. 26, 1914.

See Eng. Pat. 19,473 of 1914 ; this J., 1915, 277.

Dyeing ; Process of ——. E. Lodge and J. M. Evans, Huddersfield, Assignors to Lodge-Evans New York Corporation, New York. U.S. Pat. 1,181,906, May 2, 1916. Date of appl., Aug. 12, 1915.

See Eng. Pats. 29,852 of 1913 and 23,386 of 1914 ; this J., 1915, 135, 223. A neutral ammonium salt may be added to the bath.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Salt from Cyprus. Bull. Imp. Inst., 1916, 14, 37—40.

A sample of crude salt collected from the Larnaca Salt Lake in Cyprus, after the lake had dried up in autumn, consisted of moist, white, coarsely crystalline material containing sodium chloride 90·05%, potassium chloride 0·44%, calcium sulphate 0·58%, magnesium sulphate 0·95%, magnesium chloride 0·53%, and moisture 7·19%. No borates, phosphates, iodides, bromides, or nitrates were present. On recrystallising the material by dissolving in water, decanting from insoluble matter, and allowing to evaporate in shallow vessels at 30°—40° C., 85% of the material was recovered as salt of good quality, showing no tendency to deliquesce, and containing sodium chloride 98·34 %, potassium chloride trace, calcium sulphate 0·61 %, magnesium chloride 0·17 %, moisture 0·61 %.—T. C.

Potassium thiocyanate; Electrolysis of alkaline solutions of ——. W. J. Crook, L. E. Booth, and A. Thiel. Met. and Chem. Eng., 1916, **14**, 587—591.

DILUTE solutions of potassium thiocyanate of known strength, with and without potassium hydroxide, were electrolysed for 5 hrs. by currents of 0·5—4·0 amp. at 2·7—8·9 volts and examined at the end of each hour. Potassium cyanide and sulphate were found to be the only products of electrolysis in alkaline solutions, the decomposition probably occurring in accordance with equation, $KCNS + O_3 + 2KOH = KCN + K_2SO_4 + H_2O$ (Clennell, this J., 1911, 807). In neutral solutions hydrogen cyanide was evolved and the solution became acid. Methods for determining potassium thiocyanate and its known or probable decomposition products (cyanide, sulphate, hydroxide, cyanate, carbonate, and sulphite) in the presence of each other are given.—W. E. F. P.

Thiocyanic acid and hydrogen sulphide; Iodometric determination of ——. F. P. Treadwell and C. Mayr. Z. anorg. Chem., 1915, **92**, 127—134. J. Chem. Soc., 1916, **110**, ii., 264.

THE iodometric method of Thiel (this J., 1902, 1298) for the estimation of thiocyanates is tedious, and there is danger of loss of iodine in the evolution of carbon dioxide. If nascent bromine is used instead of iodine for the oxidation, the titration may be carried out quite rapidly. The solution is diluted until about $N/5$ or $N/6$. 5 or 10 c.c. is introduced into a litre flask provided with a tap funnel, and 50 c.c. of $N/5$ potassium bromate and 10—15 c.c. of a 10 % solution of potassium bromide are added. The flask is then evacuated with a filter pump, and concentrated hydrochloric acid is allowed to enter, without admitting air, until the volume of liquid is increased by one-third. After shaking, the flask is allowed to remain for fifteen minutes, when a solution of 2 or 3 grms. of potassium iodide is added without admitting air. After again shaking, the separated iodine is titrated with $N/10$ sodium thiosulphate and starch. Thiocyanates and chlorides or bromides may be estimated together by proceeding as above, and also by titrating thiocyanate and haloid together by Volhard's method. The estimation of hydrogen sulphide by means of bromide and bromate is more exact than that by means of iodine, the reactions being: $H_2S + 4H_2O + 8Br = 8HBr + H_2SO_4$ and $H_2S + I_2 = 2HI + S$. When concentrated hydrochloric acid is added, the solution at first becomes turbid from precipitation of sulphur, but this is oxidised in fifteen to twenty minutes, and the liquid becomes clear. In very dilute solutions thirty minutes may be required. When sulphides and thiocyanates are both present, the sulphide-sulphur is first estimated by the ordinary iodometric method, and then the total sulphur by the bromide-bromate method.

Mercuric cyanide; Action of —— *on salts and esters of thiosulphuric acid.* A. Gutmann. Ber., 1916, **49**, 949—954.

IT has previously been shown that the action of potassium cyanide on thiosulphates or sodium tetrathionate forms thiocyanate, and it is now found that mercuric cyanide reacts with sodium or barium thiosulphate to give (1) in neutral or alkaline solution, mercury sulphide, sulphite, and sulphate, together with thiocyanate, and (2) in acid solution, mercury sulphide and sulphuric acid, without the formation of any thiocyanate. The esters of thiosulphuric acid behave in a similar manner, but instead of mercury sulphide the corresponding mercaptide is produced.
—F. W. A.

Calcium carbonate; Complete solubility curve of ——. J. Johnston and E. D. Williamson. J. Amer. Chem. Soc., 1916, **38**, 975—983.

EQUILIBRIUM in the system $CaO-H_2O-CO_2$ is shown by graphs of log C (ionic concentration) against log P (the partial pressure of carbon dioxide) for the several ions in the system. The graph representing the concentration of $Ca^{\cdot\cdot}$ is made up of three curves, with hydroxide, carbonate, and bicarbonate respectively as the stable solid phase; the first curve extends to values of P of about 10^{-14} atm. at 16° C., whilst the second, starting from the transition point, decreases to a minimum (corresponding to about 16 mgrms. $CaCO_3$ per litre when $P = 3{\cdot}73 \times 10^{-7}$ atm.) and then rises to a second transition point when P is about 15 atm.; beyond the second transition point bicarbonate is the stable solid phase. Values of the transition pressure at which both hydroxide and carbonate are stable, calculated from the solubilities of hydroxide and carbonate and also from their thermal dissociation pressures, are in substantial agreement.—F. SODN.

Manganese solutions; Oxidation of —— *in presence of air.* V. Lenher. J. Amer. Chem. Soc., 1916, **38**, 638—640.

THE hydrolysis which manganous salts undergo in neutral solutions and the slow precipitation of hydrated manganese dioxide from such solutions when exposed to the air, probably account for the formation of pyrolusite in nature. The author found that the rate at which manganese dioxide is precipitated from solutions of manganous salts in contact with Iceland spar (to neutralise the acid formed by hydrolysis) and with the air, is greatly accelerated by the presence of metallic lead or lead salts in the solutions, and a similar but less pronounced effect is produced by bismuth or its compounds. Other metals and compounds investigated have no such effect, and those which, like tin, arsenic, and antimony, exert a reducing influence, retard or entirely prevent the formation of manganese dioxide.—J. H. L.

Diatomite from Australia. Bull. Imp. Inst., 1916, **14**, 40—44.

DEPOSITS of diatomite are worked at Lillicur and Portland in Victoria, from which localities 1000 and 50 tons were obtained in 1914 and 1913, respectively; and at Bunyan, near Cooma, N.S.W., whence the annual output during recent years has averaged about 25 tons. Samples of the Lillicur and Bunyan products were submitted to various firms using the material for the manufacture of dynamite and polishing preparations and for filtration. The former, particularly a snow-white variety, were found to be of such quality and price (£5 2s. 6d. to £5 10s. per ton f.o.b. Melbourne) as to be readily saleable in the United Kingdom, but the latter were considered hardly marketable in Europe in competition with diatomite from other sources.—W. E. F. P.

Thorium oxide; Preparation of colloidal ——. V. Kohlschütter and A. Frey. Z. Elektrochem., 1916, **22**, 145—161.

THORIUM dioxide prepared by igniting the oxalate, differs from that obtained from the nitrate, sulphate, etc., by its property of readily forming a colloidal solution in water after treatment with dilute acid. To obtain the oxide with maximum colloidal solubility, 10 grm. portions of the oxalate were heated at 500°—600° C. for 2½ hours and carefully stirred: temperatures of 700° C. and above gave a non-colloidal product. Specimens which had been kept for two months in a desiccator over sulphuric acid or caustic alkali were found to have lost the property of yielding a colloidal solution, but the power was recovered by heating for a short time at 300°—400° C. This "degeneration" was traced to the adsorption of carbon dioxide and moisture from the air. Samples of the dioxide, prepared in the same manner, were found not to be strictly identical in behaviour, and portions from the same preparation were always used for comparative experiments. Peptisation is effected by treatment with hydriodic acid (best), hydrobromic acid, and hydrochloric acid: hydrofluoric acid is without effect, but nitric and sulphuric acids, and certain metallic salts which are easily hydrolysed can be used. The process is favoured by raising the temperature, 70° C. being the optimum, and also by increasing the concentration of the electrolyte employed. The smallest amount of hydrochloric acid necessary to peptise a given weight of oxide increased as the concentration of the acid declined, or as the absolute amount of oxide present increased. The exceedingly porous structure of the solid oxide probably accounts for the increased density observed when in the sol form. The electric conductivity and the titre of the acid used in peptisation both undergo diminution, attaining a minimum when complete solution has taken place. The colloidal solution was found to contain small mounts of soluble thorium salts; but inasmuch as solution and peptisation do not run parallel, the reduction of the size of the particles of solid oxide by chemical erosion cannot be regarded as the determining cause of colloidal solubility. Sols prepared as above from solid thorium dioxide are opalescent even in extremely great dilution, and are very sensitive towards electrolytes. They differ both in appearance and in properties from sols prepared by peptising the freshly precipitated hydroxide, containing an equal amount of acid and oxide. The former are more sensitive to acids, the latter to basic liquids, but both are very stable n the absence of electrolytes. Although the oxide sol resembles emulsoids in appearance, the fact hat its viscosity is only slightly greater than that of the solvent, classifies it among the suspensoids. The particles carry a positive charge. The solid gels obtained by evaporation rapidly diffuse when shaken with water, and they do not lose his property when heated to 360°—500° C. for a short time. Prolonged heating, however, changes hem, inducing an alteration in physical structure and appearance. The reversible gel contains chlorine. The above phenomena are best interpreted by assuming that peptisation is brought about by interaction between the acid and the uperficial molecules of the solid oxide, causing he liberation of the ions $\mathrm{Th}^{\cdot\cdot\cdot\cdot}$ and $\mathrm{ThO}^{\cdot\cdot}$, which become associated with solid particles of oxide nd furnish them with the electrical charges necessary for their existence as sols. Thus olloidal thorium dioxide represents an intermediate condition between the solid stage and the state of true solution.—E. H. T.

Carbon monoxide; Oxidation of —— in presence of colloidal platinum, iridium, and osmium. C. Paal. Ber., 1916, **49**, 548—560.

Carbon monoxide combines with oxygen forming arbon dioxide when the mixture is shaken at rdinary temperatures with a hydrosol of platinum, ridium, or osmium, the latter hydrosol being the east active. Colloidal osmium tetrahydroxide as only a feeble catalytic action, whilst no comination was obtained with platinum black repared by reducing an alkaline solution of latinic chloride with hydrazine hydrate.—T. C.

Analysis of acid calcium bisulphite solutions. Hägglund. *See* V.

Density of aqueous solutions of copper sulphate and sulphuric acid. Holler and Pfeffer. *See* X.

Aqueous solutions of carbonic acid. Strohecker. *See* XIXb.

Determination of carbonic acid, combined and free, in solution, particularly in natural waters. Johnston. *See* XIXb.

New methods for the analysis of lime-sulphur solutions. Determination of the polysulphide sulphur. Chapin. *See* XIXb.

Patents.

Sulphuric acid; Concentrating ——. J. W. Leitch, Huddersfield. Eng. Pat. 16,001, Nov. 12, 1915. Addition to Eng. Pat. 1495 of 1915 (this J., 1916, 308).

A condenser and the tower for heating the dilute acid are arranged preferably above the level of the concentrating apparatus, the tower being almost directly over the final concentrating pan, and a series of ducts convey the hot vapours from the final pan to the tower, the dilute acid from the storage reservoirs to the top of the tower, the heated acid from the tower to the first concentrating pan of the cascade, and the hot gases from the top of the tower and the intermediate concentrating chamber to the condenser. The intermediate and final concentrating chambers are enclosed by easily removable covers. The temperature of the acid as it enters the first pan is maintained at 100°—125° C., and that of the acid passing to the second and third stages at 135°—150° C. and 200°—215° C. respectively, whilst during the third stage it is regulated from a minimum of 260° C. at the inlet to a maximum of 325° C. at the outlet.—F. Sodn.

Catalytic reactions [*synthesis of ammonia, etc.*], *and catalytic agents for use therein.* J. Y. Johnson, London. From Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 1358, Jan. 27, 1915. Addition to Eng. Pat. 8162, Apr. 3, 1914 (this J., 1915, 822).

The complex insoluble compound used in the principal patent may be coated or impregnated with a compound of a catalytic metal which does not effect an immediate exchange of bases. Natural or artificial zeolite, or sodium aluminate-silicate, may be impregnated with platinum chloride, or potassium osmate or ruthenate, the product dried, heated, and reduced by hydrogen, and the soluble salts washed out. The product obtained by treating sodium aluminate-silicate with ammonium chloride and ammonium molybdate, or with a solution of tungsten chloride in acetone may be used for the synthetic production of ammonia. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 12,977 of 1913; this J., 1914, 483.)—W. F. F.

Solutions, salts and the like; Evaporation of —— to dryness. G. W. Winn, Wakefield, Yorks., and Metals Extraction Corporation, Ltd., London. Eng. Pat. 6482, Apr. 30, 1915.

The solution is evaporated in a tray lined with a thin covering of carbonaceous substance such as paper, tar, tarred or greased paper or fabric, Brunswick black, bitumen, etc. The method is particularly applicable to the evaporation of zinc sulphate solution, the concentrated solution being heated to 300°—500° C. for 35—40 minutes. On inverting the tray, the dried cake is readily detached.—W. F. F.

Sea water: Process of extracting salts [magnesium sulphate, potassium sulphate, magnesium chloride, and potassium chloride] from ——. Y. I. A. Lalljee, Bombay. Eng. Pat. 6678, May 4, 1915.

Mother-liquor of at least 30° B. (sp.gr. 1·262), remaining after the separation of common salt, is further evaporated in stages, *a*, *b*, *c*, and *d*, to 34°, 36°, 37°, and 38° B. respectively (sp.grs. 1·308, 1·332, 1·345, and 1·357), and the salts deposited at each stage are treated as follows:—(*a*) The deposit is a mixture of sodium chloride and magnesium sulphate; it is redissolved in water or in brine free from calcium sulphate (preferably of 25°—27° B.; sp.gr. 1·210—1·230), and the solution is evaporated to 30° B.; pure sodium chloride separates, and, on evaporating the liquor to 34° B., fairly pure magnesium sulphate is obtained. (*b*) The impure double sulphate of potassium and magnesium, deposited in this stage, is dissolved in water or brine, as above, and the solution evaporated; pure sodium chloride is deposited up to 30° B. and, from this point to 34° B., fairly pure magnesium sulphate which may be purified as in (*a*); the residual liquor containing potassium magnesium sulphate and possibly potassium chloride is evaporated to 36° B., to separate the purified double sulphate, and potassium chloride is then added to the double sulphate, so as to convert it into potassium sulphate and potassium magnesium chloride which remains in solution with excess of potassium chloride. (*c*) The deposit contains potassium chloride. (*d*) The potassium magnesium chloride which separates in this stage is exposed to air which converts it into single chlorides: the magnesium chloride liquefies and drains away from the potassium chloride, which is then washed and dried. Above 38° B. the liquor contains only magnesium chloride; ammonium chloride is added and the solution evaporated in order to obtain ammonium magnesium chloride, which is dehydrated and heated to expel ammonium chloride; decomposition of the magnesium chloride is thereby avoided, and a congealed mass of the anhydrous salt obtained.—F. Sodn.

Salt: Process for converting rock salt into voluminous table ——. L. W. Damman, Zwolle, Holland. Ger. Pat. 291,265, June 30, 1914. Addition to Ger. Pat. 276,344 (this J., 1915, 138).

Finely ground rock salt is moistened with an aqueous solution of a hygroscopic salt or with a hygroscopic liquid, and the whole well mixed. A carbohydrate or the like may be added to the liquid used for moistening the salt.—A. S.

Alkali metals; Process for treating rock containing ——. F.L. Firebaugh, Berkeley, Cal. U.S. Pat. 1,182,668, May 9, 1916. Date of appl., Apr. 30, 1915.

The rock is leached with sulphuric acid, the resulting solution is evaporated to dryness, and heating is continued for some time to decompose the non-alkali sulphates. The calcined mass is then treated with water to dissolve the sodium and potassium sulphates, the solution is concentrated, and the salts separated by fractional crystallisation. For example, most of the potassium sulphate is crystallised out at 50° C., and the mother-liquor is then diluted, and cooled to 20° C., to recover sodium sulphate.—J. B. C. K.

Alkali halides; Apparatus for electrolysis of fused ——. Deutsche Gold- u. Silber-Scheide-Anstalt vorm. Roessler, Frankfort. Ger. Pat. 291,210, Feb. 11, 1914.

The part of the apparatus which comes in contact with both the anodic and cathodic decomposition products, *e.g.*, the collecting vessel for the alkali metal, is made of a zirconia mixture consisting essentially of zirconium oxide, which resists the action of alkali and of chlorine.—A. S.

Potassium carbonate: Manufacture of ——. W. Esch, Hamburg. Ger. Pat. 291,417, Nov. 3, 1914.

In the preparation of potassium carbonate from solutions of potash salts, ammonium carbonate or its components, ammonia and carbon dioxide, the reaction is effected in the presence of such a quantity of a suitable magnesium salt that secondary potassium magnesium carbonate is separated together with secondary magnesium ammonium carbonate. The mixed double salts are treated by known methods for the recovery of potassium carbonate.—A. S.

Shaft furnaces or kilns for burning or calcining limestone, dolomite, and the like. J. Magis, Paris. Eng. Pat. 7121, May 12, 1915.

The grate or grid of the kiln is situated high above the ground, and built up of bars which slope downwards from the apex of a cone to discharge apertures in the outer walls. The bars gradually deepen, and their sloping sides gradually increase in height, in the direction of the apertures, so that the channels between them, through which the cinders and dust fall, are shaped like inverted V's. The upper ends of the bars may rest upon a vertical pipe with a perforated cover, through which air passes into the furnace. The grate may be modified to suit ordinary kilns. The discharge openings in the side walls are fitted with doors, hinged at the base, which when raised prevent the exit of material but not the access of air, and when lowered act as sloping shoots for the discharge of the lime. The shaft is supported upon walls of brick or stone, spaced apart around a central chamber immediately below the grate.—E. H. T.

Radium; Extraction of —— from carnotite ores, etc. H. Schlundt, Columbia, Mo. U.S. Pat. 1,181,411, May 2, 1916. Date of appl., Sept. 24, 1915.

The comminuted ore is heated with sulphuric acid of 60° B. (sp. gr. 1·710) at 230° C. or above, and after the liquid has been separated from insoluble matter, an aqueous solution of barium salts is added to precipitate the radium and barium as sulphates.—E. H. T.

Thorium; Recovery of ——. E. D. Campbell and R. J. Carney, Ann Arbor, Mich. U.S. Pat. 1,182,880, May 9, 1916. Date of appl., Feb. 15, 1916.

Thorium (and also zirconium) may be precipitated as insoluble pyrophosphate by the addition of a soluble pyrophosphate in presence of sufficient mineral acid to retain other rare earth metals in solution.—E. H. T.

Lead chromate [basic]; Manufacture of ——. J. A. Schaeffer, Assignor to Picher Lead Co., Joplin, Mo. U.S. Pat. 1,182,172, May 2, 1916. Date of appl., Sept. 24, 1915.

Volatilised litharge, made into a paste with water, is mixed with a solution of salts derived from chromic acid and the stronger alkalis, and the whole is boiled.—E. H. T.

Silicic acid; Preparation of precipitated amorphous ——, *together with potassium or sodium sulphate or sulphite.* A. van Baerle, Worms. Ger. Pat. 290,530, Aug. 16, 1914.

Silicic acid of high absorptive and adsorptive power is obtained by treating alkali silicate solutions with an acid salt of an organic or inorganic acid, especially with alkali bisulphate or bisulphite.—A. S.

Sulphur dioxide; Production of —— by roasting sulphide ores and sulphur together. P. Lehmann, Königsberg. Ger. Pat. 291,126, Dec. 17, 1914.

The sulphur is placed in a cast iron box which can be introduced into a pyrites roasting furnace or into a compartment formed in the furnace by means of a partition.—A. S.

Hydrogen and nitrogen, or mixtures of the two; Manufacture of ——. A. Messerschmitt, Stolberg. Ger. Pat. 291,603, Aug. 7, 1913.

If steam be passed over a red hot contact mass composed of spongy iron or a mixture of spongy iron and a metallic oxide such as manganous oxide, the iron is oxidised only to the ferrous stage, unless contact with the steam be prolonged. By passing air over the partially oxidised contact material, oxidation to a higher stage is effected, so that it is possible to obtain hydrogen in the first stage and nitrogen in the second. A series of reaction chambers is preferably used. Steam is passed through a chamber containing freshly reduced contact material to obtain hydrogen, and then air is passed through to obtain nitrogen. A mixture of hydrogen and nitrogen may be obtained by mixing the nitrogen with steam and passing the mixture over freshly reduced contact material, or by passing a mixture of air and steam first over the partially oxidised, and then over freshly reduced contact material.—A. S.

Hydrogen peroxide solutions; Process for stabilising alkaline ——. Stable alkaline solutions containing active oxygen. A. Schaidhauf, Frankfort, Germany, Assignor to Roessler and Hasslacher Chemical Co., New York. U.S. Pats. 1,181,409 and 1,181,410, May 2, 1916. Dates of appl., May 1 and Oct. 21, 1913

See Fr. Pat. 460,959 of 1913; this J., 1914, 76.

Salt; Manufacture of ——. J. Leopold-Brodie, London. U.S. Pat. 1,181,465, May 2, 1916. Date of appl., Feb. 23, 1912.

See Eng. Pat. 2300 of 1912; this J., 1913, 288.

Process for recovering the combined ammonia in the condensed liquors and wash liquors from gas works and coking installations. Ger. Pat. 291,038. *See* 11a.

VIII.—GLASS; CERAMICS.

lass: Electro-chemical action on ——. F. F. S Bryson. Engineering, 1916, 101, 517—518.

n a Wehnelt electrolytic interrupter used to produce a high-tension discharge, the glass holder of he electrode becomes pitted at the point where the latinum wire is sealed into the glass. The pitting ccurs when the wire forms either the anode or athode. Soft flux glass, clear, ruby, white enamel lux, German soda, new British soda, lead, and ena glasses all behave similarly, a crater being rmed around the wire. The effect is least with ena glass. It does not appear to be due to echanical action, to the brittleness of the glass, the Joule heating effect, or to the Peltier effect. hen two wires are fused into the same piece of glass wo independent craters are formed, one around ach wire. The author attributes the corrosion the action of ultra-violet rays in the presence f free hydrogen and oxygen at a temperature bove the dissociation point of water.—A. B. S.

ilica and fireclay materials. J. West. J. Gas Lighting, 1916, **134**, 442—447.

ricks and retorts made of fireclay contract when eated, those made of silica usually expand, but if ade of a high-grade silica found in Derbyshire they do not change materially in volume. A column of bricks, 100 in. high, made of this Derbyshire silica, heated in a continuous kiln to 1430° C., increased in length by only ⅞ in. Fireclay bricks and retorts often approach the danger zone at which they will be distorted under a load, but silica bricks must be heated to a much higher temperature before they are affected. A process of manufacture recommended for silica bricks consists in grinding the material, with a small proportion of grog, in a perforated pan and screening the mixture to size, then discharging it into large bins and saturating it with water. After about a week's storage the material becomes semi-plastic and is then moulded into bricks, which are dried on hot floors and burned at a temperature well above that which they will attain in use. The author quotes instances where the Derbyshire silica has proved superior to German and other materials in actual use, and considers that tests must be made on a full working scale to be of real value. The analyses of 15 silica and fireclay materials, together with their refractoriness and change in volume when heated to 1435° C. are given.—A. B. S.

Dental cements; Physical properties of ——. P. Poetschke. J. Ind. Eng. Chem., 1916, **8**, 302—309.

A method of preparing test cylinders and determining the crushing strength of dental cements is described in detail. Forty commercial cements showed considerable variations in crushing strength. When the set cements were preserved in saliva, retrogression in strength occurred in many cases, namely, in 2 out of 7 silicate cements, in 10 out of 18 zinc oxyphosphate cements, and in 5 out of 15 copper cements. There is no relation between the resistance to saliva and the germicidal efficiency (see this J., 1915, 447) in the case of copper cements.—A. S.

Patents.

Glass-furnace. G. W. Batchell, Wellsburg, W. Va. U.S. Pat. 1,181,283, May 2, 1916. Date of appl., Feb. 25, 1913.

A glass tank made of refractory material has its sides and bottom surrounded by a water-jacket so as to cool and congeal the glass in contact therewith.—A. B. S.

Enamels and the like; Method of colouring ——. J. Weber, Essen-on-Ruhr, Germany, Assignor to Goldschmidt Detinning Co., New York. U.S. Pat. 1,181,944, May 2, 1916. Date of appl., Nov. 27, 1914.

Anhydrous calcium stannate is used as an opaque colouring material.—A. B. S.

[Potter's] slip and the like; Pumps for ——. R. T. Grocott, Stoke-on-Trent. Eng. Pat. 100,375, Jan. 21, 1916. (Appl. No. 989 of 1916.)

Glass: Manufacture of strengthened ——. E. Benedictus, Paris. U.S. Pat. 1,182,739, May 9, 1916. Date of appl., June 14, 1911.

See Eng. Pat. 10,324 of 1911; this J., 1911, 1059.

IX.—BUILDING MATERIALS.

Patents.

Bituminous compounds; Manufacture of ——. L. S. Van Westrum, Grindelwald, Switzerland. Eng. Pat. 6823, May 6, 1915.

From ½ to 2% of unslaked lime is added to a mixture of 12—20% of an emulsion of bitumen, such as asphalt, tar and its distillates, or mineral oil residues, with 80—88% of broken stones, earth, stone-dust, sawdust, hydraulic lime, cements of all kinds, cellulose, chalk, or other materials. The product may be used for road-making, as a plaster for walls and ceilings, and in the production of fuel-briquettes.—J. B. C. K.

Refractory materials for resisting corrosion ; Method of producing ——. Mineral Products Co., New York, Assignees of P. R. Hershman, Chicago, U.S.A. Eng. Pat. 17,447, Dec. 13, 1915. Under Int. Conv., Dec. 21, 1914. (See also U.S. Pat. 1,135,182 ; this J., 1915, 836.)

A material (such as aluminium or alumina) capable of forming a refractory carbide is mixed with insufficient carbon to convert the whole into carbide and heated slowly in a non-oxidising atmosphere to at least 1500° C., preferably to 2000 C. The material may be moulded into bricks, by the use of tar or other binder, and heated in an electric furnace.—A. B. S.

[*Brick-kiln ;*] *Method of effecting the combustion of gas* [*for heating a* ——]. G. C. F. Vater, Assignor to Gas Machinery Co., Cleveland, Ohio. U.S. Pat. 1,181,624, May 2, 1916. Date of appl., Jan. 23, 1913.

Gas is admitted through the bottom of a combustion chamber and air is admitted through the side walls. The volume of the chamber may be adjusted to that necessary for complete combustion and the products of combustion together with supplementary air are passed into the kiln. The combustion chamber is then gradually enlarged, while the gas supply is increased and the supplementary air decreased.—W. F. F.

Protecting materials [*wood*] *from attacks by destructive organisms.* L. H. Everhart, Decatur, Ga. U.S. Pat. 1,182,760, May 9, 1916. Date of appl., Nov. 5, 1915.

The wood is impregnated with a soluble arsenical compound, such as sodium arsenate, and then treated with a soluble lead salt, *e.g.*, normal lead acetate.—J. B. C. K.

Means for grinding or disintegrating cement or other material. Eng. Pat. 6329. *See* I.

X.—METALS ; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron ; Effect of vacuum fusion upon the magnetic properties of pure open-hearth ——. T. D. Yensen. Met. and Chem. Eng., 1916, 14, 585—586. (See also this J., 1916, 256.)

By re-melting, *in vacuo*, pure open-hearth iron containing S 0·025, P 0·005, C 0·010, Mn 0·025, Si 0·005, Cu 0·050, O 0·035, N 0·004 and H 0·001 %, the maximum permeability was increased from 7250 (at 10,000 gausses) to 14,180—20,900 (at 8500—9000 gausses) and the hysteresis loss correspondingly decreased, the results for the re-melted metal being nearly as good as those for similarly treated electrolytic iron. The density was also increased (by about 0·1 %), but the chemical composition was apparently unaffected except for a decrease in dissolved gases (CO and CO_2) which was confirmed by micrographic examination. The crystals of the treated iron were larger than those of the untreated metal ; on the other hand, pure electrolytic iron has a greater permeability when annealed at above 900 C. than when annealed at or below this temperature, whilst the crystals are smaller in the former than in the latter case.—W. E. F. P.

***Sulphur in steel ; Accurate end point in the volumetric determination of* ——.** H. Zschiegner. J. Ind. Eng. Chem., 1916, 8, 324.

The hydrogen sulphide produced by decomposition of the steel is absorbed in an ammoniacal solution of cadmium chloride, and the precipitated cadmium sulphide is decomposed by hydrochloric acid in the usual way. The solution is titrated with iodine (or iodide-iodate) solution in a white porcelain beaker, 7 cm. diam. and 16 cm. deep, with a thin disc of black hard rubber or celluloid, 2 cm. diam., cemented on the inside of the bottom, or in a glass beaker with a black spot painted on the bottom outside and then coated externally with white enamel. The point at which the black spot or disc just becomes invisible on adding the iodine solution in presence of starch, is taken as the end of the titration. The iodine solution is standardised against a steel of known sulphur content under exactly the same conditions as are observed in the actual determination. The starch indicator is prepared by pouring a paste prepared from 12 grms. of wheat starch into 2 litres of boiling water containing 3 grms. of potassium or sodium hydroxide ; it will keep indefinitely. —A. S.

Copper sulphate and sulphuric acid ; Density of aqueous solutions of ——. [*Regulation of electrolytic copper baths.*] H. D. Holler and E. L. Peffer. J. Amer. Chem. Soc., 1916, 38, 1021—1029.

The densities of solutions of equal (weight) concentration of crystallised copper sulphate and sulphuric acid are almost identical, and, within the range studied (0—20 %), the density of solutions containing both copper sulphate and sulphuric acid is approximately a linear function of the joint concentration of the two solutes. Curves are given for 25° and 40° C., from which the copper sulphate concentration of a solution may be deduced when the density and acidity (determined with standard caustic soda, using methyl orange as indicator) are known. The total concentrations of sulphuric acid and crystallised copper sulphate for solutions of different specific gravities at 25° and at 40° C. respectively are as follows :—Sp.gr. 1·01, 20, 26 grms. $CuSO_4,5H_2O+H_2SO_4$ per litre ; 1·03, 52, 60 ; 1·05, 84, 93 ; 1·07, 117, 127 ; 1·09, 150, 161 ; 1·11, 183, 195 ; 1·13, 217, 229 ; 1·15, 251, 265 ; 1·17, 286, 300 ; 1·19, 321, 336 ; 1·21, 357, 372 ; sp.gr. 1·23, 393, 408 grms. per litre.—F. Sodn.

Zinc ores ; Occurrence and utilisation of ——. *Part II.* Bull. Imp. Inst., 1916, **14**, 44—80.

Occurrence. Geological and other particulars are given of the occurrence of zinc ores throughout the world, excluding the United Kingdom, the Colonies, and India (see this J., 1916, 312).

Valuation. The type of formula used for calculating the value of zinc ore is V = 0·0095P(T—8)—R, where V is the value in £ per ton, P the price of spelter (good ordinary brands) in London, T the percentage of zinc in the ore, and R the returning charge (*i.e.*, cost of smelting per ton) ; but the value is affected adversely by the presence of impurities such as lead (which should not exceed 3 %), iron and manganese (which should not exceed 10 %), and fluorspar.

Treatment. The methods employed for concentrating, roasting or calcining, and smelting zinc ores are briefly outlined. The types of furnace in use for roasting blende include hand- and mechanically-raked reverberatories and multiple-hearth muffle furnaces. The latter are generally used when the sulphur dioxide is utilised for the manufacture of sulphuric acid ; blende containing 10 % Zn yields on the average 17 or 18 % of its weight of sulphuric acid (60° B., sp.gr. 1·71). At two plants in the United States, the cost of roasting blende concentrate is 5s. 7d. and 6s. 8d. per short ton of roasted material, the fuel employed being natural gas and coal respectively. The methods of distillation in use may be classified into Belgian, Silesian, and Rhenish (Belgo-Silesian), the chief differences being in the shape, size, and arrangement of the retorts and in the method of heating. As an example of the Rhenish process, particulars are given of the smeltery of the Broken Hill Proprietary Co. at Port Pirie, where the plant comprises 10 gas-fired furnaces each containing 2 tiers of retorts back to back, with 3 rows of 24 retorts in each tier, *i.e.*, a total of 1440 retorts. The charge consists of 10,000 lb. of roasted concentrate, 3000 lb. of coke, and 1500 lb. of coal, and the retorts are heated slowly to 1325°—1350° C. About 80—85% of the total zinc present is recovered as spelter and blue powder (zinc dust), the latter containing about 92% Zn and amounting to 12% of the total zinc obtained. The crude spelter contains 2—3% Pb and is refined to a 99% product by melting and allowing the bulk of the lead to separate by gravity. The loss of zinc in smelting 25% ore by the Silesian method varies between 25 and 35%, that in smelting 45—50% ore by the Belgian and Rhenish processes being between 10 and 15% n the best operated plants; the loss in retorts y either process is about 3% per day. The ombined cost of roasting and distilling one ton f ore has been estimated by Ingalls at 1 13s. 2½d. to £2 0s. 3d. for various plants in the nited States and Germany. The De Laval and nyder electrical processes of smelting and various et processes of extraction are also briefly conidered. As regards commercial spelter, reference made to the effects of the usual impurities, lead, on, cadmium, and arsenic, and to the classificaon suggested by the American Society for esting Materials (this J., 1915, 33); and statistics given showing, by countries, the world's roduction and consumption during recent years. *Utilisation of zinc.* About 80% of the world's utput is consumed in the process of galvanising, her important uses being the manufacture of loys and pigments, the desilverisation of lead, d the precipitation of gold from cyanide soluons.—W. E. F. P.

lver-arsenic alloys; Solidification of——. W. Heike and A. Leroux. Z. anorg. Chem., 1915, 92, 119—126. J. Chem. Soc., 1916, **110**, ii., 248—249.

HE alloys were prepared by fusion in sealed rcelain or siloxide tubes in an electric furnace mounted that the tube could be inverted to mix e metals. When the vapour pressure of the senic was high, the tube was enclosed in an outer rcelain vessel packed with sand. The freezingint curve shows a single eutectic point at 540° C. d 25 atomic % of As. Solid solutions are only med from 0 to 6 atomic % As. Alloys between is composition and the eutectic undergo a nsformation at 595° C., whilst a second transmation at 374° C. is observed over almost the ole range of composition. The first is due to a ction between the solid and liquid phases, ming a new solid solution with a limiting centration of 10·5 atomic % As, and the ond to a eutectoid decomposition of the latter. th changes may be suppressed by undercooling. ld dilute sodium hydroxide is used for etching, t the eutectoid structure is best developed means of potassium cyanide, and the same ution is used for alloys containing the two d solutions, whilst undercooled alloys are best hed with warm sodium sulphide. The freezing int of arsenic is found to be 814·5°±0·5° C.

drogen: Solubility of —— in the solid alloys f palladium with gold, silver, and platinum. A. ieverts, E. Jurisch, and A. Metz. Z. anorg. hem., 1915, **92**, 329—362. J. Chem. Soc., 1916, **10**, ii., 244.

CEPT for a few isolated measurements by Graham, the only determinations of the solubility of gases in solid alloys are those by Berry (Chem. Soc. Trans., 1911, 99, 463), according to which the solubility of hydrogen in alloys of palladium and gold decreases regularly with increasing gold, becoming zero at 80% Au. In the present experiments the alloys were heated to a constant temperature in an atmosphere of hydrogen at a given pressure. The range employed was from 138° to 820° C., and from 1 atmosphere pressure downwards. In all cases the solubility is proportional to the square root of the pressure, and, except in the platinum series, diminishes with increasing temperature. The addition of gold to palladium first increases and then diminishes the solubility of hydrogen, the maximum occurring at lower concentrations of gold, the higher the temperature, until at 827° C. any addition of gold lowers the solubility. The isotherms of relative solubility also pass through a maximum at temperatures below 600° C. Although hydrogen is insoluble in pure silver, the addition of silver to palladium greatly increases the solubility, until a maximum is reached at all temperatures at 40% Ag, beyond which it again falls rapidly. At 138° C. an alloy containing 40% Ag dissolves more than four times as much hydrogen as pure palladium, the solubility becoming zero at 70% Ag. The relative increase of the solubility in the case of an alloy containing 40% Ag increases with falling temperature until 270° C., but diminishes as the temperature falls further. Platinum in all proportions diminishes the solubility of hydrogen in palladium. The higher the temperature the less is the lowering of solubility produced by a given addition of platinum. At constant temperature the depression diminishes more slowly than the platinum content.

Ore slimes; Control of ——. *II.* O. C. Ralston. U.S. Bureau of Mines. Eng. and Min. J., 1916, **101**, 890—894. (See also this J., 1916, 638.)

IN tests made with a slime pulp containing 9·4% solids, the times required for partial and complete settling at temperatures from 2° to 49° C. were determined and compared with the absolute viscosities of water at the same temperatures. The time of settling at 2° C. was about 4 times that at 49° C., but for all temperatures the expression, time ÷ viscosity, was practically constant for the same degree of settlement, indicating that the rate of settling of a slime is inversely proportional to the viscosity of the medium in which it is suspended. For equal volumes of pulp, the velocity of settling, in the subsidence and consolidation phases, depended on the percentage of solids in the pulp and not on the depth of the pulp column; it increased with the depth of column in the compacting phase. In tubes of the same cross-section, the velocity of settling was inversely proportional to the depth of column or to the number of particles present, this discrepancy between results in long and short tubes being doubtless explained on the basis of simple mechanical action. The general laws governing the effect of electrolytes in the flocculation of colloids are briefly considered, and mention is made of the use of lime for flocculating ore-slimes in cyanide solutions and of sodium hydroxide and alum for deflocculation and re-flocculation, respectively, in the purification of clays by sedimentation. In the case of colloids tending to adsorb different cations to a greater extent than the anions, it has been found that the coagulating power of an electrolyte increases enormously with the valency of its cation. Thus, the ratios of the coaguatling powers of the chlorides of sodium, calcium, and aluminium on suspensoids (*e.g.*, a colloidal suspension of quartz particles negatively charged) are of the order 1 : 40 : 1600 respectively.—W. E. F. P.

Flotation [of minerals]. G. D. Van Arsdale. Eng. and Min. J., 1916, **101**, 851—855.

THE flotation of mineral particles, whatever system of treatment be employed, is primarily dependent on the surface tension of a liquid (water) in contact with a gas (usually air). Any particle specifically heavier than water may be made to float on the latter if it be small enough, of proper shape with respect to its size and weight, and coated with a surface film so that a suitable contact angle with the water is produced. The contact angle is the measure of wetness or "non-wetness" of the particle, and varies with the nature of the coating film, and the latter may be solid, liquid, gaseous, electric, or any combination of these, the conditions being very similar to those required for producing colloidal solutions or suspensions. Flotation oils have two main functions, viz., to coat the particles and produce a froth in the liquid, and may thus be divided into the two classes, "oilers" and "foamers;" one of each class should be present in the working mixture. Oils of the first class should be of a character permitting fine division or extension without emulsification, and the resultant of the interfacial tensions between water, oil, and ore should cause mineral particles to enter and gangue particles to be excluded from the oil. Experiments have indicated that crude or purified petroleum may be made to fulfil all these requirements. The most suitable oil of the second class would appear to be that which most reduces the surface tension of the water, but regard must be paid to the physical action of one oil on the other and to the fact that, to produce a durable film, the contamination must be such as to give a surface capable of variable surface tensions. When a small amount of an oil of the first class is placed on water, the oil at once films out (its contact angle with the water being zero), and a mineral particle surrounded by a film of oil in this condition sinks. By adding a small amount of an oil of the second class (*e.g.*, pine oil) the original film is caused to retract and assume a circular or globular form having a definite contact angle with the water, and the particle now floats. It would appear more rational in practice to coat the particles with the first oil in the mixing apparatus, and add the second oil in the flotation apparatus, instead of mixing the oils before use. —W. E. F. P.

Electrolysis of alkaline solutions of potassium thiocyanate. Crook and others. *See* VII.

Use of hydrofluoric acid in the separation of some heavy metals from tin, antimony, tungsten, and molybdenum by means of the electric current. McCay and Furman. *See* XXIII.

PATENTS.

Steel alloys. F. La Roche, London. Eng. Pat. 6062, Apr. 22, 1915.

AN alloy possessing great tensile strength and hardness, and containing steel 80, chromium 5, nickel 10, and vanadium 5%, is prepared by melting the constituents together, casting the product into blocks, and drawing the latter into bars. The bars are then heated to cherry redness and an electric current passed through each in a longitudinal direction for a short time, after which they are allowed to cool very slowly.—W. E. F. P.

Steel; Alloyed ——. J. Churchward, Mt. Vernon, N.Y., Assignor to Churchward International Steel Co., New York. U.S. Pat. 1,181,570, May 2, 1916. Date of appl., Mar. 18, 1911.

AN alloy containing, approximately, steel 93·40, Ni 3·50, Cr 2·00, V 0·35, Mn 0·50, and Si 0·25%. —W. E. F. P.

Mild steel, steel, or copper; Process for deoxidisin
——. H. König, Düsseldorf. Ger. Pat. 291,401
May 15, 1914. Addition to Ger. Pat. 290,30
(this J., 1916, 514).

IN addition to the continuous electric current use
for treating the molten metal as described in th
chief patent, a second current is used to produc
an arc for heating purposes.—A. S.

Briquetting machines [for metal borings, etc.
C. Kerte, Leeds. Eng. Pat. 1816, Feb. 5, 191

THE briquettes are compressed between two pre
plungers, both of which are reciprocated mechani
ally, one of them having a liquid transmittin
link. The pressure cylinder containing liquid
connected to a supplementary cylinder, the pisto
of which moves against a spring, so that at
predetermined pressure a valve is operated t
release the liquid in the main cylinder and reliev
the pressure on the briquette.—W. F. F.

Ore concentrators and mineral separators. Partner
Ltd., and P. J. Ogle, London. Eng. Pat. 915
June 22, 1915.

THE ore pulp is caused to flow over an incline
surface of transversely fluted glass while th
latter is subjected to vertical and horizont
percussions. The horizontal percussion
unidirectional and imparted to the lower delive
end of the working surface, the vertical percussi
being imparted to the upper feed end.—W. E. F.

Magnetic [ore] separators. F. Krupp A.-G. Gruso
werk, Magdeburg-Buckau, Germany. Eng. Pat
(A) 100,063 and (B) 100,379, Jan. 11, 1916. Und
Int. Conv., Feb. 9, and Oct. 22, 1915. (Appl
Nos. 488 and 4338 of 1916.)

(A) The stationary pole plates of the magnet
separator are surrounded by a delivery dru
carrying the material, and the poles are so co
structed and arranged with respect to one anoth
that the individual fields formed by each t
adjacent plates increase or decrease or alternate
increase and decrease in the direction of the supp
of the material. For this purpose, the plat
may be axially adjustable for varying the magne
field, and may be rotated individually or in grou
about an axis for adjusting the increasing
decreasing field with respect to the point of sup
of the material. The pole plates may be provid
on their periphery with adjustable pole pie
located one behind the other. The pole pie
may be displaced in a radial direction, for varyi
the distance between the poles and the surroundi
delivery drum. In an alternative form, the r
material is supplied beneath the drum, which
rotated in a direction opposite to that of t
supply of the material, so that it receives fi
a layer of weakly-magnetic material upon wh
the strongly-magnetic material is deposited, owi
to the increase of the intensity of the field.
magnetic roller and an adjustable counterpole
provided at the point of discharge, for remov
the upper layer of strongly magnetic mate
in order to separate the two kinds. (B) Induct
rings, made of magnetic or alternately magne
and non-magnetic material, are arranged up
the delivery drum, so that they form with t
stationary pole plates, and, if necessary, w
stationary pole pieces, increasing or decreas
magnetic fields. The pole plates are constitu
so that the distances of their effective periph
surfaces from the delivery drum increase
decrease, or alternately increase and decre
in the direction of rotation of the drum. Station
induction ring members, forming auxiliary p
pieces, may be arranged within the delivery dr
between the pole plates, the width of the mem
and the induction rings being similarly varia

in the direction of rotation of the drum. Both the induction rings and ring members may be adjusted axially, and certain or all of the induction rings may be composed of overlapping parts, each of which is axially adjustable.—B. N.

[*Cobalt-nickel-manganese*] *alloy.* British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 13,207, Sept. 15, 1915.

A DUCTILE and malleable alloy for use in the manufacture of lead wires for electric lamps, having a low heat-conductivity and composed of cobalt 20—30 (25), nickel 80—70 (75), and manganese about 2 parts by weight, is prepared by melting the cobalt and nickel together in an alundum crucible in an atmosphere of hydrogen, adding the manganese when the melt is quiescent and cooled to about 1250° C., and then chilling the product in water. The materials employed should be free from aluminium, lime and other basic impurities, sulphur, phosphorus, silicon, and carbon, these impurities tending to make the alloy brittle.—W. E. F. P.

Metallic coatings; Process for producing ——. G. Stolle, Kiel, Germany. Eng. Pat. 100,322, Feb. 19, 1915. (Appl. No. 1935 of 1916.)

IN the production of metallic coatings by spraying atomised molten or vaporised metal, oxidation of the latter is prevented by causing the pipe leading to the nozzle to traverse a ribbed or water-cooled intermediate pipe so that the metal is cooled before passing into the atmosphere.—W. E. F. P.

Ores: Art of agglomerating ——. J. H. Payne, Baltimore, Md. U.S. Pat. 1,181,244, May 2, 1916. Date of appl., July 28, 1915.

FINELY divided sulphide ore or matte is heated to incipient fusion, or until at least a portion of the ore fuses, and the hot mass cooled while in the form of a relatively thin layer in a mould, all the operations being conducted in a non-oxidising atmosphere.—W. E. F. P.

Metals [*tungsten and iron*]; *Method of joining* ——. W. D. Coolidge, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,181,741, May 2, 1916. Date of appl., Mar. 20, 1912.

TUNGSTEN is united to iron by interposing a thin ayer of copper, and heating in a hydrogen atmosphere to a temperature sufficient to melt the copper. —B. N.

Zinc, lead, copper, etc.] *Flue products; Method of treating* ——. F. C. Ryan, Hammond, Ind., Assignor to United States Metals Refining Co., Chrome, N.J. U.S. Pat. 1,182,320, May 9, 1916. Date of appl., Feb. 24, 1914.

FLUE dust, etc. (from the treatment of complex res containing gold and silver) is successively eached with water, roasted with excess of sulphuric cid, and boiled with a limited quantity of water, hereby an insoluble residue containing lead ulphate and gold is obtained. The aqueous olution is treated with air, mixed with the acid quid, and the mixture nearly neutralised to ecipitate iron, arsenic, antimony, bismuth, and llurium, the filtrate from the latter being then eated for the recovery of zinc, copper, cadmium, nd silver.—W. E. F. P.

inc vapour in electric furnaces; Apparatus for the condensation of ——. A/S Metalforedling, Drontheim, Norway. Ger. Pat. 291,492, Mar. 31, 1914. Addition to Ger. Pats. 289,493 and 290,690 (this J., 1916, 427, 606).

HE flues in which the zinc vapour is condensed are rrounded by chambers the temperature of which can be regulated so as to maintain the desired temperature in the condensing flues. For example, the waste gases from the condensing flues may be circulated through these chambers, a boiler or the like being interposed in the circuit to facilitate adjustment of the temperature.—A. S.

Bronze powder; Manufacture of ——. M. J. Fuchs, Stamford, Conn., U.S.A. Eng. Pat. 17,496, Dec. 14, 1915.

Roasting of sulphur-bearing ores. Roasting-furnace for sulphur-bearing ores. H. H. Stout, Assignor to General Chemical Co., New York. U.S. Pats. 1,181,183 and 1,181,184, May 2, 1916. Dates of appl., July 31, 1911, and June 5, 1915.

SEE Eng. Pat. 9958 of 1915; this J., 1915, 1150.

XI.—ELECTRO-CHEMISTRY.

Electrolysis of alkaline solutions of potassium thiocyanate. Crook and others. *See* VII.

Electrochemical action on glass. Bryson. *See* VIII.

Use of hydrofluoric acid in the separation of some heavy metals from tin, antimony, tungsten, and molybdenum by means of the electric current. Mackay and Furman. *See* XXIII.

PATENTS.

Battery; Electrolytic ——. H. S. Mackay, Assignor to Mackay Process Co., Norwich, Conn. U.S. Pat. 1,182,096, May 9, 1916. Date of appl., Apr. 9, 1915.

THE anode plates of the battery have openings of such size as to reduce the surface area 50%, and permit circulation of the electrolyte. Insulating strips, with rabbeted edges and openings, are secured to the vertical side edges of the plates, and cathodes are located between the edges and in the rabbeted corners of the strips, with means for locking the strips together and clamping the cathodes.—B. N.

Battery [*electrode*]. H. G. C. Thofehrn, Assignor to J. M. Flannery, Pittsburgh, Pa. U.S. Pat. 1,182,513, May 9, 1916. Date of appl., Feb. 13, 1915.

SEE Eng. Pat. 5395 of 1915; this J., 1915, 1212.

Apparatus for electrolysis of fused alkali halides. Ger. Pat. 291,240. *See* VII.

Sewage disposal means. [*Electrolytic filter.*] U.S. Pat. 1,182,316. *See* XIXB.

XII.—FATS; OILS; WAXES.

Cokerite fruits and oil from British Guiana. Bull. Imp. Inst., 1916, **14**, 8—13.

COKERITE fruits derived from the cokerite palm, probably *Maximiliana regia*, are about 1½ to 2 in. long, and consist of pericarp and nut including the kernel, the structure being analogous to that of oil-palm fruits. The pericarp is tough and fibrous externally, but soft and pulpy internally; it contains 12·1% of moisture and yields 15% of semi-solid, orange-red oil resembling palm oil in appearance and having the following characters: acid value, 28·6; saponif. value, 211·6; iodine value, 51·4%; solidif. pt. of fatty acids, 25·5° C. The kernels contain 11·3% of moisture and yield 56·9% of a fairly hard, cream-coloured fat with an odour resembling coconut oil and possessing the following characters: sp. gr. at 100°/15° C., 0·8668; m.pt., 27° C.; solidif. pt. of fatty acids, 24·2° C.; acid value, 3·1; saponif. value, 253;

iodine value, 13 % ; Hehner value, 88·9 ; insoluble fatty acids, 88·6 % ; unsaponifiable matter, 0·3 % ; indicating that the fat is similar to palm-kernel and coconut oils. The meal left after extracting the fat from the kernels gave figures on analysis indicating that its feeding value is approximately equal to that of palm-kernel cake and rather lower than that of coconut cake. The principal difference affecting the commercial value between cokerite and oil-palm fruits is that the former have a thin pericarp giving a comparatively small yield of oil, whereas the latter have a thick soft pericarp rich in oil. The yield of kernels however compares favourably with that from the best oil-palm fruits, whilst the oil-content of the kernels is rather higher than that of palm kernels.—T. C.

Sunflower, niger, and safflower seed ; Cultivation and utilisation of ——. Bull. Imp. Inst., 1916, **14**, 88—101.

The sunflower is cultivated on a commercial scale only in Central and South Eastern Europe, but trial and experimental crops have been grown in many other parts of the world, usually with success. The stems and leaves of the plant have little nutritive value, but the ash of the former yields about 39 % of potash (as K_2O), whilst the seed-husks give an ash containing 56 % of potash. An acre of land produces 2600 to 4000 lb. of stalks yielding 40 to 53 lb. of potash. Sunflower seed is used largely as a poultry food, and as a source of oil. Russian seed kernels yield 18 to 24 % whilst Hungarian seed kernels yield 28 to 30 % of oil on a commercial scale. Seed grown in the Sudan contained 22 % of oil, the kernels containing 47·9 %. Sunflower seed oil has sp. gr. 0·924 to 0·926 at 15°/15° C., saponif. value 188 to 194, iodine value 120 to 135 %. When cold-pressed it is almost tasteless and is suitable for edible purposes. Oil unsuitable for edible purposes is used for burning and soapmaking and as an inferior varnish oil. Sunflower cake is produced in large quantities in South Russia and is largely exported to Denmark, where it is a popular cattle food. The niger seed plant (*Guizotia abyssinia*, Cass.) is cultivated fairly generally in East Africa for local use and also on a large scale in India. The small black seeds contain 40 to 45 % of oil having the characters : sp. gr. at 15°/15° C., 0·925—0·927 ; saponif. value, 189—192 ; iodine value, 127—134 % ; it is used as an edible oil, for soapmaking, and as an inferior substitute for linseed oil. Niger seed cake is similar in feeding value to sunflower seed cake. Safflower (*Carthamus tinctorius*, Linn.) is an annual herb grown in India and Egypt chiefly as an oil-seed plant and also to a small extent for the dye which is obtained from the florets. The seeds contain 30 to 32 % of oil, which is very similar to sunflower seed oil and has the characters : sp.gr. at 15°/15° C., 0·925—0·928 ; saponif. value, 187—194 ; iodine value, 130 to 150 %.—T. C.

Lauric, myristic, palmitic, and stearic acids ; Solubility data for various salts of ——. C. A. Jacobson and A. Holmes. J. Biol. Chem., 1916, **25**, 29—53.

Lithium, magnesium, beryllium, barium, lead, and silver salts of these acids were prepared and their solubility determined in various solvents at temperatures from about 15·5° C. to 50° C. Methyl alcohol was found to be the best general solvent for these salts. Lithium laurate is about 5 times as soluble in water as lithium myristate, whilst absolute alcohol dissolves about 5 times as much magnesium myristate as magnesium palmitate at 15° C. and 25° C. Beryllium formed basic salts with the fatty acids.—C. A. M.

Charlock oil ; American ——. H. S. Bailey and L. B. Burnett. J. Ind. Eng. Chem., 1916, **8**, 429.

A sample of charlock (*Brassica arvensis*) seed, containing 1—2 % of brown mustard (*B. juncea*) seed, yielded 30 % of extract to ether and 29·6 % to petroleum spirit (b.pt. 35°—60° C.). The characters of the oils separated by cold pressing and by extracting the press-cake with ether and with petroleum spirit respectively, are shown in the following table :—

	Ex pressed oil.	Oil extracted by :	
		Ether.	Petroleum spirit.
Sp. gr. at 15°/15° C.	0·9221	0·9272	0·9212
Refract. index at 25° C.	1·4734	1·4739	1·4729
Saponif. value	182·9	183·1	181·0
Iodine value (Hanus)	121·1	119·8	119·3
Insol. acids and unsaponif. matter	95·3	95·4	95·2
Soluble acids	0	0	0
Mean mol. wt. of insol. acids..	339·1	338·1	334·8
Percentage of liquid acids ..	89·3	90·0	90·0
Iodine value of liquid acids	126·0	122·3	125·0
Percentage of solid acids....	3·1	1·6	2·0
Iodine value of solid acids	—	62·0	61·0

—A. S.

Lauric and myristic acids ; Separation of —— *from each other and from mixtures of other fatty acids.* C. A. Jacobson and A. Holmes. J. Biol. Chem., 1916, **25**, 55—61.

A method is based upon the differences in solubility of lithium laurate and myristate in water, and of magnesium myristate and palmitate in alcohol (see preceding abstract). A mixture of 0·5 grm. each of lauric, myristic, palmitic, and stearic acids was converted into potassium soaps which were dissolved in water and treated with a slight excess of lithium acetate. The precipitate was equivalent to 76·3 % of the original fatty acid mixture, and had a neutralisation value of 217·5 as compared with the theoretical 220·9. Treatment of the magnesium salts of myristic, palmitic, and stearic acids with absolute alcohol did not effect a good separation, probably owing to the influence of one salt on the solubility of the others. Fairly satisfactory results were obtained by digesting the mixed magnesium salts (0·5 grm. each) with 60 c.c. of 50 % alcohol for 2 hours at 60° C., cooling and filtering the liquid, and again extracting the insoluble portion. The final residue yielded a mixture of acids melting at 56·5° C. and with neutralisation value 209·3, as against 56·4° C. and 208·3 respectively for a mixture of equal parts of stearic and palmitic acids. —C. A. M.

Azelaic acid ; Occurrence of —— *as a product of the spontaneous oxidation of fats.* B. H. Nicolet and L. M. Liddle. J. Ind. Eng. Chem., 1916, **8**, 416—417.

A sample of fuller's earth, which had been used for refining cottonseed oil and then left exposed to the air for 1½ years, was extracted with alcohol. The oil thus obtained was found to contain 0·6 % of free and 9·8 % of combined azelaic acid. The low proportion of free azelaic acid confirms the view that the rancidity of fats is due not simply to hydrolysis of the glycerides, but also to oxidation, which may be independent of such hydrolysis. A "shredded" laundry soap, which had become acid on storage, was found to contain 0·5 % of azelaic acid.—A. S.

Naphthenic acid. L. G. Radcliffe and A. A. Pollitt. J. Soc. Dyers and Col., 1916, **32**, 160—166.

Five samples of imported commercial naphthenic acid varied in colour from yellow to nearly black. The sp.gr. at 15·5° C. ranged from 0·9580 to 0·9725, and the neutralisation values from 257·2 to 271·3. A so-called "pure" sample had an iodine value of 7·4 and mean molecular weight of 291·5. Another sample, distilled at the ordinary pressure, yielded a fraction of about 85 % boiling from 200° to 300° C. This fraction had sp.gr. 0·9650 and neutralisation value 273·8. The methyl ester prepared from the "pure" acid was a nearly colourless liquid boiling at 245° to 265° C. and having sp.gr. 0·9285 at 15·5° C. The fraction of commercial naphthenic acid boiling between 200° and 300° C. apparently consists of acids ranging in molecular weight from 212 (C_{13}) to 352 (C_{23}) and corresponding to the general formula $C_nH_{2n-2}O_2$. A crystalline amide was obtained by triturating the mixed acid chlorides with ammonium carbonate, extracting the product with cold water, dissolving the insoluble oily amides in ether, and allowing the solution to evaporate. Naphthenic acid is rendered soluble by sulphonation, but soon hydrolyses and becomes insoluble again. The sulphonated product may be freed from water by heating it in a water oven, when it separates as a dark reddish brown oil. A solution of the mixed sodium and ammonium salts of the sulphonated acid readily emulsifies benzene and similar substances. Naphthenic acid is an excellent solvent for gums and resins. No powdering is required and the solutions obtained by heating the resin with about half its volume of the acid can be considerably diluted with linseed oil or turpentine without rendering the resins insoluble. *Solubility of varnish resins :*—The following are readily soluble in naphthenic acid :—Kauri gum, bush Kauri gum, Kauri gum XSB, Kauri gum B.I. sap., juniper gum, sandarac, damar, Manila copal, nubs, mastiche electum, and pure Burgundy pitch. Congo gum, dragon's blood, and guaiacum gum are nearly as soluble as the preceding, but amber is only slightly soluble. *Salts of commercial naphthenic acid :*—The sodium salt, made by neutralising the acid with caustic soda and evaporating the water, is a soft, yellowish-white, soapy mass, which has good detergent properties but is deficient in lathering power. The calcium salt is a brown semi-transparent mass less soluble in hot than in cold water. It can be powdered to a resinous white powder which soon agglomerates to a solid mass. The magnesium salt is a semi-fluid, light-brown mass somewhat resembling vaseline. The lead salt dries to a plastic non-sticky resinous product, while the aluminium salt dries to an elastic, white or cream-coloured non-sticky mass. The iron salt prepared with ferrous sulphate is a white, plastic substance which rapidly oxidises to a dark reddish-brown ferric compound. It is soluble in petroleum spirit, forming a solution which can be used as a wood-stain. The nickel salt forms an emerald green translucent mass, which can be powdered when dry. The cobalt salt is a dark red, non-sticky mass, while the dried titanium salt is a creamy white, granular powder (containing 5·28 % titanium) which is soapy to the touch and darkens slightly on exposure. Destructive distillation of the calcium salt yielded a clear reddish liquid, which could be separated by fractional distillation (27° to 280° C.) into a series of undefined products with an odour of petroleum. *Dyeing tests :*—Comparative tests with *p*-Nitraniline Red showed that while naphthenic acid was inferior to Turkey-red oil, the sulphonated naphthenic acid produced a bluer and brighter shade. *Titanium naphthenate as mordant :*—By steeping cotton in sodium naphthenate solution (5 % naphthenate on the weight of the cotton, diluted with water to 20 times the weight of cotton), then passing it through a bath of titanium oxalate (5 grms. in 1000 c.c. of water with 1 grm. of salt), and dyeing it in an alizarin bath, full and pleasing shades were obtained, whereas when titanium tannate is used as mordant its yellow colour affects the final tint.—C. A. M.

Sulphonated oils ; Report of Amer. Leather Chem. Association Committee on analysis of ——. C. R. Oberfell. J. Amer. Leather Chem. Assoc., 1916, **11**, 226—233.

Determinations of water, ammonia, ash, and unsaponifiable matter should be made, and total fatty matter calculated as the difference between the sum of the first four items and 100 %. Ammonia is estimated by dissolving 10 grms. of oil in 150 c.c. of ether and extracting four times with dilute sulphuric acid (1 : 5) in a separating funnel. The acid extract is distilled with excess of alkali, and the evolved ammonia collected in 100 c.c. of *N*/10 acid.—F. C. T.

Ceanothus velutinus (snow brush) as a source of wax and tannin. Scalione and Blakemore. *See* XV.

Patents.

Heating and agitating apparatus, particularly applicable for use in the treatment of fats and oils. S. G. S. Dicker, London. From Reuter Process Co., Chicago, U.S.A. Eng. Pat. 9395, June 26, 1915.

An apparatus especially adapted for treating oils by the process described in U.S. Pat. 1,068,079 of 1913 (this J., 1913, 875) comprises a tank with a tapering bottom, containing an arrangement of tubes through which the oil is forced by means of steam injected through a nozzle, which may be composed of a series of hollow, inverted truncated cones connected by means of perforated webs. The inlet to the tubes may be arranged below the normal level of the contents of the tank, while the steam supply is adapted to discharge steam towards the outlet end of the system of tubes. —C. A. M.

Mixing apparatus [for hydrogenating oils]. F. N. Arnold, Buffalo, N.Y. U.S. Pat. 1,181,205, May 2, 1916. Date of appl., July 9, 1914.

Oils are hydrogenated in a closed vessel provided with means for heating, and containing a central vertical shaft carrying paddles, which rotate near the upper and lower surfaces of the material. The oil is driven against deflectors fixed to the side of the vessel and inclined upwards and forwards, so that portions of the material are projected up to the cover of the vessel and fall in a finely divided state through the hydrogen. —C. A. M.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Pigments : Foundation of a scientific theory of ——. *I. Fundamental properties of pigments and the size of the particles.* W. Ostwald. Kolloid. Zeits., 1915, **16**, 1—4. J. Chem. Soc., 1916, **110**, ii., 205—206.

The paper deals mainly with the influence of the size of the pigment granules on the chief properties, which are defined as colour, covering power, and effectiveness (*Ausgiebigkeit*). The colour is determined by the selective absorption, and the covering power, which depends on the scattering of the incident light, is determined essentially by the refractive index of the pigment. As a measure of the covering power, the author suggests the maximum number of sq. cm. of surface which can be covered by 1 grm. of pigment so that the underlying surface is invisible. The effectiveness, measured by the number of grms. of white pigment with which 1 grm. of the coloured pigment must be mixed before the colour of the latter begins to disappear, is determined by the magnitude of the coefficient of light absorption. The influence of the size of the particles on the colour of many substances has already been examined in some detail, and the observed changes in colour have been explained satisfactorily on a physical basis. The covering power of a pigment seems to increase to a maximum with diminution in the size of the particles, and to decrease again when the size of the particles approaches the wave-length of visible light rays. Pigments which consist of smaller particles than this have no scattering power towards light, and the covering power approximates to zero. The effectiveness of a pigment is well known to increase with the fineness of subdivision, and in general no maximum is to be expected as the size of the particles is continuously diminished. The effectiveness appears to be greatest when the degree of fineness is that corresponding with molecular dispersity.

Ester gums or artificial resin esters. C. Ellis and L. Rabinovitz. J. Ind. Eng. Chem., 1916, 8, 406—411.

When acid resins are used for the preparation of varnishes, and the latter subsequently ground with basic pigments, the products tend to "liver" or thicken owing to combination of the resin acids with the pigments. Among the methods proposed and used to overcome this difficulty is the conversion of the resin acids into esters by treating the resins with glycerin or the like. In experiments by the authors, esters having an acid value of 6—7 were obtained by heating rosin with glycerin in a vessel fitted with a stirrer and a reflux condenser, but the products were darker in colour than the original rosin. Products of satisfactory colour, with an acid value of 13—13·5, were obtained by heating 60 parts of rosin with 8 parts of glycerin for about 4 hours at 270° C.; the yield of ester was equal to the weight of rosin taken. It was not found possible to obtain esters by heating rosin with ethyl alcohol, phenol, cresol, aniline, α- or β-naphthylamine, sugar, starch, or dextrose under ordinary conditions; and rosin did not combine with aromatic amino-compounds in presence of dehydrating agents even under considerable pressure. The colour of rosin esters was not improved by treatment with bone-black, fuller's earth, or sulphur dioxide. Congo gum resin, pontianak gum, and dammar gum can also be esterified to a greater or lesser degree by heating with glycerin, and copal gums are readily esterified after being rendered soluble in the usual solvents by "cracking." The acids of rosin appear to be converted into anhydrides by passing an inert gas through the rosin at 300° C. The anhydrides are unaffected or but slowly affected by aqueous alkali, but are readily saponified by alcoholic alkali.—A. S.

Naphthenic acid. Radcliffe and Pollitt. *See* XII.

Patents.

Colour lakes; Production of ——. J. Y. Johnson, London. From Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 28,741, Dec. 12, 1913.

Colour lakes are prepared at the ordinary or a higher temperature from the synthetic tanning agents, *e.g.*, "Neradol D," mentioned in Eng. Pats. 8511 of 1912 (see Fr. Pat. 443,730; this J., 1912, 1015), 21,982 of 1912 (this J., 1913, 919), or 18,259 of 1913 (this J., 1914, 877), a basic dyestuff, and a base or salt to form a lake, in presence or absence of Turkey-red oil or other vehicle, diluent, or substratum. The products possess the same fastness but are more brilliant than those prepared by using tannin and tartar emetic. *Example*: 1 grm. of Methyl Violet B is dissolved in 700 grms. of water, 100 grms. of a 4% suspension of aluminium hydroxide added, and then 2 grms. of the neutralised product described in Example 1 of Eng. Pat. 8511 of 1912 (*loc. cit.*) introduced. —F. W. A.

Sulphate, sulphide, and oxide of lead; Manufacture of —— *directly from lead sulphide ore or other forms of sulphide of lead.* J. Gitsham, London. Eng. Pat. 5299, Apr. 8, 1915.

Finely divided lead sulphide ore is volatilised in an electric furnace, and the vapour is drawn off into a flue or combustion chamber where it is subjected to the action of oxygen (air). A mixture of lead sulphate, lead sulphide, and lead oxide, adapted for use as a pigment, is obtained by separating the solid products from the gases. —J. B. C. K.

Paint and pigment. O. W. Pickering, Springfield, Mass., Assignor to Pickering Paint and Pigment Co. U.S. Pat. 1,181,588, May 2, 1916. Date of appl., Aug. 4, 1915.

An aluminate of lead or other metal is incorporated with a hydroxide of lead or other metal, with or without a paint vehicle.—C. A. M.

Hydrocarbons; Process and apparatus for decomposing light —— [*for the production of carbon black*]. E. Herman, Budapest. Ger. Pat. 290,883, Oct. 23, 1914.

The hydrocarbon gas, *e.g.*, methane, is introduced under pressure into a slowly rotating vertical cylinder, whence it issues in the form of fine jets through nozzles fixed in the periphery. These jets strike against a second cylinder which encloses the first and is heated to a high temperature by surface combustion. The carbon deposited on the heated surface is removed by scrapers and falls through the narrow annular intermediate space into a receptacle below.—A. S.

Lacquers from polymerisation products of organic vinyl esters. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 291,299, May 8, 1915. Addition to Ger. Pat. 290,544.

Ketones, nitrohydrocarbons, or aldehydes are used as solvents, either alone or in admixture with other solvents, diluents, or swelling agents, in the preparation of lacquers from polymerised vinyl esters (see Fr. Pat. 474,086 of 1914; this J., 1915, 724). With the solvents mentioned, *e.g.*, acetone, methylethyl ketone, acetophenone, cyclohexanone, nitromethane, nitrobenzene, benzaldehyde, salicylaldehyde, it is possible to use also considerable quantities of petroleum spirit, benzene, chlorobenzene, etc., which cannot be used alone.—A. S.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber in a compound; Direct determination of the ——. R. W. Belfit. J. Ind. Eng. Chem., 1916, 8, 326—327.

The finely ground rubber is extracted with acetone, dried, treated with hydrochloric acid to decompose carbonates, again dried, and then the carbon content determined by combustion, and the quantity of $C_{10}H_{16}$ calculated from the amount of carbon dioxide found. For fine hard Para rubber the average value found was 96·38% $C_{10}H_{16}$, and the quantity of $C_{10}H_{16}$ is therefore divided by 0·96 to obtain the amount of rubber. The method is applicable only to high-grade rubber compounds not containing lampblack, "shoddy," rubber substitute, or organic loading materials. (See also Wesson, this J., 1914, 703.)—A. S.

Barium carbonate and sulphate in vulcanised rubber goods ; Determination of ——. J. B. Tuttle. J. Ind. Eng. Chem., 1916, **8**, 324—326.

The total barium in the rubber is determined as barium sulphate (Smith and Tuttle, U.S. Bureau of Standards, Circ. 38, 1915, p. 68 ; India Rubber World, 1914, **51**, 128). To determine barium carbonate, 1 grm. of the rubber is placed in a porcelain boat and ignited in a current of carbon dioxide in a glass tube (Schaeffer, this J., 1912, 1139), the residue is finely ground, treated with 5—10 grms. of ammonium carbonate, 15—20 c.c. of strong ammonia solution, and 50 c.c. of water, and boiled for 15—20 mins. to convert lead sulphate into carbonate. The insoluble matter (barium sulphate and carbonates of lead, barium, calcium, and zinc) is filtered off, washed to remove soluble sulphates, and treated with 10 c.c. of glacial acetic acid and sufficient water to make the total volume 100 c.c.; the solution is heated to boiling, and filtered. Lead is removed from the solution by precipitation as sulphide, and the barium then determined as sulphate. This gives the barium present as carbonate, and the barium present in the rubber as sulphate is obtained by difference.—A. S.

Patents.

India-rubber : Apparatus used in the coagulating and curing of ——. Rubber Curing Patents Syndicate, Ltd., London, and F. A. Byrne, Birmingham. Eng. Pat. 13,682, Sept. 27, 1915. Addition to Eng. Pat. 27,665, Dec. 9, 1911 (this J., 1913, 35).

The furnace used for heating the smoke-producing retort, described in the former patent, is surrounded by an outer jacket, with adjustable air-inlets at one end and a flue at the other, for the purpose of warming air to be passed into the curing-shed simultaneously with the smoke. By this means the curing vapours are prevented from descending to the lower levels of the shed.—E. W. L.

Vulcanising process. P. I. Murrill, New York, Assignor to Morgan and Wright. U.S. Pat. 1,182,501, May 9, 1916. Date of appl., Mar. 4, 1915.

Bone oil is used as an accelerator of vulcanisation. —E. W. L.

Rubber and fabric ; Process of treating automobile tyres and other like articles for separating the ——. C. P. Bary, Assignor to H. P. C. G. Debauge, Paris. U.S. Pat. 1,182,071, May 9, 1916. Date of appl., July 8, 1914.

See Eng. Pat. 16,116 of 1914 ; this J., 1915, 880.

XV.—LEATHER ; BONE ; HORN ; GLUE.

Ceanothus velutinus (snow brush) as a source of wax and tannin. C. C. Scalione and H. S. Blakemore. J. Ind. Eng. Chem., 1916, **8**, 411—413.

Ceanothus velutinus, Douglas, is a shrub, 2—6 ft. high, which grows abundantly in the forests of California. The leaves were found to contain 7·3% of a wax and 17·3% of a catechol-tannin. The crude wax melts at 78°—79° C., and has sp. gr. 0·988 at 15° C., acid value 20.3, saponif. value 93·4, Reichert-Meissl value, 7·5, iodine value 19·5. It is composed of palmitic and stearic acids combined with ceryl and myricyl alcohols, free cerotic acid, a hydrocarbon, and probably a small quantity of glycerides. Preliminary tests in a tannery indicated that a tanning extract of satisfactory quality could be made from the leaves. —A. S.

Analysis of sulphonated oils. Oberfell. *See* XII.

Patent.

Leather ; Impregnation of ——. W. P. Thompson, Liverpool. From. A. Wolff, Hamburg, Germany. Eng. Pat. 15,326, Oct. 30, 1915.

Leather tanned with chromic salts of organic acids, especially chromic formate, may be dried at 100° C. or above without losing pliability or becoming brittle. Leather so tanned is treated with a water-soluble mixture of soap and mineral oil to prevent shrinking during drying, and subsequently impregnated by immersion in the usual materials under reduced pressure in a vacuum pan.—F. C. T.

XVI.—SOILS ; FERTILISERS.

Soil acidity ; New method for the determination of ——. E. Truog. Science, 1914, **40**, 246—248. Wisconsin Agric. Expt. Stat., Bull. 249.

Ten grms. of soil is shaken with 1 grm. of calcium chloride, 0·1 grm. of zinc sulphide, and 100 c.c. of water and heated over a small flame. After boiling for 1 min., a strip of moistened lead acetate paper is placed over the mouth of the flask, and boiling continued for 2 mins. more. The degree of darkening of the paper is a measure of the acidity or lime requirement of the soil.—A. S.

Soil carbonates ; New apparatus for the determination of ——, *and new methods for determination of soil acidity.* E. Truog. J. Ind. Eng. Chem., 1916, **8**, 341—345.

The novel feature of the apparatus for the determination of soil carbonates is the use of the bulb of a dropping funnel as the reaction vessel ; the stem of the funnel is bent upwards and connected with a supply of purified air, which on rising through the stopcock into the bulb causes violent agitation of the mixture of soil and acid. The carbon dioxide is absorbed in barium hydroxide solution in a tower packed with glass beads (J. Ind. Eng. Chem., 1915, 1045).

The acidity of soils is of two kinds, viz., active acidity capable of neutralising bases immediately, and latent acidity which neutralises bases only by prolonged contact. The active acidity may be determined by treating the soil with excess of barium hydroxide solution, and after stirring for exactly 1 minute, converting the excess of baryta into carbonate by a current of carbon dioxide, evaporating, and determining the amount of carbonate present. To determine the latent acidity, the mixture of soil and barium hydroxide solution is boiled for 30 mins., then evaporated to dryness, and heated for 2½ hours at 110° C., after which water is added, and the excess of baryta converted into carbonate as before. This gives the total acidity, and the latent acidity is obtained by deducting the active acidity. The latent acidity is usually from twice to three times as much as the active acidity. The active acidity as determined by the method given is several times as great as that shown by the Veitch method (this J., 1904, 762). Practically the same results are usually obtained if calcium or sodium hydroxide be used in place of barium hydroxide. The injurious effect of soil acidity on crops depends not only upon the quantity of acidic substances present but also upon their strength or avidity. The relative avidity may be determined by treating the soil with a quantity of potassium acetate solution equivalent to the active acidity, shaking for 2 mins., filtering, and titrating with sodium hydroxide. For the determination of the lime requirement of a soil a method such as that described previously (see preceding abstract), which takes into account both the quantity and strength (avidity) of the acidic substances, is most satisfactory.—A. S.

Carbonates in soil; Determination of carbon dioxide as barium carbonate applied to the Marr method for determination of ——. C. J. Schollenberger. J. Ind. Eng. Chem., 1916, **8**, 427—428.

In Marr's method for the determination of soil carbonates (this J., 1909, 1213), in which the carbon dioxide, liberated by boiling the sample with dilute hydrochloric acid under diminished pressure, is absorbed in sodium hydroxide and then determined by the double titration process, the last-named operation does not give accurate results. The results by Truog's method (see preceding abstract) in which the carbon dioxide is absorbed in a measured excess of baryta, and the excess titrated with acid, are also not trustworthy unless the acid is standardised by a control test with a sample of known carbonate content. Accurate results are obtained if the carbon dioxide be absorbed in barium hydroxide solution, and the barium carbonate filtered off, dissolved in excess of $N/10$ hydrochloric acid, and the excess titrated with $N/10$ alkali (Cain, this J., 1914, 696).—A. S.

Kelp; Decomposition of the organic matter of —— *in the soil.* A. W. Christie. J. Ind. Eng. Chem., 1916, **8**, 425—427.

Laboratory tests indicate that dried and ground kelp decomposes in the soil with formation of humus and is at least as efficient in this respect as alfalfa, "manure," and straw. The proportion of pentosans decomposed in 3 months (75—80 % of the quantity originally present) was about the same in all cases.—A. S.

Aluminium salts; Toxic action of soluble —— *upon the growth of the rice plant.* K. Miyake. J. Biol. Chem., 1916, **25**, 23—28.

Solutions of aluminium chloride of greater concentration than $N/7500$ have a toxic action upon rice seedlings about equal to that of hydrochloric acid of the same normality. This toxic action is not due to hydrogen ions formed by hydrolysis of the dissolved salt. The concentration of hydrogen ions from the hydrolysis of aluminium chloride is less than that from the hydrolysis of hydrochloric acid of the same normality. Since chlorine ions in such dilute solution are not toxic to rice seedlings the toxic action may be due to colloidal aluminium hydroxide, unhydrolysed aluminium chloride, or aluminium ions. The toxicity depends upon the amount of aluminium in the soluble aluminium salts. Titration of the soil extract with standard alkali thus affords not only a measure of the amount of bases required to neutralise the acidity, but also of that required to decompose the aluminium salts, to which cause infertility of the soil may also be due.—C. A. M.

Protein synthesis in plant cells; Rôle of potassium in ——. J. Stoklasa. Biochem. Zeits., 1916, **73**, 107—160. J. Chem. Soc., 1916, **110**, i., 351—355.

A large number of bacteria were cultivated in media containing nitrate as the source of nitrogen, carbohydrates or the salts of organic acids as a source of carbon, together with the other necessary inorganic salts. The amounts of nitrate and sugars, etc., which disappeared during the growth were estimated, as were also the amounts of ammonia and nitrites formed. The amount of protein formed by the bacteria and the Hausmann (nitrogen distribution) numbers of these proteins were also determined. The conclusion drawn from the experiments is, that the formation of new living matter by bacteria, and the protein synthesis, is dependent on the source of carbon employed (carbohydrate or organic acid) when nitrate serves as a source of nitrogen. The nitrate is reduced to nitrite by the nascent hydrogen, which is derived from the degradation of the carbohydrate or organic acid by the respiratory ferments. The nitrous acid is reduced further to ammonia, which apparently reacts with products derived from the carbohydrates or organic acids to form amino-acids.

The synthesis of proteins by bacteria from carbohydrates, etc., and nitrates is, however, very small when no potassium is present, and it appears that this element plays an important part in the dissimilation processes affecting the carbohydrates, etc.

A series of experiments on higher plants was also carried out wth the object of investigating the influence of potassium on protein synthesis. Sugar-beet was grown in pots in the ordinary way, and fed by nutrient solutions containing the usual inorganic salts; in one series of experiments potassium was present; in the other series the same nutrient solution was employed, with the exception that the potassium salt (nitrate) was replaced by a corresponding amount of sodium salt. Those plants which received the nutrient medium containing potassium were far in advance in development of those which received the nutrient solution without this element. Although the percentage of protein in the dried material of leaves and roots did not differ much, there were large differences in the total amounts produced. The plants which had received potassium produced also a much larger amount of sugar. The differences in the two series of experiments became much more marked in the later than in the earlier stages of growth. A further series of experiments on the growth of sugar-beets was carried out in the absence of carbon dioxide (under bell-jars with alkali hydroxide), and the carbon was supplied by various sugars added to the nutrient solutions of inorganic salts. Two series of experiments were carried out, namely, one in which the nutrient solution contained potassium, and one in which this element was absent. Some of the plants in each series were grown in the light, and the others in the dark. As a result of numerous experiments, the following conclusions were drawn:—In an atmosphere free from carbon dioxide, and in the presence of sunlight, plants can produce proteins both in the presence and absence of potassium when dextrose, lævulose, or sucrose is added as the source of carbon. This synthesis can also take place when no sugars are added, when sufficient plastic organic material is present as reserve matter in the plant. In the absence of light, however, a similar synthesis of proteins can occur where the source of nitrogen is a nitrate, and the source of carbon a carbohydrate, but protein synthesis only takes place in the presence of a potassium salt. It is therefore only in the absence of light that the importance of potassium in the process of protein synthesis can be demonstrated, and the author calls attention to other researches, which indicate the part which this element plays in the dissimilation of the carbohydrates.

XVII.—SUGARS; STARCHES; GUMS.

Evaporators [for sugar juices]; Capacity and economy of multiple effect ——. E. W. Kerr. Met. and Chem. Eng., 1916. **14**, 603—608.

The capacity of multiple effect evaporators depends on two general factors: the coefficient of heat transmission and the temperature fall from effect to effect. The coefficient of heat transmission depends on the following factors:—1 (a) *Steam distribution*; (b) *steam velocity*. 2. *Density of heating steam*. This varies as the pressure, which itself varies from about 5 lb. in the first body to that corresponding to a vacuum of 15 in. in the last body. 3. *Quality of heating steam*. It is frequently stated that exhaust steam is more efficient than live steam, which is superheated owing to its expansion. The author, however, concludes from his experiments that superheat does not affect the co-efficient of heat transmission. 4. *Presence of air and other incondensable gases in the steam.* The presence of air is probably one of the most frequent causes of a low coefficient of heat transmission, which varies according to the expression $(P_s \div P_t)^2$, where P_s represents the partial pressure of the steam, and P_t the total pressure of the steam and air combined. Air in steam reduces the heat transmission not only by its insulating effect, but also by causing a temperature fall lower than the apparent fall. 5. *Presence of condensed liquid on the heating surface*. Loss of capacity due to this cause is greater in vertical than in horizontal tube evaporators, as in the latter case the condensed liquid flows along the lower side of the tube and is blown out by the steam. 6. *Cleanliness of heating surface (steam side)*. The fouling is chiefly due to the oil in the exhaust steam coming from the engine. In vertical juice-tube evaporators it is difficult to scale the steam side of the tubes and the best means to clean them is to fill the steam compartment with molasses during a stoppage; the acid in the molasses attacks the scale and dissolves it. 7. *Material, thickness, and molecular structure of the tubes*. 8. *Cleanliness of heating surface (liquor side)*. The rate of fouling on the liquor side depends upon the composition of the juice. The scale can be removed by adding a solution of sodium carbonate or of hydrochloric acid and boiling. In horizontal evaporators the tubes can be removed and the scale cracked off mechanically. 9. *Velocity of liquor circulation*. Rapid circulation brushes away the bubbles of vapour formed on the surface of the tubes and promotes better contact. Circulation in horizontal evaporators is less than in those of the vertical type, but the latter are more inclined to prime and should be provided with baffles or separators.

The temperature fall depends on the following factors:—1. *Steam pressure in the first body and vacuum in the last body*. It is doubtful if a vacum higher than 26 in. is desirable, especially in submerged tube evaporators. 2. *Hydrostatic head (submergence of the heating surface)*. This decreases heat transmission by increasing the temperature at which the liquor boils. 3. *Density and purity of liquor*. High density and impurities in the liquor reduce heat transmission by making the actual fall of temperature less than the apparent fall.

The following types of evaporators were tested: (A) Vertical submerged tube (standard type); (B) horizontal steam tube; (C) horizontal film evaporator; (D) vertical film evaporator; (E) standard type with special baffle steam distribution working under vacuum; (F) ditto working under pressure; (G) vertical steam tubes (double tubes); and the co-efficients of heat transmission (actual) are given in the following table:—

Type.	Average.	Maximum.	Minimum.	No. of tests included in average.	Relative coefficient (actual): standard = 100.	Relative coefficient (corrected):* standard = 100.
A	197	289	172	7	100	100
B	213	291	130	5	108	74
C	392	449	334	3	199	160
D	266	353	190	6	135	119
E	248	284	190	3	126	180
F	503	509	498	2	255	131
G	293	—	—	1	149	139

* In most of the tests on type A the steam pressure in the first body was very low, and to obtain a better means of comparison, the actual coefficients were corrected on the basis of laboratory tests.

The average number of pounds of water evaporated per square foot of heating surface per hour, assuming in all cases a steam pressure of 5 lb. per sq. in. in the first body and a vacuum of 26 in. in the last body, were calculated from the experimental results, the values obtained being as follows: for type "A" quadruple, 6·18; "A" triple, 9·2; "A" double, 16·7; "B" quadruple, 4·55; "B" triple, 11·49; "C" quadruple, 11·05; "D" quadruple, 10·05; "D" triple, 9·21; "E" triple, 16·93; "F" double, 17·4, and "G" quadruple, 9·67.—W. H. C.

Saturation (sugar) scums; Determination of carbon in the organic non-sugar constituent of ——. V. Stanek. Z. Zuckerind. Böhm., 1916, **40**, 201—206. J. Chem. Soc., 1916, **110**, ii., 267—268.

The carbon is estimated by oxidation with chromic acid-sulphuric acid solution. From 1 to 2 grms. of the material is placed in a small flask provided with a glass stopper, which carries a tapped funnel and a condenser. Ten c.c. of 0·5% alkali hydroxide solution is added, and then 5 grms. of crystallised phosphoric acid; the mixture is boiled gently to expel carbon dioxide, cooled, 5 grms. of chromic acid is added, and the upper end of the condenser is connected with a combustion tube containing copper oxide and two pieces of silver gauze; this tube is heated in a suitable furnace. Concentrated sulphuric acid is now admitted to the flask from the tapped funnel and the mixture is boiled; the condenser prevents steam from passing into the combustion tube. The gases leaving the latter are passed through a tube containing chromic acid, then dried, and the carbon dioxide is absorbed in a soda-lime tube. A current of air free from carbon dioxide is passed through the apparatus when the oxidation has been completed. The sugar content of the sample is estimated in a separate portion, and the quantity of carbon dioxide due to sugar is deducted from the total amount of carbon dioxide found.

C_3-sugars and methylglyoxal; Colour reactions of ——. C. Neuberg. Z. Ver. deuts. Zucker-Ind., 915, 679—685. Z. angew. Chem., 1916, **29**, Ref., 251.

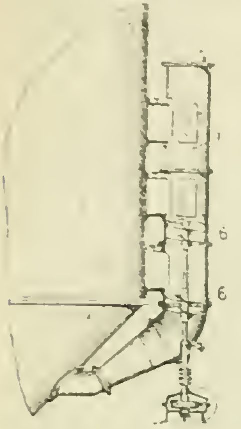
Both glyceric aldehyde and dihydroxyacetone give colour reactions with orcinol, but only dihydroxyacetone gives a typical colour reaction with phloroglucinol and with resorcinol. Methylglyoxal does not give a colour reaction with orcinol or with phloroglucinol. With sodium nitroprusside and alkalis or organic bases (secondary amines), it gives an intense red colour which changes to violet blue on addition of acetic acid. —A. S.

Rôle of potassium in protein synthesis in plant cells. Stoklasa. *See* XVI.

Detection of small quantities of glycerol and alcohols and acids of the carbohydrate series. Neuberg and Mandel. *See* XX.

Patents.

Boiling apparatus [evaporators and vacuum pans]; Circulating device for ——. A. Krug, Etrépagny, Assignor to Soc. Anon. Etabl. A. Maguin, Charmes, France. U.S. Pat. 1,179,636, Apr. 18, 1916. Date of appl., Nov. 21, 1912.



Tubes, 1, mounted vertically on the outside of the evaporator or vacuum pan at different points in its circumference, are connected with pipes leading laterally from the tubes to the boiling apparatus at different levels. The contents of each tube is driven downwards by means of a shaft within it carrying blades, 6, each blade being situated between a pair of the lateral pipes.—J. P. O.

Starch powder, and process for manufacturing same. A. S. Hoyt, New York. Eng. Pat. 9790, July 5, 1915.

See U.S. Pats. 1,148,453 and 1,148,454 of 1915; this J., 1915, 917.

Manufacture of malt syrups and maltose. U.S. Pat. 1,181,460. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Invertase; Influence of certain substances on the activity of ——. E. G. Griffin and J. M. Nelson. J. Amer. Chem. Soc., 1916, **38**, 722—730.

Experiments indicated that inhibition of the activity of invertase solutions produced by the presence of glass beads (see Beard and Cramer, this J., 1915, 677), serum, egg-albumin, charcoal, or alumina (see Eriksson, this J., 1911, 914), is due only to alterations of the concentration of hydrogen ions effected by these substances.—J. H. L.

Invertase: Adsorption of ——. J. M. Nelson and E. G. Griffin. J. Amer. Chem. Soc., 1916, **38**, 1109—1115.

In a previous paper it was shown that the apparent inhibition of invertase action consequent on the addition of animal charcoal (see preceding abstract) is due not to adsorption of the enzyme by the charcoal, though this occurs, but to a change in the concentration of hydrogen ions brought about by the charcoal. It is now shown by experiments with solutions containing buffer-salts to maintain a constant concentration of hydrogen ions, that invertase is readily adsorbed by charcoal and still more readily by gelatinous aluminium hydroxide, and that it can be removed from solution by filtering off the adsorbent; but if not so removed it exerts its full activity whether adsorbed by a solid like charcoal which rapidly subsides and remains at the bottom of the liquid (the experiments lasted 48 hours), or by one or more colloids such as saponin, serum, or egg albumin, which remain uniformly distributed throughout the liquid. This confirms the view that invertase is a colloid and that the reaction between it and sucrose depends on the contact between two phases; this contact does not appear to be impeded when the enzyme is adsorbed by a solid or dissolved colloid. Invertase adsorbed by charcoal is liberated by addition of a colloid like saponin or egg albumin, and if the charcoal is subsequently filtered off, the enzyme remains in solution with unimpaired activity. Eriksson's statement that sucrose can liberate invertase adsorbed by charcoal (*loc. cit.*) is refuted.—J. H. L.

Tartaric acid [in wine, etc.]: Determination of ——. B. G. Hartmann, J. R. Eoff, and M. J. Ingle. J. Ind. Eng. Chem., 1916, **8**, 422—425.

Halenke and Möslinger's method (Z. anal. Chem., 1895, **34**, 263) is not accurate when used for wines and fruit juices containing a considerable quantity of free tartaric acid, and the error is not completely eliminated by addition of potassium acetate. The authors recommend neutralisation of 100 c.c. of the wine with alkali, followed by addition of a weighed quantity of tartaric acid equivalent to the alkali used. The liquid is then treated with 2 c.c. of glacial acetic acid and 15 grms. of potassium chloride, and when the latter has dissolved, 15 c.c. of 95% alcohol is added. The solution is stirred until precipitation begins, allowed to stand over-night at a temperature not above 15° C., filtered, the precipitate washed with an aqueous alcoholic solution of potassium chloride, then treated with 50 c.c. of hot water and titrated with $N/10$ sodium hydroxide in presence of phenolphthalein. The burette reading is increased by 1·5 c.c. to allow for the solubility of the bitartrate, and corrected for the tartaric acid added. The tartaric acid may be added in the form of Rochelle salt. Products containing phosphoric acid and alcohol in addition to tartaric acid may give low results, owing to partial esterification of the tartaric acid, especially on ageing. In such cases, after neutralising, 5 c.c. excess of $N/1$ sodium hydroxide is added, the solution is heated to boiling, and allowed to stand overnight. After adding the required amount of tartaric acid, the determination is then continued as described.—A. S.

Vinegar manufacture: Report on ——. F. Hayduck. Generalversamm. Ver. Spiritusfab. Deutsch., Feb. 25, 1916. Chem.-Zeit., 1916, **40**, 435.

The vinegar department, under the management of Wüstenfeld, has been working for 3½ years with absolutely pure cultures, and is now obtaining results showing 12·3% of acid in the effluent vinegar. Attempts to substitute other materials, *e.g.*, wood charcoal, for the wood shavings have not been successful. Observations made on the storage of vinegar have shown that the volume of the liquid diminishes from month to month, at the rate of 0·1—1·0%, according to the texture of the wood; the percentage of acetic acid and alcohol gradually increases in the stored vinegar. A similar process of concentration has frequently been observed during the storage of whisky. In one experiment on the small scale, a sample of vinegar, containing originally 11% of acetic acid, was concentrated to 22% merely by favourable conditions of storage, whereby the water evaporated, leaving the acid in the vinegar. Very good results are reported in connection with the preparation of vinegars of special quality, *e.g.*, fine pickle vinegars; one prepared from fermented potato mash was particularly approved. The work of the vinegar generators depends largely on the quantity and velocity of the current of air in relation to the current of liquid passing through them. The air current may be observed by puffing in tobacco smoke, or better, ammonium chloride fumes, at the bottom and noting the time required for it to come out at the top.—J. F. B.

Methyl alcohol; Detection of ——. G. Fendler. Z. Unters. Nahr. Genussm., 1915, **30**, 228. Chem.-Zeit., 1916, **40**, Rep., 185.

The author has found that in the test proposed by Rinck (this J., 1911, 978), in which the alcohol vapour is led over an incandescent copper spiral, formaldehyde is formed also from ethyl alcohol. —A. S.

Rôle of potassium in protein synthesis in plant cells. Stoklasa. *See* XVI.

Patent.

Malt syrups and maltose; Manufacture of ——. W. P. Kaufmann, Toronto, Canada. U.S. Pat. 1,181,460, May 2, 1916. Date of appl., Sept. 25, 1913.

Malt is extracted with water and the aqueous solution is separated; the residue is mixed with a further quantity of water, cassava starch is added, and the mixture, which should have a density of about 20° B. (sp.gr. 1·16), is kept at 60°—70° C. for 30 mins. It is then boiled, cooled to 60° C., the aqueous malt extract is added in quantity sufficient to reduce the density to about 16° B. (sp.gr. 1·125), and the whole is maintained at 60°—65° C. until saccharification has taken place, and then filter-pressed.—W. P. S.

XIXa.—FOODS.

Casein in milk: Comparison of methods for the determination of ——. C. B. Hersey. J. Ind. Eng. Chem., 1916, 8, 335—336.

Hart's method (this J., 1909, 1099), using an electrically driven centrifuge instead of hand shaking, requires much less time than the Van Slyke volumetric method (this J., 1909, 1267), and gives results much closer to those obtained by the official (U.S.A.) method based on the determination of nitrogen by the Kjeldahl-Gunning method.—A. S.

Polypeptides of high molecular weight; Synthesis of ——. E. Abderhalden and A. Fodor. Ber., 1916, **49**, 561—578.

l-Leucyl-glycyl-glycine, prepared by condensing glycine anhydride with *d*-bromoisocapronyl chloride and treating the resulting bromo compound with ammonia, is a crystalline substance fairly soluble in water and very sparingly soluble in alcohol; $[\alpha]_D^{20°} = +45·9°$ (in water). The aqueous solution gives a bluish-violet biuret reaction. *l*-Leucyl-triglycyl-glycine, $[\alpha]_D^{20} = +28·14°$ (in water), prepared similarly from triglycyl-glycine and *d*-bromoisocapronyl chloride, has similar properties and also gives a bluish-violet biuret reaction. Diglycyl-glycine methyl ester hydrochloride on treating with the theoretical quantity of sodium methoxide is converted into the methyl ester of pentaglycyl-glycine, which after hydrolysis to pentaglycyl-glycine and condensation with bromoisocapronyl chloride and treatment with ammonia is converted into *l*-leucyl-pentaglycyl-glycine, $[\alpha]_D^{20} = +5·94°$ (in *N*/10 sodium hydroxide), which is fairly soluble in water, the solution giving a reddish-violet biuret reaction. When combined with bromoisocapronyl-diglycyl-glycyl chloride and the resulting compound treated with ammonia, it yields *l*-leucyl-triglycyl-*l*-leucyl-pentaglycyl-glycine $[\alpha]_D^{20} = —6·00°$ (in *N*/10 sodium hydroxide), which gives a reddish-violet biuret reaction. This compound again combined with bromoisocapronyl-diglycyl-glycyl chloride and then treated with ammonia, yields *l*-leucyl-triglycyl-*l*-leucyl-triglycyl-*l*-leucyl-pentaglycyl-glycine, $[\alpha]_D^{20} = —9·63°$ (in *N*/10 sodium hydroxide), giving a reddish-violet biuret reaction. This polypeptide similarly condensed with bromoisocapronyl-diglycyl-glycyl chloride and treated with ammonia yields *l*-leucyl-triglycyl-*l*-leucyl-triglycyl-*l*-leucyl-triglycyl-*l*-leucyl-pentaglycyl glycine, $[\alpha]_D^{20} = —8·42°$ (in *N*/10 sodium hydroxide), giving a reddish-violet biuret reaction. This latter polypeptide contains 19 groups and has mol. wt. 1326. *l*-Leucyl-pentaglycyl-glycine and the more complex polypeptides are salted out from aqueous solution by ammonium sulphate. The solubility in water of these polypeptides diminishes with increasing molecular weight. —T. C.

Protein compounds; Changes in the H^+ and OH^- concentration which take place in the formation of certain ——. C. L. A. Schmidt. J. Biol. Chem., 1916, 25, 63—79.

The changes in the H^+ and OH^- concentration on titrating acid and alkaline solutions of globin with solutions of other proteins (*e.g.*, casein) and of precipitating salts, were followed by means of the hydrogen electrode. The plotted titration curves indicated that true protein compounds of globin are formed, some of which are precipitated while others are soluble when a definite acidity or alkalinity is reached. By this means it is possible to distinguish between the "salting out" of globin by inorganic salts and the precipitation of a compound protein.—C. A. M.

Monoaminodicarboxylic acids from proteins; Determination of ——. A. C. Andersen and R. Roed-Müller. Biochem. Zeits., 1916, **73**, 326—339. Z. angew. Chem., 1916, **29**, Ref., 251.

The method of Van Slyke (this J., 1911, 771, 1135) has been extended to include the determination of the monoaminodicarboxylic acids. The filtrate from the phosphotungstic acid precipitate is neutralised with sodium hydroxide just as in carrying out the formalin titration method of Henriques and Sörensen (compare this J., 1908, 135). Under these conditions each mol. of a monoaminodicarboxylic acid combines with 1 mol. of base, whilst the monoaminomonocarboxylic acids remain in the free state. The solution is evaporated and the residue incinerated, and the monoaminodicarboxylic acid nitrogen is calculated from the sodium carbonate content of the ash. Non-nitrogenous acids, other amino-acids containing more carboxyl groups than amino groups, and proteins yielding relatively large quantities of glucosamine must not be present.—A. S.

Sorghum: Effect of climatic factors on the hydrocyanic acid content of ——. J. J. Willaman and R. M. West. J. Agric. Res., 1916, 6, 261—272.

Two varieties of sorghum—Early Amber from Minnesota and Southern Cane from Missouri—were grown from seed at State Experimental Stations in Minnesota, Utah, Kansas, and South Dakota, where the climatic and cultural conditions are widely different. The leaves and stalks of the sample plants destined for analysis were preserved with 3% alcoholic sodium hydroxide and chloroform. After the glucoside (dhurrin) had been hydrolysed by distilling slowly with 5% tartaric acid into 2% sodium hydroxide, the hydrocyanic acid in the distillate was determined by the method of Viehoever and Johns (this J., 1915, 351). A sample of Early Amber grown in Minnesota contained the very high hydrocyanic acid content of 0·114%. The growth and dhurrin content of the plants varied considerably in the four localities. Unhealthy plants usually contained more than healthy plants; humidity and temperature probably act only indirectly by their effects on the rate of growth; the hydrocyanic acid content was low when the water supply had been sufficient, but high when deficient; and thick, heavy stalks contained relatively more than slender stalks. There is apparently no constant variation in the amount of dhurrin present as between night and day, hence the glucoside probably does not serve as stored food. Except in one case, the Southern Cane always contained more hydrocyanic acid than the Early Amber, indicating that botanical difference may be of greater influence than the conditions of growth.—E. H. T.

Hydrocyanic acid from certain plant tissues: Separation of autogenous and added —— and its disappearance during maceration. C. L. Alsberg and O. F. Black. J. Biol. Chem., 1916, **25**, 133—140.

In the determination of hydrocyanic acid in the leaves of *Prunus virginiana*, 4 hours' distillation with acid is required to liberate all the hydrocyanic acid, whilst in the case of *Andropogon sorghum* and *Panicularia nervata* distillation for 1 hour is sufficient. When plant tissues are macerated, a certain amount of the hydrocyanic acid present is so converted that it is not recoverable by distillation with sulphuric acid; the same loss, which may amount to 50%, takes place with added cyanide. This is not due to the action of enzymes or to the presence of dextrose (see also Henry and Auld, this J., 1908, 428). It is necessary to use several methods in determining hydrocyanic acid in plants, namely, by maceration, by distillation of the fresh and macerated plant, and by distillation after extraction as suggested by Henry and Auld (*loc. cit.*). In this way, the method which yields the greatest quantity of hydrocyanic acid can be ascertained for each species of plant. —W. P. S.

Plants: Cyanogenesis in ——. Studies on Tridens flavus (tall red top). A. Viehoever, C. O. Johns, and C. L. Alsberg. J. Biol. Chem., 1916, **25**, 141—150.

Tridens flavus, a tall grass widely distributed in the United States, was found to contain considerable quantities of hydrocyanic acid; the maximum amount (0·0037%) occurred in the inflorescence tops, a trace was present in the roots, whilst the ripe seeds were free from the acid. The grass collected in August contained the maximum quantity of hydrocyanic acid, a very small quantity was present in the grass collected in September, and none in the October grass. No free hydrocyanic acid was obtained by direct distillation with steam; by maceration with water and subsequent distillation with acid, less hydrocyanic acid was obtained than by direct distillation with acid. The addition of tartaric acid during the maceration prevented loss of hydrocyanic acid; alkaline maceration caused the loss of the whole of the hydrocyanic acid present and also of that in added potassium cyanide. The loss was probably due to chemical reaction. *Tridens flavus* contains an enzyme which hydrolyses amygdalin.—W. P. S.

[*Fruit*] *jelly investigations.* W. V. Cruess and J. B. McNair. J. Ind. Eng. Chem., 1916, **8**, 417—421.

Laboratory tests showed that grapes, apples, loganberries, blackberries, lemons, and pomelos yield satisfactory jellies. Oranges contain sufficient pectin, but are deficient in acid and give better results if mixed with lemons in the proportion of 2 oranges to 1 lemon; figs and citron melons also give satisfactory jellies when acidified with citric acid or lemon juice. Apricots, cherries, pomegranates, and strawberries are deficient in pectin, and peaches, pears, and huckleberries are deficient in both pectin and acid. The most favourable degree of acidity of fruit juices for jelly making is 0·5—1·5%, calculated as citric acid, and sugar should be added to raise the concentration to 65° Brix to prevent spoiling by moulds and yeasts. Fruit juices can be clarified by addition of Spanish clay (10—20% aqueous suspension) at the rate of 1000—2000 grms. per hectolitre, followed by heating to 100° C. and settling. Loss of flavour and aroma in jelly making is due to decomposition and volatilisation of odorous constituents. In the case of fruits rich in pectin, especially loganberries and currants, jellies possessing practically the same aroma and flavour as the fresh fruit can be prepared without heating, the fruit being crushed, and the juice separated by pressing, and mixed with sufficient sugar to raise the concentration to 65° Brix.—A. S.

Lemon and orange extracts; Analysis of non-alcoholic ——. E. L. Redfern. J. Ind. Eng. Chem., 1916, **8**, 421.

For the determination of lemon oil or orange oil in non-alcoholic flavouring extracts prepared with gum tragacanth and glycerin, 25 c.c. of the sample is shaken vigorously with 25 c.c. of 95% alcohol, to precipitate the gum, then filtered through a Gooch crucible, the precipitate washed several times with 95% alcohol, and the solution diluted with alcohol to 100 c.c. The essential oil in 50 c.c. of the solution is then determined by Howard's method (J. Amer. Chem. Soc., 1908, 608).—A. S.

Patents.

Bread and the like; Manufacture of ——. Diamalt-A.-G., Munich. Ger. Pat. 291,161, Nov. 17, 1914.

A preparation containing active yeast enzymes is added to the flour or dough. Fresh expressed yeast juice, or autolysed yeast, or a dry stable product prepared by impregnating starch or flour with the enzyme preparation and drying at a low temperature, may be used. By the action of the enzymes the flour is rendered more readily fermentable by yeast and the size and quality of the loaves are improved.—A. S.

Fruit juices; Method of preserving ——. J. H. Ryan, Twin Falls, Idaho, Assignor to J. H. Billingsley, Galena, Ill. U.S. Pat. 1,182,213, May 9, 1916. Date of appl., Oct. 25, 1915.

Fruit juice, free from pulp, is agitated while subjected to the action of ultra-violet rays, and then charged with carbon dioxide under pressure. —W. P. S.

Juices of the agave plant; Process of treating ——. L. Lavedan, New Orleans, La., Assignor to V. A. Rendon, New York. U.S. Pat. 1,182,691, May 9, 1916. Date of appl., Feb. 12, 1916.

The juice is rendered slightly alkaline with sodium carbonate, then boiled with the addition of sulphurous acid, the scum which forms is skimmed off, and the liquid is allowed to settle.—W. P. S.

Olives; Process of curing ——. R. D. Hann, Orland, Cal. U.S. Pat. 1,182,270, May 9, 1916. Date of appl., Oct. 15, 1915.

Olives are immersed in water at 175° F. (80° C.) and allowed to cool therein; they are then immersed for about 4 hours in a solution containing 2 oz. of potassium carbonate per gall. of water, and afterwards washed and dried.—W. P. S.

Grain drying apparatus. Eng. Pat. 9971. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Carbonic acid; Aqueous solutions of ——. R. Strohecker. Z. Unters. Nahr. Genussm., 1916, **31**, 121—160. Z. angew. Chem., 1916, **29**, Ref., 249.

Experiments on the slow neutralisation of carbonic acid in aqueous solution by bases (compare McBain, this J., 1912, 512) indicated that two reactions are involved, of which one is bimolecular, and the other—the hydration of dissolved carbon dioxide—is unimolecular. The value $k = 44 \times 10^{-5}$ was found for the dissociation constant of carbonic acid. Direct titration of carbonic acid with phenolphthalein as indicator led to inaccurate results, but accurate results were obtained by Winkler's method, the water being treated in a stoppered bottle with excess of alkali and solid barium chloride; equilibrium was attained after 1 hour, and the excess of alkali was then titrated with hydrochloric acid. Tetrachlorophenolphthalein proved superior to phenolphthalein as an indicator: it changes sharply from an intense red to colourless and can be used in presence of ammonia. α-Naphtholphthalein is not a suitable indicator for simple titrations, but is useful in cases in which comparison is made with a control solution, *e.g.*, in determining the concentration of hydrogen ions. —A. S.

Carbonic acid, combined and free, in solution, particularly in natural waters; Determination of ——. J. Johnston. J. Amer. Chem. Soc., 1916, **38**, 947—975.

The most commonly used titration methods for the estimation of combined and free carbon dioxide are examined from the point of view of the equilibrium attained between CO_3'', HCO_3', and H_2CO_3, and between the dissolved carbonic acid and the partial pressure of carbon dioxide above the solution. It is shown that appreciable readjustment of the equilibrium is liable to take place during the time required for analysis, and that results may be vitiated by the presence of alkaline-earth metals or iron. The only generally reliable methods are considered to be those for determining (*a*) the total base combined with the carbonic acid, by titrating with acid, using methyl orange, until the solution is of the same shade as a standard made by passing carbon dioxide into water containing the same proportion of methyl orange, and (*b*) the total carbon dioxide present; but it is pointed out that these determinations usually suffice to characterise a water also with respect to the concentration of free carbon dioxide, the proportion of carbonate to bicarbonate, or the degree of alkalinity or acidity, since these may be calculated from the above results by applying the equilibrium constants.—F. Sodn.

[*Water.*] *Comparison of the permanganate methods for the determination of required oxygen.* J. H. Sachs. J. Ind. Eng. Chem., 1916, **8**, 404—406.

Comparative experiments with aqueous solutions of different organic substances showed that the method of Thresh, in which oxidation is effected in acid solution at 37° C., is most satisfactory. At higher temperatures comparable results are obtained only if the amount of permanganate used for oxidation is the same in all cases. Oxidation in alkaline solution proved unsatisfactory.—A. S.

Sea-water; The iodide and iodate contents of ——. L. W. Winkler. Z. angew. Chem., 1916, **29**, 205—207.

Water from the Adriatic in the vicinity of Fiume was found to contain no trace of iodine in organic combination. The total iodine content was 0·038 mgrm. per litre; iodide-ions were present to the extent of 0·008 mgrm. and iodate ions amounted to 0·041 mgrm. per litre. The excess of iodate in the surface water may be due to the combined influence of air and sunlight, but it is probable that the ratio of iodide to iodate would increase with depth without perceptible alteration of the total iodine present. Iodide was determined by treatment with nitrite and concentrated hydrochloric acid and extraction with carbon tetrachloride or carbon bisulphide, the colour of the final total extract being compared with that obtained with an artificial solution of similar composition and of known iodate content treated in a similar way. The iodate was estimated in a like manner, after reduction with arsenious oxide in hydrochloric acid. The absence of organic iodine was proved by evaporating the water to dryness with the purest sodium hydroxide, carefully igniting the residue, treating with distilled water, and adding concentrated sulphuric acid. On applying the nitrite test to the clear liquid, no more iodine was found than when the total inorganic iodine was determined.—E. H. T.

Sewage: [*Determination of*] *oxygen demand of* ——. F. W. Bruckmiller. J. Ind. Eng. Chem., 1916, **8**, 403—404.

The nitrate method (Lederer, this J., 1915, 731) is recommended, especially for field work. Instead of taking a number of samples and adding varying quantities of nitrate to a constant quantity of sewage, using for the determination the sample of lowest nitrate content which remains sweet and free from sediment after incubation, excess of nitrate and 0·4 c.c. of methylene blue (to indicate excess of nitrate) may be added to a single 250 c.c. sample of sewage. Comparative experiments showed that equally trustworthy results are obtained in this way.—A. S.

Arsenic [*in insecticides*]; *Reduction of quinquevalent to trivalent arsenic by cuprous chloride, and determination of* —— *by distillation as arsenic trichloride.* R. C. Roark and C. C. McDonnell. J. Ind. Eng. Chem., 1916, **8**, 327—331.

Tests with various reducing agents showed that for the reduction of quinquevalent arsenic to the trivalent condition in hydrochloric acid solution, cuprous chloride is the most satisfactory agent; only incomplete reduction is obtained with ferrous salts. A method for the determination of arsenic, based on reduction with cuprous chloride and subsequent distillation of the arsenic trichloride, gives good results in presence of antimony, lead, copper, zinc, iron, and calcium, *e.g.*, in the analysis of insecticides such as lead arsenate, Paris green, and zinc arsenite, alone or together wth Bordeaux mixture. A quantity of the sample containing arsenic equivalent to not more than 0·5 grm. As_2O_3 is treated in a distilling flask with 100 c.c. of hydrochloric acid of sp. gr. 1·19 and 5 grms. of cuprous chloride, and the mixture distilled, the vapours passing through a well-cooled condenser, and then through three flasks cooled with ice-water, the first containing not more than 40 c.c. of water, the second 100 c.c., and the third sufficient to seal the inlet tube. When the liquid in the distilling flask is concentrated to 40 c.c., a further 50 c.c. of hydrochloric acid is added, and the liquid again distilled, these operations being repeated until 200 c.c. of acid has been distilled. The distillate is made up to 1 litre, and 200 c.c. is nearly neutralised with sodium or potassium hydroxide, excess of sodium bicarbonate added, and the arsenic titrated with *N*/20 iodine solution using starch solution as indicator.—A. S.

Lime-sulphur solutions: New methods for the analysis of ——. *II. Determination of poly* [*sulphide*] *sulphur.* R. M. Chapin. J. Ind. Eng. Chem., 1916, **8**, 339—341.

The method depends upon the conversion of sodium sulphite into thiosulphate by the polysulphide sulphur:

$$CaS.S_y + yNa_2SO_3 = CaS + yNa_2S_2O_3.$$

10 c.c. of a solution of the sample, containing 1·5—2% of sulphide-sulphur, is mixed with 10 c.c. of a freshly prepared 10% solution of anhydrous sodium sulphite and 20 c.c. of *N*/5 ammoniacal zinc chloride in a 200 c.c. flask, the neck of the flask is rinsed with 25 c.c. of water, and the mixture is heated on a steam bath for 45 mins., with shaking, and rinsing of the neck of the flask with hot water, at intervals of about 10 mins. After adding 20 c.c. of a 10% solution of strontium chloride and allowing to stand for 5 mins., the precipitate of zinc sulphide and strontium sulphite is filtered off and washed, and the solution cooled, treated with 0·5—1 c.c. of a

10% solution of disodium phosphate to precipitate the excess of strontium, diluted to 250 c.c., and filtered through a dry paper into a dry flask, the first 20 c.c. being rejected. 200 c.c. of the filtrate is made slightly acid to methyl red with a 10% solution of tartaric acid, and the thiosulphate titrated with $N/10$ iodine. The titration figure is corrected by deducting 0·1 c.c. and multiplying the remainder by 1·25, and then by subtracting the thiosulphate figure of the original sample, the polysulphide sulphur figure is obtained, *i.e.*, the number of c.c. of $N/10$ iodine equivalent to the polysulphide sulphur in 10 c.c. of the diluted lime-sulphur solution. The thiosulphate in the original sample is preferably determined by adding 10 c.c. of the diluted lime-sulphur solution to 20 c.c. of $N/5$ ammoniacal zinc chloride solution, diluting to about 75 c.c., heating for 30 mins. on the steam bath, filtering, adding about 1 grm. of potassium iodide to the solution, making slightly acid to methyl red with tartaric acid, and titrating with iodine. (See also this J., 1916, 486.)—A. S.

Complete solubility curve of calcium carbonate. Johnston and Williamson. *See* VII.

PATENTS.

Sewage-disposal means. [*Electrolytic filter.*] J. W. Roche, Assignor to J. G. Kelley, jun., Hornell, N.Y., and C. A. Hager, Perrysburg, N.Y. U.S. Pat. 1,182,316, May 9, 1916. Date of appl., Aug. 18, 1913.

FILTER walls are placed between a sewage reservoir and a basin, the walls being composed of two series of spaced slats with metallic screens on either side. Carbon is placed in the spaces between the slats and sand between the two series of slats. Electrolytic action is thus set up in the filter. —W. P. S.

Raising or removing liquid and other fluid matter [*sewage, etc.*]; *Apparatus for* ——. J. Stone and Co., Ltd., Deptford, and W. S. Parsons, Grove Park, Kent. Eng. Pat. 6811, May 6, 1915.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Solanaceous drugs [*Hyoscyamus muticus and Datura Stramonium*] *from Africa.* Bull. Imp. Inst., 1916, **14**, 21—27.

THE following percentages of total alkaloid, calculated on the dry material, were found in samples of African solanaceous drugs:—*Hyoscyamus muticus*, Linn., from Sudan, mixed leaves and stem, 0·77%. *Datura Stramonium*, from Egypt, stems and fruits, 0·138%; leaves, 0·32%. From Sudan, mixed stems, leaves, and fruits, 0·13%; seeds, 0·096%. From South Africa, leaves, 0·54%.—T. C.

Damascenine; A new synthesis of ——. A. Kaufmann and E. Rothlin. Ber., 1916, **49**, 578—584.

8-HYDROXYQUINOLINE on treatment with methyl sulphate is converted into 8-methoxyquinoline, m.pt. 46°—47° C. This substance forms an additive product, 8-methoxyquinoline methylsulphomethylate, with 1 mol. of dimethyl sulphate, the same product being also formed by the action of 2 mols. of dimethyl sulphate on the sodium derivative of 8-hydroxyquinoline. On oxidising this additive compound with neutral, aqueous 4% potassium permanganate solution, it is converted in good yield into formyldamascenic acid, $CH_3O.C_6H_3(COOH).N(CH_3)CHO$, m.pt. 191°—195 C., which crystallises from alcohol in hard, colourless prisms, and on heating with hydrochloric acid is converted into the hydrochloride of damascenic acid, m.pt. 206—207° C. The latter, when esterified with methyl alcohol and hydrochloric acid, yields damascenine, m.pt. 24°—25° C. —T. C.

Isobebeerine: Demethylation of ——. M. Scholtz. Arch. Pharm., 1916, **253**, 622—628. Z. angew. Chem., 1916, **29**, Ref., 253.

IF isobebeerine (this J., 1915, 680) be heated with concentrated hydrochloric acid, its methoxyl group is eliminated, and a crystalline alkaloid, isobebeeridine, $C_{16}H_{14}O(OH)_2N.CH_3$, is produced, which melts at 238—240° C., and responds to the colour reactions of catechol. Like isobebeerine, it is dextro-rotatory in pyridine solution.—A. S.

South African drugs and poisonous plants. Bull. Imp. Inst., 1916, **14**, 27—37.

A BRIEF review is given of the results of the examination of a number of plant products from South Africa, including *Senecio latifolius*, D.C., *Acokanthera venenata*, G. Don., *Strychnos Henningsii*, Gilg., *Barosma venusta*, Eckl. et Zeyh., and *Kæmpferia Ethelæ*, J. M. Wood (see this J., 1909, 325; 1914, 1222; 1915, 511, 570, 571). The bulbs of *Ornithoglossum glaucum*, Salisb., "Cape Slangkop," a plant which causes cattle poisoning contain a bitter substance of a glucosidic nature, not yet isolated in a pure state, which has an intensely poisonous action typical of the digitalis group of heart poisons. *Homeria pallida*, Baker, which occurs commonly in the Transvaal and is said to cause much loss of cattle by poisoning, contains an alkaloid which has not yet been fully investigated. *Crotalaria Burkeana*, Benth., which causes the disease of stock known as "stiff-sickness," contains traces of an alkaloid devoid of physiological activity and a number of amorphous products of indefinite character which have not yet been fully investigated. *Chailletia cymosa*, Hook. (*Dichapetalum cymosum*, Hook.), known as "gift-blad" or "gift-blaar," which causes much loss of stock in the Transvaal and in Bechuanaland, was found to contain two resins, one readily soluble and one sparingly soluble in alcohol and both poisonous to animals. No poisonous alkaloid was detected. The roots of *Mesembryanthemum Mahoni*, N. E. Br., used by the natives of the Transvaal to prepare an intoxicating beverage called "khadi" and by white people as a substitute for yeast in bread-making, were found to contain oxalates equivalent to about 3% of oxalic acid, but no glucosides or alkaloid. The organisms present capable of producing fermentation were a yeast (Torula), *Mucor erectus*, *Aspergillus oryzæ*, and *Aspergillus niger*, the latter mould producing a large amount of oxalic acid when grown on sugar solution.—T. C.

Sandalwood, its assay, yield of oil, and changes in the oil during distillation. C. H. Briggs. J. Ind. Eng. Chem., 1916, **8**, 428—429.

THE following method proved satisfactory for the determination of essential oil in small samples of sandalwood:—100 grms. of the finely ground sample is extracted with ether in a Soxhlet apparatus, the ether is evaporated from the extract on a steam bath with the aid of a current of air, and the residue is mixed with 35 c.c. of glycerin and distilled *in vacuo* until 25 c.c. of the glycerin has passed over. The distillate is mixed with 25 c.c. of water, extracted with three 25 c.c. portions of chloroform, the extract evaporated in a tared dish on the water-bath with the aid of a current of air, and the residue dried over sulphuric acid in a vacuum desiccator, and weighed. In twelve samples of sandalwood obtained from the Government of Mysore Province, India, the oil content varied between 3·5 and 8·3%. The oil recovered by extraction had an optical rotation of at least —18° and was readily soluble in 5 vols. of

70% alcohol at 25° C., whereas oil obtained from the same wood by steam distillation required more than 5 vols. of 70% alcohol, and had an optical rotation of —14° or less. Experiments indicated that these differences are due to changes in the oil caused by prolonged contact with boiling water.—A. S.

Limonene; Oxidation of —— by ozone. C. Harries and H. Adam. Ber., 1916, **49**, 1034—1036.

LIMONENE on oxidation with concentrated ozone in glacial acetic acid solution is converted into limonene diozonide, which on oxidation with a mixture of chromic and acetic acids or on heating with potassium hydroxide solution is converted into diacetylvaleric acid. This is obtained as a viscid syrup; on esterification it loses water, forming a keto-ester, which gives a crystalline semicarbazone, m.pt. 173°—174° C., and phenylhydrazone, m.pt. 135° C.—T. C.

Phenols with unsaturated side chains; Oxidation of —— with ozone. C. Harries and H. Adam. Ber., 1916, **49**, 1029—1034. (See also this J., 1915, 573.)

EUGENOL methyl ether treated with ozone in ethyl acetate solution is converted into an oily ozonide, which on reduction with zinc dust and acetic acid is converted into homovanillin methyl ether; after rectification this forms a pale-yellow liquid, b.pt. 121° C. at 0·3—0·4 mm., sp.gr. 1·155 at 20°/20° C., which has a faint vanillin-like smell, is slightly soluble in water and forms a crystalline semicarbazone and *p*-nitrophenylhydrazone. Safrol by similar treatment is converted into homopiperonyl aldehyde, which is a fairly mobile, almost colourless liquid, somewhat soluble in cold water, b.pt. about 137° C. at 10 mm., which shows no tendency to crystallise and hence is not identical with the homopiperonylalde hyde described by Semmler (Ber., 1908, **41**, 2751). Chavicol methyl ether similarly oxidised with ozone and the ozonide reduced with zinc dust and acetic acid is converted into homo-anisaldehyde, a colourless oil, b.pt. 78°—79° C. at 1·4 to 1·5 mm., whilst myristicin and apiol are not converted by ozone directly into ozonides but into indefinite substances containing ozone attached directly to the benzene nucleus.—T. C.

Yeast nucleic acid; Hydrolysis of —— with ammonia. W. Jones and H. C. Germann. J. Biol. Chem., 1916, **25**, 93—102.

THERE is no evidence that a trinucleotide can be produced from yeast nucleic acid either by the action of enzymes or by hydrolysis with ammonia (see Thannhauser and Dorfmüller, this J., 1916, 63). Experiments made by the authors show that, when hydrolysed with enzymes or ammonia, yeast nucleic acid is first decomposed into two dinucleotides, one of which contains the adenine and uracil groups whilst the other contains the guanine and cytosine groups. The former is comparatively stable but the latter readily undergoes hydrolysis, yielding the component mononeucleotides. This decomposition occurs to a considerable extent when yeast nucleic acid is heated at 115° C. for an hour or two with 2·5% ammonia, and to a much greater extent at 125° C. At the latter temperature the products begin to lose phosphoric acid and nucleosides are formed. At 145° C. all the phosphoric acid is set free and the formation of nucleosides is complete.—W. P. S.

Glycerol and alcohols and acids of the carbohydrate series; Detection of small quantities of ——. C. Neuberg and J. A. Mandel. Z. Ver. deuts. Zucker-Ind., 1916, 4—8. Z. angew. Chem., 1916, **29**, Ref., 251.

A N/1 alkaline solution of sodium hypochlorite oxidises glycerol, in dilute aqueous solution at the boiling point, almost instantaneously to glycerose, which can be recognised by means of its reducing power, or, better, by its colour reaction with orcinol; 2 c.c. of 0·1% solution of glycerol can be detected in this way. Calcium glycerophosphate, and homologues of glycerol and their carboxylic acids react in a similar manner. The hexonic acids, *d*-glucosaminic acid, *d*-glucosamine hydrochloride, dextrose, *d*-mannose, and *d*-galactose all give a positive reaction with orcinol, as also, under certain conditions, do the alcohols, erythritol, adonitol, *l*-arabitol, *d*-mannitol, *d*-sorbitol, dulcitol, and ethyleneglycol.—A S..

Colour reactions of C_3-sugars and methylglyoxal. Neuberg. *See* XVII.

Separation of autogenous and added hydrocyanic acid from certain plant tissues, and its disappearance during maceration. Alsberg and Black. *See* XIXA

Cyanogenesis in plant. Studies on Tridens flavus (tall red top). Viehoever and others. *See* XIXA.

PATENTS.

Tobacco; Removal of nicotine from ——. K. W. Goadby, London. Eng. Pat. 7071, May 11, 1915.

TOBACCO is partially deprived of its nicotine by heating it to about 60° C. under a vacuum of about 20 in. of mercury, and allowing a small quantity of warm dry air to pass over it. The products removed from it may be condensed and estimated from time to time. The apparatus consists of a glass or porcelain vessel heated electrically and kept at a constant temperature by a thermostat, warm dry air being admitted at one end and drawn off at the other end by a vacuum pump connected to a condenser. The requisite moisture is restored to the tobacco in a second vessel, through which moist air is passed at a lower temperature and higher pressure than in the first vessel. About 80% of the nicotine and some free ammonia is removed by the process, without substantially affecting the quality and flavour of the tobacco.—F. SP.

Secretin; Method of stabilising ——. J. W. Beveridge, Assignor to A. A. Thomas, New York. U.S. Pat. 1,181,424, May 2, 1916. Date of appl., May 6, 1914.

SECRETIN is produced in a stable form by digesting the epithelial cells of intestinal mucosa lining the duodenal tract of a lower animal, with a hot acid solution (*e.g.*, 0·1 to 0·8% hydrochloric acid) below its boiling point, and filtering. To the clear filtrate, which contains active secretin chemically adapted to the human system, is added a substance, *e.g.*, blood serum, to aid the activating power of the secretin.—F. SP.

Chlorine derivatives of aliphatic hydrocarbons; Saponification of ——. [Preparation of methyl alcohol.] E. Szarvasy, Budapest. U.S. Pat. 1,181,697, May 2, 1916. Date of appl., Nov. 2, 1915.

CHLORO-DERIVATIVES of aliphatic hydrocarbons, *e.g.*, methyl chloride, are saponified by heating them (*e.g.*, to 140° C.) under pressure (*e.g.*, 20—24 atmos.) with an alkaline solution, the interior surface of the vessel being coated with a film of the reacting liquids by rotating the vessel.—F. SP.

3-*Methylbutinol, its homologues and analogues; Preparation of ——.* Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 291,185, Mar. 24, 1914. Addition to Ger. Pat. 280.226 (this J., 1915, 378).

BY the action of acetylene on acetone (or its homologues or analogues) in presence of alkali ethoxide, a mixture of 3-methylbutinol and alcohol is obtained. It is shaken with concentrated sodium hydroxide solution whilst cooled with ice water, and the crystalline alcoholate of 3-methylbutinol which separates is dissolved in water, the solution cooled with ice, saturated with carbon dioxide, and extracted with ether. The ether solution is dried with sodium carbonate and distilled to recover first the ether and then 3-methylbutinol.—A. S.

[Hydr]oxyphenylquinolinedicarboxylic acid and process of making same. R. Schwabe, Assignor to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,181,485, May 2, 1916. Date of appl., Dec. 1, 1914.

See Eng. Pat. 22,828 of 1914 ; this J., 1915, 889.

Tartaric acids or their compounds : Process of making ——. M. Vavgouny, Berkeley, Cal., Assignor to Royal Baking Powder Co. U.S. Pat. 1,181,555, May 2, 1916. Date of appl., July 21, 1910.

See Fr. Pat. 455,972 of 1912 ; this J., 1913, 959.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Silver chloride and bromide ; Effect of light on solid ——. R. Lorenz and K. Hiege. Z. anorg. Chem., 1915, **92**, 27—34. J. Chem. Soc., 1916, **110**, ii., 207.

Colloidal metallic "fogs" are usually prepared by fusing salts in contact with the corresponding metals. The silver halides also form fogs when the solid salts are exposed to light. Optically clear crystals of silver chloride and bromide become more or less opaque and dark in colour when exposed to a beam of light, but remain at first optically clear, the beam being invisible. Later, the surface at which the beam enters becomes brown, and particles, visible in the ultramicroscope, are formed. The particles grow rapidly, and will continue to grow if the crystal is removed from the light and heated at 350° C. Heating in the absence of light does not produce particles. The growth of the particles is accompanied by a diminution of the coloration in their immediate neighbourhood. The effect is evidently due to the separation of metallic silver in a colloidal form, growing in size as the illumination is continued. These facts strongly support the view that the latent photographic image consists of colloidal silver in ultramicroscopic form.

Colloid chemistry and photography. Lüppo-Cramer. Kolloid-Zeits., 1915, **17**, 105, 135. Chem.-Zeit., 1916, **40**, Rep., 171.

(A) *Resins in collodion films.* A collodion-silver bromide emulsion, suitable for use only in the wet plate process, is made suitable for dry plates by addition of 5% of a 10% alcoholic solution of resin. Colophony, shellac, gum elemi, turpentine oil, and especially Canada balsam act in the same way, but camphor only slightly. These additions do not improve the keeping qualities of the plate, which fogs in a few days. (B) *Effect of grain surface.* Grainless gelatin-silver bromide plates, impregnated with nitrite, are, after exposure, treated with a 5% solution of ammonium molybdate. Subsequent chemical development is very slightly affected, while physical development is strongly restrained. (C) *Pseudo-solarisation with thiourea.* Treatment of exposed silver bromide plates with 0·1% thiourea solution accelerates subsequent development with slow developers but restrains the action of rapid metol developers. Also physical development with an acid metol silver developer is more rapid. With prolonged development pseudo-solarisation appears to about the same extent in all cases.

—B. V. S.

Patent.

Photographic developers ; Manufacture of ——. Elektrochem. Werke Ges., Berlin, and O. Dreibrodt and H. Röhler, Bitterfeld, Germany. Eng. Pat. 14,714, Oct. 18, 1915. Under Int. Conv., Oct. 3, 1914.

See Ger. Pat. 286,727 of 1914 ; this J., 1916, 199.

XXII.—EXPLOSIVES ; MATCHES.

Guncotton ; Rapid method for the determination of soluble nitrocellulose in ——. H. C. Mallinson. J. Ind. Eng. Chem., 1916, **8**, 401—402.

Five grms. of the guncotton (or 2 grms. if the amount of soluble nitrocellulose is known to be 25% or higher) is treated with 200 c.c. of ether-alcohol in a graduated cylinder, which is then shaken mechanically for about 1 hour. After allowing to settle, 50 c.c. of the supernatant liquid is transferred to a porcelain dish and treated with 500 c.c. of water at about 75°—80° C. The precipitated nitrocellulose is submerged by means of a glass rod to expel the last traces of solvent, and if it forms a coherent mass, it is transferred to a piece of filter-paper resting on absorbent material, moistened with alcohol, partially dried by pressing between filter paper, and then completely dried in an oven at 160° F. (70° C.). If the precipitate is not coherent, it is collected on a double filter, of which one paper has been counterpoised against the other, or in a tared Gooch crucible. The method is much quicker than the British Government process in which a known volume of the ether-alcohol solution is evaporated, and it gives somewhat lower and more accurate results, since it is very difficult to remove the last traces of solvent by evaporation.—A. S.

XXIII.—ANALYSIS.

Tin group ; Separation of the metals of the ——. J. M. Welch and H. C. P. Weber. J. Amer. Chem. Soc., 1916, **38**, 1011—1016.

The mixed sulphides of the copper group are treated with ammonium polysulphide solution containing 5% of caustic soda, which has no effect on the sulphides of mercury and copper, and the sulphides of arsenic, antimony, and tin, reprecipitated from the filtered solution, are superficially dried, by suction or with filter paper, and heated for 10 minutes on the water-bath with 10 c.c. of hydrochloric acid of sp. gr. 1·2. The residual arsenic sulphide is examined in the usual way, and the filtrate, diluted to 70 c.c., is saturated with hydrogen sulphide ; antimony and tin are thereby thrown down together, when both are present, as a characteristic brown precipitate (possibly a thioantimonite of tin), the colour of which, within rather wide limits, is a reliable indication of the presence of the two metals. Excess of hydrogen sulphide is expelled by heating, 5 c.c. of 3% hydrogen peroxide solution is introduced, and heating is continued until the precipitate has redissolved, or solution may be effected by simply evaporating the mixture, without hydrogen peroxide, or by adding a few drops of bromine water. Five to ten grms. of oxalic acid is then added, and the solution, whilst cooling, is saturated with hydrogen sulphide. Antimony is thus precipitated as a bright red sulphide, and tin is detected in the filtrate by boiling with 1—2 grms. of granulated lead for 2—3 minutes, cooling, and filtering into mercuric chloride solution.—F. Sodn.

Hydrofluoric acid ; Use of —— in the separation of some heavy metals from tin, antimony, tungsten, and molybdenum, by means of the electric current. L. W. McCay and N. H. Furman. J. Amer. Chem. Soc., 1916, **38**, 640—652.

McCay has previously shown that from a nitro-hydrofluoric acid solution of copper, lead, tin, and antimony, the last two metals being in the higher state of oxidation, the electric current precipitates the copper and lead only, the former at the cathode, the latter as peroxide at the anode (this J., 1914, 1117). Silver and mercury can also be quantitatively separated from tin and antimony by similar means. The silver deposits are free from platinum, but mercury deposits, like those of copper, contain a small quantity which is left as a black powder if the deposits are subsequently dissolved in nitric acid, so that a correction can be readily made. In nitrohydrofluoric acid solutions, tungstic and molybdic acids behave like stannic and antimonic acids towards the electric current, and the authors give details of experiments in which copper, lead, silver, or mercury was quantitatively separated from tin, antimony, tungsten, and molybdenum, even when these were all present together. Lead peroxide deposited from nitrohydrofluoric acid solutions contains fluorine, and weighs some mgrms. more than the calculated amount; it is therefore advisable to redissolve the washed precipitate by reversing the current, and reprecipitate from pure nitric acid solution, or if greater accuracy is desired, to determine the lead in the deposit as sulphate (*loc. cit.*).—J. H. L.

Fluorine: New method of determining ——. F. Pisan. Comptes rend., 1916, **162**, 791—793.

Thorium nitrate gives with fluorine in alkaline solutions, made slightly acid with acetic or nitric acid, a gelatinous, voluminous precipitate of thorium fluoride (ThF_4+4H_2O), which settles rapidly. A large excess of the reagent is necessary to obtain complete precipitation, and it is best to pour off the supernatant liquid before testing whether all the fluorine is precipitated. The precipitate should be washed by decantation as far as possible, using hot water. It loses one molecule of water on drying at 100° C., and may be weighed after drying, but it is better, however, to burn the filter paper and to convert the precipitate into thorium dioxide by strong ignition. Certain fluorides insoluble in water may be decomposed by fusing in a platinum crucible with five parts by weight of sodium carbonate, and after extracting the melt with water, acidifying slightly with acetic acid. Calcium fluoride and cryolite require fusion with two and a half parts of silica and six parts of sodium carbonate. Details are also given of the treatment required for decomposing silicates, fluosilicates, and fluoborates. The amount of mineral required for the test is only 0·2 to 0·3 grm. when the amount of fluorine present is between 5 and 8%.—J. B. C. K.

Vanadium: New method for the iodometric determination of ——. H. Ditz and Fr. Bardach. Z. anorg. Chem., 1915, **93**, 97. Chem.-Zeit., 1916, **40**, Ref., 181.

Quinquevalent vanadium can be rapidly estimated in the cold by use of the following reaction: $V_2O_5+2KBr+6HCl=2VOCl_2+Br_2+2KCl+3O$, and subsequent addition of potassium iodide, when the hydriodic acid produced, in absence of quinquevalent vanadium, is without action on the quadrivalent vanadium. To 25 c.c. of a solution containing about 0·1 grm. of vanadium are added 10 c.c. of 10% potassium bromide solution and 75 c.c. of concentrated hydrochloric acid; after 5—10 mins. the volume is made up to 1 litre, 20 c.c. of 5% potassium iodide solution added, and the solution titrated with $N/20$ thiosulphate.
—F. W. A.

Halogens in organic compounds; Removal and determination of —— by catalytic reduction. M. Busch and H. Stöve. Ber., 1916, **49**, 1063—1071.

Organic halogen compounds when shaken in aqueous or in alcoholic solution with palladinised calcium carbonate (prepared by heating an aqueous suspension of freshly-precipitated calcium arbonate with palladous chloride solution) and lcoholic potash in a current of purified hydrogen, are rapidly and quantitatively reduced, with absorption of hydrogen and formation of the norganic halogen salts. The method can be applied to the quantitative determination of the halogen in organic halogen compounds by taking about 0·2 grm. of the substance and after complete reduction (shown by the cessation of hydrogen absorption) determining the amount of halogen salt by precipitation with silver nitrate. The results so obtained for a large number of compounds are tabulated.—T. C.

Halogens: Detection and determination of —— in organic compounds. I. Drogin and M. A. Rosanoff. J. Amer. Chem. Soc., 1916, **38**, 711—716.

The modifications of Stepanoff's method (this J., 1907, 35) proposed by Bacon (this J., 1909, 161) and Maryott (this J., 1911, 11) are untrustworthy, but the following new modification of Bacon's procedure gave uniformly excellent results in 64 analyses of 11 substances of various types, including hexachlorobenzene. The reagents required are:—absolute alcohol redistilled from sodium (10 grms. per litre), preferably in a current of hydrogen; metallic sodium free from halogens (if not quite free the necessary correction should be determined on a 10 grm. sample), cut into clean pieces of known weight and stored in kerosene; pure dilute nitric acid (1 : 3); $N/15$ silver nitrate and ammonium thiocyanate solutions; ferric indicator prepared by adding concentrated nitric acid to a nearly saturated solution of ferric ammonium alum until the colour has changed from red to straw-yellow. The substance to be analysed (0·2—0·3 grm.) is dissolved in alcohol in a 300 c.c. Kjeldahl flask attached to a reflux condenser, and the sodium is added in small pieces over a period of about 30 mins., during the latter half of which the liquid should be gently heated to assist solution. If *w* denote the weight in grms. of substance taken, 156 *w*, 68 *w*, or 44 *w* c.c. of alcohol and 21·5 *w*, 9·4 *w*, or 6·1 *w* grms. of sodium should be used, according as the substance contains chlorine, bromine, or iodine respectively. After all the sodium has been added the liquid is boiled for an hour and shaken occasionally. If a small quantity of sodium remains undissolved it is immaterial. The liquid is cooled and 1 c.c. portions of water are added through the condenser so long as vigorous action ensues. Carbonisation sometimes occurs but this does not matter. The liquid, diluted to about 250 c.c., is cautiously acidified with the nitric acid reagent and continuously cooled meanwhile; if iodine is present ice cooling is necessary and much more dilute acid must be used. The acidified liquid is treated with a known volume of $N/15$ silver nitrate solution, about 3—4 c.c. in excess of that required to precipitate all the halogen. The precipitate is filtered off, the filtrate is run into a large porcelain dish, and after addition of 10 c.c. of the ferric indicator the excess of silver is determined by titrating with $N/15$ thiocyanate solution until a faint pink colour appears.

For the detection of halogens in organic substances a few mgrms. may be dissolved in 1 c.c. of pure absolute alcohol. A few bright pieces of sodium are thrown one at a time into the liquid, which is finally warmed gently. After cooling, the liquid is acidified with dilute nitric acid, filtered if necessary, and tested with about 10 drops of $N/15$ silver nitrate solution. The test is extremely sensitive, especially if accompanied by a blank.—J. H. L.

Distilling flask: New form of —— together with a note on benzyl benzoate. Earl of Berkeley. Chem. Soc. Trans., 1916, **109**, 520—523.

For distilling liquids of high boiling point, a flask of silica or hard glass having a vacuum jacket fused on round the neck and upper portion of the bulb, after the manner of a Dewar flask, is recommended. With this apparatus, it was possible, for a given consumption of gas, to distil four times the quantity of benzyl benzoate, b.pt. 322° C., that could be obtained, under otherwise similar conditions, from an ordinary distilling flask. In the preparation of benzyl benzoate by Claisen's method (Ber., 1887, **20**, 646) increased yields are obtained when care is taken that the benzaldehyde and benzyl alcohol are dry and freshly distilled. Under these conditions 24 hours' heating on a water bath of the aldehyde with sodium benzoxide is quite sufficient to complete the reaction.—G. F. M.

Method for testing the efficiency of boiler scale preventives. Benson and Hougen. *See* I.

Determination of benzene, toluene, and solvent naphtha in light oils. Wilson and Roberts. *See* III.

Analysis of acid calcium bisulphite solutions. Hägglund. *See* V.

Iodometric determination of thiocyanic acid and hydrogen sulphide. Treadwell and Mayr. *See* VII.

Accurate end point in the volumetric determination of sulphur in steel. Zschiegner. *See* X.

Simple and rapid assay of lead. Torossian. *See* X.

Separation of lauric and myristic acids from each other and from mixtures of other fatty acids. Jacobson and Holmes. *See* XII.

Analysis of sulphonated oils. Oberfell. *See* XII.

Direct determination of the rubber in a compound. Belfit. *See* XIV.

Determination of barium carbonate and sulphate in vulcanised rubber goods. Tuttle. *See* XIV.

New method for the determination of soil acidity. Truog. *See* XVI.

New apparatus for the determination of soil carbonates, and new methods for determination of soil acidity. Truog. *See* XVI.

Determination of carbon dioxide as barium carbonate applied to the Marr method for determination of soil carbonates. Schollenberger. *See* XVI.

Determination of carbon in the organic non-sugar constituent of saturation (sugar) scums. Stanek. *See* XVII.

Colour reactions of C_3-sugars and methylglyoxal. Neuberg. *See* XVII.

Determination of tartaric acid in wine, &c. Hartmann and others. *See* XVIII.

Detection of methyl alcohol. Fendler. *See* XVIII.

Comparison of methods for the determination of casein in milk. Hersey. *See* XIXA.

Determination of monoaminodicarboxylic acids from proteins. Andersen and Roed-Müller. *See* XIXA.

Separation of autogenous and added hydrocyanic acid from certain plant tissues, and its disappearance during maceration. Alsberg and Black. *See* XIXA.

Analysis of non-alcoholic lemon and orange extracts. Redfern. *See* XIXA.

Aqueous solutions of carbonic acid. Strohecker. *See* XIXB.

Determination of carbonic acid, combined and free, in solution, particularly in natural waters. Johnston. *See* XIXB.

Comparison of the permanganate methods for the determination of required oxygen in water analysis. Sachs. *See* XIXB.

Determination of oxygen demand of sewage. Bruckmiller. *See* XIXB.

Reduction of quinquevalent to trivalent arsenic by cuprous chloride, and determination of arsenic [in insecticides] by distillation as arsenic trichloride. Roark and McDonnell. *See* XIXB.

New methods for the analysis of lime-sulphur solutions. Determination of the polysulphide sulphur. Chapin. *See* XIXB.

Sandalwood, its assay, yield of oil, and changes in the oil during distillation. Briggs. *See* XX.

Hydrolysis of yeast nucleic acid with ammonia. Jones and Germann. *See* XX.

Detection of small quantites of glycerol and alcohols and acids of the carbohydrate series. Neuberg and Mandel. *See* XX.

Rapid determination of soluble nitrocellulose in guncotton Mallinson. *See* XXII.

ERRATA.

Alkalimetric determination of certain divalent metals as phosphates. W. R. Schoeller and A. R. Powell (this Journal, 1916, 656). Under *Cobalt*, col. 2, lines 10—11, for " the boiling continued " read " the liquid vigorously stirred," and line 30, for " a lilac colour is given to the liquid " read " the precipitate just disappears."

PATENT.

Gas-analysing apparatus. H. K. Moore, Berlin, N.H., Assignor to J. Quincy, Boston, Mass. U.S. Pat. 1,182,851, May 9, 1916. Date of appl., Nov. 29, 1910.

THE gaseous mixture to be analysed is drawn into a measuring device and measured at atmospheric pressure. It is then forced through an absorbent by liquid displacement, into a second measuring device where the residue is measured at atmospheric pressure. This device comprises a floating bell with means for compensating for the changes of buoyancy. The apparatus is operated automatically.—W. F. F.

Trade Report.

Prohibited exports. Amendments in and Additions to List. Order in Council, May, 25, 1916.

THE Proclamation dated the 10th day of May, 1916 (see this J., 1916, 620), is amended as follows :

The heading " (c) Sodium carbonate and bicarbonate " is replaced by the headings :—(c) Sodium bicarbonate ; (b) Sodium carbonate. The following headings are added :—(c) Asphalt, coal tar ; (c) Citric acid ; (c) Honey ; (c) Pitch, coal tar ; (c) Pitch, rosin ; (c) Pitch wood ; (c) Syrups which may be used as food for man, and molasses produced from cane sugar.

Books Received.

TRANSACTIONS OF THE FARADAY SOCIETY. Vol. XI Parts 2 and 3. April, 1916. 284 pages. Price 15s

THIS volume contains the papers read at th meetings of the Society on October 19th and December 8th, 1915 (see this J., 1915, 1089, 1091 1100 ; 1916, 19, 50, 51).

PERFUMERY AND ESSENTIAL OIL RECORD. Vol VII. SPECIAL NUMBER. June 12, 1916. Edite by J. C. UMNEY. 8, Searle Street, London, W.C Price 1s. 6d.

THIS number consists of a list of the variou plants from which essential oils have been obtained together with the habitat and part used, chie constituents, percentage yield, and physica characters of the oils themselves. References t literature are also appended. This list, which con tains some 1500 names, arranged botanically i alphabetical order, should prove of great valu to all those who have to deal with essential oil- A list of common plant names with their botanica equivalents is appended.

Journal of the Society of Chemical Industry.

No. 13, Vol. XXXV. JULY 15, 1916. No. 13, Vol. XXXV.

Manchester Section.

Meeting held at the Grand Hotel, Manchester, on Friday, May 5th, 1916.

MR. J. H. HOSEASON IN THE CHAIR

SOME THEORETICAL CONSIDERATIONS BEARING ON THE PERFORMANCE OF BIOLOGICAL SEWAGE PURIFICATION PLANT.

BY GUY T. P. TATHAM. B.SC.

Papers have been published from time to time dealing with the "Mean time of contact" of a sewage liquor with the material of the biological filter in which it is undergoing purification, the idea being that the degree of purity attained in the effluent is dependent on the average time that a drop of the liquid remains in contact with the filtering medium. But there is no uniformity in the methods used to determine this mean time of contact, on the one hand, nor, on the other hand, any very definite idea how the degree of purification attained in the effluent may be expected to vary with the mean time of contact. The present paper is a general discussion of the theoretical aspect of these questions.

Some time ago, when the author was on the staff of the Royal Commission on Sewage Disposal, the Commissioners were good enough to give him permission to use figures in their possession for the purposes of the work here to be described. The work is based upon those figures.

The following symbols are used in the course of the paper:—

C.—Concentration of salt in grams of chlorine per 100 litres.

F.—Rate of flow in gallons per unit time.

W.—Total liquid content of the purification pparatus at time t.

t.—Time.

T.—Mean time of contact of liquor with the iltering medium, or average time that a particle f liquor remains in the purification apparatus.

x.—Quantity of polluting matter (pollute) per nit volume of liquid.

P.—Value of x for the final effluent.

p.—The "percentage purification."

$$p = \frac{x_0 - P}{x_0} \times 100$$

K, m, n, a, t′, x_0.—Constants which will be xplained as they occur.

e.—The base of the natural logarithms.

The average time of contact of the liquid with he filtering material is defined as the sum of the mes of passage of all the particles of the liquid rough the filter divided by the number of articles. In order to distinguish the particles of quid whose progress through the filter it is esired to watch, it is necessary to add to the flowing liquid some soluble substance which can adily be detected quantitatively in the effluent. dose of the selected substance is put into the ter and the effluent analysed for it at regular tervals of time following the application. The ncentration of the artificially added substance the effluent, given a constant flow, is proportional to the number of "marked" particles suing per unit time at the moment.

Common salt has been found most convenient for the purpose. The greatest drawback to its use is that it occurs in varying quantity in sewage liquors so that, towards the end of the experiment, when most of the artificially added salt has been washed out the "blank" is proportionally large and the measurements in consequence uncertain. Special methods, to be described immediately, must be employed to avoid this uncertainty.

Allowance having been made for the blank, the figures so corrected are plotted as ordinates against the corresponding times as abscissæ and a smooth curve drawn through the points so obtained. From this curve there are several ways of calculating the mean time of contact.

The mean time of contact is given mathematically by the formula

$$T = \frac{\int_0^\infty Ctdt}{\int_0^\infty Cdt}$$

It will be observed that the same formula gives the position of the ordinate through the centre of gravity of the plane figure bounded by the curve and the axis of time. This is the theoretical basis of the method used by Mr. C. C. Frye to calculate the results of salt experiments done for the Sewage Commission. The salt curves were drawn on cardboard and the figure bounded by the curve and the axis of time was cut out and the position of the centre of gravity found, the ordinate to which was then drawn and the mean time of contact thus found mechanically.

Again, if the salt concentrations are multiplied each by the corresponding time in hours and the products plotted against time we get a second curve giving the product, concentration × time against time, and the formula above shows that the mean time of contact is the quotient of the area enclosed between this second curve and the axis of time by that enclosed between the first curve and the same axis. Or, if a standard paper be used for drawing the curves the figures can be cut out and weighed. The quotient of the respective weights will then give the mean time of contact in hours.

An objection to all these methods will be raised at once, viz., the mathematical formula requires that the duration of the experiment be extended indefinitely and the washing out of the salt has no recognisable end point, so that the mean time of contact arrived at will be more or less arbitrary depending on the point at which the observer has seen fit to discontinue the experiment.

Another method of getting the result, which is not open to this objection, is suggested by the mathematical expression for T. One might be able to express the connection between C and t by a mathematical formula and so do away with the arbitrary element of the duration of the experiment. Unfortunately the shapes of the salt curves in the early stages of the experiments vary considerably among themselves and it is not possible to fit all of them closely with a standard type of equation. The curves rise quickly to a maximum and then descend, sharply at first, but less and less steeply as the axis of time is approached. In the case of a high rate of flow and with a filter of coarse material the maximum is very sharply defined and occurs perhaps an hour from the start of the experiment; with a low rate of flow, or with a fine filtering medium, on the other hand, the maximum may not be attained for several hours and the summit of the curve is gently rounded; following the maximum the curve descends at first concavely to the axis of time, later with curvature reversed it follows the course previously described.

The curves of the latter type can be fitted fairly closely with the graph of an equation of the type, $C = Kte^{-mt}$. This curve passes through the origin, which the salt curve of course cannot do, but the departure here is not practically of great importance.

Results obtained by the use of this equation will be described presently.

It has been found that the later parts of all the curves, where they descend convexly to the axis of time, can be fitted tolerably by equations of the form $C = Ke^{-nt}$.

These equations suggested a convenient method of avoiding the arbitrary element of the duration of the experiment, referred to above as being inherent in the purely graphic method.

The expression for T may be written thus

$$T = \frac{\int_0^{t'} Ctdt + \int_{t'}^{\infty} Ctdt}{\int_0^{t'} Cdt + \int_{t'}^{\infty} Cdt}$$

the first terms in the numerator and denominator respectively may be obtained graphically and the second terms applied as corrections, being calculated from one or other of the equations given above. Using the equation $C = Ke^{-nt}$ the constants "K" and "n" are found as the respective averages of a number of values calculated from a number of corresponding values of C and t taken from that part of the curve where it descends convexly to the axis of time, and "t′" is taken as late as reliable estimations of C can be obtained. The exact value of t will depend on the particular experiment.

The second term of the numerator is given by the formula

$$\int_{t'}^{\infty} Ctdt = \int_{t'}^{\infty} Kte^{-nt}\,dt = \frac{K}{ne^{nt'}}\left(t' + \frac{1}{n}\right)$$

and of the denominator by

$$\int_{t'}^{\infty} Cdt = \int_{t'}^{\infty} Ke^{-nt}dt = \frac{K}{ne^{nt'}}$$

The equations obtained by the use of the formula $C = Kte^{-mt}$ are a trifle longer. They are easily obtained by integrating the corresponding expressions and introducing the limits of integration.

It is interesting to notice that the salt curve of the effluent from a tank initially filled with brine and constantly stirred while a current of fresh water flows steadily into it and overflows, would follow a curve of the type $C = Ke^{-nt}$, that is to say this curve applies to the case of "washing by dilution."

On working out this case it will be found that "n" is equal to the rate of flow divided by the liquid content of the plant, and that

$$T = \frac{1}{n} = \frac{W}{F}$$

The same relation is obviously true for the case of washing by displacement and in fact may be shown to be true universally. If the rate of flow is given in gallons per hour and the liquid content in gallons the equation gives T in hours; conversely when T has been found the liquid content of the filter (W) may be calculated, given the rate of flow.

(The constant "K" depends only on the amount of salt added and so does not appear in the above equation for T.)

In Tables I to IV are given the figures calculated for 40 salt experiments done at the Dorking Experimental Station of the Royal Commission on Sewage Disposal by Mr. E. H. Richards. For details of the working of the filters, etc., the reader is referred to the Commission's Fifth Report and Appendix IV., pp. 199—210 (1910).

In the tables here given will be found (1) the flow for each experiment in gallons per square yard per diem for the top surface of the filter, also the flow in gallons per diem per cubic yard of the filtering material; (2) T calculated as above described; (3) W calculated in gallons per cubic yard of the filtering material; (1) I n; (6) the amount of added salt accounted for in the effluent. This is readily calculated knowing the area enclosed between the salt curve and the axis of time and the rate of flow. The amount of salt used in each experiment was 7 lb.

It will be observed that I/n is a poor approximation to T. This shows that the washing out of the salt is not just an instance of washing by dilution and the formula $C = Ke^{-nt}$ for a trickling is only approximate and empirical.

The irregular value for the amount of salt accounted for in the effluent suggests that the recorded flows were not always quite accurate. Tables were prepared in which the flows were provisionally corrected so as to bring the salt accounted for in each case exactly to the average of the values for the particular filter. The values for W were recalculated correspondingly but were no more uniform than the values in the original tables here given.

The values found for W seem to suggest seasonal as well as irregular changes in the internal conditions of the filters. It is outside the scope of the present paper to discuss these values further.

In the same tables are given values for the mean time of contact deduced by fitting an equation of the type $C = Kte^{-mt}$ to the salt curves. In this case it will be found by working out

$$T = \frac{\int_0^{\infty} Ctdt}{\int_0^{\infty} Cdt} = \frac{\int_0^{\infty} Kt^2e^{-mt}dt}{\int_0 Kte^{-mt}dt}$$

that $T = \frac{2}{m}$. Comparing the results with thos obtained by the more laborious but more accurat method employed above it will be seen that ther is general but not very close agreement betwee the results obtained by the two methods.

It will be found on working out the position o the maximum value for C that it is given by th ordinate at $t = \frac{1}{m}$ while the average time o contact is given by $T = \frac{2}{m}$ so that one might b tempted to apply a ready rule that the mean tim of contact is found by taking the time when C i a maximum and doubling. Unfortunately it i just in the neighbourhood of the maximum tha the salt curve departs most widely from the grap so that the rule would be practically useless. I fact, it is necessary for success by this method t get values of m from the descending portion of th curve.

Having thus got a curve which resembles th shape of the salt curve it is interesting to deduc from the correspondence the way in which the purification effected in the sewage would theoretically depend on the mean time of contact.

In order to do this one must know how the purification of a particle of liquid in the filter progresses with the time, or, what is the same thing, how the purification would depend on the time of contact if this were the same for every particle of the liquid.

Suppose we denote the quantity of polluting matter, or "pollute" in unit volume of the sewage by x, x_0 being the value of x when $t = o$, *i.e.*, that present in the original sewage.

Then, if we suppose for a moment that the rate of oxidation of the pollute is constant right up to the point of complete purification we should have—

Expressing the dependence of x on the time of contact of the particle as a functional relationship.

$$x = \phi(t)$$

And the rate of oxidation being constant

$$\frac{dx}{dt} = a$$

$$x_0 - x = at$$

The pollute carried by a fraction of the effluent having contact between $(t + dt)$ and t is

$$F \cdot \frac{C\phi(t)dt}{\int_0^\infty Cdt}$$

And the pollute carried per unit volume of the effluent is :—

$$P = \frac{\int_0^\infty C\phi(t)dt}{\int_0^\infty Cdt} = \frac{\int_0^\infty C(x_0 - at)dt}{\int_0^\infty Cdt}$$

$$= x_0 - aT$$

or if p is the "percentage purification"

$$\frac{p}{100} = \frac{x_0 - P}{x_0} = \frac{a}{x_0} T.$$

That is to say in such case the percentage purification is directly proportional to the mean time of contact, and, further, the above law of the constant rate of oxidation is the only law for which this relation can hold.

But it is well known that the rate of oxidation becomes less as the quantity of oxidisable matter decreases so that, in reality, the purification cannot be directly as the mean time of contact.

It remains to discover a likely form of the function ϕ.

We have only one guide, we can make our law consistent with the theory of the dissolved oxygen absorption test, or the "aeration test," as it is often called.

It is generally accepted that the oxidation of sewage in a biological filter follows the same general course as in the aeration test.

The theory of the aeration test implies that the dissolved oxygen absorption in a given time is directly proportional to the initial concentration of the pollute, for, if we dilute the liquor 1 in z to make the test, then we multiply the observed oxygen absorption by z to arrive at the "dissolved oxygen absorbed" for the liquid, and the whole value of the test rests on the fact that the result is independent of z.

So to determine ϕ we have the following conditions to satisfy : (1) the oxidation depends in some way on the length of time it is continued, (2) it is directly proportional to the initial concentration of the pollute, (3) we assume that the rate of oxidation at any moment is determined by the concentration of the pollute at the time.

In accord with these conditions we may write

$$x_0 - x = x_0 \psi(t)$$

Differentiating

$$-\frac{dx}{dt} = x_0 \psi'(t)$$

Now $\frac{dx}{dt}$ depends only on x, further, at the beginning of the oxidation $x = x_0$.

Hence we may write :—

$$-\frac{dx}{dt} = \alpha x$$

$$x = x_0 e^{-\alpha t}$$

That is to say the oxidation follows the laws of a "monomolecular" reaction.

a is the rate of oxidation at unit concentration and we shall call it for convenient reference the "avidity constant."

Now returning to the relation,

$$P = \frac{\int_0^\infty C\phi(t)\,dt}{\int_0^\infty C\,dt}$$

and using the equation $C = Kte^{-mt}$ to express the connection between C and t we have

$$P = \frac{\int_0^\infty x_0 Kte^{-(m+\alpha)t}dt}{\int_0^\infty Kte^{-mt}dt} = x_0 \frac{m^2}{(m+\alpha)^2}$$

Now $T = \frac{2}{m}$

Whence

$$P = \frac{4}{(2+\alpha T)^2} x_0.$$

In the case of purification in a tank with constant mixing as *e.g.* by blowing in air, and supposing that a constant flow is maintained, it has been shown above that C and t are exactly connected by the equation

$$C = Ke^{-nt}$$

$$\text{and } T = \frac{1}{n} = \frac{\text{Capacity of tank}}{\text{Flow}}$$

In this case we have the equation

$$P = \frac{\int_0^\infty x_0 Ke^{-(n+\alpha)t}dt}{\int_0^\infty Ke^{-nt}dt}$$

$$= x_0 \frac{n}{n+\alpha}$$

$$= x_0 \frac{1}{1+\alpha T} = x_0 \frac{F}{F+\alpha W}$$

The constant *a* depends, of course, on the method of purification as well as on the sewage. Given *a* we can by the above equations connect the percentage purification of the effluent with the mean time of contact, or with the flow and the liquid content of the purification plant. We have already named *a* the "avidity constant."

See Tables V and VI.

In Tables I. to IV. are given—

No. The number of the experiment.
Flow in gallons per square yard per diem.
in gallons per cubic yard per diem.
T in hours.
W in gallons per cubic yard of the filtering material.
S the weight of added salt accounted for in the effluent in lb.

Note—The weight of salt used in each experiment was 7 lb.

The dates on which the experiments were performed were as follow:—No. 1. October 9th, 1907. No. 2. January 23rd, 1908. No. 3. February 6th, 1908. No. 4. May 5th, 1908. No. 5. July 14th, 1908. No. 6. July 20th, 1908. No. 7. July 23rd, 1908. No. 8. October 6th, 1908. No. 9. October 9th, 1908. No. 10. January 7th, 1909.

TABLE I.

Filter No. 1.

Coarse shallow filter.—Top surface area, 6·03 square yards. Capacity 5·14 cubic yards. Material, clinker. Depth of material 2 ft. 3 in. Size of material, 1 in. to ¼ in. throughout.

No.	Flow.		T	W	1 h.	2 m.	S.
	sq. yd.	cu. yd.					
1...	75	93	4·0	15	3·6	4·5	3·5
2...	150	187	1·0	23	2·5	3·5	4·7
3...	75	93	5·2	32	6·0	5·9	7·3
4...	200	249	2·4	24	2·5	2·6	7·1
5...	250	311	1·8	16	1·2	1·9	6·8
6...	200	249	2·2	23	2·3	2·9	7·0
7...	150	187	2·7	21	2·2	3·6	6·5
8...	300	373	1·9	30	1·4	2·1	6·2
9...	450	559	2·[illegible]	45	1·1	1·8	6·2
10...	350	437	1·4	25	1·0	1·6	6·6

TABLE II.

Filter No. 2.

Coarse deep filter. Surface area, 6·03 square yards. Capacity 10·28 cubic yards. Material, clinker. Depth of material, 4 ft. 1 in. Size of material 1 in. to ¼ in. throughout.

No.	Flow.		T	W.	1 h.	2 m.	S
	sq. yd.	cu. yd.					
1...	75	47	7·0	14	5·5	7·0	4·4
2...	150	93	4·6	15	4·1	5·2	4·5
3...	75	47	10·6	21	6·9	11·9	5·2
4...	200	124	5·9	18	5·2	5·2	4·4
5...	250	155	3·2	20	2·5	3·7	5·7
6...	200	124	4·5	25	4·0	5·9	7·8
7...	150	93	5·5	30	5·0	7·3	6·7
8...	300	186	3·3	25	2·5	3·2	6·2
9...	450	280	2·2	25	1·5	2·7	5·7
10...	700	435	1·5	27	1·[illegible]	1·5	6·5

TABLE III.

Filter No. 3.

Fine deep filter. Top surface area, 6·03 sq. yds. Capacity, 10·28 cub. yds. Material, clinker. Depth of material, 4 ft. 1 in. Size of material: Top, 2 ft. 5 in. of ⅛ to ¼ in. diam. Bottom, 1 ft. 8 in. of ¼ to ½ in. diam.

No.	Flow.		T.	W.	1 h.	2 m.	S.
	sq. yd.	cu. yd.					
1...	75	47	[illegible]	42	11·5	16·0	5·1
2...	150	93	[illegible]	42	[illegible]	11·4	5·4
3...	75	47	[illegible]	35	9·5	15·4	[illegible]
4...	200	124	5·2	17	[illegible]	[illegible]	[illegible]
5...	250	155	3·0	[illegible]	[illegible]	3·5	5·6
6...	200	124	5·0	44	7·5	[illegible]	6·4
7...	150	93	[illegible]	33	7·0	[illegible]	[illegible]
8...	300	186	3·9	37	3·4	4·[illegible]	6·1
9...	450	279	3·2	[illegible]	3·5	3·5	5·2
10...	700	435	2·5	41	1·4	1·7	6·7

TABLE IV.

Filter No. 4.

Fine shallow filter. Top surface area, 6·03 square yards. Capacity, 5·14 cubic yards. Material, clinker. Depth of material, 2 ft. 3 in. Size of material: Top, 1 ft. 2½ in. of ⅛ to ¼ in. diam. Bottom, 1 ft. 0½ in. of ¼ to ½ in. diam.

No.	Flow.		T.	W.	1 h.	2 m.	S.
	sq. yd.	cu. yd.					
1...	75	93	5·8	32	5·5	7·[illegible]	4·9
2...	150	186	5·[illegible]	[illegible]	4·1	5·6	4·4
3...	75	93	17·1	66	15·6	14·7	[illegible]
4...	200	[illegible]	1·6	17	1·6	[illegible]	4·4
5...	250	[illegible]	3·3	39	2·6	1·6	[illegible]
6...	200	[illegible]	7·6	[illegible]	[illegible]	6·2	[illegible]
7...	150	186	6·5	32	3·2	[illegible]	[illegible]
8...	300	372	2·3	36	[illegible]	3·2	[illegible]
9...	450	559	1·7	39	1·6	[illegible]	[illegible]
10...	350	435	2·4	44	1·9	[illegible]	7·5

TABLE V.

Table showing the connection between the avidity constant, the mean time of contact and the percentage purification for the salt curves. $C = Kn^{-m}$

n	Percentage purification.							
	60	70	80	84	87	90	92	[illegible]
0·10	11·6	16·5	24·7	30·0	35·4	43·2	50·6	[illegible]
0·15	7·8	11·0	16·5	20·[illegible]	23·6	[illegible]	[illegible]	[illegible]
0·20	5·8	8·3	12·3	15·0	17·7	21·6	[illegible]	[illegible]
0·25	4·7	6·6	9·9	12·0	14·2	17·3	[illegible]	[illegible]
0·30	3·9	5·5	8·2	10·0	11·8	14·4	16·9	[illegible]
0·40	2·9	4·1	6·2	7·5	8·9	10·8	12·7	[illegible]
0·50	2·3	3·3	4·9	6·0	7·1	8·6	10·1	[illegible]
0·60	1·9	2·[illegible]	4·1	5·0	5·9	7·2	8·4	[illegible]
0·70	1·7	2·4	3·5	4·3	5·1	6·2	7·2	[illegible]
0·80	1·5	2·1	3·1	3·8	4·4	5·4	6·3	[illegible]
0·90	1·3	1·8	2·7	3·3	3·9	4·8	5·6	[illegible]
1·00	1·2	1·7	2·5	3·[illegible]	3·5	4·3	5·1	[illegible]

TABLE VI.

Table showing the connection between the avidity constant, the mean time of contact and the percentage purification for the salt curves. $C = Ke^{-}$

n	Percentage purification.							
	60	70	80	84	87	90	92	[illegible]
0·10	15·[illegible]	23·3	40·0	52·5	67·0	90·0	115	[illegible]
0·15	10·[illegible]	15·5	26·6	35·0	44·7	60·0	77	[illegible]
0·20	7·8	11·6	20·0	26·2	33·5	45·[illegible]	[illegible]	[illegible]
0·25	6·0	9·3	16·0	21·0	26·8	36·[illegible]	46·0	[illegible]
0·30	5·0	7·8	13·3	17·5	22·3	[illegible]	38·4	[illegible]
0·40	3·8	5·8	10·0	13·1	16·7	22·5	28·6	[illegible]
0·50	3·0	4·7	8·0	10·5	13·4	18·0	[illegible]	[illegible]
0·60	2·5	3·9	6·7	[illegible]	11·2	15·0	[illegible]	[illegible]
0·70	2·1	3·3	5·7	7·5	9·6	12·8	16·4	[illegible]
0·80	1·9	2·9	5·0	6·6	8·4	11·2	14·3	[illegible]
0·90	1·7	2·6	4·4	5·8	7·4	[illegible]	12·[illegible]	[illegible]
1·00	1·5	2·3	4·0	5·3	6·7	9·0	11·[illegible]	[illegible]

Thus we have determined theoretical laws connecting the quality of the effluent with the mean time of contact. These laws are expressed by the formulæ given above from which the Tables V and VI have been calculated. We find that the purification should not even theoretically be directly proportional to the mean time of contact. The relations given involve only one constant n which is dependent jointly on the nature of the sewage liquor and the method of purification applied. I have termed this constant the "avidity constant," as it expresses the eagerness with which the sewage takes up oxygen: it is the numerical measure of the rate at which the sewage pollute is oxidised when it is present in unit concentration.

As regards the use of the tables. Suppose we wish to purify a given sewage 90 % on a biological filter. We must find by suitable laboratory experiments the value of α for the particular sewage and filtering material under the conditions likely to obtain in practice. Suppose we find α to be 0·45. Looking at Table V we find that a mean time of contact of about 9·6 hours will be required. If the sewage is to be purified by *e.g.* blowing air through it in a tank under conditions of continuous flow, then Table VI must be used as it is calculated from the equations applying to this case. If the avidity constant were still 0·45 we see that 20 hours contact would be required.

The equations and tables calculated from them must be regarded as provisional until their applicability has been proved in practice: at all events they give consistency to the different aspects of the theory of sewage purification: also it will be noticed from the tables that they give mathematical expression to the fact, well known to those conversant with works practice, that the size of the plant required to give a specified degree of purification increases very greatly per unit increase in the percentage purification as the latter itself increases. For instance, looking for a moment at Table V, it will be seen that filter beds giving 80 % purification would have to be more than doubled in size to give 92 %. In this respect hen the formulæ give promise of representing he facts with tolerable exactness. Furthermore, s they are based on the well tested theory of the eration test which has been found to apply to ll waste liquors which are amenable to biological urification so these same formulæ will apply to all uch liquors.

Again, if the theory of the avidity constant is onfirmed by experiment it may be expected o supply a very good measure of the degree of ifficulty of purification of any particular liquor it s proposed to treat. It has been pointed out that he avidity constant is characteristic jointly of the ewage liquor and the method of purification. bviously if the mean time of contact and the ethod of purification are kept constant the value educed for α depends only on the sewage; using standard sewage and a fixed mean time of ontact the value found for α will be characteristic f the method of purification. Thus one is led to xpect that the avidity constant may be split into wo constants, one characteristic of the sewage nd the other of the method of purification. Thus sing standard sewage one might be able to get measure of the activity of a particular kind of lant, or using a standard plant of the stability a particular liquor.

Given the flow it has been shown that the mean me of contact is proportional to the liquid ntent of the purification plant and this in turn pends on the biological conditions obtaining side the filter and on the physical nature of e filtering medium. In this connection see ifford, Proc. Inst. Civil Eng., Vol. 172, 1907–1908, rt 2, and this Journal, 1908, No. 13, Vol. 27.

The first step towards making the chemical-gineering problem of sewage plant design exact to analyse it into its component parts. It is s theoretical dissection which has been attempted this paper. For the sake of obtaining simple l convenient formulæ one has to replace the l complex changes by which the oxidation sewage takes place with ideal simple ones and son from these. We thus obtain the simple mulæ which are the most likely to fit the ts. The degree of closeness to which they and therefore the practical use of the formulæ n only be decided by experiment.

Communication.

VULCANISATION EXPERIMENTS ON PLANTATION PARA RUBBER. II. THE CAUSE OF VARIABILITY AND SOME CONTRIBUTORY FACTORS.

BY B. J. EATON, F.I.C., AND J. GRANTHAM, B.A.

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In a previous communication by the authors on the variability of plantation Para rubber (this Journal, October 15th, 1915, p. 989) the theory was propounded that the variability in respect to rate of cure, which was shown to be the most important variation in different raw rubbers, both from the manufacturers' point of view and in respect to degree of variability when compared with differences in mechanical strength of the vulcanised samples from "First latex" rubbers, was due either to some accelerating substance, probably the protein, present in small quantities in the original latex and in the rubber prepared from such latex, or to some substance produced subsequently in the raw rubber from a constituent, probably the protein, present in the latex. The primary influence on the amount of such substance referred to in that paper was the quantity of serum left in the raw rubber, and it was shewn that the greater the amount of serum left in the coagulated rubber for a certain period, the greater the rapidity of cure. One factor influencing the rapidity of cure was also investigated, viz., smoking of freshly coagulated raw rubber, which was shown to retard the rate of cure. It was also suggested that certain antiseptics, *e.g.* formalin, also retarded the rate of cure, but no systematic investigation had been made at the time. Before giving the results of our more recent work, we should like to mention that our previous paper published in this Journal in October, 1915, was despatched in March or April, 1915, but that publication was delayed for various reasons. Dr. Schidrowitz had read a very important paper at the International Rubber Congress, London, 1914, showing the differences in rate of cure between various plantation Para rubbers, which, as far as we are aware, was the first systematic work on the subject. Mr. Williams, General Works Superintendent of the North British Rubber Company, at the same congress, also referred to the manufacturers' difficulties due to this particular variability. Considerable differences are also shown between the mechanical properties of the rubbers examined by Schidrowitz at optimum cure, whereas our results for about a thousand "First latex" rubbers collected over the whole Federated Malay States do not show greater differences in breaking loads, at optimum cure, than 25 %, although much larger differences are obtained in this latter respect between first grade and lower grade samples, as would be expected from the nature of the latter samples. We did not see Dr. Schidrowitz's paper, however, till ours was completed and no details are given in his paper of methods of preparing and testing the vulcanised rubber. Since the first publication of our work appeared in the Agricultural Bulletin of the Federated Malay States in February, 1915, a number of subsequent papers have been published in the same journal, showing the influence of various factors on the rate of cure of plantation Para rubber, but, so far, no summary of the present position of the work and the development of one or other of our alternative theories has been prepared, except in lectures delivered by one of us to various Planters' Associations in the

Federated Malay States, and it seems desirable to publish the results obtained recently in a more scientific form than we are able to do in a local publication, in which it is not possible to illustrate the differences by means of curves, which are more reliable than numerical results in indicating differences between raw rubbers after vulcanisation. The somewhat unsatisfactory nature of the breaking point figures, when used for ascertaining the relative rate of cure of different samples, especially when only two test rings are used at each cure was referred to in our previous paper. Consequently in this paper all our conclusions regarding rate of cure are based on the difference shown between the load-stretch curves at a particular time of cure, these differences being relative at all cures. By this method very small differences in rate of cure can be detected. One of the two test rings prepared at each time of cure is used to produce the series of curves for each sample at different times of cure, and the other is used to give series of curves showing the differences in rate of cure between different samples. By means of the time series, any error in temperature of the autoclave or any error due to variable thickness of the test pieces is quickly seen. Each experimental series containing different samples is vulcanised for different times of cure at ¼ hour intervals over a considerable period, and ample confirmation of differences in rate of cure is thus obtained. Samples from which the curves are to be thus plotted together, are always cured at the same time in the same autoclave. We have found by numerous experiments that the two curves for the test rings of similar cross section from each sample, when superimposed, always coincide, except as to the end point, which may vary, owing to the experimental error of the actual breaking point. We should mention that the samples are tested three days after vulcanisation.

Since none of our curves show any substantial variation in type, a standard curve was selected, which was the average of the curves obtained at the optimum times of cure as shown by the maximum tensile figures in a number of preliminary experiments. An "optimum time of cure" based on the load-stretch curves could thus be obtained from each curve series by reference to this standard curve. The times so obtained provided a numerical means of expressing the differences shown by the curves from different samples, and avoids the necessity for the publication of large numbers of curve diagrams. They do not always agree with the time of cure given by the more erratic maximum breaking point figures although the difference is never very great. The "breaking load" and "elongation at break" figures are, however, given in most cases in addition in the tables in this paper, in order to show the maximum tensile properties of the vulcanised rubbers, and the time of cure at which these are obtained are also given.

Development of theory as to the nature of the accelerating substance.

As indicated in our previous paper, the primary cause of variability in rate of cure was attributed to the accelerating action of a small quantity of some substance existing in the latex or produced subsequently in the raw rubber from some constituent present in the latex.

Our subsequent experiments have therefore been directed to ascertaining the nature of this substance and its behaviour under different treatments which would give some clue as to its probable constitution. We have been able, as will be seen in Part II. of this paper, to isolate or prepare a substance or substances from the latex serum to which acceleration in rate of cure can be attributed and have obtained evidence of the presence of a second substance which also has a similar effect. The experimental results recorded in Part I. will also indicate the nature of the accelerator and have enabled us to control its action and to prepare samples of raw rubber having definite rates of cure within narrow limits and within the extreme limits of cure found by us in the case of different rubbers, under the conditions of vulcanisation employed, or, if the complete life history of the raw rubber from latex to finished rubber is known, to forecast very closely what will be its rate of cure, under the conditions employed. Apart from the theoretical and scientific interest attached to the nature of this substance, the practical importance to the rubber industry is obvious, since, by adopting certain rigid methods of preparation of raw rubber, uniformity in rate of cure can be obtained, and also various types of raw rubber, having specific rates of cure, can be prepared, if desired. In order not to overload this paper with tables of figures and curves, we propose to give only a few typical curves showing the differences obtained between the vulcanised samples from different raw rubbers under different treatments, since all the curves are apparently of a similar type. Tables showing the numerical results of tensile strength and elongation at break of one sample only under each different treatment will be given, together with controls. Each experiment, to prove any particular fact, has however been repeated usually ten times, from latex collected on different dates, and, since many experiments have been made to overlap, many samples have been prepared by similar methods and have given identical results for many more than ten series of experiments. By controlling the density and hence the rubber content of our latex and the amount of coagulant, very concordant results can easily be obtained in different series of the same experiment on different dates. Our method of procedure in vulcanising and testing is given in the previous paper in this Journal, to which reference has been made. Experiments, an account of which will be published later, also show, as would be anticipated, that different proportions of sulphur and also mineral mixings give similar relative results.

A number of experiments in connection with technique, which we do not propose to describe here, have also shown us that we can rely on the mixing and calendering, vulcanising, and testing, carried out by our Malay laboratory assistants under our constant supervision and that the differences due to any variation in treatment by them are practically negligible.

As will be seen in the experimental results given in this paper, one of our alternative theories is confirmed, *viz.*, that the rate of cure is influenced by the amount of an accelerating agent formed by the decomposition of some constituent of the latex and that this substance is a decomposition product of the protein or nitrogenous constituents of the latex, produced usually in the freshly coagulated raw rubber by the action of microorganisms, which gain access to the latex after it leaves the tree, or possibly in some cases decomposition by chemical action. The effect of smoking, in retarding the rate of cure, which was shown in the previous paper, has proved to be a more complicated problem than at first appeared and will not be dealt with here. The retarding effect, though invariably shown by slab, has been found not to be constant in sheet, especially thin sheet; this is due to the fact that, in smoking rubber, more than one variable factor, influencing the rate of cure, is present.

EXPERIMENTAL.—PART I.

Experiments on the preparation of rubber.

In the experiments described here, the different treatment accorded the raw rubber or latex was directed towards the determination of the nature of the accelerating agent affecting the rate of cure, the clue to the possible nature of this substance being derived from preliminary experiments published in our previous paper. In most of the experiments described here the raw rubber used was in the form of slab, *i.e.*, slightly pressed or unpressed coagulum containing a large percentage of the mother liquor or serum. The latex is coagulated one day at about 12 to 1 p.m., left in the serum till about 10 a.m. the following day and then rolled by means of a wooden rolling pin on a sloping table. All samples are eventually converted to thin crepe before vulcanising. All the samples, except for special purposes, were prepared in pans of similar shape and size, so that, for control purposes, they could be rolled to the same extent and the same or some definite amount of serum squeezed out by pressure. We have found that this type of rubber, as would be expected, in view of the theory propounded, is much more sensitive to differences in treatment than sheet and crepe rubbers, prepared from freshly coagulated rubber, from which most of the serum has been removed by passing through heavy rollers. Hence the extreme differences between ordinary estate samples of sheet and crepe, although great, are never as great as the extremes found in our experimental samples, since rubbers curing as rapidly as our "slab" samples are never prepared in ordinary estate practice except by accident or for special purposes. In order to show however that the differences obtained in our experimental samples are not a special feature of the latex or rubber prepared in our factory, our methods of preparation have been repeated for us on different estates with identical results.

The change in slab rubber causing an increase in rapidity of cure.

In our previous experiments it will be remembered that the slab rubber (*i.e.*, rubber containing most of the serum of the latex) was left in this state, before being creped and dried, till the comparative samples of thin sheet and crepe had become quite dry, that is, for a period of about three weeks. Now the only essential difference between the rapidly curing slab and slow curing crepe is that the slab is left for the period stated, before being creped and dried, whereas the sheet or crepe is made at once or on the day after coagulation from the freshly coagulated slab. The following experiments were therefore carried out to find the length of time during which it was necessary to keep the slab, before crepeing, in order that the maximum rate of cure might be developed.

Experiment 1.—Samples of slab rubber were prepared from latex containing 1·5 lb. of rubber per gallon coagulated by the addition of 3 oz. of a 5 % solution of acetic acid, this being approximately the minimum amount required. In the case of samples 58 A—H the slabs were rolled out to the same thickness on the following day and one slab was creped about every three days up to the 22nd day, commencing with the day after coagulation, and in the case of samples 62 A—H the slabs were not pressed at all, but only allowed to drain on racks, after removal from the coagulating pans.

The following table (Table I) gives the results of the tests of the vulcanised samples.

Diagram I shows the load-stretch curves for the 1¼ hour cure in both cases.

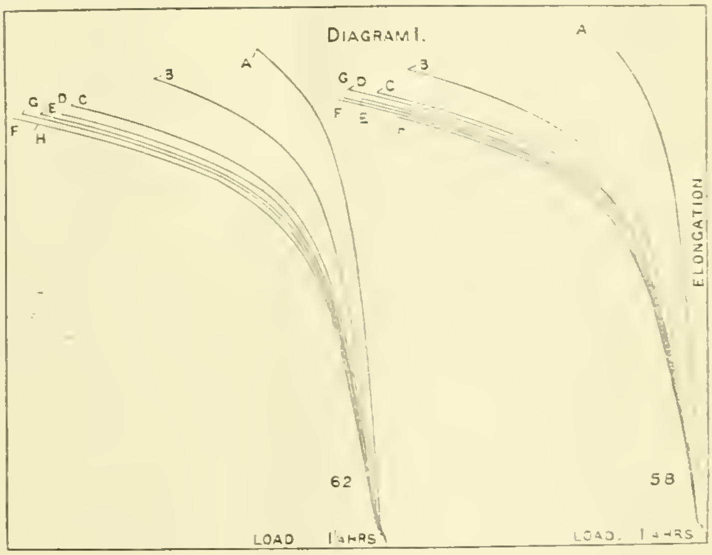


TABLE I.

Ref. No.	Time of vulcanisation giving the standard curve.	Time of vulcanisation giving the maximum product.	Elongation at break (original length = 100).	Breaking load (kilos. per sq. mm.)	Product.	Date machined.
	Hours.	Hours.	A.	B.	A × B.	
58 A.	2¾	2¾	1012	1·14	1153	1 day after coagulation.
58 B.	1½	1½	1038	1·50	1557	4 days ,, ,,
58 C.	1¼	1½	976	1·50	1464	7 ,, ,, ,,
58 D.	1¼	1¼	1032	1·51	1558	10 ,, ,, ,,
58 E.	1¼	1¼	1005	1·41	1417	14 ,, ,, ,,
58 F.	1¼	1¼	1006	1·53	1539	16 ,, ,, ,,
58 G.	1¼	1¼	1010	1·51	1529	19 ,, ,, ,,
58 H.	1¼	1	1040	1·40	1456	22 ,, ,, ,,
62 A.	2½	2½	997	1·25	1246	1 day after coagulation.
62 B.	1¾	2	988	1·59	1570	4 days ,, ,,
62 C.	1¼	1½	975	1·37	1335	7 ,, ,, ,,
62 D.	1¼	1¼	1001	1·38	1381	10 ,, ,, ,,
62 E.	1¼	1¼	998	1·48	1427	13 ,, ,, ,,
62 F.	1¼	1¼	981	1·42	1303	17 ,, ,, ,,
62 G.	1¼	1¼	990	1·43	1415	19 ,, ,, ,,
62 H.	1¼	1¼	967	1·38	1334	22 ,, ,, ,,

NOTE.—One feature of the above results is the high standard of mechanical properties for the slab specimens 58 B—H.

In both cases it will be seen that the change which causes an increase in rate of cure of the rubber, occurs during the first six or seven days after coagulation, after which the rate of cure becomes constant. Some accelerating substance is therefore developed in the slab during these six days. The figures and curves also show that the change is gradual and progressive during this period.

(b) Experiments with antiseptics, heat, and cold. The effect of formalin.

It was noted in our previous paper that the use of formalin in estate samples appeared to retard the rate of cure, in consequence of which further experiments were carried out as follows:—

Experiment 2.—Two samples of pressed slab were prepared as follows:—

(A) 1 gallon of latex coagulated with 3 oz. of 5 % acetic acid.

(B) 1 gallon of latex plus 1 oz. commercial formalin coagulated by 3 oz. of 5 % acetic acid.

The coagulation of (B) was peculiar, the coagulum being very crumbly and only cohering with difficulty.

The slabs were kept for over 3 weeks before being creped and dried.

The vulcanisation results obtained are given in Table II.

TABLE II.

Ref. No.	Time of vulcanisation giving the standard curve.	Time of vulcanisation giving the maximum product.	Breaking load. (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
56 A. ..	1¼	1¼	1·38	1007	1389
56 B. ..	2¾	2¾	1·14	993	1132

The effect of the formalin added to the latex was thus to retard greatly the rate of cure.

Experiment 3.—The following samples were prepared from latex containing 1½ lb. of dry rubber per gallon, coagulated by means of 3 oz. of 5 % solution of acetic acid.

A. Slab untreated.
B. Slab soaked in a 10 % solution of commercial formalin for 24 hours after removal from the serum.
E. Sheet untreated.
F. Sheet soaked in formalin as above for 24 hours.
G. Crepe untreated.
H. Crepe soaked in formalin as above for 24 hours. The samples were left for three weeks in the original form after which A, B, E, and F were washed and creped before vulcanisation.

The vulcanisation results are shown in Table III. below.

TABLE III.

Ref. No.	Time of vulcanisation giving the standard curve.	Time of vulcanisation giving the maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
54 A. ..	1¼	1¼	1·40	979	1370
54 B. ..	2¾	2¾	1·22	1013	1235
54 E. ..	2¼	2¼	1·50	991	1387
54 F. ..	3¼	3¼	1·09	1025	1117
54 G. ..	2¾	2¾	1·30	955	1313
54 H. ..	3½	3¼	1·13	1015	1146

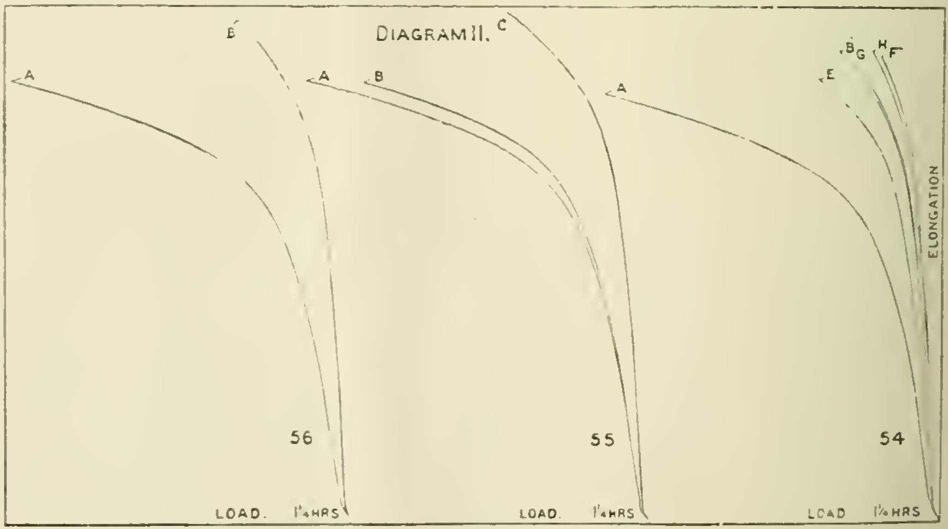
It will be seen that in every case the effect of the soaking in formalin has been to retard the rate of cure.

Experiment 4.—In order to estimate any possible effect of merely soaking in water the following series was prepared:—

55 A. Slab untreated.
55 B. Slab soaked in water. 24 hours.
55 C. Slab soaked in formalin. 24 hours.

The results of vulcanisation are given in Table IV.

The soaking in water is seen to have only a slight effect on the rate of cure.



The load-stretch curves at 1¼ hour cure for samples 56 A and B, 54 A, B, E, F, G, H, and 55 A, B, C are given in Diagram II.

It will be noticed that in all the samples treated with formalin, a certain amount of deterioration has taken place in the physical properties.

Further experiments were carried out to ascertain whether this retarding action of formalin extended to subsequent stages in the preparation of "slab" rubber.

Experiment 5.—Five unpressed slabs were prepared, removed from the serum the day after coagulation and treated subsequently as follows:—

84 A. Control untreated.
84 F. Placed in formalin the same day and removed after 24 hours.
84 H, M, and T. Placed in formalin for 24 hours after 1, 3, and 5 days respectively.

TABLE IV.

Ref. No.	Time of vulcanisation giving standard curve.	Time of vulcanisation giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
55 A. ..	1¼	1¼	1·43	1013	1448
55 B. ..	1¼	1¼	1·40	991	1387
55 C. ..	2¼	2¼	1·25	1010	1281

TABLE V.

Ref. No.	Rate of cure.
	Hours.
84 A.	1
84 T.	2¼
84 M.	3
84 H.	3¼
84 F.	3¼

These samples were all creped seven days after coagulation. The relative times of vulcanisation in hours required to produce the optimum load-stretch curve are given in Table V.

The relative rates of cure are also shown in Diagram III which gives the load-stretch curves for a 2 hours' cure. It will be noticed that the longer the soaking in formalin is delayed, the less effect it has in retarding the rate of cure. This effect may not, however, be solely due to the formalin inhibiting the formation of the accelerating substance, but also to the destruction or neutralisation of the accelerating substance by the formalin, the differences between the samples being due to the more imperfect penetration of the formalin in the drier slabs. This latter view is supported by the fact that Sample 84 T, which was left for 5 days, is slower curing than 62 B in experiment 1, which was only left for three days after being removed from the serum.

That formalin has some action on the substance determining the rate of cure is shown by the following experiment.

Experiment 6.—A fast-curing crepe rubber was prepared in the usual way by crepeing a piece of slab which had been left until it had developed its maximum rapidity of cure.

A portion of this dry crepe rubber was immersed in 10% formalin for 24 hours, and then rewashed on the crepeing machine. Three controls were prepared as follows:—(1) Crepe untreated, (2) crepe rewashed and recreped, (3) crepe soaked in water for 24 hours. The results obtained on vulcanisation are given in Table VI below.

It will be seen that the controls are all similar while the rate of cure of the dry crepe soaked in formalin has been retarded.

Experiment 7.—In order to investigate further the action of formalin a series of slabs which had all been allowed to mature, *i.e.*, develop the maximum rate of cure, were treated as shown below.

Unpressed slab.

169 S 1. A. Control slab.
169 S 1. F. Slab cut into thin slices and placed in 10% formalin for 42 hours.
169 S 1. G. Slab creped and placed in 10% formalin for 24 hours.

Pressed slab.

169 S 1. H. Control slab.
169 S 1. M. Slab placed whole in 10% formalin for 24 hours.
169 S 1. N. Slab cut into thin slices and placed in 10% formalin for 24 hours.
169 S 1. O. Slab creped and placed in 10% formalin for 24 hours.

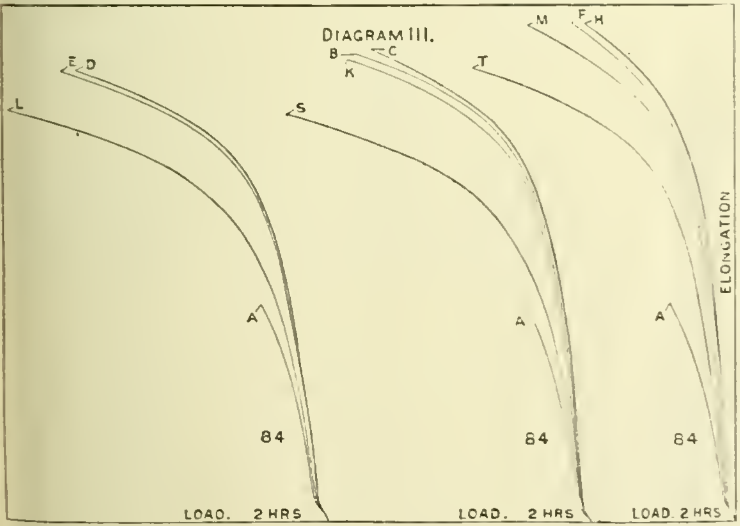


TABLE VI.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
174 A (recreped)	1¼	1¾	1·48	955	1413
174 B (soaked in water)	1¼	1¾	1·38	953	1298
174 C (soaked in 10% formalin) ..	1½	2	1·45	989	1434
174 D (untreated control)	1¼	1½	1·35	977	1318

The vulcanisation results are given in Table VII.

TABLE VII.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
169 S 1 A.	1	1	1·29	1025	1322
169 S 1 F.	1¼	1½	1·43	964	1378
169 S 1 G.	1½	1½	1·44	1001	1450
169 S 1 H.	1¼	1½	1·54	942	1262
169 S 1 M.	1¼—1½	1¾	1·44	977	1406
169 S 1 N.	1¼—1½	1¾	1·56	976	1522
169 S 1 O.	1½	2	1·48	954	1411

The order of rapidity of cure shown by the curves was as follows :—A, F, G and H, N, M, O respectively.

Experiment 7 (*a*).—A second series in which the time of immersion in the formalin was doubled is given in Table VIIa.

Unpressed slab.

169 S 2. A.	Control slab.
169 S 2. E.	Slab placed whole into 10 % formalin for 48 hours.
169 S 2. G.	Slab creped and placed into 10 % formalin for 48 hours.

Pressed slab.

169 S 2. H.	Control slab.
169 S 2. N.	Slab cut into thin slices and placed in 10 % formalin for 48 hours.
169 S 2. O.	Slab creped and placed in 10 % formalin for 48 hours.

The vulcanisation results are given in Table VIIa.

TABLE VIIa.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
169 S 2 A.	1¼	1¼	1·42	1005	1427
169 S 2 E.	1¼	1¼	1·46	1000	1460
169 S 2 G.	1¾	1¼	1·52	1008	1532
169 S 2 H.	1¼—1½	1½	1·52	979	1483
169 S 2 N.	1¼—1½	1¼	1·39	978	1359
169 S 2 O.	1¾	1½	1·40	1066	1492

The order of rapidity of cure shown by the curves was as follows :—E, A, G and H, N, O.

It will be seen that in every case but one (169 Series 2 E) the formalin-treated rubber takes slightly longer to vulcanise, the effect being the greatest in samples which are creped before immersion. Between the slab immersed whole and cut into thin slices there is little difference, nor does increasing the time of immersion in the formalin appear to increase the retarding effect.

Finally this retarding effect is in no case as great as that produced by the formalin during the earlier stages of the preparation of the rubber, and it appears therefore that the major part of the effect must be due to the inhibition of the formation of the accelerating substance.

Experiment 8.—One further experiment was carried out to produce the maximum effect on fast-curing rubber as follows :—

177 A.	Fast-curing finished crepe soaked in 10 % formalin for 1 day.
177 B.	The same, for 3 days.
177 C.	The same, for 10 days.
177 D.	Fast-curing finished crepe soaked in 50 % formalin for 1 day.
177 E.	The same, for 3 days.
177 F.	The same, for 10 days.
177 G.	Control.

The vulcanisation results are given in Table VIII.

TABLE VIII.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
171 A. ..	2	2¼	1·44	954	1373
171 B. ..	2	2¼	1·39	961	1355
171 C. ..	2	2¼	1·51	987	1490
171 D. ..	2	2½	1·44	980	1411
171 E. ..	2	2¼	1·43	990	1415
171 F. ..	2¼	2½	1·43	979	1399
171 G. ..	1½	1½	1·50	993	1489

The order of rapidity of cure shown by the curves is as follows :—G—A B—C D E F.

It will be seen that even by increasing enormously the strength of the formalin and the time of immersion, little additional effect is produced on the finished rubber, and its rate of cure cannot be retarded to the same extent as in freshly prepared rubber.

Action of heat.

Experiment 9.—The action of moist heat at different stages in the preparation of slab rubber was also investigated. The following series was prepared :—

84 A.	Control slab untreated.
84 B.	Heated on removal from serum, the day following coagulation.
84 C.	Heated one day later.
84 K.	Heated three days later
84 S.	Heated five days later.

The slabs were heated in the steam autoclave for about 20 minutes at 150° C., this being presumably sufficient to sterilise them completely.

The slabs were all creped 7 days after coagulation. The vulcanisation results are given in Table IX. and the load-stretch curves for a 2 hours' cure in Diagram III.

TABLE IX.

Ref. No.	Time of vulcanisation giving standard curve.	Time of vulcanisation giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
84 B.	2½	3	1·50	956	1431
84 C.	2¾	3	1·43	987	1411
84 K. ..	2¼	2½	1·51	1001	1511
84 S.	1½	1¾	1·27	973	1235
84 A.	1	1¼	1·40	992	1388

It will be seen that the heating has retarded the rate of cure, while no effect on the mechanical properties is apparent.

The possible direct effect of heat on the accelerating substance was investigated in a similar manner to that of the formalin, by the following experiment, details of which are given below :—

Experiment 10.—

Unpressed slab.

169 S 1 A. Control.
169 S 1 B. Heated whole in autoclave for ¼ hour at 40 lb. steam pressure.
169 S 1 C. Cut into thin slices and heated as above

Pressed slab.

169 F H. Control.
169 F K. Cut into thin slices and heated for ¼ hour at 40 lb. pressure.
169 F L. Creped and heated as above.

The vulcanisation results are given in Table X.

TABLE X.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
169 S I A.	1	1	1·29	1025	1322
169 S I B.	1¼	1¼	1·34	1014	1358
169 S 1 C.	1¼	1	1·29	1033	1332
169 S I H.	1¼	1¼	1·34	942	1262
169 S 1 K.	1¼—1½	1¼	1·29	1038	1339
169 S 1 L.	1½	1¼	1·49	1057	1574

The order of rate of cure shown by the curves was as follows :—A, C, B and H, K, L respectively.

Experiment 10a.—A second series was treated in a more drastic manner, as follows :—

Unpressed slab.

169 S 2 A. Control.
169 S 2 B. Placed whole into autoclave for 1 hour at 40 lb. steam pressure.
169 S 2 C. Cut into thin slices and heated as above.
169 S 2 D. Creped and heated as above.

Pressed slab.

169 S 2 H. Control.
169 S 2 J. Placed whole into the autoclave for 1 hour at 40 lb. steam pressure.
169 S 2 K. Cut into thin slices and heated as above.
169 S 2 L. Creped and heated as above.

The vulcanisation results are shown in Table X(a).

The actual curve order was respectively : A, B, C, D, H, J, K, L.

In these experiments, as with formalin, it will be seen that a slight effect was produced by the heat and again it was greatest in the case of the slab treated after crepeing. The retardation of rate of cure is, however, small compared with that produced by the action of heat on the freshly prepared coagulum.

TABLE X (a).

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
169 S 2 A.	1¼	1¼	1·42	1005	1427
169 S 2 B.	1¼—1½	1¼	1·37	1024	1402
169 S 2 C.	1¼—1½	1½	1·55	999	1548
169 S 2 D.	1¾	1¾	1·38	1010	1393
169 S 2 H.	1¼—1½	1¾	1·52	979	1488
169 S 2 J.	1½	1½	1·51	1025	1547
169 S 2 K.	1½—1¾	1¾	1·49	982	1453
169 S 2 L.	1¾	2	1·46	951	1388

The heat, therefore, like the formalin, is principally active in preventing the development of the substance which accelerates the rate of cure.

Action of cold.

The action of cold was also investigated in the following experiments.

Experiment 11.—Four slabs were prepared and treated with the results shown in Table XI. and Diagram III.

It is evident from the times of vulcanisation that cold has had the effect of inhibiting the development of the factor causing increase in rate of cure. Three days without treatment followed by six days in the ice chest (L) gives a slower curing rubber than 6 days in the slab form without treatment (A). The temperature of the ice chest used was not very low, being about 40°—50° F. (4·5°—10° C.).

TABLE XI.

Ref. No.	Days after coagulation.										Time of vulcanisation giving standard curve.
	1	2	3	4	5	6	7	8	9	10	
84 A.	Removed from serum	←——— untreated———→					Creped.				1 hour.
84 D.	,,	←——In ice chest——→				←removed from ice.→Creped.					2¼ hours.
84 E.	,,	Untreated	←—In ice chest——→				Creped.				2¼ ,,
84 L.	,,	←—Untreated—→		←——In ice chest.——→						Creped.	1¾ ,,

A further experiment on the effect of cold was made as follows :—

Experiment 12.—Nine slabs were prepared and treated as follows :—

179 A. Slab control creped after a fortnight.
179 B. Placed in cold storage on day after coagulation at 0° C. for 2 days and creped on removal.
179 C. Placed in cold storage on day after coagulation at 0° C. for 2 days and creped a fortnight after removal.
179 D. Placed in cold storage on day after coagulation at 0° C. for 5 days and creped on removal.
179 E. Placed in cold storage on day after coagulation at 0° C. for 5 days and creped a fortnight after removal.
179 F. Placed in cold storage on day after coagulation at 0° C. for 7 days and creped on removal.

179 G. Placed in cold storage on day after coagulation at 0° C. for 7 days and creped a fortnight after removal.

179 H. Placed in cold storage on day after coagulation at 0° C. for 12 days and creped on removal.

179 J. Placed in cold storage on day after coagulation at 0° C. for 12 days and creped a fortnight after removal.

179 K. Portions cut from slabs B—J on the day following coagulation and creped at once.

The vulcanisation results are given in Table XII.

TABLE XII.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
179 A. ..	1¼	1¼	1·46	999	1458
179 B. ..	3¼	3½	1·35	956	1290
179 C. ..	1	1¼	1·47	954	1402
179 D. ..	3¼	3½	1·32	955	1260
179 E. ..	1	1¼	1·50	1004	1506
179 F. ..	3¼	3¾	1·37	950	1301
179 G. ..	1	1¼	1·49	1000	1490
179 H. ..	3¼	3½	1·33	956	1271
179 J. ..	1¼	1¼	1·36	1008	1370
179 K. ..	3¼	3¼	1·40	935	1309

It will be seen from this experiment that in every case by keeping the coagulum at 0° C., development of the accelerating substance was inhibited, and also that subsequently, if the rubber is kept in slab form for a sufficiently long period after removal from cold storage the accelerating substance is produced just as it is in the ordinary slab which is left for about six days before crepeing. It will be observed that the rubber produced by crepeing the slab immediately it is removed from cold storage behaves exactly the same as the rubber produced by crepeing immediately on removal from the serum on the day following coagulation (K). During prolonged periods in cold storage the slab rubber therefore undergoes no change, similar to that which it undergoes at ordinary temperature (about 28° C.).

It was also found in a further experiment that prolonged cold was without effect on dry finished fast-curing crepe prepared from slab. These experiments show that cold has no effect on the accelerating agent after formation, but that it inhibits its formation, the effect being maintained only during the action of cold, since the slabs kept in cold storage up to a period of 10 days, during which the change, causing rapidity of cure invariably occurs under ordinary conditions, and subsequently allowed to recover at the ordinary temperature, again become rapidly curing.

Effect of soaking in running water.

Experiment 13.—It was also found that the development of rapidity of cure could be retarded by keeping the slab in running water after removal from the serum. The details of this experiment and the results of vulcanisation are given in Table XIII.

The retardation in this case may be due to gradual removal of the accelerating substance, or the substance from which the accelerating agent is formed, by prolonged soaking in running water or may be due to the fact that the running water prevents or retards the decomposition changes.

TABLE XIII.

Ref. No.	Treatment.	Time of vulcanisation giving standard curve.
84 A. ..	Control.	1 hour.
84 G. ..	Creped immediately after coagulation.	3¼ hours.
84 V. ..	Slab kept in running water for 6 days previous to crepeing.	2¼ hours.

Conclusions.

The conclusions which are reached from all the above experiments are :—

1. That the rate of vulcanisation of rubber from any given latex is determined by the extent to which a certain change takes place subsequent to coagulation.

2. This change is normally limited to the first few days after coagulation. The change is progressive and reaches a maximum in "slab" rubber (*i.e.*, coagulum containing a large proportion of the serum) in approximately six days after coagulation.

3. The change can be arrested either partially or completely by the action of formalin, heat, and cold. It is also arrested by crepeing shortly after coagulation, which may be due either to the larger surface exposed or to the more rapid drying or both, combined with the removal of most of the serum in machining to crepe form.

4. The complete arrest or inhibition of the change by formalin (similar effects have been obtained with other antiseptics) and by the action of both heat and cold, indicates the formation by biological action of a substance which increases the rate of cure of raw rubber, the decomposition being probably of an anærobic nature. There is no evidence that the change is due to chemical agencies.

In this connection experiments carried out by us on latex frozen for several days at 12°—15° F., are of considerable interest, since by freezing for this period, the rubber no longer cures rapidly, even if left for a considerable period afterwards at ordinary atmospheric temperature (84° F.).

(NOTE.—This method, *i.e.*, freezing of latex to produce rubber, has been patented in the F.M.S., and we are not at liberty at present to give any further information. Latex after freezing for 4—5 hours is coagulated and, on thawing the solid block thus formed, a solid coagulum is formed, whereas latex can be frozen for a short period and on thawing is reconverted to latex.)

PART II.

The second part of this research deals with the probable nature of the constituent of the latex involved in the changes in raw rubber, and the nature of the constituents which are responsible for the variations in rate of cure of different rubbers.

Experiments on the addition of proteins to rubber.
(*a*) *Effect of casein and peptone.*

It has long been considered that the proteins in rubber derived from latex play an important part in its vulcanisation both from the point of view of ultimate strength of the vulcanised rubber and the curing capacity.

Experiments showing the importance of the protein have been carried out by Clayton Beadle and Stevens (*vide* this Journal, Dec. 16th, 1912). It was found in these experiments that the removal of the insoluble nitrogenous matter from rubber greatly retarded the vulcanisation while an excess of the nitrogenous matter accelerated it. In a subsequent paper (India Rubber J., Feb. 28th,

1914) Stevens showed that the insoluble nitrogenous constituent could be replaced by peptone. Casein did not prove to be equally effective, but had a slight effect. It was also stated that starch had a slight effect in promoting vulcanisation in the protein free rubber but the figures quoted do not appear very convincing.

In the experiments which are given here we have incorporated casein and peptone with slow curing raw rubber, that is, ordinary crepe rubber which contains a normal amount of protein (about 2·5 %). The incorporation was carried out on the mixing rolls at the same time as the addition of the sulphur.

Experiment 14.—The following were the mixings made in this experiment :—

72 A. 450 grms. rubber + 50 grms. sulphur.
72 B 450 grms. rubber + 50 grms. sulphur + 20 grms. peptone.
72 C. 430 grms. rubber + 50 grms. sulphur + 20 grms. peptone.
72 D. 450 grms. rubber + 50 grms. sulphur + 20 grms. casein.
72 E. 430 grms. rubber + 50 grms. sulphur + 20 grms. casein.

The vulcanisation results are given in Table XIV. and Diagram IV.

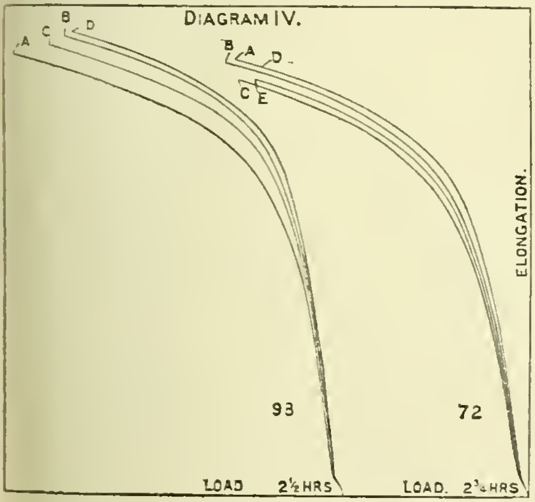


TABLE XIV.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
4 A. ..	2½	3	1·40	957	1339
2 B. ..	2½	2¾	1·33	940	1250
2 C. ..	2½	2¾	1·25	946	1182
2 D. ..	2½	3	1·24	939	1164
2 E. ..	2½	2¾	1·24	956	1185

As will be seen the differences shown by the oad-stretch curves are *nil*. The addition of the eptone and casein also appears to have produced ferior mechanical or physical properties in the ulcanised rubber. This may be partly due to he nature of the substances added, which, in the ethod of incorporation adopted, do not mix well ith the raw rubber.

Effect of decomposed casein.

Experiment 15.—Since our previous experiments in connection with slab rubber left for at least six days before crepeing indicated a change in some constituent in the raw rubber, and the production of an accelerating agent or catalyst from some constituent of the raw rubber by decomposition, and that the most likely substance to be so affected would be the proteins in the rubber, further experiments were carried out by the addition of decomposed casein to raw rubber. In the first experiment the casein was mixed to a paste with water and allowed to decompose in an open vessel for several days, such decomposition being effected by infection with bacterial and fungus spores from the air. In another experiment, the casein was mixed with a small measured quantity of latex of known rubber content and allowed to decompose in a similar way in an open vessel. The resulting decomposition products were eventually dried in a desiccator and in the case of the casein alone, the residue was subsequently ground to a fine powder ; in the case of the mixture of latex and casein, the dried product was eventually creped.

Both the casein decomposition product, and the mixture of dried latex and casein were incorporated with a slow-curing crepe rubber and sulphur on the mixing rolls allowance being made for the weight of rubber from the latex in the latter experiment.

The following mixings were therefore prepared :—

Ref. No. 98 A. 450 grms. rubber + 50 grms. sulphur + 15 grms. decomposed casein.
Ref. No 98 B. 450 grms. rubber + 50 grms. sulphur.
Ref. No. 98 C. 450 grms. rubber + 50 grms. sulphur + 15 grms. decomposed casein from (latex + casein) mixture.
Ref. No. 98 D. 450 grms. rubber + 50 grms. sulphur.

(NOTE.—Two controls, 98 B and 98 D, were made, on account of the fact that it was difficult to dry completely the latex and casein mixture (No. 98 C), so that this was mixed with a part of the sulphur and rubber on one day, made thin on the mixing machine and then hung to dry a few days, before completing the mixing and calendering. The control 98 D was treated similarly to 98 C).

The results of vulcanisation tests are given in Table XV. and Diagram IV., showing curves at 2½ hours' cure.

TABLE XV.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
98 A. ..	2¼	2½	1·35	977	1318
98 B. ..	2¾	2¾	1·32	979	1292
98 C. ..	2¼	2½	1·24	1001	1241
98 D. ..	2¾	2¾	1·22	979	1194

As will be seen, there is a slight increase in the rate of cure caused by the addition of the decomposed casein A and C. In the above experiment the decomposition of the casein is ærobic, whereas the decomposition which takes place in "slab" rubber is largely anærobic which may produce an entirely different decomposition of the proteins.

Experiment 16.—A further experiment was therefore carried out, in which the casein was mixed to a paste and allowed to decompose in a closed vessel. After about 10 days the decomposed paste was dried in a desiccator and incorporated on the mixing machine with a slow-curing crepe rubber at the same time as the sulphur, as in previous experiments. Three samples were taken, including the control, as follows :—

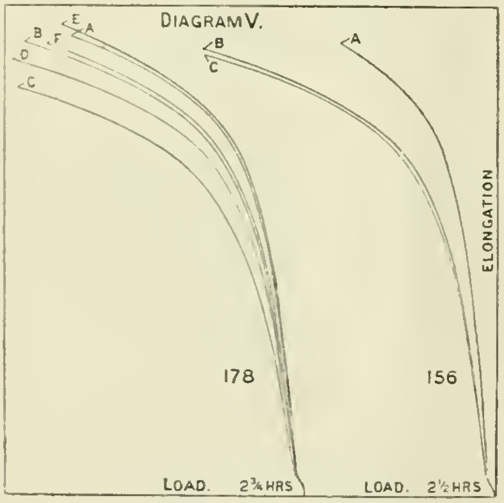
Ref. No. 156 A. Control sample of slow curing rubber. 450 grms. + 50 grms. sulphur.
Ref. No. 156 B. Control sample of slow curing rubber. 450 grms. + 50 grms. sulphur + 10 grms. decomposed casein.
Ref. No. 156 C. Control sample of slow curing rubber. 440 grms. + 50 grms. sulphur + 10 grms. decomposed casein.

In sample No. 156 B, the sulphur is added to the same amount of raw rubber as in the control and in Ref. No. 156 C allowance is made for the 10 grms. of decomposed casein.

The vulcanisation results are given in Table XVI. and Diagram V., shewing curves at 2½ hours' cure.

Table XVI.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
156 A. ..	3	3¼	1·20	958	1149
156 B. ..	2½	2¾	1·36	963	1309
156 C. ..	2½	2¾	1·30	961	1249



As will be seen, there is a marked acceleration in the rate of cure of the rubber to which the anaerobically decomposed casein has been added, demonstrating the formation of an accelerating agent or catalyst from the casein, which itself, under the conditions of mixing employed, had no effect on the rate of cure. Both samples 156 B and 156 C are very much over-cured at 3¼ hours and quite brittle.

Experiment 17.—Further supplies of casein and peptone were obtained and the previous experiments all repeated and controlled in one experiment. The following series was prepared :—

178 A. Control. 450 grms. rubber + 50 grms. sulphur.
178 B. 10 grms. anaërobically decomposed casein + 450 rubber + 50 grms. sulphur.
178 C. 10 grms. aërobically decomposed casein + 450 rubber + 50 grms. sulphur.
178 D. 10 grms. undecomposed casein + 450 rubber + 50 grms. sulphur.
178 E. 10 grms. peptone + 450 rubber + 50 grms. sulphur.

The vulcanisation results are shown in Table XVII. and Diagram V., showing curves at 2¾ hours' cure.

Table XVII.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load kilos. per sq. mm.).	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
178 A. ..	3¼	3½	1·35	970	1310
178 B. ..	2¾	2¼	1·47	975	1433
178 C. ..	2½	2½	1·36	988	1343
178 E. ..	3¼	3	1·09	1006	1096
178 F. ..	3	3½	1·47	960	1410

The relative rates of cure are also shown in Diagram V. giving the load-stretch curves at 2¾ hours.

These results confirm those previously obtained in so far that the decomposed casein produces acceleration in rate of cure while undecomposed casein does not. In this case, however, the aerobically decomposed product has proved more effective than the anærobic. Evidently other uncontrolled factors are active in deciding the optimum method of decomposition. It will also be noticed that the peptone has had a slight accelerating action, confirming Beadle and Stevens' results.

These experiments support the theory that the accelerating agent is formed by decomposition of the protein in latex, and that the preparation of "slab" rubbers forms a suitable type of rubber in which such decomposition can take place, which it does during the first six days after coagulation and that this period in the life history of the rubber may be described as its vital period, as far as vulcanising capacity is concerned, unless the rubber is subsequently treated in such a way that the accelerating agent formed is destroyed or rendered inactive.

The relationship between the nitrogen content of fast and slow curing rubbers, with which we shall deal later, in Part III., further supports the decomposition theory.

It was probable of course that casein or its decomposition product might not give the same proportion of the accelerating substance as do the proteins in latex itself and further experiments were therefore conducted with the proteins from latex itself, before and after decomposition.

Experiments with the protein from latex.

Two methods of experiment were adopted to ascertain the effects of the proteins present in latex

1. Retention of all the serum in the finished rubber by a process of rapid drying of the latex, in which decomposition was avoided.

2. Addition of proteins and decomposed proteins derived from the serum to slow curing crepe rubbers, as in the case of casein, etc.

Experiment 18.—Latex was dried in a thin film by desiccation over calcium chloride *in vacuo*. Only a small quantity of rubber could be prepared in this manner owing to the extremely thin film necessary to obtain effective drying in a short time. Dry rubber was produced in this manner in from 2 to 3 days. On vulcanisation this rubber gave an optimum time of cure, indicated by the load-stretch curves, of 1¼ hours. The results of the vulcanisation tests are given in Table VIII.

TABLE XVIII.

Ref. No.	Time of cure giving standard curve.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	A.	B.	A × B.
60	1¼	1·35	979	1321

The above results show that the sample was rapidly curing, but, as will be seen from a later experiment, the rapidity of cure is due to another factor.

Experiment 19.—A large quantity of the serum from ordinary acetic acid coagulation of rubber was evaporated. During evaporation, a precipitate of protein material formed and was collected by skimming and filtering, dried and ground to a powder and mixed with a slow curing rubber. The mixture (57 A) consisted of 450 grms. of rubber, 50 grms. of sulphur, and 5 grms. of the substance. It was vulcanised and the results compared with those obtained from a control mixing (57 B) consisting of 450 grms. of the same rubber with 50 grms. of sulphur.

The optimum results were in both cases given at 2¾ hours as shown in Table XIX. and Diagram VI., showing the curves at 2¾ hours' cure.

TABLE XIX.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
57 A. ..	2¾	2¾	1·22	981	1196
57 B. ..	2¾	2¾	1·33	999	1316

The load-stretch curves of both samples were practically the same.

It was evident that the protein material thus obtained had no accelerating effect on the rate of cure of the rubber to which it was added.

Evaporated serum minus protein.

Experiment 20.—The evaporation of the serum used in Experiment 19, after separating the heat coagulated protein, was continued and a sticky mass of deliquescent material, still containing some protein, eventually obtained. This was dried in a desiccator *in vacuo*. It was found impossible to mix the substance with rubber or even to grind it up owing to its deliquescent nature, consequently flowers of sulphur was mixed with it and the resulting mixture re-dried and ground up. It was necessary to repeat the process several times to obtain a fine powder. An estimation of the sulphur in this mixture was then made. The percentage of sulphur was 70 %. A control mixing (178 A) containing 450 grms. rubber and 50 grms. of sulphur and a mixing (178 D) of the following composition was made by incorporating this serum extract mixture with slow curing crepe :—

Rubber 450 grms.
Sulphur 36 grms. (+ 14 grms. sulphur in serum) = 50 grms.
Dried (serum residue — sulphur) 20 grms.

The vulcanisation results are given in Table XX. The load-stretch curves at 2¾ hours are given, with others, in Diagram V.

TABLE XX.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.).	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
178 A. ..	3¼	3¼	1·35	970	1310
178 D. ..	2¾	2½	1·21	970	1173

In this experiment definite and marked acceleration is seen to have been produced.

Experiment 21.—A further quantity of the serum residue used in Experiment 20 was obtained, and the sticky mass obtained after drying in a desiccator was mixed direct with rubber on the mixing rolls. This was a matter of some difficulty but eventually a fairly good mixing was obtained and the sulphur then added. This time a larger quantity of the substance was used, the composition of the mixing being as follows :—

193 A. Rubber 450 grms. Dried serum extract 60 grms. Sulphur 50 grms.
193 B. Control. Rubber 450 grms. Sulphur 50 grms.

The vulcanisation results are given in Table XXI. and Diagram VI., showing the curves at 1¾ hours' cure.

TABLE XXI.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B.
193 A. ..	2	1½	1·33	1090	1449
193 B. ..	3¼	3¾	1·42	949	1375

It will be seen here also that a very marked acceleration in rate of cure has been produced, combined with good physical qualities.

Decomposed protein from serum.

Experiment 22.—Some of the protein material obtained by precipitation from the serum on boiling, as used in Experiment 19, was mixed to a paste with water and allowed to become partially decomposed in a bottle, during a period of about 10 days. Hydrogen sulphide was freely evolved during decomposition. The decomposed substance was subsequently dried *in vacuo*.

The mixings were made with slow curing crepe rubber as follows :—

A. Control. 450 grms. rubber + 50 grms. sulphur.
B. 450 grms. rubber + 50 grms. sulphur + 5 grms. decomposed product.

The vulcanisation results are given in Table XXII. and Diagram VI., showing the curves at 2 hours' cure.

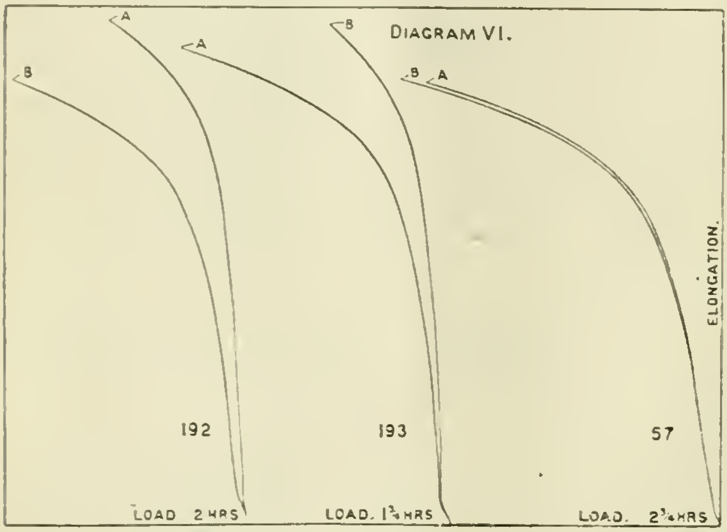
In this experiment a marked acceleration in rate of cure has taken place accompanied, however, by inferior mechanical properties. This latter fact is particularly evident when the figures at all the different times of cure are considered.

TABLE XXII.

Ref. No.	Time of cure giving standard curve.	Time of cure giving maximum product.	Breaking load (kilos. per sq. mm.)	Elongation at break (original length = 100).	Product.
	Hours.	Hours.	A.	B.	A × B
192 A. ..	3½	3½	1·24	983	1218
192 B. ..	2	2	1·1	992	1091

TABLE XXIII.

Type of rubber.	Percentage of nitrogen (average of two determinations).	Optimum time of vulcanisation in hours.
Smoked sheet	0·445	3
Smoked sheet after crepeing when dry..............	0·441	3
Smoked slab (after crepeing)	0·451	1¾
Unsmoked sheet	0·423	2½
Unsmoked sheet after crepeing when dry	0·434	2¾
Unsmoked slab (after crepeing)	0·321	1¾



It was not found possible to induce the serum residue used in Experiments 20 and 21 to decompose even when infected with putrefactive bacteria.

Conclusions.

It is apparent from these experiments that there exists in the serum two substances: (1) a substance of the nature of protein, precipitated or coagulated by heat, which is ineffective in accelerating the rate of vulcanisation unless decomposed, and (2) a soluble substance, only obtained by evaporation and not easily decomposed, which has itself an accelerating action on vulcanisation.

The decomposed precipitated protein is effective in much smaller quantity than the serum residue obtained by evaporation, after the heat coagulated protein has been removed.

In the ordinary preparation of sheet and crepe rubbers the greater part of the serum is removed in machining the coagulum and the whole of the soluble products may be washed out in crepeing, so that normally the accelerating effect of the soluble serum residue is *nil*. The whole of the experiments in the first part of this paper show the gradual development of the accelerating substance during the first few days after coagulation; this must be attributed to the decomposition of protein (similar in nature to that precipitated from the serum by heat) which is precipitated with the rubber during coagulation.

PART III.

The nitrogen content of rubber and its relation to rate of vulcanisation.

At an early stage in our work in view of the vulcanisation results obtained on "slab" rubbers, an attempt was made to discover whether any relationship existed between the nitrogen content of rubber and its rate of vulcanisation.

A series of determinations of the amount of nitrogen in slab and sheet rubbers, both smoked and unsmoked, having different rates of vulcanisation, was made, Kjeldahl's method of estimation being used. The results, together with the optimum time of vulcanisation for each sample, are given above in Table XXIII. All the samples were prepared from different portions of the same latex.

The estimation on the slab rubber was carried out on the dry crepe into which it is necessary to convert this form of rubber prior to vulcanisation. That on the sheet rubber was carried out on both the sheet itself and the crepe produced from it. No difference is apparent between the results from the sheets, creped and uncreped.

Although there is a wide difference in rate of vulcanisation between smoked slab and smoked sheet, no difference in the nitrogen content is shown. On comparison of the unsmoked sheet and unsmoked slab, however, it is seen that a low nitrogen content is connected with rapidity of vulcanisation.

A second series was prepared in order to confirm these results; the figures are given in Table XXIV.

TABLE XXIV.

Type of rubber.	Percentage of nitrogen.	Optimum time of vulcanisation.
		Hours.
Thick smoked slab	0·425	1¾
Thin smoked slab	0·398	1¾
Thick smoked sheet	0·400	2½
Thin smoked sheet	0·416	3
Thick unsmoked slab	0·210	1¾
Thin unsmoked slab	0·352	1½
Thick unsmoked sheet ..	0·356	2½
Thin unsmoked sheet	0·394	3

Again no relation can be traced between the nitrogen content and rate of vulcanisation in the smoked rubber and the small differences in nitrogen content are probably experimental errors. The unsmoked rubbers, however, show an increasing percentage of nitrogen with a decreasing rapidity of vulcanisation.

In the smoked rubbers there is evidently no relationship between the nitrogen content and rate of vulcanisation. The amount of nitrogen appears to be constant and fixed by the smoking so that none is lost on crepeing. In the unsmoked rubbers low nitrogen content is associated with rapidity of vulcanisation. These nitrogen figures were all obtained on the finished dried crepe, the samples being machined to thin crepe after they had become as dry as possible under ordinary atmospheric conditions.

In order to determine at what stage in the preparation of a slab rubber the nitrogen is lost, the following experiments were carried out. A nitrogen determination was made in the first place on an ordinary unsmoked slab which had been allowed to become dry externally. The moisture in it was estimated by two methods as a control: (1) by cutting a portion into slices which were dried at 100° C. (2) by crepeing and drying without heating. The nitrogen was then estimated in both dry samples; the results are given in Table XXV.

TABLE XXV.

	Per cent.
Nitrogen in unsmoked slab calculated on 82·7% dry rubber	0·307
Nitrogen in sliced slab heated to 100° C. till dry	0·240
Nitrogen in the dry crepe from the slab	0·218

There is, therefore, a large loss of nitrogen when the slab is creped previously to vulcanisation. It also appears that most of this nitrogen is in such a form in unsmoked slab that it is lost in the gaseous form when the slab is heated to 100° C.

A second experiment was carried further back and estimations made from the fresh coagulum onwards. All the percentages of nitrogen given below in Table XXVI. were calculated on the content of dry rubber. The estimation of the percentage of dry rubber in the fresh coagulum was a matter of considerable difficulty owing to the continual exudation of serum, and the result obtained from it must be regarded as approximate only.

TABLE XXVI.

	% Calculated on dry rubber.
Nitrogen in wet slab 2 hours after pressing	0·6 (approx.)
Nitrogen in slab after drying for 13 days	0·324
Nitrogen in dry crepe from slab	0·220
Nitrogen in wet crepe made immediately from the wet slab, machined 2 hours after pressing	0·396
Nitrogen in the above crepe when dry	0·360

It will be seen that there is a large loss of nitrogen during the drying of the slab. This can be attributed only partly to the loss in the serum which drains away and must partly be ascribed to loss in the gaseous form due to decomposition. That there was some loss in this form is shown by a comparison of the nitrogen content of the wet crepe prepared immediately and that of the slab after drying for 13 days. There has also been a slight loss in the gaseous form from the crepe during drying.

The contrast between the high nitrogen content of a slow-curing crepe compared with the low nitrogen content of fast-curing crepe from a slab rubber can only be explained on the theory that, in the slab rubber, decomposition of the protein or nitrogenous constituents takes place. A soluble portion is washed out during crepeing and the insoluble residue or part of it is presumably the substance causing acceleration in rate of cure in the case of slab rubbers. Thus we have a further confirmation of the experimental results and theory put forward in Parts I. and II.

In view of the vulcanisation results obtained in Parts I. and II. of this communication and similar results on other samples, which are not included in this paper, nitrogen determinations have since been carried out on a large number of our experimental samples. The results of the determinations made on some of the samples referred to in Part I. are tabulated in Table XXVII., together with the rate of cure, determined by the load-stretch curve method, for comparison.

TABLE XXVII.

Ref. No.	Nitrogen in dry sample.	Optimum time of cure.
	%	Hours.
58 A.	0·31	2¼
58 B.	0·26	1½
58 C.	0·19	1¼
58 D.	0·16	1¼
58 E.	0·17	1¼
58 F.	0·17	1¼
58 G.	0·18	1¼
58 H.	0·18	1¼
62 A.	0·33	2½
62 B.	0·30	1¾
62 C.	0·16	1¼
62 D.	0·11	1¼
62 E.	0·13	1¼
62 F.	0·12	1¼
62 G.	0·12	1¼
62 H.	0·18	1¼
56 A.	0·17	1¼
56 B.	0·42	2¾
54 A.	0·19	1¼
54 B.	0·37	2¾
54 E.	0·36	2¼
54 F.	0·36	3½
54 G.	0·35	2¾
54 H.	0·38	3½
55 A.	0·20	1¼
55 B.	0·20	1¼
55 C.	0·40	2¾
85 A.	0·19	1
85 F.	0·40	3¼
85 H.	—	3¼
85 M.	0·33	3
85 T.	0·23	2¾
84 B.	0·27	2½
84 C.	0·36	2¾
84 K.	0·28	2¼
84 S.	0·22	1½
84 D.	0·31	2¼
84 E.	—	2¼
84 L.	0·19	1¾
179 A.	0·24	1¼
179 B.	0·37	3¼
179 C.	0·24	1
179 D.	0·38	3¼
179 E.	0·20	1
179 F.	0·39	3¼
179 G.	0·26	1
179 H.	0·36	3¼
179 J.	0·27	1¼
179 K.	0·38	3¼
84 G.	0·40	3¼
84 V.	0·19	2¼

In every case, the amount of nitrogen in a slow-curing rubber, is about 50 to 100% greater than the amount of nitrogen contained in a fast-curing slab rubber, the amount of nitrogen being determined on all samples after conversion to crepe and drying.

On the other hand the amount of nitrogen in samples of rubber prepared by the evaporation of thin layers of latex or by pouring out the latex into thin layers, after addition of acid coagulant, and allowing the thin sheets thus obtained to dry rapidly, is high, and amounts in some cases to 0·5% and such samples are rapid curing, although the percentage of nitrogen indicates that no decomposition of the protein or nitrogenous constituents of the rubber has taken place, the factor deciding rapidity of cure being apparently in this case, the unknown substance present in the evaporated serum after removal of the major portion of the protein. The nature of this constituent is now being investigated.

There is still another aspect of this question, with which we have not dealt here, but to which reference should be made, and that is the influence of certain chemicals when used as coagulants or allowed even to act on the dry finished rubber, *e.g.*, mineral acids, potash alum and probably other mineral salts, in retarding the rate of cure even of slab samples in which the decomposition of the protein, as indicated by the nitrogen content, has occurred. The acceleration in rate of vulcanisation due to treatment with alkalis may also be referred to here. We are dealing in these cases, however, probably with a direct chemical effect of these substances or their effect on the accelerating agent after its formation. Our experiments, which are being continued in this direction, are not yet sufficiently complete for further report. These effects are, however, subsidiary and additive and thus complicate any relationships between the nitrogen content and rate of cure.

The influence, therefore, of various substances used as coagulants on the rate of vulcanisation and the fact that a relationship exists only under certain conditions between the nitrogen content of raw rubber and its rate of vulcanisation has been the cause of many obscurities in the past and has apparently prevented many workers who are unable to deal with the freshly prepared rubber, shortly after coagulation, from elucidating the nature of one of the changes which are responsible for variations in the behaviour of rubber during vulcanisation.

The complication introduced also, from the fact that more than one factor is responsible for these variations, has till now still further obscured the problem.

It is not claimed that these researches are by any means complete, but considerable light is thrown on a problem which hitherto has appeared very complex.

SUMMARY.

1. The experiments and results contained in Part I. of this paper show that one factor which causes variability in respect of rate of cure in plantation Para rubber is produced during the first six days after coagulation and that the change which takes place in the coagulum is progressive during this period while after this period no further change under ordinary conditions takes place.

2. The action of antiseptics, such as formalin, also heat and cold are also shown to inhibit this change, while soaking of the fresh coagulum in running water considerably retards the rate of cure.

3. The action of formalin is also shown to be partly though not to any great extent an action on the accelerating agent after its formation.

4. Experiments on the cold storage of freshly coagulated rubber show that while the change which produces rapidity of cure is inhibited as long as the coagulum remains in cold storage, if the rubber is removed again and allowed to remain, without machining, for a further period (13 days or possibly less) at ordinary atmospheric temperatures (about 85° F. in the Federated Malay States) rapidity of cure is again brought about.

5. All the experiments in Part I. suggest that the change which produces rapidity of cure in the rubber is caused by biological agencies, *i.e.*, micro-organisms entering the latex after collection and remaining in the coagulum and that the change is probably a decomposition of the protein or nitrogenous substances present in the coagulum producing an accelerating agent which is a decomposition product of the proteins.

6. The experiments in Part II. on the addition to slow-curing rubbers of various proteins and nitrogenous substances and their decomposition products, including the proteins from latex serum, decomposed by suitable methods after separation from the serum, confirm the conclusions arrived at from the experimental evidence contained in Part I., and show that the original proteins have little or no effect under the conditions employed, while the decomposed proteins have a marked effect.

7. Experiments with undecomposed evaporated serum, after separation of the proteins coagulated by heat, suggest the presence of a second factor which accelerates the rate of cure, and due to some substance originally present in the latex.

8. In the case of our so-called "slab" rubbers possibly both factors are responsible for the acceleration in rate of cure and it would appear that the second factor may be responsible for the actual superior tensile properties of the rubber; some evidence to this effect is contained in the comparatively poor quality of the rubbers to which the protein decomposition product has been added, in which the second factor has been removed, and also in the good quality in the case of the evaporated latex samples and the rubber to which the evaporated serum has been added. Further experiments are, however, necessary to confirm this.

9. Experiments with evaporated latex, which contains all the serum constituents and dried sufficiently rapidly to prevent decomposition of the proteins, also confirm the presence of this second factor.

10. The nitrogen figures given in Part III. still further confirm the decomposition theory, *i.e.*, the production of some substance from the protein which accelerates the rate of cure, the nitrogenous portion which becomes soluble in water and is removed on crepeing being non-essential. The high nitrogen content on the other hand in rapidly curing rubbers produced by evaporation of the latex, without decomposition of the protein, again confirms the evidence obtained as to a second factor which is probably of a non-nitrogenous nature.

11. These experiments and results also show why it has not been possible hitherto to connect the nitrogen content of a rubber with its rate of cure, since a rapidly curing rubber may have either a low or high nitrogen content and indicates how previous workers have gone astray or not gone sufficiently far in their investigations in connection with the protein or nitrogenous constituents of latex and rubber.

12. Many other experiments on nearly 1000 samples of rubber which are not included in this present paper all confirm the above results and conclusions.

13. A further investigation is now being made as to the exact nature of the protein decomposition product, which accelerates the rate of cure and as to the nature of the second factor responsible for acceleration together with the numerous subsidiary factors which influence rate of cure, a number of which have already been investigated.

NOTE.

1. Since completing this paper to this stage we have found that the protein left in sheet of average thickness can be decomposed and so produce a more rapidly curing sheet rubber by simply rolling up the sheets after machining in order to retain a sufficient moisture content for the bacterial decomposition, which demonstrates that the rapidity of cure of the so-called slab rubber is largely due to the decomposition of protein normally retained by the rubber even after rolling to sheet form. These results also show the importance of the rate of drying during early stages as a factor in the preparation of sheet rubber, in order to have a uniform rate of cure.

2. For further information, bearing on the influence of various factors on rate of cure of plantation Para rubber, reference should be made to the monthly Agricultural Bulletin, Federated Malay States; which contains papers from time to time, dealing especially with various aspects of the problem affecting methods of coagulation and preparation on estates.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—
English.—6d. each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.
United States.—1s. each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.
French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Ferou 8, Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Fume, flue-dust and other matter suspended in gas; Collection of——. R. F. Pearce, Liverpool. Eng. Pat. 6199, Apr. 26, 1915. Addition to Eng. Pat. 24,509, Oct. 21, 1910 (this J., 1911, 732).

In the apparatus described in the principal patent, the flow of gas through the water containing the filtering medium is caused by a suction fan in the outlet pipe. The gas inlet is provided with a piston having a screwed rod so that it may be forced into the pipe to remove condensed solid material.—W. F. F.

Filter mediums. E. J. Sweetland, Montclair, N.J., U.S.A. Eng. Pat. 7469, May 18, 1915. Under Int. Conv., May 25, 1914.

A filtering medium is composed of a closely woven fabric, the warp and weft threads of which are composed of bundles of fine wires. The fabric is afterwards flattened by rolling. Alternatively one set of threads is composed of single wires having approximately the same diameter as the bundles of wires.—W. F. F.

Separating finely divided substances [*clay*] *from mixtures of coarser or foreign particles; Process for*——. Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.), Frankfort, Germany. Eng. Pat. 7590, May 20, 1915. Under Int. Conv., May 25, 1914.

A mixture of finely divided and coarser particles, *e.g.*, clay, is suspended in a suitable medium (water) and an electrolyte, such as ammonia, is added, which causes the finer particles to pass into the sol state whilst the coarser particles either separate in the gel state, or form a sol of a lower degree of stability than that of the finer particles. The mixture is then subjected to centrifugal force to effect a fractional separation of the constituents. The separation of the components in the sol state may be facilitated by electro-osmotic action, the containing vessel forming one electrode, and the other being placed in the liquid.—W. F. F.

Drying room. F. A. Lippert, Assignor to Wenborne-Karpen Dryer Co., Chicago, Ill. U.S. Pat. 1,183,889, May 23, 1916. Date of appl., Nov. 17, 1915.

A drying chamber is provided with air-heating chambers which are formed by partitions spaced apart from the side walls and communicate with the drying chamber at both top and bottom. Above each heating chamber is an inlet flue for fresh air along the length of the chamber, bounded by an inclined partition extending from the side wall to the roof. The heated air rising from the heating chambers meets the fresh air entering through openings in the inclined partition and is deflected by the partition towards the middle of the drying chamber. Outlet flues lead upwards from the bottom of the drying chamber, through the heating chambers, and out through the roof. —A. S.

Dryer for dehydrating macaroni and the like. A. V. Alberto, Los Angeles, Cal. U.S. Pat. 1,185,594, May 30, 1916. Date of appl., Aug. 31, 1915.

Air is forced by a fan into the drying chamber through circumferential openings in the top, and is withdrawn through a central opening in the bottom, into an inclined condensing coil in a chamber below. The coil is sprayed with water and air is blown over it, while drain cocks are provided at the lowest points. The dried air is led back to the inlet of the drying chamber. —W. F. F.

Melting-furnace. A. W. Carroll, Elizabeth, N.J. U.S. Pat. 1,182,893, May 16, 1916. Date of appl., July 7, 1915.

The material to be melted is contained in a vessel supported centrally in the inner of two concentric chambers communicating at the top. Combustible gases are introduced into the outer chamber with a whirling movement and pass over the melting-vessel into the inner chamber and thence to a flue below, which contains a coil for preheating the combustible gases.—W. F. F.

Retort or still. H. M. Chase, Wilmington, N.C. U.S. Pat. 1,184,925, May 30, 1916. Date of appl., Mar. 3, 1914.

A vertical, cylindrical shell contains a number of sets of heating coils arranged one above the other; each set comprises coils arranged one within the other and has a separate inlet and outlet. The material, in pieces or fragments, passes downwards over the coils and is supported near the bottom by a set of transverse bars through which disintegrated material passes. A heating coil, arranged in the form of an inverted cone below the grating, directs the solid material to the central outlet at the bottom, while the liquid passes between the convolutions of the coil to a heated annular surrounding chamber.—W. F. F.

Furnace. R. Niedergesaess, Seattle, Wash., Assignor to American Smokeless Burner Co. U.S. Pat. 1,185,526, May 30, 1916. Date of appl., Dec. 17, 1914.

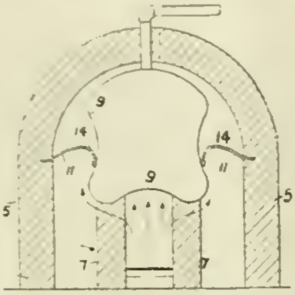
The fuel is contained in a receptacle which also contains water to a predetermined depth. A concentric inner fire-box has its inner contour shaped as an inverted cone at the top, and cylindrical at its lower end which dips into the water. A fixed vertical tubular member having its outer surface shaped as a helix of large pitch is arranged within the cylinder and extends downwards into the fuel receptacle. The fire-box is rotated and is provided with means which, in conjunction with the helix, raises the fuel into the conical part of the firebox. Air for combustion passes upwards through the tubular member.—W. F. F.

Oxidising apparatus. M. J. Chaplin, Assignor to W. A. Ingham, Seattle, Wash. U.S. Pat. 1,183,838, May 16, 1916. Date of appl., July 27, 1915.

An annular retort is provided with an outer cylindrical wall and an inner concentric conoidal wall. Part of the annular roof revolves about the axis of the retort and carries a hopper which is caused to rotate intermittently and distribute the material on to the conoidal wall. The furnace is located within the inner wall and is provided with a central conical passage for heating the air which passes through from below to the space above the fuel.—W. F. F.

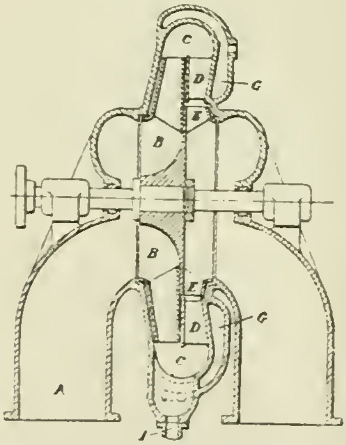
[Retort] furnace. S. Sparling. Evanston, Ill., Assignor to W. M. Kelso. Oak Park, Ill., and R. A. Austin. Chicago, Ill. U.S. Pat. 1,185,550, May 30. 1916. Date of appl., Jan. 13, 1910; renewed Mar. 20, 1916.

The retort is constructed with curved sides and bottom, 9, and rests on arches, 7, on each side of the fire-box. Arched members, 11, connect the sides of the retort to the outer furnace walls, 5, and are provided with gas-circulating openings, 14. —W. F. F.



Elastic fluids [gas]; Means for purifying ——. C. E. Rateau, Paris, Assignor to Rateau Battu Smoot Co., New York. U.S. Pat. 1,184,261, May 23, 1916. Date of appl., Apr. 16, 1914.

Gas enters by the passage, A, to the fan, B, from which it is delivered to the purifying chamber, C, heated by a jacket, G. The melted impurities are withdrawn by the pipe, I. The gas changes its direction before passing through the nozzles, D, to the turbine, E, which abstracts some of its kinetic energy. Liquid may be injected into the gas. —W. F. F.



Stirring mechanism for chemical furnaces. T. V. Fowler, jun., Assignor to General Chemical Co., New York. U.S. Pat. 1,184,339, May 23, 1916. Date of appl., July 24, 1915.

Rabble-arm for roasting-furnaces. H. H. Stout, Assignor to General Chemical Co., New York. U.S. Pat. 1,184,394, May 23, 1916. Date of appl., Oct. 30, 1913.

Refrigerating apparatus. Method of refrigeration. A. H. Eddy, Windsor, Conn., Assignor to C. E. Shepard, Hartford, Conn. U.S. Pats. 1,185,596 and 1,185,597, May 30, 1916. Date of appl., June 17, 1910.

Catalytic or contact agent. H. von Kéler and A. Weindel, Leverkusen, Germany, Assignors to General Chemical Co., New York. U.S. Pat. 1,183,114, May 16, 1916. Date of appl., Jan. 16, 1914.

See Fr. Pat. 460,074 of 1913; this J., 1914, 22.

Heat from hot solutions: Apparatus for and method of recovering ——. H. M. Liese, Hamburg, Germany. U.S. Pats. 1,184,359 and 1,184,360, May 23, 1916. Dates of appl., Jan. 23, 1911, and June 4, 1913.

See Eng. Pat. 1832 of 1911; this J., 1911, 1141.

Grinding mills: High-speed ——. J. S. Fasting, Fredericksberg, Denmark, Assignor to F. L. Smidth and Co., New York. U.S. Pats. 1,184,841 and 1,184,842, May 30, 1916. Date of appl., June 5, 1914.

See Eng. Pats. 14,781 and 18,432 of 1914; this J., 1915, 68, 945.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Patents.

Methane or marsh gas given off from mine workings and like places; Means for utilising ——. E. Moxon, Sheffield. Eng. Pat. 16,748, Nov. 27, 1915.

Air containing methane passes from the upcast shaft through a restricted orifice to an expansion chamber, where the methane rises to the top while the air is drawn off at the bottom by an exhaust fan at the end remote from the inlet. The collected methane passes upwards through pipes to suitable gas-holders. A separate pipe, provided with branches at its lower end for tapping accumulations of gas in "pockets" in the mine workings, passes up the upcast shaft to the gas-holders.—W. F. F.

Oil distillation. Lime reclamation from oil-distillation residuum. S. M. Herber, Inza, Mo. U.S. Pats. (A) 1,183,457 and (B) 1,183,458, May 16, 1916. Dates of appl., Dec. 7 and Dec. 8, 1915.

(A) To obtain products of lower boiling point from hydrocarbon oils, the oil is mixed with lime and heated in a horizontal retort which is rotated or oscillated intermittently or continuously to ensure uniform heating. Steam or air or both may be introduced and the mixture may be heated under pressure or without pressure. (B) A furnace for the recovery of lime from carbon, oil, and the like, comprises a vertical cylindrical chamber with perforated air-supply pipes rising from the grate to the top of the chamber. Air is introduced at the lower ends, and close-fitting inner perforated pipes are provided which can be raised and lowered so as to admit the air to the charge at any desired point. The recovered lime is withdrawn from the bottom, by manipulating the grate-bars from without.—W. F. F.

Feeding pulverised fuel; Apparatus for ——. J. E. Bell, New York. U.S. Pat. 1,184,303, May 23, 1916. Date of appl., July 29, 1914.

Feeding and burning fine fuel. W. D. Wood, New York. U.S. Pat. 1,185,156, May 30, 1916. Date of appl., Apr. 17, 1914.

[Gas] retort-bench. G. H. Niles, Ridgefield Park, N.J., Assignor to The Improved Equipment Co., New York. U.S. Pat. 1,185,602, May 30, 1916. Date of appl., May 11, 1914.

[Hydrocarbon] oils; Treating ——. O. D. Lucas, Assignor to Lucas's Low Pressure Oil Cracking Process, Ltd., London. U.S. Pat. 1,183,091, May 16, 1916. Date of appl., Nov. 25, 1914.

See Eng. Pats. 12,653 and 18,923 of 1914; this J., 1915, 707.

Gasolene substitute ; Process of obtaining ——. H. Zerning, Halensee, Germany. U.S. Pat. 1,183,266, May 16, 1916. Date of appl., Jan. 20, 1913.

See Fr. Pat. 452,919 of 1913 ; this J., 1913, 781.

Fuel for internal-combustion engines. J. de Cosmo and H. Quinaux, Liege, Belgium. U.S. Pat. 1,184,727, May 30, 1916. Date of appl., May 15, 1913.

See Addition of Aug. 8, 1913, to Fr. Pat. 459,857 of 1913 ; this J., 1914, 304.

Manufacture of liquid organic compounds from products of distillation of coal and other solid carbonaceous material of vegetable origin. Eng. Pat. 5021. *See* III.

Process of making chlorinated hydrocarbons from petroleum. U.S. Pat. 1,183,094. *See* XX.

Registering device for gas-analysers. U.S. Pat. 1,184,095. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Rapid method for comparing the decolorising efficiencies of charcoals. Wickenden and Hassler. *See* XII.

Patents.

Oil baths and the like and means for heating the same E. B. Higgins, Wallasey, Cheshire. Eng. Pat. 17,881, July 28, 1914. Addition to Eng. Pat. 17,190 of 1914, dated July 28, 1913 (this J., 1914, 912).

The oil bath or like heating apparatus described in the principal patent is adapted for use on a commercial scale by fixing the Field tube or thermal siphon devices in a furnace setting so as to be heated by the hot gases.—W. F. F.

Heating liquids or solid substances or mixtures of liquids and solid substances ; Devices for ——. A. Lang, Karlsruhe, Germany. Eng. Pat. 8642, June 11, 1915.

See Ger. Pat. 290,908 of 1914 ; this J., 1916, 684. The heating cartridge is made of paper or other easily carbonised substance, and the reaction mixture is ignited locally by means of a fuse of "nitrated cotton wool cord" impregnated with sulphur and aluminium dust and a little iron. The charge for the cartridge may consist of asbestos or the like impregnated with the components of the reaction mixture.

Metallic filaments for incandescence electric lamps and for other purposes ; Process for manufacturing ——. K. Nishimoto, Tokyo, Japan. Eng. Pat. 7829, May 26, 1915.

Finely-divided tungsten with about 5% of thorium is pressed into sticks and heated to a white heat for 10 minutes by an electric current in an atmosphere of hydrogen. The sticks are allowed to cool slowly for a period up to 50 hours by reducing the current step by step, and finally hammered or rolled while at a dull red heat. The final product may be rolled or drawn at ordinary temperatures.—W. F. F.

Electrode for arc lamps. R. Mylo, Charlottenburg, Germany. U.S. Pat. 1,183,317, May 16, 1916. Date of appl., July 21, 1915.

An electrode containing luminous admixtures is made with longitudinal capillary passages to absorb molten particles as formed.—W. F. F.

Manufacture of liquid organic compounds from products of distillation of coal and other solid carbonaceous material of vegetable origin. Eng. Pat. 5021. *See* III.

Process of producing new oils from wood creosote oil, etc. U.S. Pat. 1,185,588. *See* III.

Process of treating wood creosote oil. U.S. Pat. 1,185,592. *See* III.

III.—TAR AND TAR PRODUCTS.

Benzene ; Solidifying and melting point of ——. R. Meldrum. Chem. News, 1916, **113**, 266—267.

Commercial "pure" benzene was left for 24 hours at 3° C. and the liquid portion drained off. This solidified at 3·92 C. Complete solidification of the whole sample was not obtained, even after 12 hours' exposure at 1° C. Supercooling prevents the normal formation of crystals, even in the presence of a large excess of crystals. The m.pt. of the liquid portion was 4·0° C. The crystals deposited on supercooling the benzene solidified at 5·60° C., melted at 5·70° C., and the liquid boiled at 80·05° to 80·15° C. (0·45° C. lower than the accepted b.pt. of benzene). Superfusion of this benzene could be produced by exposing it to a temperature of 3° C. in a stoppered bottle. When allowed to solidify in a tube of 1 in. diameter at a room temperature of 1° C., it assumed a transparent colloidal form, its temperature after 48 hours being 2° C. In some cases superfused benzene when shaken became viscous before crystallisation, which is probably due to solution of the solid colloid in liquid benzene. The variations in the recorded constants of benzene may be attributed to this occurrence above the m.pt. of different modifications in which the molecule becomes more complex. The purity of benzene may be determined with greater accuracy by the melting and solidification points than by the boiling point.—C. A. M.

Pyridine bases ; Formation of —— by condensation of ketones and amides. A. Pictet and P. Stehelin. Comptes rend., 1916, **162**, 876—878.

By the condensation of 2 mols. of acetone and 1 mol. of acetamide, by heating to 250° C. in a sealed tube, without the addition of a dehydrating agent, a 2—3% yield of trimethylpyridine was obtained. A yield of 9% of triphenylpyridine was obtained by heating benzamide and acetophenone at 275° C. This substance forms colourless prisms, m.pt. 137° C., and is almost devoid of basic properties, crystallising for example from concentrated hydrochloric acid unchanged. An attempt to synthesise pyridine itself from formamide and acetaldehyde by this reaction was unsuccessful owing to the complete decomposition of the formamide. A small quantity of α-picoline was however isolated from the product obtained by heating paracetaldehyde and acetamide to 280° C. The addition of dehydrating agents in the above reactions defeats the main object by converting the amides into nitriles.—G. F. M.

Phloroglucinol and resorcinol ; Quantitative determination of —— by means of furfural. E. Votocek and R. Potmesil. Ber., 1916, **49**, 1185—1194

Phloroglucinol and resorcinol when treated in solution with furfural in presence of hydrochloric acid (about 12% concentration) give a greenish black precipitate, which is formed with sufficient regularity to serve as a basis for the quantitative determination of these phenols. After standing for 24 hours the precipitate is collected in a Gooch crucible, washed free from chloride, and dried at 102°—105° C. to constant weight in an atmosphere of hydrogen. It is important that the solution should not contain less than 0·015 grm. of phloroglucinol or 0·05 grm. of resorcinol per 100 c.c.

otherwise precipitation will be incomplete. As the average of a large number of experiments the factor, condensation product : $C_6H_6O_3$ is about 2·1. The presence of phenol, catechol, or quinol has no detrimental effect on the above determinations, but with the cresols, xylenols, pyrogallol, and orcinol precipitates are also obtained which interfere with the results.—G. F. M.

PATENTS.

Liquid organic compounds ; Manufacture of —— from the products of distillation of coal and other solid carbonaceous material of vegetable origin formed by natural or artificial carbonisation. F. Bergius, Essen-Ruhr, Germany. Eng. Pat. 5021, Mar. 31, 1915. Under Int. Conv., Apr. 2, 1914. Addition to Eng. Pat. 18,232 of 1914 (this J., 1916, 167).

THE process described in the principal patent is found to be applicable also to the products of distillation of coal and other carbonaceous materials such as tar and pitch, and also to solid residues from coke ovens and gas retorts. As an example 1 kilo. of gas tar is heated with hydrogen at 100 atmospheres pressure, to 400° C. After 4 hours the mass is distilled at about 250° C., and about 60 % of distillate resembling petroleum oil is obtained, which can be further treated by rectification. Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 4574 of 1914 (this J., 1915, 862).
—W. F. F.

Tar distillates ; Method of producing pure ——. M. Melamid, Freiburg, Germany. U.S. Pat. 1,183,749, May 16, 1916. Date of appl., May 28, 1915.

TAR, tar oils, and hydrocarbons contained in the tar are heated to 150°—200° C. with phosphorus-oxygen compounds other than orthophosphoric acid.—F. W. A.

Oils [from wood creosote oil, etc.] ; Process of producing new ——. H. M. Chase, Wilmington, N.C. U.S. Pat. 1,185,588, May 30, 1916. Date of appl., Apr. 29, 1916.

CREOSOTE oil, pitch, or other liquid product of the destructive distillation of resinous wood is heated in a still or retort, dry steam is introduced below 130° C. to distil off light oil, and subsequently the temperature is raised to 200° C. and dry steam introduced to distil off an oil having the characteristics of rosin oil.—F. W. A.

[Wood] creosote oil ; Process of treating ——. T. W. Pritchard, Assignor to National Wood Distilling Co., Wilmington, N.C. U.S. Pat. 1,185,592, May 30, 1916. Date of appl., Aug. 14, 1911 ; renewed Oct. 26, 1915.

CREOSOTE oil from resinous wood is heated first to a temperature below 500° F. (260° C.) until all substances having a creosote odour have distilled off, and then to a temperature below 700° F. (370° C.) to distil off an oil free from creosote odour. The product has the general characteristics of rosin oil, but contains less rosin acids and more oxidised acids and possesses a lower iodine value than rosin oil.—F. W. A.

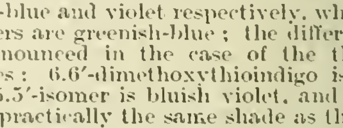
IV.—COLOURING MATTERS AND DYES.

Thioindigo ; Hydroxy- and methoxy-derivatives of ——. P. Friedländer. Ber., 1916, **49**, 955—966.

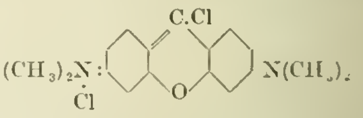
6.6′-DIHYDROXYTHIOINDIGO has been synthesised from 4-sulpho-2-aminobenzoic acid (sulphoanthranilic acid) by converting the latter into the sulphothioglycine-*o*-carboxylic acid, which is fused with caustic potash, when the hydroxyphenylthioglycine-*o*-carboxylic acid first produced lose water at a higher temperature to give 3.6-dihydroxythionaphthene (m.pt. 212 C.), which by oxidation yields 6.6′-dihydroxythioindigo. Methylation with methyl sulphate yields 6.6′-dimethoxythioindigo, which is more readily obtained by commencing with 4-methoxy-2-aminobenzoic acid. Unlike the hydroxy-derivatives of indigo (Friedländer and Schenk, this J., 1915, 708), 6.6′-dihydroxythioindigo is stable in alkaline solution in presence of air even after continued boiling. The absorption spectra of the hydroxy and methoxy derivatives of thioindigo are practically identical ; the alkaline solutions of the former are somewhat bluer than the alcoholic solutions. The position of the hydroxy or methoxy groups exerts a great influence : 6.6′-dibromo- and dimethoxy-indigo are violet-blue and violet respectively, whereas the 5.5′-isomers are greenish-blue ; the differences are more pronounced in the case of the thioindigo derivatives : 6.6′-dimethoxythioindigo is orange-red, the 5.5′-isomer is bluish violet, and the 4.4′-isomer is practically the same shade as thioindigo. The introduction of sulphonic groups causes a further small change in shade, as in many other dyestuffs ; 5.5′- and 6.6′-thioindigo-disulphonic acid differ very slightly from one another.
—F. W. A.

Pyronine ; The para-quinonoid constitution of ——. J. v. Braun and E. Aust. Ber., 1916, **49**, 989–999.

IT was not found possible to convert dicyanodimethyldiaminoxanthone into the corresponding xanthydrol necessary for the production of the pyronine. The dicyanodimethyldiaminoxanthene, unlike leucopyronine, is very stable to oxidising agents, and hence the formation of the highly coloured pyronine salts is considered to be bound up with the presence of the two basic nitrogen groups. Dicyanodimethyldiaminoxanthone, like pyrone and xanthone, only gives pale yellow salts with concentrated acids, easily hydrolysed by water, and probably having the oxonium formula :



The essential part played by the two basic nitrogen groups in the production of pyronine salts is also shown by the action of phosgene or oxalyl chloride on colourless tetramethyldiaminoxanthone, which gives a deep red-brown product in which the oxygen atom is replaced by two chlorine atoms to give the ketochloride, which changes to :



This compound gives a solution of the colour of pyronine in which only one of the chlorine atoms is electrolytically dissociated ; by energetic hydrolysis the xanthone is again produced. Treatment of dicyanodimethyldiaminoxanthone in this manner gives a yellow product which does not form salts, and is insoluble in water. In consequence of the essential part played by the two basic nitrogen groups it is considered that pyronine dyestuffs are not *ortho*-quinonoid as usually accepted, but are more probably *para*-quinonoid.—F. W. A.

Phenyl derivatives of Methylene Blue and of thionine. F. Kehrmann. Ber., 1916, **49**, 1013–1023.

MONOPHENYL Methylene Blue (trimethylphenylthionine) has been prepared by condensing thiodiphenylamine with one molecule of monomethylaniline by means of ferric chloride and treating the nitrate of the product with dimethylamine in alcoholic solution: with concentrated sulphuric acid it gives an olive solution which becomes blue on dilution: caustic alkalis decompose it rapidly; the iodide and perchlorate are very slightly soluble in cold water. and somewhat more soluble in boiling water. Symmetrical dimethyldiphenylthionine is produced. together with 2.3-di-[methylanilino]-phenazthionium and phenazthionium. by the action of an excess of monomethylaniline on a cold alcoholic solution of the 3-methylanilino-phenazthionium nitrate. and is separated as the zinc chloride double salt. which is not readily soluble even in hot water. but is readily soluble in alcohol; with concentrated sulphuric acid it gives a dirty olive solution. changed to blue by dilution; its behaviour towards alkalis is the same as that of monophenyltrimethylthionine and of Methylene Blue; the iodide and perchlorate are practically insoluble in water. Diphenyl- and *asym*-monophenylmonomethylthionine have also been prepared. The replacement of a methyl group in Methylene Blue by a phenyl group had not the optical effect expected, viz.. the production of a greener shade.—F. W. A.

Dyestuffs permitted in food products in the United States. See XIXA.

Patents.

Gallocyanine series; Manufacture of chromium compounds of the ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,751, Nov. 8. 1915.

Dyestuffs of the gallocyanine series in the form of a salt or hydrochloride are treated in aqueous solution or suspension with a chromium salt or a chromate, sodium acetate with or without acetic acid being added if necessary; the chromium compound crystallises or may be salted out. The products can be fixed directly without the aid of mordants for printing cotton, wool, and silk, yielding bright tints of uniform fastness. *Example:* A solution of 35 grms. of Gallamine Blue in 1 litre of cold water is mixed with 9 grms. of fused sodium acetate, a solution of 15 grms. of sodium bichromate crystals in 150 grms. of water added, and the mixture stirred for half-an-hour: 20 grms. of the separated chromium compound, 100 c.c. of concentrated formic acid, 100 c.c. of water, 10 grms. of hydrosulphite NF conc, 650 grms. of starch-British gum thickening, and 120 cc. of water are heated to 90° C., the goods printed with this paste, dried, and steamed. —F. W. A.

Disazo dyestuffs; Manufacture of chromable secondary ——. G. B. Ellis, London. From Chemical Works, formerly Sandoz. Basle, Switzerland. Eng. Pat. 100.472, Apr. 1, 1916. (Appl. No. 4818 of 1916.)

In place of 1.8-aminonaphthol-3.6-disulphonic acid used in Eng. Pat. 17.607 of 1915. 2.8-aminonaphthol-6-sulphonic acid is coupled with *o*-diazophenols. *e.g.*. diazotised picramic acid or 2-amino-6-nitrophenol-4-sulphonic acid. in alkaline medium. and the resulting monoazo dyestuffs are diazotised and combined with pyrazolones containing a free 4-position. *e.g.*, 1-[4′-sulphophenyl]-3-methyl-5-pyrazolone or 1-phenyl-3-methyl-5-pyrazolone respectively. Valuable *o*-hydroxydisazo dyestuffs are produced. of which the wool dyeings give on afterchroming brown to bronze-brown shades. fast to milling and to potting, and of excellent fastness to light.—F. W. A.

Sulphur dyes; Manufacture of new ——. P. A. Newton. London. From Farbenfabr. vorm. F. Bayer und Co., Leverkusen, Germany. Eng. Pat. 13.952, Oct. 1, 1915.

See U.S. Pat. 1,175.230 of 1916; this J.. 1916. 531.

Trisazo dyes; Green substantive ——. J. Dedichen. Berlin-Halensee, and W. Lange, Berlin-Friedenau. Germany. Assignors to Act.-Ges. f. Anilinfabr.. Berlin. U.S. Pat. 1,183,831. May 16, 1916. Date of appl.. June 5. 1915.

See Eng. Pat. 8996 of 1915; this J., 1915. 1136.

Leather dyes. U.S. Pat. 1,185,605. *See* XV.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Filter-paper; Manufacture of chemical ——. E. J. Bevan and W. Bacon. Analyst, 1916, 45, 159—163.

It is estimated that, prior to the war, 500.000 to 600.000 lb. of filter-paper of all grades was imported into this country; at the present time only four English paper makers are producing filter paper, but excellent qualities of paper are now on the market. For most filtering purposes a paper should possess the character of "softness," and the technical term for this is "bulk," a term defining the relation of the volume of the paper to the volume of the fibre; generally, for a moderately rapid filter paper the bulk should be about 3·5 (fibre = 1). Pinholes sometimes occur in papers of this class and are due to faulty manipulation of the beaten stuff at the mill. Cotton cellulose is preferable to linen (flax) cellulose in the manufacture of high-grade filter papers owing to its low hydrating power and to the fact that it imparts more bulk to a paper. It is difficult to get new waste material for this manufacture, and the source of many of the chemical impurities in the finished paper may be traced back to the raw material. The lime present in filter paper is chiefly derived from the water used in the manufacture; chemical bleaching of the material also contributes to this impurity. Iron and copper are frequently present and sometimes alumina and silica, due to loading of the material with kaolin. Starch and oil are the chief organic impurities in filter paper; both are derived from the raw material and are for the greater part removed by the alkali treatment and washing.—W. P. S.

Patents.

Ungumming silk and silk wastes; Process for ——. Gebr. Schmid, Basle, Switzerland. Eng. Pat. 100.029, Jan. 22, 1916. Under Int. Conv., Jan. 22, 1915 (Appl. No. 1062 of 1916).

In degumming silk or silk wastes free from chrysalides. in place of 100 kilos. of soap 30 to 60 kilos. of soap and about 40 to 50 kilos. of chrysalides are used. The soap bath or lather containing these proportions possesses a less degree of alkalinity and does not attack the silk, which is more readily washed neutral for dyeing. or may be placed directly in a tin chloride bath without washing. The treatment also assists the carding and combing of silk waste. In case the silk wastes contain many chrysalides. the whole of the soap is replaced by soda which is added gradually to the degumming bath.—F. W. A.

Sulphite [-cellulose] mills; Acid-reclaiming apparatus for ——. G. S. Witham. sen.. Hudson Falls, and J. J. McEwen. Fort Edward. N.Y. U.S. Pat. 1:183.152. May 16. 1916. Date of appl.. Dec. 11, 1915.

The gases are led from the digester first to a mixing tank and then to the lower part of an absorption tower, which is fed with alkali and also with the liquor separated from the fibre when the digester is discharged. From the top of the tower the gases pass into the tank which feeds the tower. The acid liquor from the bottom of the tower is conveyed to the mixing tank, where it meets the gases coming directly from the digester, and the enriched liquor from the mixing tank is used in the digester.—F. Sp.

Plastic composition [*from cellulose*], *and method of making the same.* W. K. Freeman, Oscawana, N.Y. U.S. Pat. 1,183,446, May 16, 1916. Date of appl., Jan. 28, 1915.

A plastic composition is produced by hydrolysing cellulose with an alkaline solution, drying it, mixing the dry fibre with dry magnesium oxide, and adding a solution of magnesium chloride, which causes the whole to set.—F. Sp.

Cellulose threads; Process for manufacturing brilliant ——. J. Christophe, Lyon, France. U.S. Pat. 1,184,323, May 23, 1916. Date of appl., March 6, 1915.

Threads of natural cellulose are submitted to the action of caustic soda solution of 20° to 30° B. (sp.gr. 1·16—1·26), the excess of the solution is removed by a hydro-extractor, and the threads are then treated in a vacuum apparatus with carbon bisulphide equal to 15 to 30% of the weight of the thread. The resulting cellulose xanthate threads are stretched, re-converted into cellulose by treatment with a suitable solution, at 65° C., and then treated successively with sodium sulphide solution, boiling water, a solution of a mineral acid, and hot water. The treatment with carbon bisulphide may be repeated any number of times.—J. B. C. K.

Plastic composition [*celluloid substitute*]. A. Eichengrün, Berlin. U.S. Pat. 1,185,074, May 30, 1916. Date of appl., Aug. 1, 1910.

See Fr. Pat. 418,741 of 1910; this J., 1911, 79. The quantity of filling material is specified as more than 25%, preferably more than 100% of the weight of acetylcellulose.

Counterboard [*waterproof board*] *and method of preparing the same.* A. L. Clapp, Braintree, Mass., Assignor to Hide-Ite Leather Co., Boston, Mass. U.S. Pat. 1,184,518, May 23, 1916. Date of appl., Dec. 23, 1914.

Manila paper is beaten out and mixed with the solution obtained by the action of caustic soda on leather, and with rosin size. Alum is added to precipitate the "leather in solution" and the size on the fibre, and the mass after being kneaded is shaped into boards.—F. Sp.

Cork articles: Method of making ——. *Cork-board.* L. L. Bentley, Beaver Falls, Pa., Assignor to Armstrong Cork Co., Pittsburgh, Pa. U.S. Pats. 1,184,306 and 1,184,308, May 23, 1916. Dates of appl., Nov. 25, 1914, and May 19, 1915.

See Eng. Pat. 16,935 of 1915; this J., 1916, 686. The heat transmission of the cork-board, determined by the hot plate test, is less than 5 B.Th.U. per sq. ft. for 1° F. difference in temperature per 24 hours for a test-piece 1 in. thick.

Cork; Method of treating granulated ——. L. L. Bentley, Beaver Falls, Pa., Assignor to Armstrong Cork Co., Pittsburgh, Pa. U.S. Pat. 1,184,307, May 23, 1916. Date of appl., Nov. 25, 1914.

Granulated cork is heated in a closed vessel in which a partial vacuum has been produced, so as to vaporise moisture, etc., superheated steam is then forced into the vessel, and the pressure is released suddenly to cause expansion of the cork particles.—A. S.

Wool and like washing machines. F. B. Petrie, Rochdale. U.S. Pat. 1,184,869, May 30, 1916. Date of appl., Nov. 26, 1915.

See Eng. Pat. 23,837 of 1914; this J., 1916, 172.

Artificial silk, artificial threads and films; Manufacture of ——. E. Dammann, Tempelhof-Berlin, Germany. Eng. Pat. 13,872, June 8, 1914. Under Int. Conv., June 11, 1913.

See Fr. Pat. 473,126 of 1914; this J., 1915, 546.

Cellulose bodies; Device for producing filamentous or filmy ——. A. Pellerin, Trouville, France. U.S. Pat. 1,184,206, May 23, 1916. Date of appl., Mar. 31, 1913.

See Fr. Pat. 442,022 of 1912; this J., 1912, 916.

Wood stain from sulphite-cellulose waste liquor. U.S. Pat. 1,185,604. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Patents.

Sericin soap [*for silk dyeing*]; *Manufacture of a substitute for* ——. Gebr. Schmid, Basle, Switzerland. Eng. Pat. 100,169, Jan. 19, 1916. Under Int. Conv., Mar. 12, 1915. (Appl. No. 878 of 1916.)

A substitute for sericin soap for use in the dyeing of silk, silk wastes, etc., is obtained by boiling silkworm chrysalides or silk wastes containing chrysalides with water to which sodium carbonate may have been added. The product contains mainly substances related to sericin, and influences favourably the handle, lustre, elasticity, and strength of the fibre and its uniform dyeing.
—F. W. A.

Dyeing or printing fabrics; Process for ——. P. M. Justice, London. From Bakelite G.m.b.H., Berlin. Eng. Pat. 7284, May 14, 1915.

Water-soluble phenol-formaldehyde condensation products, of value as mechanical and chemical fixing agents in dyeing or printing on account of their miscibility with the usual thickening and dissolving agents, are obtained, for example, by heating to the boiling-point 100 grms. of phenol, 100 grms. of 40% formaldehyde, and 5 grms. of caustic soda, neutralising the cooled solution with hydrochloric acid, and concentrating *in vacuo*. Such products are mixed with metallic powders, pigments, or dyestuffs in a neutral, acid, or alkaline medium, and the printed or padded fabrics steamed to render the condensation products insoluble: an alternative method is to pad the fabric with a solution of 1500 grms. of condensation product in 900 grms. of water, dry, steam, and then dye with acid, basic, or direct dyestuffs. The affinity of animal fibres for certain dyestuffs, *e.g.*, Victoria Violet 4BS, is increased by these condensation products, the dyeings being of good fastness to light. The elasticity may be increased by the addition of cellulose derivatives.—F. W. A.

Dyeing; Azo dye and process of ——. C. Heidenreich, Leverkusen, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,183,378, May 16, 1916. Date of appl., Mar. 27, 1915.

See Ger. Pat. 287,752 of 1914; this J., 1916, 174.

Dyeing skins, hairs and the like; Process for ——. K. Marx, Dessau, Assignor to Act.-Ges. f. Anilinfabr., Berlin, Germany. U.S. Pat. 1,183,748, May 16, 1916. Date of appl., July 16, 1914.

See Fr. Pat. 472,702 of 1914; this J., 1915, 489.

Fast orange, red, or brown shades on vegetable fibres; Production of —— *and [azo] dyestuffs therefor.* H. Levinstein and J. Baddiley, Assignors to Levinstein, Ltd., Manchester. U.S. Pat. 1,185,413, May 30, 1916. Date of appl., Nov. 28, 1913.

See Eng. Pat. 27,525 of 1912; this J., 1913, 1005.

Manufacture of chromium compounds of the gallocyanine series. Eng. Pat. 15,751. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Hydrocyanic acid; Determination of small quantities of ——. M. O. Johnson. J. Amer. Chem. Soc., 1916, **38**, 1230—1235.

The accuracy of the results obtained by the colorimetric thiocyanate method of estimating hydrocyanic acid (Francis and Connell, J. Amer. Chem. Soc., 1913, **35**, 1624) are vitiated by factors, such as the potassium chloride, or hydrochloric acid present, which influence the ionisation of ferric thiocyanate, and moreover the removal of the sulphur in the method is very tedious. These disadvantages are overcome by the following modification:—The hydrocyanic acid is distilled into potassium hydroxide solution and to 50 c.c. of the distillate, containing 0·1 to 8 mgrms. of potassium cyanide, 1 c.c. of yellow ammonium sulphide is added and the liquid is evaporated to dryness on the water-bath. The residue is three times extracted with 10 c.c. of acetone, the evaporated residue of the acetone extracts, which contains only the potassium thiocyanate, is dissolved in water, made up to 50 c.c., 2 c.c. of 0·5% ferric chloride solution added, and the colour matched with that of a standard thiocyanate solution. Should the acetone extract be coloured with organic matter this can be removed by extracting the aqueous solution of the residue with ethyl acetate, in which solvent the thiocyanate is insoluble.—G. F. M.

Sodium hydroxide; Solubility of —— *in liquefied ammonia.* N. Tchitchinadzé. J. Chim. Phys., 1916, **14**, 153—175.

The solubility of sodium hydroxide in pure liquefied ammonia, completely protected from atmospheric gases, was estimated gravimetrically by evaporating the saturated solution, and indirectly by determining the electrical conductivity. The former method gave 4 mgrms. per 1000 grms. of solvent (or 1·8 mgrms. per litre) and the latter method 1 mgrm. per 1000 grms. of solvent as the maximum value. Traces of moisture sensibly ncreased the solubility.—E. H. T.

alcium carbonate; Several forms of ——. J. Johnston, H. E. Merwin, and E. D. Williamson. Amer. J. Sci., 1916, **41**, 473—512.

ALCIUM carbonate appears in three crystalline nhydrous forms, viz., as calcite, aragonite, and hat the authors term μ-$CaCO_3$. Other reputed orms are not definite forms, their divergent properties being due to differences in the size of the articles or their mode of aggregation. *Calcite* the most stable form at all temperatures between and 970° C.; at 970° C., under a sufficient ressure of carbon dioxide to prevent dissociation, inverts reversibly into α-$CaCO_3$ (Boeke, Neues ahrb. Min., 1912, i., 91) which differs very little om it crystallographically. Calcite is the general roduct from slow precipitations and other forms e readily converted into it at about 400° C. *ragonite* is unstable at all temperatures within the ange of experiment, and no definite limiting conditions determining its precipitation can be specified. Natural aragonite is formed (*a*) through organic agencies, (*b*) by deposition from hot springs, (*c*) when an isomorphous carbonate is present as a nucleus, (*d*) in salt waters containing sulphate. It is formed artificially by slow precipitation at 85°—90° C. or in presence of an isomorphous carbonate, essential conditions being the use of very dilute solutions which are mixed very slowly. At 60° C. the precipitation produces a mixture of aragonite and μ-$CaCO_3$, and at lower temperatures a mixture of μ-$CaCO_3$ and calcite, except in the presence of a sulphate, in which case aragonite containing some sulphate is precipitated. Aragonite when dry can be kept for an apparently indefinite period at the ordinary temperature; the inversion of the dry material at 400° C. requires several hours. In the presence of water at 25° C. it required a month before any appreciable change could be seen. The presence of calcite nuclei increases the rate of inversion. The heat of transformation is probably small, but its sign is unknown. μ-$CaCO_3$ often occurs as an intermediate step in the precipitation of other forms, but it is soon transformed in the presence of water. It is best obtained by precipitation at 60° C. of a solution virtually supersaturated with respect to both calcite and aragonite, in the absence of nuclei of the two latter. μ-$CaCO_3$ may be separated from calcite and aragonite by flotation in a fluid of sp.gr. 2·6, as its sp.gr. is only 2·54. It is usually precipitated in scales or plates but varies greatly. Its crystalline form is hexagonal. The dry material persists apparently indefinitely at room temperatures, but when heated to 410° C. it is rapidly converted into calcite. In the presence of water inversion occurs readily. The difficulty of distinguishing it from aragonite by means of the usual chemical tests has delayed its recognition in nature, though optically and in sp.gr. it is quite distinct. *Vaterite* appears to be a porous aggregate consisting of radiating prisms of calcite too small to be resolved by the microscope. *Ktypeite* and *conchite* are porous aragonite, and *lublinite* is merely a special variety of calcite consisting of rhombohedral needles. The so-called "*amorphous*" forms of calcium carbonate appear to owe their special properties to the extreme minuteness of the particles and to the mode of aggregation, and do not offer evidence of being distinct in crystalline form. *Hydrated carbonates* are produced by precipitation below 20° C., but $CaCO_3,6H_2O$ is the only one of which the existence is undoubted. It changes rapidly, at the ordinary temperature, into calcite and water, and readily passes undetected.

Properties of the forms of $CaCO_3$.

Form.	Crystal system.	Optical character.	Refractive index.		sp.gr.
			max.	min.	
Calcite:					
Artificial crystals	—	—	1·658	1·486	2·71
Iceland	Hex.	—	1·658	1·486	2·713
Spherules ("vaterite")	—	—	1·585 to 1·64	1·455 to 1·47	2·51 and greater
Aragonite:					
Artificial pure	—	—	1·682	1·527	2·88
From a solution containing sulphate ..	Orth.	—	1·673 to 1·650	1·520 to 1·510	
Natural	—	—	large range		large range
μ-$CaCO_3$ artificial	Hex.	+	1·650	1·550	2·54
$CaCO_3,6H_2O$ artificial	Mon.	—	1·545	1·460	1·75

The authors have found that optical and crystallographic properties afford a rapid means of determining the various forms of calcium carbonate and that they are more reliable than chemical tests. They state that much previous work is vitiated by the use of insufficient criteria and requires revision.—A. B. S.

Permanganate: Titrations with —— in strongly alkaline solution. B. Brauner. Z. anal. Chem., 1916, **55**, 225—267.

In alkaline solution, arsenious acid reduces permanganate (Mn^{vii}) to the Mn^{iii} state if an electrolyte (K_2SO_4) is present to convert the colloidal $Mn(OH)_3$ into a precipitate; when the colloidal $Mn(OH)_3$ remains in the solution, the reduction of the permanganate proceeds as far as the Mn^{ii} state. In the case of manganous salts, the oxidation of the latter and the reduction of the permanganate produce hydrated manganese dioxide. Thallous salts are oxidised completely to thallic (Tl_2O_3) salts, and cerous to ceric salts. Lead salts are oxidised partially, the product containing somewhat more oxygen than corresponds with a mixture of $PbO + PbO_2$. Selenous and tellurous acids are converted into selenic and telluric acids, respectively, and ferrous salts into ferric salts. In feebly alkaline solution nickel is oxidised to an extent slightly greater than that corresponding to the formation of NiO, but in strongly alkaline solution the oxidation proceeds approximately to the formation of Ni_2O_3. Cobalt, when oxidised with permanganate in strongly alkaline solution, yields an oxide containing rather more oxygen than corresponds with the formula Co_2O_3.—W. P. S.

Nitrate and nitrite assimilation. XI. [Constitution of nitrates and nitrites.] O. Baudisch. Ber., 1916, **49**, 1176—1182.

The old valency formulæ for nitrates and nitrites afford no explanation of the great tendency towards the formation of the nitrite stage when either ammonia is oxidised, or nitrates are reduced by photochemical action in the absence of an oxygen-activating catalyst. Formulæ are suggested for metallic nitrates and nitrites which afford an explanation of the fact that the nitrate for example can split off oxygen under illumination in an oxygen atmosphere whereas the nitrite cannot. On the other hand, in presence of alcohol or other oxygen activator the nitrite is oxidised to nitrate, because the alcohol peroxide has the power of bringing about such an oxidation, but in the absence of any such activator the oxidation of a lower nitrogen oxide stops at the nitrite stage.—G. F. M.

Erbium; Separation of —— from yttrium. I. P. S. Willand and C. James. J. Amer. Chem. Soc., 1916, **38**, 1198—1202.

A number of rare earth separation methods were investigated in respect to their utility for the separation of erbium from yttrium. Oxides containing an excess of yttrium were used, and of the methods tried, the following proved most satisfactory:—(1) Fractional precipitation with sodium nitrite of a solution of 10 grms. of the oxides in hydrochloric acid, diluted to 1000 c.c. The atomic weights of the first and last fractions were 115·9 and 89·9 respectively, and this method is recommended on account of its cheapness and ease of manipulation. (2) Fractional precipitation from a hydrochloric acid solution with 10% potassium cobalticyanide solution, and subsequent decomposition of the cobalticyanide fractions by boiling with sodium hydroxide. (3) Fractional precipitation with sodium phosphate from a dilute nitric acid solution of the oxides, the fractions being then redissolved in nitric acid (1 : 1) and reprecipitated as oxalates. In all three methods the last fraction was obtained by the addition of oxalic acid to the final liquors.—G.F.M.

Ferric oxide: Dissociation of —— in air. J. C. Hostetter and R. B. Sosman. J. Amer. Chem. Soc., 1916, **38**, 1188—1198. (See also this J., 1916, 536.)

Experiments on the ignition of ferric oxide in air and in oxygen at temperatures of 1100°—1300° C. were conducted in a horizontal electric tube furnace provided with a water-cooled silica glass cooling chamber at one end. The oxide was contained in an alundum boat which was found to remain practically constant in weight at 1100—1200° C., whereas the loss in weight of platinum in contact with ferric oxide was considerable at these temperatures, due probably to the absorption of iron by the platinum and the liberation of oxygen. An increasing difference in weight between ignitions in air and oxygen was observed as the temperature was increased, whence it is concluded that the greater weight in oxygen is due to a measurable dissociation of Fe_2O_3 in air at all temperatures between 1100° and 1300 C., the amount of dissociation increasing with the temperature. The formation of Fe_3O_4 by the ignition of Fe_2O_3 in air had previously only been detected at temperatures above 1350° C. (Walden, this J., 1908, 979). The dissociation pressure—composition curve takes the form of a curve asymptotic to the axis of ordinates when the ordinates are pressures. A theoretical explanation is offered of the ease of dissociation of the first small fractional percentage of the oxygen of ferric oxide, based on the essential continuity of the two kinds of combination of oxygen—adsorbed and chemically combined.—G. F. M.

Behaviour of metals towards acids containin hydrogen peroxide. Salkowski. *See* X.

Determination of potassium in presence of othe substances. Bennett. *See* XXIII.

Nitrate and nitrite assimilation. [Decompositio of nitrite solutions by light.] Baudisch. *See* XVI

Patents.

Concentrating acids: Process for ——. H. W Jones, Assignor to Armour Fertilizer Works Chicago, Ill. U.S. Pat. 1,183,207, May 16, 1916 Date of appl., Nov. 6, 1915.

Acid is concentrated by allowing it to trickle down in the form of alternate pools and films, ove an irregular inclined surface in an enclose chamber while a current of hot gases passes ove it. The gases are introduced at the lower par of the chamber and directed by means of a baffl on to the surface of the acid. The concentrate acid collects at the bottom of the chamber, an the moisture-laden gases leave at the top.—F. Sp.

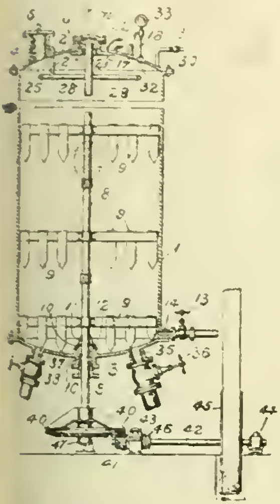
Formic acid or its compounds; Process of makin ——. M. Vaygouny, Berkeley, Cal., Assignor t Royal Baking Powder Co. U.S. Pat. 1,185,028 May 30, 1916. Date of appl., July 23, 1910.

Formates are produced by treating an aqueou solution containing carbonic acid in excess wit an alkali amalgam produced electrolytically. —F. Sp.

Sulphuric acid; Process for the manufacture of —— W. H. Waggaman, Washington, D.C. U.S. Pa 1,185,029, May 30, 1916. Date of appl., Sept. 1915. (Dedicated to the public.)

In the manufacture of sulphuric acid, the gase from the Glover tower are mixed with wate vapour, and passed through "a relatively lon sinuous channel," the temperature being equalise and controlled by water-cooling. The acid forme is collected in a chamber below the channel. (See also this J., 1916, 42.) —F. Sp.

Ammonia; Apparatus for producing —— [*from calcium cyanamide*]. W. S. Landis, Niagara Falls, N.Y., Assignor to Ammo-Phos Corporation. U.S. Pat. 1,183,885, May 23, 1916. Date of appl., Feb. 10, 1915.



Calcium cyanamide is decomposed in a vessel (see Fig.) provided with suitable inlets and outlets, and with a central shaft which is keyed on to a disc-shaped bearing at one end of the vessel, and to a hollow conical bearing provided with a suitable packing at the other end. (See also this J., 1916, 252.)
—J. B. C. K.

Ammonia: Process of making ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,184,839, May 30, 1916. Date of appl., Dec. 15, 1915.

A mixture of hydrogen and nitrogen is brought into contact with a porous base, *e.g.*, granular coconut charcoal, carrying cerium and a small quantity of another element, such as lanthanum, didymium, and yttrium, capable of increasing the catalytic activity of the cerium.—J. B. C. K.

[*Synthesis of ammonia.*] *Hydrogen and other gases; Apparatus for carrying out reactions between* ——. H. Wade, London. From M. Pier, Zehlendorf, Germany. Eng. Pat. 100,470, Apr. 18, 1914. (Appl. No. 147 of 1916.)

See Fr. Pat. 469,391 of 1914, and Addition thereto: this J., 1915, 28. The inner reaction vessel may be a thin iron tube and the outer pressure-resisting vessel a thick-walled nickel steel tube, the intermediate space being occupied by a thin-walled aluminium tube.

Ammonium phosphate: Manufacture of acid ——. W. Wollenweber, Bochum, Germany. Eng. Pat. 8037, May 31, 1915.

Phosphoric acid of sp.gr. 1·26 (30° B.) is heated to 80°—90° C., and ammonia, or a gas containing ammonia, is passed in until a sp.gr. of 1·31—1·35 (37°—38° B.) is attained, the temperature being maintained at 110° C. When the liquid shows a slightly alkaline reaction, it is sucked off, the reaction mass is cooled in an air current, and then centrifuged. The mother-liquor is used again in the process.—E. H. T.

Copper sulphate; Manufacture of ——. H. E. Dolphin, Widnes. Eng. Pat. 8581, June 10, 1915.

Copper sulphate is obtained in dry, very small, non-cohesive crystals by crystallising its solution when in motion, and by drying it at 160° F. (70° C.), in a copper trough (16 ft. long by 8 in. internal diameter), provided with a steam or hot-water jacket. The crystals are carried through the trough on a spiral worm at the rate of 5 ft. per min. The finished product contains about 0·25% of free water.—E. H. T.

Bisulphites; Manufacture of solid ——. B. Setlik, and "Fistag" Fettindustrie- und Stärkefabriken Akt.-Ges., Prague-Vysocan, Bohemia. Eng. Pat. 8877, June 16, 1915.

Sodium bisulphite is precipitated from a saturated solution by adding common salt, or by passing in hydrogen chloride. It can also be obtained by adding finely-ground sodium bisulphate to a saturated solution of the normal sulphite, and, after separation from the lye, washing out the sodium sulphate formed with a saturated solution of the bisulphite.—E. H. T.

Salts: Impregnation of —— *with radio-active material.* T. T. Baker, South Croydon. Eng. Pat. 10,151, July 12, 1915.

Dry amorphous particles of sodium chloride, produced by grinding or breaking up the fused salt, are spread on a suitable surface, sprayed with an aqueous solution of the radio-active material, and then dried.—J. B. C. K.

Limestone, dolomite and the like; Shaft furnaces or kilns for burning or calcining ——. J. Magis, Paris. Eng. Pat. 100,127, May 12, 1915. (Appl. No. 3700 of 1916.)

The kiln-shaft is enlarged at mid-height and is provided with a central chimney or aspirating pipe, which dips down into the shaft at the top. A suitable amount of water is mixed with the fuel used for heating the kiln, and the steam evolved, assisted by the strong upward draught in the aspirating pipe, carries off from the lower part of the kiln the heavy combustion gases, which usually collect there, and not only retard the calcination of the lime, but also prove detrimental to the health of the workmen. The upper end of the aspirating chimney may be provided with swan necks for the purpose of collecting the carbon dioxide.—J. B. C. K.

Lime: Process of slaking ——. W. E. Carson, Riverton, Va. U.S. Pat. 1,184,320, May 23, 1916. Date of appl., Dec. 4, 1915.

The lime is slaked with water containing finely divided mineral matter, such as clay, in suspension, together with a small amount of a deflocculating and suspension-stabilising agent, *e.g.*, caustic soda.
—J. B. C. K.

Iron sulphates; Manufacture of ——. *Manufacture of iron chloride.* A. C. Knowles, Wolverhampton. Eng. Pats. (A) 100,516, Jan. 27, 1916 (Appl. No. 1292 of 1916) and (B) 100,517, Feb. 23, 1916. (Appl. No. 2679 of 1916.)

(A) Waste pickle, from the interaction of iron and sulphuric acid, is concentrated to the crystallising point by spraying it under pressure into the top of a tower, where it is atomised by meeting an upward current of heated air, or other gas, which enters through a pipe at the base. There is an exit pipe at the top through which the hot gases are led away to a condensing chamber and a chimney with adjustable draught. The lower end of the tower rests peripherally upon a tank, and just below the inlet pipe for the hot air is a perforated plate through which the concentrated liquor flows into the tank. (B) Waste pickle from iron and hydrochloric acid is treated as described under (A).—E. H. T.

Arsenates; Method of making metallic ——. T. A. Mitchell, Reading, Mass., Assignor to Merrimac Chemical Co., North Woburn, Mass. U.S. Pats. (A) 1,183,315 and (B) 1,183,316, May 16, 1916. Date of appl., July 23, 1915.

(A) A metallic arsenate, *e.g.*, lead arsenate, is made by oxidising arsenious oxide with nitric acid in presence of lead. (B) A metal, *e.g.*, lead is immersed in an aqueous solution of arsenic acid in presence of a catalyst, *e.g.*, nitric acid, which also acts as a solvent for the metal. The liquid is heated and concentrated during the reaction. —E. H. T.

Lead arsenate; Method of manufacturing ——. E. O. Barstow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pats. (A) 1.184.693 and (B) 1.184.694, May 23, 1916. Date of appl., Aug. 1, 1912.

(A) AN alkali arsenite, *e.g.*, sodium arsenite, is treated with a halogen (chlorine) in presence of water, and then caused to interact with an oxygen derivative of lead, *e.g.*, lead oxide. (B) Lead arsenate is produced by the reaction between arsenious oxide, chlorine, an alkali arsenate, and a lead compound, the arsenate being present in such quantity that the amount of base it contains is equivalent to the quantity of chlorine used. —E. H. T.

Titanic oxide; Method for obtaining ——. A. J. Rossi, Niagara Falls, N.Y., Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1.184.131, May 23, 1916. Date of appl., Oct. 10, 1911.

ORE containing ilmenite is melted with sodium bisulphate, and the resulting melt is boiled with water and acid until the titanic oxide has dissolved. The solution, after filtering off the insoluble matter, on further boiling with addition of water to replace that which has been evaporated, yields the titanic oxide as a precipitate, which is separated from the solution, washed, and dried.—J. B. C. K.

Active oxygen; Compounds containing ——. [*Stable perborate compounds.*] O. Liebknecht, Frankfort, Germany, Assignor to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,185,216, May 30, 1916. Date of appl., Dec. 24, 1913.

STABLE perborate compounds are claimed consisting of a double salt of an alkali perborate and a perborate of a non-alkali metal, *e.g.*, the product obtained by treating sodium perborate with a magnesium compound.—F. SP.

Sulphur: Process of recovering —— *from sulphurous gases.* W. F. Lamoreaux, Isabella, Tenn. U.S. Pat. 1.182.915, May 16, 1916. Date of appl., June 19, 1915.

GAS containing sulphur dioxide is mixed with a reducing agent in the proportion necessary to combine with the free and combined oxygen, and the mixture is passed into a bed of incandescent carbon, and kept in contact with it for a definite time. To ensure the complete reduction of the sulphur dioxide, heat is applied by passing an electric current through the bed.—E. H. T.

Hydrochloric acid; Apparatus for producing ——. L. Scherbel, Bussi, Italy. U.S. Pat. 1,184.576, May 23, 1916. Date of appl., Jan. 20, 1915.

SEE Eng. Pat. 24,024 of 1914; this J., 1915, 1142.

Nitrogen and hydrogen; Production of mixtures of —— *suitable for the manufacture of ammonia.* J. Y. Johnson, London. From R. Koepp und Co., Oestrich, Germany. Eng. Pat. 30,073, Dec. 31, 1913.

SEE U.S. Pat. 1,098,139 of 1914; this J., 1914, 788. Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 22.225 of 1905 (see U.S. Pat. 802,980 of 1905; this J., 1905, 1251)

Calcium cyanamide; Process of producing ——. J. H. Lidholm, London. U.S. Pat. 1,184,109, May 23, 1916. Date of appl., Feb. 14, 1914.

SEE Fr. Pat. 469,016 of 1914; this J., 1191, 962.

VIII.—GLASS; CERAMICS.

Crystal glass; Devitrification of ——. H. Le Chatelier. Comptes rend., 1916, 162, 853—855.

As a result of the occupation of the glass works at Baccarat by the Germans, the furnace, containing molten crystal glass, was kept at about 800° C. for three weeks by reducing the fuel consumption to one-third of the normal amount and the fire was then allowed to die out. On breaking the cold pots containing "*quinquet*" glass, a felted mass of hexagonal scales was found at the bottom, the upper portion consisting of transparent glass with isolated spherulites in suspension. The latter were composed of lamellar crystals of tridymite varying from less than 5 mm. to 20 mm. in diameter. This is the first recorded instance of the crystallisation of silica in the devitrification of glass. It only occurred in pots containing "*quinquet*" crystal glass, those containing another form of crystal glass being free from devitrification. The mixture used for "*quinquet*" glass consists of 300 kilos. of Fontainbleau sand, 76 of sodium bicarbonate, 14 of potassium carbonate containing 20% of water, 200 of red lead, 4 of potassium nitrate, 4 of arsenious acid, and 2500 kilos. of cullet. The production of tridymite under these conditions confirms the view that this form of silica is stable at 800° C. and at other temperatures above that at which quartz exists, and suggests that cristobalite is a metastable variety which is only produced when the inversion of the quartz is incomplete.—A. B. S.

PATENTS.

Kaolins and similar clays for use in making pottery and like products; Refining ——. W. W. Simonson, Cincinatti, Ohio. U.S. Pat. 1,185,254, May 30, 1916. Date of appl., Oct. 20, 1915.

THE clay is treated with an acid and a soluble copper salt, *e.g.*, sulphuric acid and cuprous chloride, with or without addition of sulphurous acid, in order to reduce iron compounds and remove them from the clay.—A. B. S.

Process for separating finely divided substances [clay] from mixtures of coarser or foreign particles. Eng. Pat. 7590. *See* I.

Gelatin solutions particularly for use in the manufacture of compound glass. Eng. Pat. 9178. *See* XV.

IX.—BUILDING MATERIALS.

Oak: Note on a specimen of ancient Russian ——. P. A. E. Richards. Analyst, 1916, 41, 169—170.

CONSIDERABLE quantities of oak are obtained from trees found more or less covered by soil i the old bed of the River Moksha, Central Russi The age of the wood is estimated to be at least 1000 years. The wood has recently been introduced into England with the intention of using i for the same purposes as ordinary oak; it has a grey or dull-brown colour. Two specimens o the wood examined yielded the following results the corresponding figures for a specimen of Englis oak being given for comparison:—

.	Russian oak, 1.	Russian oak, 2.	English oak.
	%	%	%
Mineral matter	1·12	2·21	0·49
Ether-alcohol extract	3·26	2·51	8·23
Water and total extractives	39·7	47·4	39·9
Cellulose	33·6	31·0	34·6
Lignin, etc.	26·7	21·6	25·5
The mineral matter contained			
Fe_2O_3	49·73	69·45	1·28
Al_2O_3	0·86	1·98	6·48
CaO	22·53	24·12	22·79
MgO	0·49	None	3·12
SiO_2	7·56	Trace	2·52
SO_3	4·49	2·02	None
CO_2	12·24	2·43	18·20
Na and K salts	2·10	Trace	45·61

—W. P. S.

Utilisation of iron and steel works' slags. Brown. *See* X.

Patents.

Plastic composition. J. J. W. H. van der Toorn, The Hague, Netherlands. U.S. Pat. 1,183,255, May 16, 1916. Date of appl., Sept. 22, 1915.

A plastic composition is made of titaniferous iron oxide, Portland cement, water, and a binding medium composed of lime, magnesia, alumina, and silica, with or without a colouring material and sodium carbonate.—A. B. S.

Building materials; Composition for ——, and process of making the same. A. H. Krieger, Assignor to Kieselguhr Co. of America, Los Angeles, Cal. U.S. Pat. 1,184,184, May 23, 1916. Date of appl., Mar. 2, 1914.

Blocks, slabs, or other moulded articles are made of partially fritted fragments of kieselguhr united by a binding material, such as plaster of Paris, and water.—A. B. S.

Cement; Process of making ——. R. C. Newhouse, Assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. U.S. Pat. 1,184,656, May 23, 1916. Date of appl., Aug. 31, 1914.

THE raw materials are ground with an excess of vater; the finer portions are separated and the oarser ones are re-ground. The finely ground naterial is then dried and burned, or it may irst be submitted to a further grading operation, he oversize being added to the "fines" separated n the first grading.—A. B. S.

Dust-separating and steam-generating apparatus. K. J. Seaman, Catasauqua, Pa. U.S. Pat. 1,185,135, May 30, 1916. Date of appl., Dec. 5, 1914; renewed Jan. 19, 1916.

HE hot gases from a rotary Portland cement kiln re passed downwards through vertical flues or ubes extending through a cylindrical boiler and hence into a large dust-settling chamber. Highly harged electric separating conductors extending xially through the tubes separate the dust from e kiln gases, and oscillating strikers prevent the parated dust from choking the tubes.—A. B. S.

ement; Apparatus for burning —— and recovering the resulting dust. H. J. Seaman, Catasauqua, Pa. U.S. Pat. 1,185,136, May 30, 1916. Date of appl., Nov. 5, 1915.

ROTARY cement kiln is provided, at its upper end, ith a dust separator consisting of a series of rtical tubes, through which extend highly arged electrostatic conductors. Air heated by ing circulated around these tubes is used to burn e fuel in the kiln, whilst the waste gases ich pass through the tubes are cooled and freed from dust. Supplementary dust separators of the same or other types may be used.—A. B. S.

Seasoning timber. J. J. Owen, Liverpool. U.S. Pat. 1,185,529, May 30, 1916. Date of appl., Jan. 11, 1916.

See Eng. Pat. 23,111 of 1914; this J., 1916, 256.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Mild steel; Influence of heat treatment on the strength, size of grain, and hardness of low-carbon ——. A. Pomp. Ferrum, 1916, **13**, 49—59, 65—78. Z. angew. Chem., 1916, **29**, Ref., 214.

The strength was measured by determining the resistance to impact, using notched test-pieces. By annealing at temperatures above 1000° C. and then cooling slowly, the strength was reduced, and more rapidly the higher the annealing temperature. At temperatures up to 1100° C. the size of grain was only slightly increased by annealing, but at higher temperatures it increased rapidly. The hardness diminished slightly as the annealing temperature was increased. In the case of test-pieces quenched after annealing, the strength was hardly affected by annealing at temperatures up to 1100° C., but began to diminish when the annealing temperature was increased to 1200° C., and attained a minimum after annealing for 2 hours at 1300° C. The hardness of the quenched specimens increased with the annealing temperature, slowly from 700° to 1100° C., and more rapidly above 1100° C., attaining a value of about 230 Brinell units after annealing at 1300° C. Low-carbon steel which had been overheated by annealing at too high a temperature was completely restored by annealing for 1 hour at a temperature above the Ac_3-point and then cooling slowly, or by annealing for a short time above the Ac_3-point and then quenching and tempering. In some cases the steel thus treated showed a greater resistance to impact than the original metal before it was overheated.—A. S.

Iron and steel works' slags; Utilisation of ——. E. C. Brown. Proc. Eng. Soc. W. Penna., 1916, **31**, 884—896.

Average commercial blast-furnace slag has a sp.gr. of about 2·62 and is somewhat porous, the latter being an important characteristic. The weight per cub. yard for crushed and sized bank slag is approximately 2000 lb., that for granulated slag being about 1300 lb., but varying between 800 and 1600 lb. according to fineness and moisture content. Hard slag, crushed and screened to size, is employed for railway ballast, road macadam and paving foundations, concrete aggregate, filtering, roofing, fire-proof construction, etc., the most extensive use being for road improvement work; granulated slag is used for cement manufacture, as a cushion under brick and block pavements, as a filtering medium, and as a fine aggregate in concrete. In a fairly complete modern plant for producing steel from iron ore, the ratio of pig iron produced to slags, etc., obtained is about 10 : 8. Except for limited agricultural uses, open-hearth and converter slags, the production of which is only about one-fifth that of blast-furnace slag, have not yet been employed commercially to any extent. A summary is appended of the results of comparative tests of slag, stone, and gravel concretes, made by the Carnegie Steel Co. during 1908—1910. The results for the slag concretes were fully equal, and in many cases superior to those for the stone and gravel products.—W. E. F. P.

Platinum; Volatilisation of ——. G. K. Burgess and R. G. Waltenberg. J. Ind. Eng. Chem., 1916, 8, 487—490.

Experiments similar to those described previously (this J., 1915, 853) were made at 700°, 1000°, and 1200° C., respectively with seven platinum crucibles ranging in purity from the purest thermo-element and "*Tiegelplatin*" ware of Heraeus to platinum containing up to 2·7% Ir and 8% Rh, with varying proportions of iron and other impurities. In all cases the loss on heating is negligible at temperatures below about 900° C., and there may even be a slight gain in weight owing to iron diffusing to the surface and becoming oxidised. At higher temperatures the loss of weight is less when the platinum contains iron or rhodium and very much greater when iridium is present; each impurity appears to exert its effect independently. In an oxidising atmosphere at about 1000° C., platinum appears to take up small quantities of silica when heated in presence of but not in contact with, this substance. If the platinum crucible, after heating, be treated with hydrochloric acid, the loss is variable according to the quality of the platinum and may be very large: the loss is relatively greater after heating at low than at high temperatures. It is confirmed that in the case of platinum containing iridium or rhodium but very little iron, the loss on heating at temperatures up to 1200° C. may be predicted (*loc. cit.*).

Approximate loss in weight, mgrms. per 100 sq. cm. per hour, at temperatures indicated, for platinum nearly free from iron.

Temp.	Pure platinum.	Platinum containing:		
		1% Ir.	2·5% Ir.	8% Rh.
1000° C.	0·08	0·30	0·57	0·07
1200° C.	0·81	1·2	2·5	0·54

—A. S.

Silver; Gaseous impurities in —— with special reference to atomic weight determinations. P. A. Guye and F. E. E. Germann. J. Chim. Phys., 1916, 14, 204—243. (See this J., 1914, 922.)

Two different specimens of the purest industrial silver obtainable were further purified by melting them in a quartz test-tube in a current of pure dry hydrogen, passing the latter for some time through the molten metal so as to produce a vigorous effervescence, and then cooling in the same gas. One gram of each specimen was converted into iodide (see Guichard, this J., 1914, 1018) and the liberated gas was examined by the micro-analytical method (see page 756). The first specimen gave 0·17 c.c. (at N.T.P.) of gas, four-fifths of which was oxygen and the remainder carbon monoxide; the second, which was analysed under better conditions, contained no oxygen, but 0·026 c.c. of carbon monoxide + 0·01 c.c. of water vapour. The last traces of carbon monoxide are extremely difficult to eliminate. By observing the changes in weight when a known amount of chlorine was passed over a known weight of silver, previously heated *in vacuo* to 470°—480° C., and by measuring the residual gas, it was found that the occluded gas was not distributed uniformly throughout the mass of silver, but increased from the surface to the interior. The chlorine was used in the form of pure nitrosyl chloride, prepared from nitric oxide and chlorine (both previously purified by fractional distillation in the liquid state), and obtained free from admixed chlorine by distilling it in presence of an excess of nitric oxide under 2 atmospheres pressure. Although the quantity of occluded gas in any specimen of silver can only be known by direct determination, it is considered probable that the majority of atomic weights determined through that of silver need correcting in the second decimal place. The determination of the atomic weight of silver through the ratios $2Ag : I_2O_5$ and $Ag : I$ can only be accurate to the third decimal place if the amount of occluded gas be less than $\frac{1}{20000}$ of the weights of the materials used. In general, the existence of occluded gas in solids used in such determinations, points to the superiority of direct over indirect methods. Silver used in atomic weight determinations should be prepared in large quantities and internationally standardised.

—E. H. T.

Brass; Manufacture of cartridge ——. C. R. Barton. Amer. Machinist, May 18, 1916. Eng. and Min. J., 1916, 101, 975—981.

Specifications for cartridge brass usually require pure electrolytic or Lake copper (99·97%) and "Horsehead" spelter (99·75%). In the mixture for melting, 50—65% of clean scrap brass from the same manufacturing process may be used, but the employment of foreign scrap, or skimmings, etc., is not permitted. The finished alloy is usually required to contain Cu 67—71 and Zn 33—29%, with not more than 0·4% of total impurity, of which As, Sb, P, and Cd must be kept within 0·04 to 0·08%. It should have a minimum breaking load of 44,000 lb. per sq. in. and a minimum elongation of 50—62%, and should conform to a specified cupping test. The blanks or discs from which the cartridges are made are inspected for flaws, folding cracks, and similar defects in the surfaces, and for pipes and cracks on the edges, 99% of all rejections being usually made on this visual examination. The unit of equipment for a cartridge brass installation generally comprises 10 round or square crucible furnaces. Furnaces of other types are also employed, but the crucible furnace is still largely preferred although the cost of crucibles forms the greatest item of expense in production by this method. With 18 in. round and 21 in. square furnaces the fuel consumption (coal and coke mixed) varies from about 0·4 to 0·6 lb. per lb. of metal melted. The best crucibles are made of Ceylon graphite (98% pure) and Klingenberg (Germany) clay, and contain 50—60% of the former; the life of these averages 25 heats, or less, per crucible, but is much shortened by ill-fitting tongs, excess of fluxes, "soaking" in the fire, excessive furnace temperatures, wet or sulphurous fuel, and carelessness in stirring and handling. The most suitable size is the No. 80, which holds 200—220 lb. of brass, sufficient for one wide or two narrow bars of convenient length. As regards fluxes, the best results are obtained by the use of common salt and phosphor-copper (15% P) of which latter 1 oz. or more per 100 lb. of brass may be employed. The melting loss varies from 3 to 5% gross and from 1 to 3% net. The direct cost of producing sheared bars ready for rolling is about ½ c. (¼d.) per lb. of metal melted, this being divided about equally between labour supplies, renewals, etc., but to this figure must be added the value of metals lost and burden, both of which may vary greatly. In fair to good operation, 80·5% of the original metal employed is obtained as good, sheared bars, 10% as shear scrap, and 5% as floor scrap, 2% being recovered from the ashes, and 2·5% lost by volatilisation, etc

—W. E. F. P.

Tin in tin ashes; Determination of ——. N Welwart. Chem.-Zeit., 1916, 40, 458—459.

From 3 to 10 grms. of the sample is boiled with 30 to 100 c.c. of dilute nitric acid (1 : 1) unti nitrous fumes cease to appear, the solution ther diluted with three times its volume of boilin water, the mixture boiled for 30 mins., an filtered; the insoluble portion is washed first with dilute nitric acid, then with water, dried, ignited in a porcelain crucible, and weighed. A weighed portion (about 0·3 grm.) of this ignited substance is fused with a mixture of sodium carbonate and sulphur, the melt is dissolved in dilute hydrochloric acid, the solution boiled until all hydrogen sulphide has been expelled and then diluted with three times its volume of water. The hot solution is treated with 25 c.c. of concentrated hydrochloric acid and 2·5 grms. of antimony powder and boiled for 30 mins. in a current of carbon dioxide. The mixture is then cooled, the current of carbon dioxide being maintained, and titrated with N/10 iodine solution, which has been standardised against a known weight of pure tin. The presence of lead, copper, antimony, and zinc does not interfere with the titration, but in case large quantities of iron are present the sulphide-melt should be dissolved in water and the solution filtered before hydrochloric acid is added.—W. P. S.

Metals; Behaviour of —— towards acids containing hydrogen peroxide. E. Salkowski. Chem.-Zeit., 1916, **40**, 448—449.

A mixture of hydrochloric acid (sp.gr. 1·125) and 30% hydrogen peroxide solution dissolves copper, bismuth, nickel, gold, platinum, and antimony, but not silver or mercury; lead is only slightly soluble in the mixture owing to the formation of insoluble lead chloride. Dilute sulphuric acid containing hydrogen peroxide dissolves copper, silver, nickel, and bismuth, but not tin, lead, gold, platinum, or antimony. Copper, silver, mercury, lead, and bismuth are soluble in acetic acid containing hydrogen peroxide; tin, nickel, gold, and platinum are insoluble. The solubility of aluminium in the three acids mentioned is not affected by the presence of hydrogen peroxide. Since the solvent action of a mixture of hydrochloric acid and hydrogen peroxide is the same as that of chlorine, the insolubility of mercury in the mixture is difficult to explain; it is not due to the catalytic action of the metal on the hydrogen peroxide, or gold and platinum would not be dissolved, nor to the reducing action of hydrogen peroxide on the mercury salt, for although hydrogen peroxide reduces mercuric acetate to mercurous acetate, it has no action on mercuric chloride.
—W. P. S.

Ore slimes; Control of ——. III. O. C. Ralston. U.S. Bureau of Mines. Eng. and Min. J., 1916, **101**, 990—994. (See also this J., 1916, 638, 693.)

The flocculation or deflocculation of slimes depends largely upon the suspended particles, and this factor is governed by the composition of the liquid in which they are suspended. The electric charge may be made positive, negative, or zero by adding electrolytes to the solution, flocculation generally resulting when the value of the charge is reduced below a certain minimum, whether the sign be positive or negative. By treating the same ore-slime at different dilutions (5—20% solids) with varying amounts of lime water (0—0·025% CaO), the velocity of settling was increased by 17—39% in the weakest and hardly affected in the strongest suspension; the water content of the settled pulp increased with the rate of settling or degree of flocculation. The action of organic colloids on suspension colloids was found to be of two different kinds. When the particles of both were of the same electrical sign, the organic colloids had a protective effect, the resulting sol being more difficult to flocculate by means of electrolytes than the original suspensoid; but when of opposite sign the particles of the two colloids coalesced into larger composite particles and were often flocculated to a high degree, so that rapid settling occurred. Contrary to expectation, many organic colloids were found to be efficient flocculators of the slimes used in the present investigation, but the action of a particular organic colloid varied with the nature of the ore slime; for example, by the addition of gelatin (13 parts per million of water) the rate of settling was doubled in one case but retarded in another. The high efficiency of gelatin in the former case was subsequently traced to the presence in the ore of soluble and other sulphates known to be good coagulators of this colloid. The possibilities of preferential flocculation in the treatment of ore slimes are also discussed and a summary given showing the effects of addition agents on the materials used in the present work; but it is pointed out that generalisation is difficult since no two ores behave in exactly the same way towards any given addition agent.—W. E. F. P.

Manufactured articles containing alloy steels; Export of ——. Board of Trade J., June 22, 1916.

The Director of the War Trade Department announces that manufactured articles with a small constituent part of steel containing chrome, nickel, cobalt, or vanadium, may be exported without licence on production of a certificate from the Cutlers' Company (or an approved Chamber of Commerce) to the effect that the weight of steel containing the prohibited alloy does not represent more than 10% of the total weight of the whole manufactured article. This decision is, of course, subject to the manufactured article not being otherwise prohibited.

A similar concession cannot be allowed in respect of manufactured articles with a small constituent part of steel containing tungsten or molybdenum, except that the Customs have been authorised to allow all manufactured articles not containing more than 5% of steel, and not otherwise prohibited, to proceed without licence.

Volumetric determination of tin by potassium iodate. Jamieson. *See* XXIII.

Patents.

Magnet; Permanent —— and process of making the same. A. J. Weed, Assignor to E. W. Caldwell, New York. U.S. Pat. 1,183,258, May 16, 1916. Date of appl., June 21, 1909.

A hard iron casting is heated for several hours, at a temperature somewhat below a visible red heat, in contact with a mixture of equal parts of cobalt oxide and cobaltous sulphate, in a closed chamber, and then slowly cooled. The resulting iron contains a trace of cobalt in its surface layer. It can be easily machined and finished and is capable of retaining magnetism to a considerably higher degree than similar cast iron free from cobalt.—A.S.

Ores [e.g., nickeliferous iron ores]; Treatment o ——. F. A. Eustis, Milton, Mass., and C. P. Perin, New York, Assignors to Moa Bay Iron Co. U.S. Pat. 1,185,187, May 30, 1916. Date of appl., Dec. 27, 1915.

In the treatment of ores containing several metals which can be reduced together to form an alloy, a portion of the ore is treated so as to obtain a solution containing a compound of one of the metals, and this solution is treated with a precipitant in presence of the untreated ore, and the product reduced to metal. It is possible in this way to obtain an alloy in which the component metals of the ore are present in any desired proportions. For example, in treating nickeliferous iron ore of low nickel content, a portion of the ore is treated to obtain a solution of a nickel compound, which is precipitated in presence of a suitable quantity of the untreated ore, so as to obtain an ore product so enriched in nickel that it can be directly reduced to nickel-steel.—A. S.

Steel: Manufacture of ——. H. E. Sheldon, Pittsburgh, Pa. U.S. Pat. 1,185,252, May 30, 1916. Date of appl., Mar. 30, 1912.

Molten steel is cast in an ingot mould having an inner face of steel of the same carbon content as the molten steel and in which the proportion of any one of the chief alloying elements is not more than 2 % above the content of the alloying element in the molten steel.—A. S.

Metal [steel]; Process of melting scrap ——. A. E. Greene, Chicago, Ill., Assignor to American Electric Smelting and Engineering Co., St. Louis, Mo. U.S. Pat. 1,185,394, May 30, 1916. Date of appl., Jan. 23, 1911.

Steel scrap containing manganese is melted in a basic electric furnace, under a basic slag, and the oxides of iron and manganese which are dissolved by the slag are reduced by an added carbonaceous reducing agent. The reduction is regulated so that the slag is freed from iron and manganese oxides, and the steel left in an essentially deoxidised condition without having been undesirably carburised.—T. St.

Steel-scrap; Process of melting ——. A. E. Greene, Chicago, Ill. U.S. Pat. 1,185,395, May 30, 1916. Date of appl., Dec. 18, 1912.

Steel scrap containing manganese is melted in an electric furnace without the addition of slag-forming materials. A reducing atmosphere containing a considerable proportion of carbon dioxide is maintained above the metal, whereby the oxides of iron and manganese present are reduced without the steel becoming carburised. Also, the formation of slag is avoided, and power consumption is minimised throughout.—T. St.

Ferro-metals; Process of refining ——. A. E. Greene, Chicago, Ill. U.S. Pat. 1,185,396, May 30, 1916. Date of appl., Dec. 27, 1912.

High-carbon metal and a metallic oxide are maintained at a high temperature in an electric furnace lined with refractory material which does not exercise a carburising effect on the reduced metal. The carbon in the metal and the oxygen in the ore react with the production of refined low-carbon metal. The reduction is facilitated and completed, and the gaseous products of the reaction removed, by a current of reducing gas continuously forced through the furnace chamber. —T. St.

Metal [pig-iron]; Combined process of refining —— and reducing ore. A. E. Greene, Chicago, Ill. U.S. Pat. 1,185,397, May 30, 1916. Date of appl., Dec. 27, 1912.

An iron-manganese alloy is heated in an electric furnace with an oxide of either iron or manganese and a flux containing lime, whereby the phosphorus and carbon are removed from the alloy and the ore is reduced. Throughout the process a gas having reducing properties towards iron oxide, but not towards the ultimate slag compound containing the phosphorus, is forced continuously through the furnace.—T. St.

Metallic coatings; Process for producing ——. G. Stolle, Kiel, Germany. Eng. Pat. 2692, Feb. 19, 1915.

In producing metallic coatings by spraying the object to be coated with an atomised liquid or vaporised metal, the latter is protected from oxidation by surrounding the spray with an inert atmosphere. In one form of apparatus the operation is carried out inside a cylinder provided with sleeved openings for the introduction of the operator's hands, and with outlet pipes at the top and bottom opening into a tank of water. Carbon dioxide is continuously passed into the lower part of the cylinder to provide the inert atmosphere. In order that the operation may be carried out in the open, an inert atmosphere for the spray may be formed by using a nozzle with two concentric annular passages. The inert gas is forced under pressure through both passages, the inner gas current producing a sucking and atomising effect, whilst the outer current forms a protective mantle for the spray.—T. St.

Metal-coating of ferrous articles; Composition for ——. J. H. Maddy, New York, and B. H. Schubert, Weehawken, N.J., Assignors to The Lohmann Co., New York. U.S. Pat. 1,183,217, May 16, 1916. Date of appl., Feb. 2, 1915.

A protective metal coating is formed upon an iron or steel article by means of an intimate mixture of a powdered readily fusible metal and a solution containing a small proportion of mercuric chloride, with or without ammonium chloride The mixture is applied to the article by means ol a hot blast.—A. S.

Protective [lead-zinc] coatings; Method of applyin —— to metallic [iron] articles. C. Mark, Evanston, Ill., Assignor to C. Mark, Chicago, Ill U.S. Pat. 1,184,191, May 23, 1916. Date o appl., July 29, 1915.

The article to be coated is passed first through preheating bath of molten metal, then throug a bath of a molten lead-zinc alloy upon which, a the point of entrance of the article, is a super incumbent layer of molten zinc. A zinc-iron allo is thus formed on the surface of the article an serves as a base of adhesion for the lead-zin alloy.—A. S.

Coating metal articles with metals; Process an apparatus for ——. W. Kuhn, Berlin. Ge Pat. 291,410, Aug. 14, 1914.

In coating metal bands or wires by means of zin dust or the like, both the metal to be coated an the zinc dust are conveyed continuously dow wards through a heated, inclined, rotating dru with fixed end walls sealed by means of sand the like. The feed and discharge of the zinc du are regulated so that the drum is always fu The bands or wires to be coated enter and lea the drum through openings in the end walls, al sealed by sand, and travel through the drum at velocity different from that of the zinc dust.—A.

Copper constituents from cupriferous ores and the gangues: Process for extracting valuable ——. Erdös, Kolozsvár, Hungary. Eng. Pat. 480 Feb. 24, 1914.

Low-grade copper ores, after roasting if necessar are treated with a solution of aluminium sulphat whereby copper sulphate and basic double sal of aluminium and copper are formed. Sulphu acid is then added in just sufficient quantity decompose the basic salts present. The aluminiu sulphate thus regenerated acts on fresh quantit of copper oxide in the ore with the formation more basic salts. More sulphuric acid is th added and the operations repeated until all copper in the ore has passed into solution. T solutions formed may also be run off after ea treatment into a common collector, and t collected solution poured over the charge alt nately with fresh quantities of sulphuric a Other aluminium compounds which yield a minium sulphate when treated with sulphuric a may be used as leaching agents, and felspat ores may be roasted to produce the requis aluminium sulphate. The final solution is c centrated sufficiently for copper sulphate crystallise whilst the aluminium sulphate remains in solution.—T. St.

Copper; Process of refining ——. E. C. King, Cananea, Mexico. U.S. Pat. 1,183,736, May 16, 1916. Date of appl., Oct. 22, 1910.

Liquid hydrocarbon oil is injected below the surface of a bath of molten copper until all the impurities and the oxygen present in the copper are removed.—A. S.

Furnaces [for heating metals]. A. Smallwood, London. Eng. Pat. 6325, Apr. 28, 1915.

A furnace for heating metal articles, such as rivets, shells, or the like, where it is desirable to heat one part only of the article, comprises an annular heating chamber through which furnace gases are passed and which is provided with a revolving floor. The rivets, shells, or the like are fitted in perforations in the floor in such manner that the part within the perforation is protected from the heat. The furnace gases, after leaving the heating chamber, are used to preheat the air for combustion.—A. S.

Crucible furnaces; Gas-heated ——. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 100,499, Jan. 5, 1916. (Appl. No. 176 of 1916.)

An annular or vertical-flue crucible, for melting brass, tin, lead, etc., is arranged in a gas-heated furnace in such a way that the heat from the burner passes first upwards in direct contact with the inner wall of the crucible and then downwards between the outer wall of the crucible and the wall of the furnace.—A. S.

Furnace; Reheating ——. J. Diether, Brandenburg, Germany. U.S. Pat. 1,183,353, May 16, 1916. Date of appl., July 2, 1913.

The furnace consists of heating chambers with a floor-heating chamber situated below. The lower chamber communicates with the heating chambers by means of valve-controlled openings. Exhaust flues situated adjacent to the openings serve to withdraw cold air entering the heating chambers, and thereby prevent oxidation of the contents of the chambers. Combustion nozzles are provided for heating the heating chambers, and the floor is heated by controllable hot-air supply flues which are connected to the floor-heating chamber.—T. St.

Furnace; Metallurgical ——. G. L. Danforth, jun., and S. Naismith, South Chicago, Ill. U.S. Pat. 1,185,290, May 30, 1916. Date of appl., Jan. 24, 1916.

Situated below the furnace are slag pockets and checker chambers, which are divided by intersecting partition walls. Gas or air connections in co-operation with a stack serve to regulate the flow through the chambers. The intersecting walls are cooled by means of embedded pipes which communicate through valves with the outside air, and open into a vertical flue formed at the intersection of the partition walls. This flue communicates by valve-controlled exhaust connections with the stack and also with a supplementary chimney.—T. St.

Separating metals by electrolysis; Method of and means for ——. A. Walker, Stoke-on-Trent. Eng. Pat. 8305, June 4, 1915.

A curved non-conducting frame, between the outer anode and inner cathode, is provided with a number of blades with concave surfaces facing the cathode. The frame is reciprocated rapidly, thus driving the electrolyte against the cathode at an oblique angle in the form of jets, producing a brushing action, whilst the fluid around the anode remains quiescent.—B. N.

Composite metal bodies. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 8327, June 4, 1915.

See U.S. Pat. 1,162,342 of 1915; this J., 1916, 125. The tungsten (or molybdenum) is coated by dipping it into the molten gold-platinum alloy in an atmosphere of hydrogen.

Tungsten; Extraction of —— from tungsten ores. J. C. Butterfield, London, and A. Ashworth, Bury. Eng. Pats. 10,117, July 12, and 17,186, Dec. 7, 1915.

Ores consisting of iron and manganese tungstates are treated in the finely powdered state first with hot dilute sulphuric acid, and then with a mixture of sodium or potassium chloride and sulphuric acid, and, in certain cases, with sodium or potassium nitrate. The operation is carried out in a series of lead-lined tanks, the acid running from one tank to the next until it is substantially neutralised. The resulting solution contains the iron and manganese, and the residue consists of practically pure tungstic oxide, which, after drying, may be reduced to metal. The solution may be concentrated to obtain crystals of iron and manganese sulphates, which may then be ignited in retorts to "paint oxide" with recovery of the sulphur oxides formed, or the iron may be precipitated by manganese acetate and manganese sulphate obtained separately.—T. St.

Solder for soldering metals. J. Lavine, London. Eng. Pat. 14,128, Oct. 12, 1915.

In operations where a gold solder is produced during the process of soldering, silver (or silver alloy) and gold (or gold alloy) are used in suitable proportions, united together but not alloyed. The two may be united in the form of sheets welded together, or they may be in the form of a drawn wire containing the gold or gold alloy as a core, or they may be formed into the links of a fine chain, in which the links of the one alternate or are interspersed with those of the other.—T. St.

Ores; Process of desulphurising ——. H. F. Wierum, Upper Montclair, N.J., Assignor to The Sulphur Syndicate, Ltd., London. U.S. Pat. 1,182,951, May. 16, 1916. Date of appl., Dec. 29, 1914.

The ore passes through a furnace in which it is subjected successively to a non-oxidising flame, a strongly reducing flame, and an oxidising flame, the gases and vapours formed being made to pass in the opposite direction to that of the travel of the ore. The presence of large amounts of steam is avoided throughout the process. In the first section of the furnace sulphur distils from the ore. In the third section the greater part of the sulphur remaining is oxidised to sulphur dioxide with some sulphur trioxide. In the second section, in which the ore is heated to just below its melting point, the sulphur oxides formed in the third section are reduced to sulphur. Means are provided to prevent the oxidation or combination with carbonaceous matter of the sulphur formed.—T. St.

Cyaniding; Process of ——. H. R. Layng, Seneca, Cal. U.S. Pat. 1,183,086, May 16, 1916. Date of appl., Dec. 29, 1914.

Solutions obtained by cyaniding ores are treated with a suitable reagent to precipitate cyanogen compounds of the metals, and after separating the precipitate, the solution is treated to convert the hydrocyanic acid therein into an available cyanide. The precipitate is heated with an oxidising agent, in presence of an acid, in order to form simple salts of the metals and hydrocyanic acid.—A. S.

Zinc blende : Process of roasting ——. C. A. H. de Saulles, New York. U.S. Pat. 1,183,172, May 16, 1916. Date of appl., Oct. 17, 1914.

Carbon is added to the charge towards the end of the roasting operation, and the admission of air is regulated so as to produce a temperature not exceeding 1000° C. and thus effect reduction and dissociation of the sulphates present without volatilising any of the metals. The roasted product is treated in a suitable furnace to reduce the zinc to metal.—A. S.

Ore : Method of treating [sintering] ——. M. McMurray, Cleveland, B. J. Mullen, and H. Peppel, Leetonia, Ohio, Assignors to United Iron and Steel Co., Cleveland, Ohio. U.S. Pat. 1,183,891, May 23, 1916. Date of appl., Oct. 11, 1913.

Fine ore is mixed with fuel, and the mixture, spread out in a layer, is ignited. Ignition is allowed to proceed until sintering conditions have been established, when water is added in sufficient quantity to maintain the sintering conditions.
—T. St.

Gas [from ore-treating furnaces] : Method of purifying ——. C. F. Moore, Salt Lake City, Utah, Assignor to United States Smelting, Refining, and Mining Co., U.S. Pat. 1,184,006, May 23, 1916. Date of appl., Dec. 17, 1913.

Gas containing sulphur dioxide from ore-treating furnaces is passed successively through three sets of filtering fabrics, the accumulation of dust being removed periodically from the first, and also, but less frequently, from the second. The third filter becomes impregnated with dust, which is not removed, and serves to remove the last traces of dust from the gas.—W. F. F.

Metal-bearing material ; Electrochemical treatment of ——. W. H. James, Assignor to New Refractory Ores, Ltd., Johannesburg, Transvaal. U.S. Pat. 1,184,456, May 23, 1916. Date of appl., Sept. 6, 1913.

A solution of sodium chloride is electrolysed, and the portion in the vicinity of the anode is withdrawn separately from the circuit, and used for treating refractory precious metal ores until the refractory constituents are removed in solution. The residue may be treated by the ordinary cyanide process for the extraction of the precious metal.—B. N.

Molten materials [metals] ; Process for casting ——. H. E. Field, Wheeling, W. Va. U.S. Pat. 1,184,523, May 23, 1916. Date of appl., Jan. 19, 1916.

The molten metal passes into the mould through a vertical tube which is of such a nature that it melts as the metal rises in the mould. The entering metal is thus continuously delivered on to the surface of the metal in the mould. The tube is composed of such material as to improve the composition and condition of the metal.—T. St.

Ores ; Process of treating ——. E. H. Snyder, Pioche, Nev. U.S. Pat. 1,184,585, May 23, 1916. Date of appl., Mar. 31, 1915.

Complex sulphide ores are roasted with a small quantity of an alkali sulphate and the roasted ore is leached successively with (*a*) an alkali sulphate solution containing a small proportion of free sulphuric acid, (*b*) a strong solution of caustic alkali, and (*c*) sulphuric acid. Solution (*a*) is treated first with a metal to precipitate silver and then with a slight excess of alkali to precipitate zinc. Solution (*b*) is made slightly acid with sulphuric acid to precipitate lead, and then treated with a slight excess of alkali to precipitate zinc. Solution (*c*) is treated with zinc to precipitate copper, then with alkali to precipitate zinc and iron ; the precipitate is treated with excess of alkali to dissolve the zinc, which is subsequently re-precipitated by reducing the alkali concentration. The sulphur dioxide evolved in the roasting is oxidised to sulphuric acid. The alkaline liquors from the different operations are acidified with sulphuric acid and used again for the first leaching of the roasted ore, until ultimately a relatively concentrated solution of alkali sulphate is obtained, which is then causticised.—A. S.

Anode slimes and similar materials ; Treatment of ——. F. C. Ryan, Hammond, Ind., Assignor to United States Metals Refining Co., Chrome, N.J. U.S. Pat. 1,185,005, May 30, 1916. Date of appl., Feb. 21, 1914.

Anode slime or other mineral-bearing material, containing arsenic, selenium, gold, silver, copper, bismuth, tellurium, antimony, and the like, is roasted with an alkali carbonate at a temperature low enough to complete the reaction without sintering. The mass is leached to remove the soluble arsenic and selenium, the residue roasted at a red heat in the presence of sulphuric acid, and treated with sufficient water to dissolve the copper and silver sulphates, leaving a residue containing gold, tellurium, and basic sulphates of antimony and bismuth. The solution is treated with sodium chloride to precipitate silver chloride.—B. N.

Metal articles ; Process for heating and subsequently cooling ——. E. W. Beardsley, Cheshire, Conn., Assignor to American Brass Co., Waterbury, Conn. U.S. Pat. 1,185,280, May 30, 1916. Date of appl., July 15, 1913 ; renewed, Apr. 14, 1916

Oxidisable metal articles are heated to the required temperature, in an externally heated chamber, in an atmosphere of steam supplied from an external source. The chamber is then allowed to cool to a point above the condensing point of the steam, which is driven out and replaced by a non-oxidising gas. The articles are finally allowed to cool to a non-oxidising temperature in the latter atmosphere.—T. St.

Rust-preventing composition. D. Albu, Cleveland, Ohio, Assignor to J. O. Pope, Detroit, Mich. U.S. Pat. 1,185,361, May 30, 1916. Date of appl., July 25, 1914.

A mixture of 120 parts by weight of borax and 1 part of benzaldehyde.—A. S.

Casting metal ; Means for ——. I. Hall, Birmingham. Eng. Pat. 9530, June 30, 1915.

Aluminium castings ; Production of ——. J. D. Paton and T. Carbin, Manchester. Eng. Pats. 10,771, July 24, 1915, and 2784, Feb. 24, 1916.

Sulphides ; Separation of metallic ——. L. Bradford, Broken Hill, N.S.W. U.S. Pat. 1,182,890, May 16, 1916. Date of appl., Sept. 10, 1913.

See Fr. Pat. 462,580 of 1913 ; this J., 1914, 319.

Zinc from its ores ; Electric furnace permitting the extraction in a state of purity of ——. E. F. Côte and P. R. Pierron, Assignors to Soc. Anon. pour l'Electrométallurgie du Zinc, Proc. Côte et Pierron, Lyon, France. U.S. Pat. 1,184,520, May 23, 1916. Date of appl., July 21, 1914.

See Eng. Pat. 14,192 of 1914 ; this J., 1915, 497.

Collection of fume, flue-dust and other matter suspended in gas. Eng. Pat. 6199. *See* I.

XI.—ELECTRO-CHEMISTRY.

Patents.

Dry batteries. R. de Fortuny, Barcelona, Spain. Eng. Pat. 9627, July 1, 1915.

The absorption body for the liquid electrolyte consists of wood-pulp in the form of a cell.
—J. B. C. K.

Dry cell. J. W. Brown, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,184,818, May 30, 1916. Date of appl., Dec. 1, 1911.

The filling material for the cell contains super-baked petroleum coke.—B. N.

Battery depolarising material; Process for making ——. M. E. Holmes, Assignor to The National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,184,854, May 30, 1916. Date of appl., Nov. 21, 1912.

Potassium permanganate solution is maintained approximately between 90° and 100° C. by means of steam, and manganese chloride is added alternately with the passage of the steam. Hydrated manganese peroxide is precipitated and the water of hydration is afterwards removed. —B. N.

Electrolytic apparatus. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,183,188, May 16, 1916. Date of appl., May 24, 1909; renewed Jan. 24, 1916.

An anode bell is suspended within and partially immersed in the electrolyte contained in the cathode tank. Means are provided for oscillating the bell horizontally, and for adjusting the distance vertically between the electrodes.—B. N.

Furnace [; Electric ——]. J. W. Brown, Lakewood, Ohio, Assignor to The National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,184,817, May 30, 1916. Date of appl., Dec. 1, 1911.

A) The furnace is provided with outer and inner walls, separated by a space filled with granular carbon, the inner walls enclosing a heating chamber into which material is fed through an opening of less cross-sectional area than that of the heating chamber, so that the upper part of the charge forms a conical heap. An electric current is passed between the top and bottom of the material included between the slanting sides. A conveyor is situated at the lower part of the heating chamber for the removal of the material.—B. N.

Insulating compound. J. W. Aylsworth, East Orange, N.J., Assignor to The Halogen Products Co., West Orange, N.J. U.S. Pat. 1,183,423, May 16, 1916. Date of appl., July 29, 1911.

The insulating composition, which is flexible, non-inflammable, cohesive, and practically non-crystalline at ordinary temperatures, is produced by oxidising a wax-like chlorinated derivative of naphthalene, by heating with from 25 to 100% of concentrated nitric acid, so as to form a mixture of solid chloronaphthalene compounds containing combined oxygen and having different melting points. The acid used is insufficient in oxygen content to oxidise the product to a halogen-phthalic acid. The mass is treated with caustic alkali to break up unstable addition products, and to remove acids used in or formed in the process, and the alkali salts are afterwards removed.—B. N.

Insulating composition; Plastic ——. H. Grossmann, Ober-Urdorf, Switzerland. U.S. Pat. 1,183,640, May 16, 1916. Date of appl., Aug. 5, 1914.

See Fr. Pat. 462,992 of 1913; this J., 1914, 322.

Insulating material and method of producing same. H. B. McFarland, Chicago, and R. J. Shoemaker, Topeka, Kans., U.S.A. Eng. Pat. 8004, May 29, 1915.

See U.S. Pats. 1,146,189 and 1,146,190 of 1915; this J., 1915, 901.

Electrical resistance. G. Mascarini and A. Contardi, Milan, Italy. U.S. Pat. 1.185,227, May 30, 1916. Date of appl., Jan. 3, 1914.

See Fr. Pat. 467,167 of 1914; this J., 1914, 872.

Electrolytic cell. H. C. Jenkins, London. U.S. Pat. 1,185,407, May 30, 1916. Date of appl., Nov. 9, 1915.

See Eng. Pat. 22,867 of 1914; this J., 1916, 55.

XII.—FATS; OILS; WAXES.

Fatty oils in the light of mesomorphic polymerisation. W. Fahrion. Ber., 1916, **49**, 1194—1196.

The author repudiates as baseless the hypothesis of Krorstein (this J., 1916, 608) that all fatty oils are mixtures of polymerisable and non-polymerisable glycerides and that the "distillation number" is any criterion whatever of their drying properties, which depend solely on the chemical constitution of the oil. Moreover, the similarity noted by Kronstein between the various distillates and residues is only an apparent one, and no proof is adduced that the latter really consist of polymerised glycerides, except in the case of Chinese wood oil and castor oil, and in this latter case it is difficult to see why some of the glyceryl ricinoleate should be polymerisable, and some not, which must be so if, as Kronstein states, it is specifically the non-polymerisable portion of the oil which suffers decomposition and passes over into the distillate. Further, no proof is given that the "gelatins" of other oils behave, as regards "depolymerisation," in the same manner as Chinese wood oil.—G. F. M.

Decolorising efficiencies of charcoals; Rapid method for comparing the ——. L. Wickenden and J. W. Hassler. J. Ind. Eng. Chem., 1916, **8**, 518—519.

Five grms. of the charcoal is added to 100 c.c. of a solution in kerosene of Soudan III. (0·25 grm. per litre) or Oil Red RN (1 grm. per litre), the mixture is heated in a steam bath for 10 mins. with frequent stirring, filtered, and the colour of the filtrate compared with that of standards prepared in a similar manner with 1, 2, 3, etc., up to 10 grms. of a charcoal of average quality. The results given by the test agree with those obtained when the charcoals are used for the purification of fatty oils (cottonseed, coconut, and palm-kernel oils), but animal charcoals when used for decolorising certain aqueous solutions, such as solutions of argols (crude tartar) show higher efficiencies than are indicated by the test, and many charcoals which give quite satisfactory results with oils and other liquids are worthless for decolorising glycerin. The method is not recommended for charcoal to be used for treating sugar solutions. —A. S.

Emulsions and living cells; Action of antagonistic electrolytes on ——. Protoplasmic equilibrium. I. G. H. A. Clowes. J. Phys. Chem., 1916, **20**, 407—451.

When olive oil containing some free oleic acid is shaken with water containing varying proportions of sodium hydroxide and calcium chloride, there may be formed either an emulsion of oil in water, an emulsion of water in oil, or a system in which neither type of emulsion predominates and the oil and water separate into two layers. With 10 c.c. each of olive oil and of an aqueous solution containing respectively 1, 2, 3, or 4 c.c. $M/10$ NaOH and 0·25, 0·5, 0·75, or 1 c.c. $M/10$ $CaCl_2$, the critical point where the oil and water separated into layers was reached when the system contained 4 mols. NaOH to 1 mol. $CaCl_2$; with more sodium hydroxide, emulsions of oil in water, and with less, emulsions of water in oil were formed. Emulsions of oil in water can be converted into emulsions of water in oil by shaking with salts of Ca, Mg, Fe, and other di- and trivalent cations, and the change may be prevented or the reverse change induced by shaking with a sufficient excess of sodium hydroxide. Sodium chloride acts in the same way as sodium hydroxide but in a much less degree. The effect is not due to antagonism between the cations $Ca^{\cdot\cdot}$ and $Na^{\cdot}$, but to a balance between cations and anions adsorbed on or reacting with soaps or other colloidal constituents of surface films or membranes. Experiments with the stalagmometer (compare Shorter, this J., 1916, 519) showed that adsorbed anions increase the dispersion of interfacial soap films in water, whilst adsorbed cations increase the dispersion of soap films in oil; hence, in accordance with Bancroft's view (J. Phys. Chem., 1913, 17, 501), emulsions of oil in water and of water in oil respectively tend to form in the two cases. Electrolytes may be divided roughly into two classes as regards their effect on emulsions: salts of di- and trivalent cations, etc., which possess a more reactive or more readily adsorbed cation, promote the formation of emulsions of water in oil, whilst alkalis, salts of univalent cations, and of di- or trivalent anions, which possess a more reactive or more readily adsorbed anion, promote the formation of oil in water emulsions. Acetone, acetone-ether, and alcohol-ether when added in large quantities to oil in water emulsions, promote the dispersion of oil in water to such an extent that the dispersed particles can be recognised only by means of the ultramicroscope. When smaller quantities are added, the dispersed oil particles remain distinguishable by means of the microscope, but the emulsion is rendered extremely sensitive to small variations in the proportions of antagonistic electrolytes.—A. S.

Varnish analysis and varnish control. I. Molecular weights of vegetable oils. Seaton and Sawyer. *See* XIII.

Patents.

Reducing or hydrogenating organic bodies; Process of ——. *Chemical process [hydrogenation]. Unsintered-metal-powder catalyst and process of making same.* C. Ellis, Montclair, N.J. U.S. Pats. (a) 1,182,995, May 16, 1916; (b) 1,184,086, May 23, 1916; and (c) 1,185,075, May 30, 1916. Dates of appl., Aug. 26, 1915, May 17, 1912, and July 13, 1915.

(a) Reducible organic substances are hydrogenated at a suitable temperature in presence of a catalyst containing nickel carbide, alone or in admixture with the carbide of another catalytically active metal, which may be deposited on a medium capable of occluding hydrogen. (b) Fats or other unsaturated substances are hydrogenated under pressure at about 100° C., in presence of a colloidal nickel catalyst, by means of hydrogen freshly prepared by the electrolysis of an aqueous solution of sodium chloride, but free from chlorine and chlorides. (c) Oxidised nickel powder or other reducible raw catalytic material is heated under pressure at a temperature sufficient to reduce it to the metallic condition without causing material shrinkage or increase in density, and the resulting bulky powder is protected from oxidation, *e.g.*, by being kept in oil.—C. A. M.

Unsaturated compounds [oils]; *Method and means for hydrogenating* ——. H. K. Moore, Berlin, N.H. U.S. Pat. 1,184,480, May 23, 1916. Date of appl., Oct. 31, 1911.

Hydrogen in excess is made to circulate under pressure in contact with oil or other unsaturated substance through a porous diaphragm of catalytic material, the weight of hydrogen being reduced as the resistance of the diaphragm increases, so that uniform pressure on the diaphragm is maintained. After cooling, the hydrogenated oil and moisture are separated from the residual hydrogen, which may then be heated and used again.—C. A. M.

Oil and cellulosic material from nuts; Process for producing ——. A. H. and P. A. A. Suzmeyan, Manchester. U.S. Pat. 1,185,262, May 30, 1916. Date of appl., May 20, 1915.

See Eng. Pat. 12,621 of 1914; this J., 1915, 970.

Sulphonated palmitic products; Production of ——. I. Levinstein. Assignor to Levinstein, Ltd., Manchester. U.S. Pat. 1,185,213, May 30, 1916. Date of appl., Feb. 17, 1914.

See Eng. Pat. 16,578 of 1913; this J., 1914, 875.

Sulpho compounds of hydrogenised fats and oils; Preparation of —— *and of compositions therewith.* I. Levinstein, Assignor to Levinstein, Ltd., Manchester. U.S. Pat. 1,185,414, May 30, 1916. Date of appl., Jan. 20, 1915.

See Eng. Pat. 16,890 of 1914; this J., 1915, 913.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Turpentine oil; Testing the purity of ——. A. Krieger. Chem.-Zeit., 1916, 40, 472—473.

By the following modification of Herzfeld's method (this J., 1904, 271), aromatic hydrocarbons (solvent naphtha) and petroleum spirit in turpentine oil may be rapidly determined with sufficient accuracy for practical purposes. 20 c.c. of the sample is shaken for 10—15 mins. with 100 c.c. of sulphuric acid (80 : 20; sp. gr. 1·76) in a dry 500 c.c. flask, then diluted with 200 c.c. of water, and distilled with steam until 100 c.c. has passed over. The oily portion of the distillate is measured and treated with 10—15 c.c. of oleum (8% SO_3), the reaction mixture poured into water, and if any oil separates, this is recovered by steam distillation and measured: the volume is that of the petroleum spirit present in the sample, and the diminution of volume caused by the treatment with oleum corresponds to the content of aromatic hydrocarbons. Alcohol when present may be determined by shaking the oil of turpentine with three times its volume of water and observing the diminution in volume.—A. S.

Varnish analysis and varnish control. I. Molecular weights of vegetable oils. M. Y. Seaton and G. B. Sawyer. J. Ind. Eng. Chem., 1916, 8, 490—493.

Attempts to determine the average molecular weights of fatty oils and varnish products by the freezing point and boiling point methods with several of the common organic solvents gave unsatisfactory results, the values differing widely according to the concentration of the dissolved substance. Satisfactory results are, however, obtained by the freezing point method, using stearic acid as solvent. The acid must be dried for some hours below 100° C. before use, and the bath in which the freezing point tube is immersed must be kept constant at 40° C. A piece of brass tubing covered with asbestos paper is fitted over the top of the freezing point tube and heated electrically by means of a nichrome wire coil to about 60° C.; the top of the tube is thus kept clean and free from stearic acid which tends to crawl up the side. The average values found for the molecular weights of a number of oils and varnish products were:—Chemically refined linseed oil, raw, 745; heated to 600° F. (316° C.), 757; heated for 1 hour at 600° F., 1007; heated for 2 hours at 600° F., 1237; heated for 3 hours at 600° F., 1513. Fatty acids from refined linseed oil, 297; after heating for 1 hour at 600° F., 326; after heating for 3 hours at 600° F., 356; China wood oil, raw, 810; polymerised by heating for 45 mins. at 450° F. (232° C.), 1733. Soya bean oil, raw, 735; polymerised by heating for 2 hours at 600° F., 1240. "W.G." rosin, 285.—A. S.

Patents.

Pigments; Process of producing ——. F. F. Hunt, New York. U.S. Pat. 1,183,201, May 16, 1916. Date of appl., June 2, 1911.

Freshly precipitated calcium carbonate is heated with a solution of zinc sulphate until action ceases, and the precipitate formed, consisting of a mixture of calcium sulphate and a substantially insoluble zinc compound, is dried and "furnaced."—E. W. L.

Paint and pigment; Aluminous ——. O. W. Pickering, Springfield, Mass., Assignor to Pickering Paint and Pigment Co. U.S. Pat. 1,183,665, May 16, 1916. Date of appl., Aug. 4, 1915.

The paint is made with a vehicle and a pigment, consisting of a metal aluminate, *e.g.*, lead aluminate, and a hydroxide of a different metal, *e.g.*, aluminium hydroxide.—E. W. L.

Paint, varnish, or other substances; Compound or composition for removing ——. H. S. Blackmore, Mount Vernon, N.Y. U.S. Pat. 1,181,164, May 23, 1916. Date of appl., Oct. 21, 1911.

The composition comprises a comparatively non-volatile solvent ester, such as an ethereal acetate, and a volatile ethereal acetate, *e.g.*, methyl acetate or a mixture of this with ethyl acetate.—E. W. L.

Wood-stain [from sulphite-cellulose waste liquor]. J. Puring, Assignor to Robeson Process Co., New York. U.S. Pat. 1,185,604, May 30, 1916. Date of appl., Nov. 19, 1915.

The stain consists of an emulsion of concentrated sulphite-cellulose waste liquor, linseed oil, and a little sulphuric acid, with or without the addition of formaldehyde.—J. H. J.

Lacs from derivatives of cellulose; Process for manufacturing ——. F. Lehmann and J. Stocker, Berlin. U.S. Pat. 1,185,514, May 30, 1916. Date of appl., Apr. 13, 1914.

See Fr. Pat. 471,104 of 1914; this J., 1915, 187.

Process of producing new oils from wood creosote oil, etc. U.S. Pat. 1,185,588. *See* III.

Process of treating wood creosote oil U.S. Pat. 1,185,592. *See* III.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Vulcanisation of caoutchouc; Chemical investigation of the —— *and the possibility of its regeneration from the vulcanised product.* I. C. Harries. Ber., 1916, **49**, 1196—1201.

In the ordinary hot vulcanisation process with about 10% of sulphur two distinct stages must be differentiated. The primary action is an adsorption phenomenon, since the sulphur can be extracted practically quantitatively with a solvent such as acetone, and moreover does not pass into the derivatives such as the hydrochloride, which contains only traces of sulphur, although, unlike the hydrochloride of natural caoutchouc, it is quite insoluble in chloroform. On the other hand a vulcanised caoutchouc which has been kept for a long time in a warm place, contains from 2 to 4% of sulphur, corresponding to about one atom per molecule of $(C_{25}H_{40})_3$, which resists the action of solvents, and it also gives a sulphur-containing hydrochloride. The vulcanisation of caoutchouc is accompanied by a change from the metastable form of the natural caoutchouc to a stable form, a change which is accompanied by the above-mentioned difference in solubility between the hydrochlorides of the natural caoutchouc and of the caoutchouc obtained by desulphurising the vulcanised product. In chemical structure both forms are apparently identical, although the stable form is more slowly attacked by ozone, and in their solubility relationships they behave very differently. The desulphurised vulcanisation product cannot again be satisfactorily vulcanised. This is not due to the extraction by the acetone of a substance which favours the vulcanisation, as the author had previously supposed, but rather to the fact that a regeneration of the caoutchouc or reconversion to the metastable form is an essential preliminary to revulcanisation; theoretically the desulphurisation is but a secondary consideration.—G. F. M.

Patents.

Vulcanised rubber; Method of making ——. *Vulcanised rubber articles.* C. D. Mason, Naugatuck, Conn., Assignor to Goodyear's Metallic Rubber Shoe Co. U.S. Pats. 1,183,022 and 1,183,023, May 16, 1916. Date of appl., June 18, 1915.

Crude rubber is passed through rolls until it is partially broken down, and thereby assumes sheet form with a rugose structural formation and appearance, and the article is then prepared from the sheet and vulcanised.—E. W. L.

Rubber articles; Process of treating —— *and product thereof.* R. B. Price, Mishawaka, Ind., Assignor to Rubber Regenerating Co. U.S. Pat. 1,184,015, May 23, 1916. Date of appl., June 23, 1911.

Fabric or fibrous material is impregnated with a non-vulcanising agent, such as copper, and is then coated with a rubber-sulphur mixture, and the whole is vulcanised. Firm adhesion of the rubber covering to the fabric is thus secured.—E. W. L.

Fabric coating and drying apparatus. C. F. Hopewell, Newton, Mass. U.S. Pat. 1,184,452, May 23, 1916. Date of appl., Apr. 19, 1911.

XV.—LEATHER; BONE; HORN; GLUE.

Anthrax spores on hides and skins; Destruction of ——. E. Hailer. Arb. Kais. Gesundh. Pharm. J., 1916, **96**, 597.

When hides infected with the spores of *B. anthracis* are treated with a 0·5 to 1% solution of sodium hydroxide at 15° to 20° C. for 72 hours, nearly all the anthrax spores are destroyed. The addition of 5 to 10% of sodium chloride increases the efficacy of the alkali. The weight of alkali solution used should be at least ten times that of the skins treated.

Deliming [skins] with sulphuric acid. L. Balderston. J. Amer. Leather Chem. Assoc., 1916, **11**, 309—310.

The statement by Coombs, Swinbourne, and Gabb (this J., 1916, 233), that lime is fixed in sheepskins by the use of a sulphuric acid pickle, is controverted. A piece of sheep skiver after thorough soaking in milk of lime was dried and then divided, one portion being put into a salt and sulphuric acid pickle and afterwards washed in cold water. Analyses of both portions showed that the lime had been almost entirely removed by the pickle. Practical conditions do not allow so large a quantity of pickle as was used in the experiment, so that the proportion of lime removed will not be so great, athough calcium sulphate is 3·5 times as soluble in a pickle containing 1% sulphuric acid and 6% common salt as in pure water.—F.C.T.

Hide powders; Report of the Hide Powder Committee on methods of testing ——. H. G. Bennett. Collegium (London), 1916, 155—160.

In determining moisture, stoppered weighing bottles and not open basins must be used ; the drying is preferably done in the steam oven, and an allowance must be made for alteration in the weight of the bottle on standing. This is done by weighing on taking the bottle out of the desiccator (W_1), and re-weighing after allowing the bottle to stand five minutes in the balance case (W_2). The hide powder is then added (W_3), and finally dried to constant weight (W_4). The last weighing is made after cooling 30 mins. in the desiccator. The percentage of moisture is

$$100\{(W_3-W_2)-(W_4-W_1)\} \div (W_3-W_2).$$

For the acidity determination a quantity of powder (R) containing 6·5 grms. dry hide powder is allowed to stand (with occasional shaking) with 100 c.c. distilled water for 10 mins. 1 c.c. of 1 % phenolphthalein solution is then added and the mixture titrated to a permanent pink with $N/10$ sodium hydroxide. If the acidity is outside the legal limits of 2·5—5·0 c.c. of $N/10$ alkali per unit, acid or alkali must be added to bring it to the nearer limit, *i.e.*, powder of acidity 5·8 is brought to 5·0, and powder of acidity 2·1 is brought to 2·5. Soluble matter is determined by slowly churning R grms. of hide powder with (126·5—R) c.c. of distilled water for one hour. The solution is filtered first through linen and then through filter paper, 60 c.c. of filtrate is evaporated, and the residue dried to constant weight. Twice the weight of this residue is the soluble matter in 6·5 grms. of dry hide powder. The blank test is carried out exactly as an ordinary detannisation except that 100 c.c. distilled water is used instead of the tannin solution. The residue is calculated for 6·5 grms. of dry hide powder.—F. C. T.

Leather ; Determination of the permeability of ——. E. Nihoul. Collegium (London), 1916, 147—150.

In Kilp's method the leather is subjected to the action of a column of water from 40 to 75 cm. in height, and the time needed for penetration is recorded. More effective comparisons could be made by measuring the volume of water which passes through the leather in a given time. A somewhat elaborate apparatus is described, including an electric bell which rings as soon as a circuit is completed by water appearing on the under surface of the leather. Thuau's method needs only simple apparatus. Water is drawn through the leather by means of an air-pump, the pressure being maintained at 15 cm. of mercury. The time required for the passage of 10 c.c. of water is the basis of comparison. A third very unsatisfactory method is in use in France and Belgium. Leather dried in the ordinary way is immersed in water for definite periods, and the amount of absorbed water determined by weighing. The leather which absorbs least water is regarded as best, though this is often directly contradicted by analytical results.—F. C. T.

Tannery wastes ; Analysis of —— *for use as manures.* A. Harvey. Collegium (London), 1916, 151—152.

Moisture is determined by drying 10—15 grms. of waste to constant weight in an air oven at 100°—110° C., and the residue is gently ignited with a small flame to determine organic matter. The inorganic residue is evaporated with concentrated hydrochloric acid and heated to render silica insoluble ; hydrochloric acid is then again added and the solution made up to 500 c.c., after thoroughly washing the residue, which is weighed as insoluble matter ; 50 c.c. of the filtrate is treated with ammonia to remove iron and aluminium, and filtered. Calcium is estimated by precipitating with ammonium oxalate. Sulphates are determined in another aliquot portion of the original solution, and phosphates in a third portion. For this determination 100 c.c. of filtrate is evaporated to dryness and the residue treated with nitric acid. Phosphates are then determined by the usual method with ammonium molybdate. Nitrogen in the waste is determined by the Kjeldahl process. Caustic lime is determined by leaving 5—10 grms. of waste in 200 c.c. of 10 % sucrose solution for a few hours, and subsequently titrating with hydrochloric acid, using phenolphthalein as indicator. The physical condition of the sample also should always be taken into account.—F.C.T.

Patents.

Tanning. C. V. Greenwood, Liverpool. Eng. Pat. 7635, May 21, 1915.

Hides are tanned in pits with a mucilage made from a soluble hemicellulose and ordinary tannins, or in drums with a solution of the mucilage (see Eng. Pat. 5018 of 1910 ; this J., 1911, 439). Greater rapidity of tannage and a better quality of leather are claimed for this process, as compared with the usual methods.—F. C. T.

Tanning hides ; Method of ——. G. Bosio and A. Peradotto, Turin, Italy. Eng. Pat. 16,761, Nov. 27, 1915. Under Int. Conv., Apr. 14, 1915.

Hides are tanned in strong liquors of from 6° to 25° Beaumé (sp.gr. 1·045—1·21), the temperature being gradually raised from 15° to 36° C. at which it is maintained. This treatment lasts from one to fifteen days.—F. C. T.

Artificial leather ; Method for the manufacture of ——. N. G. Scheuer, Copenhagen. Eng. Pat. 100,038, Jan. 24, 1916. Under Int. Conv., Jan. 22, 1915. (Appl. No. 1133 of 1916.)

Linen duck is varnished, dried, and caused to adhere in several layers by means of a mixture of wood tar pitch and a solution of rubber in benzene mixed to a thick consistency with turpentine and powdered cork, and coloured with Venetian red.—F. C. T.

Enamelled leathers ; Process for manufacture of ——. R. M. Hunter, Philadelphia. U.S. Pat. 1,182,013, May 9, 1916. Date of appl., Feb. 9, 1910.

Skins are varnished in a stretched condition, placed horizontally one above the other in a closed oven, and hot air drawn over the varnished surfaces. The air is continually renewed, and the temperature is sufficient to vaporise volatile matter without causing blistering or burning. A current of cool air is subsequently drawn through to harden the varnished surfaces before removing the leather from the oven.—F. C. T.

Leather dyes. J. Puring, Assignor to Robeson Process Co., New York. U.S. Pat. 1,185,605, May 30, 1916. Date of appl., Dec. 13, 1915.

Dyes for leather consist of pyrolignite of iron, pyrogallol, and a filler, *e.g.*, a preparation of sulphite-cellulose waste liquor and linseed oil. —J. H. J.

Gelatin solutions, particularly for use in the manufacture of compound glass. E. Wiese, Hamburg, Germany. Eng. Pat. 9178, June 22, 1915.

One litre of 3% hydrogen peroxide is added to 100 c.c. of acetic acid, and in this mixture first 180 grms. of zinc chloride and then 600 grms. of gelatin are dissolved. After standing for four to five days, the solution is filtered. The clear and colourless solution of gelatin thus obtained is fluid when cold, and is particularly adapted for use in the preparation and mounting of microscopic and natural history specimens, and in the manufacture of compound glass generally, by joining under great pressure large or small sheets of glass after coating them with the solution.—J. B. C. K.

Hides and felts; Softening ——. O. Röhm, Darmstadt, Germany. Eng. Pat. 15,814, Nov. 9, 1915. Under Int. Conv., Nov. 11, 1914.

See Ger. Pat. 288,095 of 1914; this J., 1916. 372.

Counter-board [waterproof board] and method of preparing the same. U.S. Pat. 1,184,518. *See* V.

XVI.—SOILS; FERTILISERS.

Lime; Relation of —— to production of nitrates and mineral nitrogen [in soils]. F. M. Scales. Science, 1915, 42, 317. Bull. Agric. Intell., 1916, 7, 196.

The lime requirement of an acid soil was found by treating it with calcium carbonate, moistening, and after an hour testing with litmus paper. The quantity of lime required to give a neutral reaction, determined in this way, agreed with that found by the Veitch method (this J., 1904, 762). To find the effect of added lime upon ammonification and nitrification, 100 grm. portions of the same soil were treated with varying quantities of lime and after moistening with 18% water were incubated at 28°–30° C. for three weeks one duplicate set receiving alfalfa powder. The nitrifying bacteria were most active when 50% of the lime requirement was added: nitrification and ammonification, combined, were most favoured when 75% was present. An excess of calcium carbonate hindered nitrification and did not stimulate the ammonifying organisms.—E. H. T.

Sulphur; Relation of —— to soil fertility. O. M. Shedd. Kentucky Agric. Exper. Stat., Bull. 188. 1914, 595—630. Bull. Agric. Intell., 1916, 7, 198—203.

The determination of sulphur in a large number of plants, showed that several were very rich in this element. Of 31 varieties of tobacco, the large majority contained more sulphur than phosphorus, two only contained less, and in some cases the sulphur content was double that of the phosphorus. The averages were: sulphur 0·458%, phosphorus 0·302%. The effects on fertility of the addition of sulphur or its compounds to the soil were investigated in a series of greenhouse experiments. In the first, Yellow Pryor tobacco was grown from seed in a soil of medium fertility containing about 240 lb. sulphur and 860 lb. phosphorus to the acre. The application of sulphur (100 lb. per acre) or of gypsum (500 lb.) alone resulted in depressed crop yields, but each had a stimulating effect when potassium nitrate (200 lb.), calcium phosphate (500 lb.), and calcium carbonate (500 lb.) were applied at the same time. In the second series, the soil was poor but contained more sulphur and phosphorus than the first. Calcium carbonate was applied at the rate of 400 lb. per acre, and the plants sown were soya beans and turnips, consecutively. Sulphur in the elemental form (100 lb. per acre) gave the best results with the beans, though many of the metallic sulphates also improved the yield, and in this case the beans acquired a higher sulphur content. Considerable crop increases were also observed with the turnips in many cases. The same soil, with added calcium carbonate, was also used to determine the effect of sulphates on red clover; but in this case only potassium sulphate gave a noticeable increase, an effect which was probably due to the potassium. In the fourth series, with the same soil, calcium carbonate, and the same sulphates (to the extent of 12 lb. of sulphur per acre), cabbage, mustard, and radishes were grown in succession, and the results were compared with those obtained by substituting the mineral carbonate or oxide for the sulphate. Only two sulphates proved beneficial to the cabbage, a few were without effect, and several were injurious. Of the non-sulphur compounds only nickel carbonate (51 lb.) and copper carbonate (16 lb.) improved the yield. Sulphates generally gave good results with mustard, and all gave higher yields than the corresponding carbonates. In the case of radishes, the results were irregular, but in several cases improved yields were obtained. The availability of the sulphur in 38 different substances was ascertained by growing alfalfa in sand cultures. The best results followed the use of the sulphates of magnesium, iron (ferric), sodium, potassium, and ammonium. Sulphur was also beneficial, and nine of the fifteen sulphates were more efficient than the corresponding carbonates. Only four of the substances acted detrimentally. Sulphur is quickly oxidised to sulphate in the soil at a rate which increases with the fertility; when large amounts are applied, the addition of calcium carbonate to neutralise the resulting acidity is indispensable. —E. H. T.

Fermentation of manure; Effects of litter on the ——. W. E. Tottingham. J. Ind. Eng. Chem., 1916, 8, 511—515.

Comparative experiments were made with a mixture of 1 part by weight of fresh horse manure and 2 parts of fresh cow manure; of four 25 lb.-lots of the mixture, one served as control and the others were mixed with 2 lb. each of pine shavings, oak shavings, and oat straw respectively, and all were kept in loosely covered vessels for 12 weeks, and examined at intervals. The most important changes were in the nitrogen content. The total nitrogen increased in all cases up to the fourth week, and then decreased, until after 12 weeks the nitrogen content was lower than at first; the gains ranged from 8% of the original quantity in the control sample to 20% in the manure mixed with straw, whilst the ultimate net loss ranged from 3 to 13% of the total nitrogen, and was less in the manure mixed with straw than in the other cases. Field experiments indicated that straw-littered fermented manure produces a greater increase of yield than shavings-littered manure, and confirmed the superiority of fermented over unfermented straw-littered manure (see this J., 1916, 481).—A. S.

Calcium hypochlorite; Use of —— as a seed steriliser. J. K. Wilson. Amer. J. of Botany, 1915. 2, 420—427. Bull. Agric. Intell., 1916, 7, 216—217.

A study of the relative efficiency of various disinfectants for the sterilisation of seeds showed that bleaching powder was the most satisfactory. Ten grams of the commercial substance (with 28% of available chlorine) is mixed with 140 c.c. of water, and the mixture allowed to stand for 5—10 mins. The clear liquid, containing about 2% available chlorine, is used in an amount equal to about five times the volume of the seed. Traces of hypochlorite left on the seed are not harmful unless the period of treatment has been greatly and unnecessarily prolonged; the period varies greatly for different seeds, thus *e.g.*, alfalfa requires 6 hours but wheat more than 12 hours. —E. H. T.

Nitrate and nitrite assimilation. [Decomposition of nitrite solutions by light.] X. O. Baudisch and G. Klinger. Ber., 1916, 49, 1167—1176.

By exposure to ultra-violet rays or sunlight, potassium nitrite and formaldehyde solutions, either in the presence or absence of magnesium carbonate, generate gases consisting of 50% hydrogen and 50% nitrous oxide in the first case, and the same two gases together with oxygen (5·8%), carbon dioxide (5·5%), and carbon monoxide (4·7%) in the second case. If, however, the potassium nitrite is replaced by magnesium nitrite, the gases produced by illumination in sunlight are free from hydrogen, and the hydrogen content is much reduced when illumination by the mercury vapour lamp is resorted to. The gases in the first instance had the composition, 51 % N, 21·4 % N_2O, 12·6 % CO_2, 7·4 % CO, and in the latter case 33·14 % N, 23·14 % N_2O, 20·14 % H, 22·8 % CO, 0·6 % CO_2. By long continued illumination in the ultra-violet light the hydrogen eventually disappeared in the latter case also, and an activating influence on the molecular hydrogen is ascribed to the combined magnesium, an influence not possessed by potassium. A similar activating action is probably to be ascribed to the magnesium complex in the chlorophyll molecule.—G. F. M.

Analysis of tannery wastes for use as manures. Harvey. *See* XV.

Composition and preparation of Bordeaux mixture. Sicard. *See* XIXB.

Nitrate and nitrite assimilation. XI. Baudisch. *See* VII.

PATENTS.

Nitrogenous manures and other liquids; Machinery for converting —— into a dry state. H. B. Daglish, St. Helens, Lancs., and W. Horsfall, Prestatyn, N. Wales. Eng. Pat. 8921, June 17, 1915.

THE fluid material is run into a tray, in which large cylinders, heated internally by steam at 75—100 lb. pressure, revolve. The material is taken up by the cylinders and evaporated, and the residue is removed by scrapers. The distance between two cylinders can be adjusted by means of weights and springs; when pressed together, they are free to open to allow hard, foreign materials to pass through. The liquid is freed from grosser solids in a trough between the supply tanks and the tray, and its supply from the former can be regulated by sluice valves.—E. H. T.

Insecticide. U.S. Pat. 1,184,665. *See* XIXB.

Insecticide and process of making same. U.S. Pat. 1,185,603. *See* XIXB.

XVII.—SUGARS; STARCHES; GUMS.

Reducing sugars in cane products; Gravimetric determination of ——. G. P. Meade and J. B. Harris. J. Ind. Eng. Chem., 1916, 8, 504—509.

COMPARATIVE experiments were made with solutions of cane molasses and of raw cane sugar, using different proportions of normal lead acetate for clarifying and different reagents for removing the excess of lead. The Meissl-Hiller method was used throughout. It was found that the results vary if different quantities of lead acetate are added, and that when the excess of lead is precipitated as oxalate, the results are 4—5 % higher than when a carbonate or sulphate is used as precipitant. The sugar solutions may be clarified satisfactorily by means of kieselguhr alone, without the use of lead; the results are concordant and slightly lower than when lead acetate and an oxalate are used. It is recommended that the direction to boil the mixture of sugar solution and Fehling's solution for 2 mins. after boiling begins be modified; by using a thermometer and heating to gentle ebullition for 2 mins. after 100° C. is reached, more concordant results are obtained. If the cuprous oxide is weighed the results are about 5 % higher than when it is first ignited to cupric oxide. The results obtained by weighing as cupric oxide agree with those given by the iodometric determination of the copper.—A. S.

Gelatinising temperature of the starches from grain sorghums by means of a thermo-slide; Determination of the ——. C. K. Francis and O. C. Smith. J. Ind. Eng. Chem., 1916, 8, 509—511.

A THERMO-SLIDE for use in microscopic examination at different temperatures is described. It consists essentially of a small chamber formed by glass plates clamped between steel frames, provided with an inlet and outlet so that hot water can be passed through the chamber. A small quantity of dry starch is placed on the slide and covered with water, and hot water (60° C.) from a flask is passed through the chamber; the heating of the flask is controlled so that the temperature rises 1° C. per minute. The temperature is noted when all the starch granules have lost their polarising properties when examined with a polarising microscope, and a second observation is then made with a fresh sample, the water in the flask being first heated to the temperature noted in the preliminary test; the result of this second test is taken as the gelatinising temperature. —A. S.

Galactan of Larix occidentalis. A. W. Schorger and D. F. Smith. J. Ind. Eng. Chem., 1916, 8, 494—499.

THE wood of the Western larch, *Larix occidentalis*, contains about 10% of a galactan, which has not been previously described, and to which the name ε-galactan has been given. It was isolated by treating an aqueous extract of the larch sawdust with tannin and lead acetate, removing excess of lead from the filtered solution with hydrogen sulphide, neutralising with sodium carbonate, evaporating to a syrup under reduced pressure, and pouring the syrup into a large excess of 95% alcohol. The precipitated galactan was purified by repeated precipitation with alcohol from aqueous solution. It dissolves to a clear solution in water, without gelatinisation; $[\alpha]^{20}_{D} = +12{\cdot}11°$, in 10% aqueous solution; 25 c.c. of a solution containing 2·5 grms. of ε-galactan reduced 0·1554 grm. Cu by Allihn's method. When distilled with 12% hydrochloric acid, the galactan gave 6·18% of furfural, equivalent to 10·5% of pentosan, but on hydrolysis with 2·5% sulphuric acid, galactose was the only sugar formed; a yield of 99% of the theoretical quantity of galactose was obtained after heating for 8 hours at 105°—110° C., and this method of preparation of galactose is decidedly superior to the customary method of hydrolysing lactose and eliminating dextrose by fermentation. It is shown that Tollens' method of determining galactans by oxidation to mucic acid is not trustworthy; it does not give satisfactory results even with the pure galactan. The presence of galactans has also been detected in longleaf pine (*Pinus palustris*), pond pine (*P. serotina*), Cuban pine (*P. heterophylla*), loblolly pine (*P. taeda*), and Douglas fir (*Pseudotsuga taxifolia*).—A. S.

A new colour reaction of aldehydes. De Fazi. *See* XX.

PATENTS.

Glucose [dextrose] or allied products; Process for converting starch into ——. C. L. Sovereign and A. W. H. Lenders, Waukegan, Ill., Assignors to Corn Products Refining Co. U.S. Pat. 1,183,408, May 16, 1916. Date of appl., Jan. 23, 1909.

AN acid starch solution is continuously converted into dextrose or allied products by passing it through a series of connected converters with the liquor at such a level that the spaces in them above the level of the liquor are in communication. The starch and dilute acid are introduced at the upper part of the first converter, and pass continuously through the series. Steam is introduced at the bottom of the first converter so as to heat the liquor and keep the pressure in the whole system sufficiently above atmospheric pressure to discharge the product from the last converter.—F. Sp.

Sugar; Extracting ——. W. Searby, Puunene, Hawaii. U.S. Pat. 1,185,009, May 30, 1916. Date of appl., Oct. 16, 1915.

Lengths of sugar cane are beaten or shredded to produce a loose fibrous mass in which there is lateral separation of the fibres, and these are rolled to extract as much juice as possible. The fibrous mass is then subjected to a diffusion operation, and again pressed to extract moisture.—B. N.

XVIII.—FERMENTATION INDUSTRIES.

Bákhar, the Indian rice beer ferment. C. M. Hutchinson and C. S. Ram Ayyar. Mem. Dept. Agric. India, Bacter. Ser., 1915, **1**, 137—168. Bull. Agric. Intell., 1916, **7**, 283—286.

Bakhar (*murcha, ranu, or u-t-iat*) is an artificial ferment prepared from rice, powdered roots, and other parts of certain plants, by Indian natives, and used in the production of Hindu rice beer (*pachwai*) and of the rice spirit distilled from it. It contains many varieties of *Mucor*, which saccharify starch, and several sorts of alcohol-producing yeasts. The most active mucor was found to be *Aspergillus oryzæ*, and the saccharifying power of the various species depended largely upon the temperature, humidity, and aeration. This power was markedly lower in samples from Indian sources than in the "*koji*" ferment from Japanese rice beer, the latter being practically a pure culture of *Aspergillus oryzæ* (Ahlburg) Cohn. The fermentative power of samples of bákhar from different parts of India was determined by finding the volume of alcohol produced from 100 grms. of steamed rice and 1·5 grms. of the ferment. Bákhar from Dumka gave 61·6 c.c., from Ranchi 53·5 c.c., from Darjeeling 49·5 c.c., and that from Balasore 46·3 c.c. The vegetable matter added when the beer is prepared, stimulates the growth of he yeasts, and prevents the development of nimical bacteria, but it adds nothing to the flavour or aroma of the beverage. Of the bákhar ferments, prepared in the laboratory, a mixture of *Aspergillus oryzæ* and *Saccharomyces cerevisiæ D.* (isolated rom bákhar from Khasi) gave the best results. The failure of Indian rice beer is due more to the absence of good types of saccharomycetes than of efficient amyloclastic enzymes; hence the brewer is recommended to inoculate the rice, already saccharified with bákhar, with active wash from his own ats, or to use a separate supply of yeast from a eliable source.—E. H. T.

Lactic ferments; Proteolytic action of ——. C. Gorini. Atti. R. Accad. dei Lincei, 1915, **26**, 470—475. Bull. Agric. Intell., 1916, **7**, 292—293.

The fact that certain lactic ferments show proteoytic action in milk but not in gelatin cultures, is not ue to any difference in the nature of the enzymes cting on the casein, and on the gelatin, nor to the nfavourable nature of the latter as a medium for he development of the bacteria. The uncertain ction on milk of some lactic ferments is partly consequence of the changes wrought in the milk uring sterilisation, and it is also related to the ercentage of soluble albuminoids (peptones) in that quid, particularly in retailed milk. It is possible hat the inability to liquefy gelatin may have a imilar cause, and also that the stimulus producing he proteolytic enzymes is subordinate to the ecessity for the lactic ferments to produce soluble itrogen for their own needs; when the soluble itrogen is already present in the medium in sufficient quantity the formation of the dissolving enzyme is no longer necessary. Both gelatin and milk cultures taken alone are insufficient for estimating the proteolytic power of a lactic ferment.—E. H. T.

Yeast; Prohibition of importation of ——.

By virtue of a Royal Proclamation dated June 27th, the importation of yeast into the United Kingdom is prohibited, but licences will be granted to permit an importation of yeast up to about 50% of the amount imported in 1915.

Patents.

Spirits in casks; Method of maturing ——. Verein der Spiritus-Fabrikanten in Deutschland, Berlin. Ger. Pat. 291,349, Apr. 1, 1915.

The beneficial effect of storing spirit in casks charred on the inside is due not only to aromatic substances yielded by the charred wood to the spirit, but also to a catalytic action exerted on the vapour by the charred wood not in contact with the liquid, resulting in the formation of aldehydes, organic acids, and esters. The effect is intensified, according to the present patent, by bringing the vapours rising from the spirit into contact with charred wood shavings, wood charcoal, or other substances capable of acting as catalysts.—A. S.

Carbonic acid [from fermentation]; Apparatus for cooling —— *during its compression.* H. Müry, Assignor to H. Frisch, Zürich, Switzerland. U.S. Pat. 1,184,370, May 23, 1916. Date of appl., June 3, 1914.

See Eng. Pat. 13,530 of 1914; this J., 1915, 505.

XIXa.—FOODS.

Dyestuffs permitted in food products in the United States. U.S. Dept. Agric., Food Inspection Decision No. 164.

The coal-tar dyes which may be used in food, subject to the provisions of "Food Inspection Decisions" Nos. 76, 117, and 129 are the following: *Red shades:* Amaranth, Ponceau 3 R, Erythrosine. *Orange shade:* Orange I. *Yellow shades:* Naphthol Yellow S., Tartrazine. *Green shade;* Light Green S. F. yellowish. *Blue shade:* Indigo-disulphonic acid.

Proteolytic action of lactic ferments. Gorini. *See* XVIII.

Patents.

Soy [soya] beans; Process for treating ——, *and utilisation of the products of same in connection with the making of edible food such as bread, chocolate, confectionery, soup and the like.* T. W. Rees, Cannock, Staffs. Eng. Pat. 7351, May 7, 1915.

Washed soya beans are immersed in water at 75° F. (24° C.) for 3—4 hrs., or at a higher temperature for a shorter time, with the addition of 6—8 oz. of sodium bicarbonate for every 28 lb. of beans. Alternatively, the beans are sprayed with a solution of sodium bicarbonate (8 oz. to the gall.) at the temperature desired and left to stand for the necessary time. After completion of the soaking, the beans are washed with water, dried, and ground. For making bread, 25% of the bean flour is added to ordinary flour, and for chocolate 10—15% to ordinary hard chocolate. An artificial chocolate may be made by mixing the bean flour with cacao butter, or nut butter, and sugar.
—J. H. J.

Banana food and process of making same. United States Tropical Food Co., Assignees of H. E. Plunkett, Malden, Mass., U.S.A. Eng. Pat. 8372, June 5, 1915. Under Int. Conv., June 6, 1914.

Banana fruit is peeled, beaten into a moderately thick paste, and transferred to water at 210°—230° F. (99°—110° C.). Afterwards it is placed on trays on steam-heated shelves in a vacuum drying machine for 10 hrs., when the water and any natural discolouring substances present in the fruit are removed. The crisp, granulated product retains the natural colour and flavour of the fruit.—J. H. J.

Margarine; Method of and apparatus for making ——. H. Borgen, Urmston, Lancs. Eng. Pat. 13,563, Sept. 23, 1915.

The fat emulsion is passed into a trough in which a small heated roller revolves and carries the emulsion against the side of a large roller, which is kept cooled. The congealed emulsion is scraped off the large roller at its lowest point, and falls between two warmed rollers, the same distance apart as the previous rollers. It is scraped off these and falls between two kneading rollers at the ordinary temperature.—J. H. J.

Flour; Process of treating ——. J. N. Alsop, Owensboro, Ky., Assignor to New Alsop Flour Process Co., Portland, Me. U.S. Pat. 1,184,295, May 23, 1916. Date of appl., Nov. 19, 1914.

The flour is bleached and matured by a disruptive electric discharge in an atmosphere of air which has been preheated and saturated with moisture. —J. H. J.

Coffee extract; Method of aromatising dry ——. K. Aslund, T. Böberg, and Techno-Chemical Laboratories, Ltd., London. Eng. Pat. 2332, Feb. 13, 1915.

Dryer for dehydrating macaroni or the like. U.S. Pat. 1,185,591. *See* I.

XIXb.—WATER PURIFICATION; SANITATION.

Mechanical filtration [of water]; Improvements in the ——. T. Fleming, jun. Proc. Eng. Soc. W. Penn., 1916, **31**, 827—857. (See also Clemence, this J., 1916, 650.)

An account of the improvements in the present day construction of mechanical filters in the United States as compared with 15 years ago is given. (1) Pressure filters have been altogether displaced by gravity filters. These are constructed of reinforced concrete in rectangular form, as are also the settling basins which accompany them. (2) Most waters, and especially those with high turbidity, are now allowed to settle for at least 4 hours after treatment with coagulants, before filtration. The settling basins are constructed in pairs, the floors sloping to a central drain for removal of the solids. The coagulants are added to the water in a special mixing compartment before entering the settling basins, and baffles are provided in the basins to prevent cross currents. (3) The rate of flow through the filters is usually regulated by a small Venturi meter constructed on the outlet from each filter and controlling a pilot valve, which in turn controls a hydraulic operating valve on the outlet. It has been found that loss of head on a filter leads to a danger of the breaking of the surface film formed on the sand, and a gauge to determine exactly the loss is now attached to each filter. The loss of head is limited to 10 ft. in average cases. (4) It has been found desirable to provide he filters with a false bottom about 18 in. above the floor; this is convenient in keeping the collecting system free from accumulation of sand, and also allows of uniform distribution of the wash water over the entire filter area in cleaning the filter by reverse flow. Mechanical agitation has been entirely abandoned. The reverse flow used is 15 galls. per sq. ft. per min. This rate is sufficient to float the entire sand bed and to lift the finer sand 30 in.; the troughs for leading away the wash water are at this height. If the washing is started slowly, the gravel below the sand is not disturbed. When necessity requires the complete removal and replacement of the sand water-carriage is used. (5) The feed of the chemical solutions is automatic and adjustable and is automatically proportioned to the quantity of raw water entering the plant. There is an electric alarm in case of a stoppage in the flow of the chemical solutions. (6) The average efficiency in a modern plant is over 99%. In one instance the number of bacteria in the raw water averaged over 9000 per c.c. during 4 years, and in the filtered water 19 per c.c., none of the latter being *B. coli.*—J. H. J.

Sewage: Modification of Whipple's method fo [determining] organic nitrogen in ——. F. W Bruckmiller and L. E. Jackson. J. Ind. Eng Chem., 1916, **8**, 499—500.

In the direct determination of total nitrogen i sewage by digesting with concentrated sulphuri acid and a small quantity of copper sulphate unti colourless, with addition of a small quantity o permanganate towards the end of the digestion then diluting, adding excess of sodium hydroxide and nesslerising, it was found that the results varied according to the length of time the alkalin solution is left before nesslerising. The bes results, with Kansas sewage, were obtained b allowing the alkaline solution to stand for 2 hours.—A. S.

Bordeaux mixture; Composition and preparation o —— L. Sicard. Ann. de l'Ecole Nation d'Agric. de Montpellier, 1915, **14**, 213—25 Bull. Agric. Intell., 1916, **7**, 303—304.

The amount of lime necessary to render th copper in Bordeaux mixture completely insolubl is much less than that usually prescribed. All th metal is precipitated from 1 kilo. of copper sulphat when 168·5 grms. of calcium oxide is added slowl and with agitation in the form of milk of lime, an the resulting mixture is neutral. Less than 16 grms. of lime produces an acid preparation, an more than 225 grms. causes alkalinity. The so called "neutral" mixtures, prepared in the vine yards by adding lime until blue litmus paper ceas to be reddened, contain an excess of lime and ar inferior. A good Bordeaux mixture is made a follows: A solution of 2 kilos. of copper sulphat in 50 litres of water is added very slowly and wit vigorous and prolonged stirring to milk of lime which contains sufficient alkali to precipitate a the copper and is diluted to 50 litres.—E. H. T.

Micro-analytical method for the study of gase Application to the analysis of traces of air. Guy and Germann. *See* XXIII.

Patents.

Straining of water and other liquids; Devices f the mechanical purification or ——. F. Brackett, and F. W. Brackett and Co., Ltd, Colchester. Eng. Pat. 100,465, Mar. 17, 191 (Appl. No. 4014 of 1916.)

An endless travelling screen is supported on framework placed in the flow of water to treated, the base of the frame being much wid than the top portion; in this way there is a considerable area of the screen at the base of th frame exposed to the water, and the portion exposed may be horizontal or slightly inclined against the flow. A protecting grating below the base prevents leaves from passing through the screen. The refuse collected on the screen is removed at the top of the framework by a water jet or other means. The water which has passed through the front and base of the screen also passes through the back of the screen, or it may be taken away from inside the base by a pipe or opening in the side of the channel.—J. H. J.

Water ; Process of obtaining sterilised and distilled ——. W. B. Underwood, Assignor to American Sterilizer Co., Erie, Pa. U.S. Pat. 1,183,142, May 16, 1916. Date of appl., Dec. 26, 1914.

Water is heated under pressure sufficiently long to sterilise it, the pressure is then relieved, the steam formed is condensed, and the condensed water collected under sterile conditions. The sterilised water, not converted into steam, is stored at a suitable temperature for use.—J. H. J.

Insecticide. C. D. Vreeland, Upper Montclair, N.J. U.S. Pat. 1,184,665, May 23, 1916. Date of appl., Apr. 3, 1915.

The insecticide is in the form of discrete particles, each composed of an arsenical substance with a coating of ferric oxide or other insoluble substance less harmful to vegetation than the arsenical substance.—J. H. J.

Insecticide and process of making same. I. F. Peck, Greenwood, Miss. U.S. Pat. 1,185,603, May 30, 1916. Date of appl., Mar. 9, 1916.

An insecticide consisting essentially of a double arsenite of calcium and an alkali metal, is prepared from commercial "arsenic," slaked lime, and a compound of an alkali metal. It is produced in the form of a pasty mass containing a small amount of free alkali, capable of forming a suspension with water.—J. H. J.

Water and sewage ; Purification and clarification of ——. L. Linden, London. Eng. Pat. 8126, June 1, 1915. Under Int. Conv., July 9, 1914,

See Fr. Pat. 474,907 of 1914 ; this J., 1915, 1112.

XX.—ORGANIC PRODUCTS ; MEDICINAL SUBSTANCES ; ESSENTIAL OILS.

Morphine alkaloids. III. J. v. Braun. Ber., 1916, **49**, 977—989.

THE nitrogen ring of morphine is more stable than ny other known nucleus, and it has been possible o synthesise numerous O-derivatives of nornorphine and N-derivatives of norcodeine. Examnation of the physiological action of these derivaives by Pohl (Zeit. f. exp. Path. u. Ther., 1915, 17, vol. 3) has shown that, with the exception of he N-allyl derivatives, their action is weaker than hat of codeine. The N-allyl derivatives of norodeine exert a physiological action antagonistic o that of morphine.—F. W. A.

rganic arsenic compounds ; Biology of ——. E. Sieburg. Z. physiol. Chem., 1916, **97**, 53—108.

HE toxicity of organic arsenic compounds correponds with that of arsenic, but in no case is it roportional to the arsenic content, taking senious acid as the standard. Although the ompounds containing trivalent arsenic are someimes more poisonous than those containing uinquevalent arsenic, in many cases there is no reat difference between the two classes of comounds ; arsenophenylglycine is, in fact, somehat less poisonous than the arsenic acid compounds of phenol, aniline, and benzoic acid. Nor does the intensity of the toxicity depend on the presence of a basic or acid group in the benzene nucleus. There is no ground for the assumption that the presence of an amino group in the molecule has an effect on the parasiticidal value of the compounds ; amino-free hydroxyphenylarsenic oxide kills trypanosomes in a dilution of 1 : 10,000,000, whilst arsanilic acid and salvarsan have no action, *in vitro*. The parasiticidal value appears to be due rather to the atomic grouping —As=O— than to the toxicity. In the body, the action of the compounds appears to be that of inorganic arsenic, either as arsenic acid or arsenious acid ; the formation of arsenic acid from arsenious acid, and *vice versa*, is a reaction which always takes place in the body tissues, etc.
—W. P. S.

Cyclopentamethylenemethylarsine. A new heterocyclic chain containing arsenic in the nucleus. E. V. Zappi. Bull. Soc. Chim., 1916, **19**, 151—154.

By the action of dichloromethylarsine on the organo-magnesium derivative of 1.5-dichloropentane, a product was obtained possessing the characteristics of a tertiary arsine to which the constitution

$$CH_2{<}\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}{>}As.CH_3$$

was assigned. It is a colourless liquid, b.pt. 160° C., has an odour of mustard oil, is converted by oxidation into a white solid containing quinquevalent arsenic, and in other respects it closely resembles its nitrogen analogue, methylpiperidine, giving for example a methiodide, which on treatment with silver oxide is converted into a strongly basic quaternary hydroxide.—G. F. M.

ac-Tetrahydro-β-naphthylamine ; Some derivatives of ——. E. Waser. Ber., 1916, **49**, 1202—1207.

The urethane, ethyl N-*ac*-tetrahydro-β-naphthyl carbamate $(C_{10}H_{11})\ NH{\cdot}COOC_2H_5$, was obtained by the action of ethyl chloroformate (1 mol.) on 2 mols. of the base in absolute ethereal solution. After filtering off the precipitated hydrochloride, the substance was isolated from the filtrate in needles, m.pt. 82° C. *ac*-Tetrahydronaphthylethylthiourea, $C_2H_5NH{\cdot}CS{\cdot}NH(C_{10}H_{11})$, was formed quantitatively by the action of the naphthylamine base on ethyl isothiocyanate in ethereal solution. It crystallised from alcohol in prisms, m.pt. 131·5° C. N-Dimethyl-*ac*-tetrahydro-β-naphthylamine was obtained by the dry distillation of tetrahydro-β-naphthyl-trimethylammonium chloride (Willstätter and King, Ber., 1913, **46**, 531). It is a very strong base, b.pt. 132°—133° C. at 11 mm., which has a strong violet fluorescence and absorbs carbon dioxide from the air. The corresponding monomethyl-derivative was formed as a colourless oil, b.pt. 118°—120° C. at 9 mm., by the action in the cold of 1 mol. of dimethyl sulphate on the naphthylamine. The reaction is complete in about six days. Most of the above compounds possess marked therapeutic properties, having an action on the pupil of the eye, the blood pressure, and the temperature.—G. F. M.

Aldehydes ; A new reaction of ——. R. de Fazi. Gaz. Chim. Ital., 1916, **46**, I., 334—359.

The following reaction appears to be characteristic of cyclic aldehydes. One c.c. of concentrated sulphuric acid is added to a mixture of a few drops of a chloroform solution of the aldehyde and two or three drops of a 1% solution of acenaphthene in chloroform : a green coloration changing to reddish-violet is produced if a cyclic aldehyde be present. The reaction is given by benzaldehyde, salicylaldehyde, *m*-hydroxybenzaldehyde, the mononitrobenzaldehydes, vanillin, piperonal, cinnamic aldehyde, *m*-toluic aldehyde, cumic aldehyde, anisaldehyde, helicin, and furfural, but not by aliphatic aldehydes; formaldehyde and acetaldehyde, give dark-coloured condensation products but not the characteristic reddish-violet coloration. Aldoses and other carbohydrates, including cellulose, capable of yielding furfural or an analogous aldehyde, give the reaction, but a considerably longer period elapses before the reddish-violet colour appears. It is possible to detect by this test 0·0078 mgrm. of benzaldehyde, 0·019 mgrm. of vanillin, and 0·006 mgrm. of furfural.—A. S.

Hydroxylamine: A new method for preparing —— from hydroxylamine sulphate. O. Baudisch and F. Jenner. Ber., 1916, **49**, 1182—1185.

A solution of hydroxylamine in absolute alcohol was obtained by the extremely cautious addition of finely powdered hydroxylamine sulphate to anhydrous liquid ammonia contained in a long glass or, better, quartz tube with a perforated base supporting a small porcelain filter plate. The upper end of the tube was closed by a soda-lime tube and the whole was fixed through the neck of a 3-litre filter flask enclosed in a wooden box to safeguard against damage caused through possible explosions. A 2 cm. layer of ammonium sulphate was bedded firmly on the filter plate, and when sufficient hydroxylamine salt had been added (about 10 grms. to 50 c.c. of liquid ammonia), the excess of ammonia was removed by aspirating air through this filter bed and the filter flask by connecting the latter to the vacuum pump. Nearly all the ammonia was removed by this means and the addition of absolute alcohol to the residue remaining in the glass tube produced a pure alcoholic hydroxylamine solution, which could be kept for weeks unchanged.—G. F. M.

Ethylene dibromide: Preparation of ——. E. B. R. Prideaux. Chem. News, 1916, **113**, 277—278.

A stream of ethylene, prepared by passing alcohol vapour over heated phosphoric acid and removing the excess of alcohol by means of a condenser, was passed to the lower part of a second condenser down which flowed a stream of bromine vapour. The ethylene dibromide was formed in the condenser down which it passed into a tap-funnel. It was arranged that the supplies of alcohol and bromine could be renewed, and the ethylene dibromide removed without interrupting the process. It was not found possible to keep the supplies of ethylene and bromine perfectly balanced, so a slight excess of ethylene was assured, as the subsequent absorption of this was easier than the removal of excess of bromine from the ethylene dibromide.—B. V. S.

Patents.

Chlorinated hydrocarbons [from petroleum]: Process of making ——. F. W. Mann and M. L. Chappell, Berkeley, Cal., Assignors to Standard Oil Co., Richmond, Cal. U.S. Pat. 1,183,094, May 16, 1916. Date of appl., Apr. 16, 1915.

Petroleum distillates are treated with sulphuryl chloride in presence of liquid sulphur dioxide in order to chlorinate the unsaturated and aromatic hydrocarbons; sufficient sulphur dioxide is allowed to evaporate during the process to maintain the temperature below 0° C.—F. W. A.

Mercury catalysts: Method of regenerating ——. N. Grünstein, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pats. 1,185,499 and 1,185,500, May 30, 1916. Dates of appl., Aug. 4, 1915, and Jan. 4, 1916.

See Eng. Pat. 10,140 of 1915; this J., 1916, 328. The exhausted catalyst may be treated with acetylene in acid solution, to convert the greater part of the mercury into metallic mercury, before subjecting to the treatment described previously.

Safranine dyes: Compounds of the —— especially adapted for internal use. J. Altschul, Berlin, and W. Urban, Berlin-Wilmersdorf, Germany, Assignors to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,183,711, May 16, 1916. Date of appl., Mar. 13, 1914.

See Fr. Pat. 463,357 of 1913; this J., 1914, 415.

Acetaldehyde; Manufacture of ——. N. Grünstein, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,184,177, May 23, 1916. Date of appl., July 16, 1914.

See Fr. Pat. 474,246 of 1914; this J., 1915, 735.

Pharmaceutical compounds. [2-Piperonylquinoline-4-carboxylic acid derivatives.] A. Thiele, Assignor to Chem. Fabr. auf Aktien, vorm. E. Schering, Berlin. U.S. Pat. 1,185,265, May 30, 1916. Date of appl., July 3, 1913.

See Ger. Pat. 281,603 of 1912; this J., 1915, 637.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Coloured reproductions; Methods of [making] ——. J. Lewisohn, New York. Eng. Pat. 2474, Feb. 16, 1915. Under Int. Conv., Apr. 3, 1914.

The usual three colour negatives are obtained. A blue print is made through the "yellow" negative, the blue part of the print treated with a solution of a yellow dye such as Aurantia, dried, and then treated with silver nitrate solution to remove the blue image. After thorough washing the print is re-sensitised and the process repeated with the "red" negative and a red dye such as Eosin, and finally a blue print through the "blue" negative is added. The process is applicable to methods using more or fewer than three colours.—B. V. S.

Cinematograph films; Manufacture of ——. A. Boularan, dit Deval, Paris. Eng. Pat. 7753, May 25, 1915. Under Int. Conv., June 5, 1914.

A cinematograph positive film is coated on the face with a bichromated gelatin solution, and after this is set but before it is dry, a film of black needle-paper is squeezed on to it. After drying, the bichromated gelatin film is exposed behind the positive and then mordanted, *e.g.*, with calcium hypochlorite solution. The black paper comes away in this operation and the film is then developed in the usual way with hot water, hardened, and dried. A film in relief is obtained which can be mounted and used for printing with suitabl inks; greater uniformity in printing is ensured by having a relief band on each edge obtained by leaving clear bands on each edge of the positive —B. V. S.

Cinematograph films; Method of renovating —— A. P. H. Trivelli, The Hague, Holland. Eng Pat. 7956, May 28, 1915. Under Int. Conv. May 30, 1914.

Cinematograph film is restored after formation o "rain" and protected against its formation, by coating the face, or preferably both sides, with flexible, hard varnish or lacquer. Oil spots ar removed before varnishing, by soaking in ligh petroleum spirit. A further treatment with weak solution of fat or grease in petrol reduces th risk of sticking in tropical climates.—B. V. S.

Intaglio printing surfaces; Process of producin ——. J. Rieder, Steglitz, Germany. Eng. Pat 8357, Apr. 2, 1914. Under Int. Conv., Apr. 2, 191

The metal plate to be etched is coated wit bichromated fish glue, or similar sensitive materia exposed behind a screen, and the resulting screen negative developed and fixed. The plate is then recoated with a sensitive material such as a mixture of caoutchouc and asphalt, exposed behind the negative, and etched.—B. V. S.

Sensitised film for process printing. L. A. Orans, New York. Eng. Pat. 16,040, Nov. 13, 1915.

The sensitive film for the negative is coated on a base of celluloid or similar material, which may have a glass support, and has a serrated or undulating surface, similar for instance to a Levy screen. This gives a ready means for making corrections on the negative, which would otherwise require to be made on the etched printing plate, by scraping away the crests, or by filling up the hollows with an opaque paint.—B. V. S.

Gelatinous [photographic] film and process of forming the same. E. A. Pin, Clichy, France. U.S. Pat. 1,184,772, May 30, 1916. Date of appl., Jan. 20, 1916.

The temporary support for a stripping film is oated with an aqueous solution of soap, preferably made from coconut oil, and with which may be mixed resinous substances, then with an aqueous solution of gelatin, soap, and glycerin, and finally with the light-sensitive emulsion.
—B. V. S.

XXII.—EXPLOSIVES ; MATCHES.

ilitary explosives. London Gazette, June 20, 1916.

HE articles mentioned below are included under he term "Military Explosives" specified by the rmy Council as War Material to which Defence of he Realm Regulation 30A is applied :—Acetate grey) of lime (*a*). Acetone. (*a*). Ammonal. allistite. Bellite. Blastine. Cordite. Fulminate f mercury. Guncotton. Gunpowder (except porting and commercial). Melinite. Megadine. itrocellulose powder. Nitroglycerine. Perhlorate of ammonia. Perchlorate of potash. icric acid. Sabulite. T.N.T. (trinitrotoluol). rotyl. Tetryl. Tonite. T.N.X. (trinitroxylol).

Application for a permit under Regulation 30A respect of any of the above, with the exception grey acetate of lime or acetone, should be dressed to the Secretary (M.I.6D), War Office.

(*a*) Applications for a permit under Regulation A in respect of grey acetate of lime or acetone ould be addressed to the Director of Propellant pplies, Ministry of Munitions, 32, Old Queen reet, London, S.W.

Patent.

riming charge. W. H. Buell, Assignor to Winchester Repeating Arms Co., New Haven, Conn. U.S. Pat. 1,184,316, May 23, 1916. Date of appl., Apr. 30, 1915.

HE charge contains an alkali (sodium) salt of drazoic acid, with or without an oxidising ent (potassium chlorate) and a non-gaseous mbustible substance (antimony sulphide).
—C. A. M.

XXIII.—ANALYSIS.

tassium ; Determination of —— in presence of other substances. A. H. Bennett. Analyst, 1916, **41**, 165—168.

TSCHERLICH and Fischer (this J., 1912, 1055) ve shown that the precipitate obtained in the tassium-sodium-cobaltinitrite method varies in mposition, whilst Davis (*ibid*, 1912, 1045) and Thin and Cumming (*ibid*, 1915, 514) have pointed out certain possible sources of error in the perchlorate method. To determine potassium in the presence of very large quantities of sodium and magnesium salts, *e.g.*, in the mother liquors of salt works, the author recommends a combination of these two methods ; the potassium cobaltinitrite precipitate first obtained is dissolved in hydrochloric acid and the solution evaporated with perchloric acid, the potassium perchlorate being thus obtained in a pure state. Sodium and cobalt perchlorates are readily soluble in the alcohol used for washing the potassium perchlorate. To every 50 c.c. of the solution containing potassium (from 0·1 to 0·2 grm.) is added 30 c.c. of cobalt reagent (cobalt nitrate, 50 grms., sodium nitrite, 300 grms., and glacial acetic acid, 25 c.c., per litre) ; after 2 hours, the precipitate is filtered, washed with water containing a small quantity of the cobalt reagent, dissolved in hot dilute hydrochloric acid, the solution filtered, and the filtrate evaporated to dryness in a porcelain basin. The residue is dissolved in hot water, the solution filtered, if necessary, treated with 6 c.c. of perchloric acid, and evaporated to dryness ; a few c.c. of water is now added, and the evaporation repeated. When cold, the residue is stirred with 25 c.c. of 98% alcohol, the insoluble portion collected on a weighed filter, washed with alcohol containing 0·2% of perchloric acid and saturated with potassium perchlorate, then dried at 100° C., and weighed. If iron and aluminium phosphates are present, sodium citrate is added to prevent their precipitation when the cobalt reagent is added. Ammonium salts must not be present.
—W. P. S.

Metals having sulphides insoluble in dilute acids ; Separation of the common ——. J. Clarens. Bull. Soc. Chim., 1916, **19**, 154—158.

An alternative method for the separation of the metals of group II. is based on their fractional precipitation from hydrochloric acid solutions of different concentrations. From the neutralised liquid to which half its volume of concentrated hydrochloric acid (sp.gr. 1·18) has been added, the sulphides of copper, mercury, arsenic, and antimony are precipitated by hydrogen sulphide, and are further separated by treatment with 10% potassium hydroxide. From the filtrate, diluted with an equal volume of water, tin and bismuth sulphides are precipitated and are likewise separated by means of potash. Lastly the second filtrate is neutralised with ammonia, acidified with a few drops of hydrochloric acid, and again treated with hydrogen sulphide, when lead and cadmium sulphides are precipitated and are separated after solution in nitric acid and neutralisation with sodium carbonate, by the usual potassium cyanide method.—G. F. M.

Tin ; Volumetric determination of —— by potassium iodate. G. S. Jamieson. J. Ind. Eng. Chem., 1916, **8**, 500—502.

Titration of precipitated tin or stannous chloride with potassium iodate solution in presence of chloroform is recommended in preference to titration with ferric chloride or iodine solution. The end-point is very sharp and it is not necessary to take extreme precautions to prevent atmospheric oxidation, as the potassium iodate may be added very rapidly until iodine appears in the solution, and then the titration completed as slowly as desired. The reactions are represented by the equations :—

$KIO_3 + Sn + 6HCl = SnCl_4 + KCl + ICl + 3H_2O$;

$KIO_3 + 2SnCl_2 + 6HCl = 2SnCl_4 + KCl + ICl + 3H_2O$.

The method is not applicable in presence of cuprous, ferrous, or antimonious salts, or precipitated metals.—A. S.

Gases; Micro-analytical method for the study of ——. *Application to the analysis of traces of air.* P. A. Guye and F. E. E. Germann. J. Chim. Phys., 1916, 14, 195—203.

By the observation of pressure changes when the volume is kept constant, and by using very low pressures, exceedingly small amounts of gas (down to 1—1·5 cub. mm. at N.T.P.) can be measured. The apparatus is entirely of glass and consists essentially of a volumeter of 25-50 c.c. capacity, shaped like a pipette with bent stems, and connected with a simplified form of the Macleod vacuum-meter, the readings of which are standardised against a mercury differential manometer. The volumeter is connected at the top with a series of small receptacles, each provided with a tap, into which the gas can be passed and submitted to (a) an electrically-heated iron wire to remove oxygen, (b) solid potassium hydroxide to absorb carbon dioxide, (c) a spark-discharge between platinum electrodes, and (d) spectroscopic examination in a Plücker tube, at the entrance to which is a gold leaf to retain mercury vapour. The lower stem of the volumeter carries a tap, and is in connection with a mercury pump by means of which high vacua can be established in, or the gas driven into any desired part of the apparatus. The oxygen in a 0·12 c.c. sample of air was found by this method to be 21·0%, in agreement with the results found by other methods using larger quantities of air. Great accuracy, however, is not claimed, the minimum error being $\frac{1}{200}$ of the oxygen found.—E. H. T.

Quantitative determination of phloroglucinol and resorcinol by means of furfural. Votocek and Potmesil. *See* III.

Determination of small quantities of hydrocyanic acid. Johnson. *See* VII.

Titrations with permanganate in strongly alkaline solution. Brauner. *See* VII.

Volatilisation of platinum. Burgess and Waltenberg. *See* X.

Determination of tin in tin ashes. Welwart. *See* X.

Rapid method for comparing the decolorising efficiencies of charcoals. Wickenden and Hassler. *See* XII.

Tests of the purity of oil of turpentine. Krieger. *See* XIII.

Varnish analysis and varnish control. I. Molecular weights of vegetable oils. Seaton and Sawyer. *See* XIII.

Report of the Hide Powder Committee on methods of testing hide powders. Bennett. *See* XV.

Determination of the permeability of leather. Nihoul. *See* XV.

Analysis of tannery wastes for use as manures. Harvey. *See* XV.

Gravimetric determination of reducing sugars in cane products. Meade and Harris. *See* XVII.

Determination of the gelatinising temperature of the starches from grain sorghums by means of a thermo-slide. Francis and Smith. *See* XVII.

Modification of Whipple's method for organic nitrogen in sewage. Bruckmiller and Jackson. *See* XIXb.

A new reaction of aldehydes. De Fazi. *See* XX.

Patent.

Gas analysers: Registering device for ——. J. W. and C. W. Hays, Chicago, Ill. U.S. Pat. 1,184,095, May 23, 1916. Date of appl., Sept. 14, 1914; renewed Sept. 27, 1915.

The gas is analysed and measured in an apparatus comprising an absorption vessel containing an absorbent chemical and communicating near the bottom with a second vessel, the lower part of which also contains the absorbent. This second vessel is connected at the top with a third vessel containing a liquid and communicating at the bottom with a tube also containing the liquid. The upper parts of the second and third vessels are filled with a third liquid of lower specific gravity than either of the other liquids, and which is soluble in neither. This third liquid forms a liquid piston between the absorbent chemical and the other liquid. —C. A. M.

Trade Report.

Prohibited exports. Orders in Council, June 28 and July 4, 1916.

In the Proclamation dated May 10th, 1916 (see this J., 1916, 620), the heading [3]Resins and resinous substances (except such as contain caoutchouc), is replaced by the heading [3]Resins, resinous substances (except such as contain caoutchouc), and articles containing resins and resinous substances. The following headings are added: [3]Felspar. [1]Fire bricks and fire clay. [3]Insulating materials: leatheroid, oiled cloth and tape, vulcanised fibre. [3]Spirit varnishes containing gum. [2]Vinegar containing not more than 6% of acetic acid. [1]Vinegar essence and similar preparations containing more than 6% of acetic acid. [1]Rennet powder, rennet extract, and other preparations of rennet.

Contraband of war.

By virtue of a Royal Proclamation, dated June 27th, 1916, the following are added to the list of articles which will be treated as absolute contraband:—Asphalt, bitumen, pitch, and tar. Sensitised photographic films, plates, and paper. Felspar. Talc.

Book Received.

The Testing of Tars and Pitches for Roads: A Practical Guide for Engineers and Surveyors By John Hutchinson. Published by the Author at 11, Tothill Street, London, S.W. 1s. 6d. net.

A pamphlet of 16 pages giving illustrations an concise descriptions of apparatus specially devis for ascertaining the physical qualities of ta pitches, and bitumens for use in road constructio and maintenance. The apparatus includes th types of hydrometer and viscosimeter recommended by the Road Board for tars, and a penetration machine, melting point apparatus, an ductility test for pitches.

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R. G. Pelly	V., XII., XIII., XV.
T. H. Pope, B.Sc.	XVII., XVIII., XX.
W. E. F. Powney	II., X.
W. R. Schoeller, Ph.D.	VII., X.
A. B. Searle	II., VIII., IX.
A. Shonk	III., VII., X., XI.
W. P. Skertchly	XII., XIX.
F. Southerden, B.Sc.	VII., XX.
F. Sproxton, B.Sc.	V., VII., XX.
T. Stenhouse, B.Sc. A.R.S.M., F.I.C.	X., XIII. XIV.
B. V. Storr, M.Sc.	XXI,
F. C. Thompson	XV.
E. H. Tripp, Ph.D.	VII., XVI., XXIII.

Birmingham Section.

Chairman: W. J. Rees.

Vice-Chairman: H. T. Pinnock.

Committee:

F. H. Alcock.
N. P. Booth.
W. Clifford.
J. E. Coates.
P. F. Frankland.
H. L. Heathcote.
O. F. Hudson,
A. W. Knapp.
J. C. Mann.
R. S. Morrell.
T. Slater Price.
E. C. Rossiter.
Harry Silvester.

Hon. Local Secretary and Treasurer:
F. R. O'Shaughnessy, 42, Temple St., Birmingham.

Canadian Section.

Chairman: T. H. Wardleworth.

Vice-Chairmen:

S. B. Chadsey, N. N. Evans, W. L. Goodwin.

Committee:

L. T. Acton.
J. W. Bain.
J. S. Bates.
D. G. Buchanan.
J. A. De Cew.
J. R. Donald.
C. F. Heebner.
Milton L. Hersey.
Robt. Job.
Otto G. Palm.
W. H. Thorn.

Hon. Treasurer: E. G. R. Ardagh.

Hon. Local Secretary:
Alfred Burton, 2-16, Liberty Street, Toronto.

Asst. Hon. Secretary for Montreal:
Joel B. Saxe, 171, St. James Street, Montreal.

Edinburgh Section.

Chairman: James Walker.

Vice-Chairman: D. B. Dott.

Committee:

J. G. Annan.
J. F. Briggs.
J. D. Brunton.
L. Dobbin.
J. Rutherford Hill.
Jas. C. Irvine.
D. S. Jerdan.
A. P. Laurie.
Wilfrid A. Sim.
Allan Smith.
S. Stewart.
H. E. Watt.

Hon. Local Secretary:
A. Lauder, 13, George Square, Edinburgh.

Glasgow Section.

Chairman: James Macleod.

Vice-Chairman: Quintin Moore.

Committee:

E. G. Beckett.
A. R. Berry.
Thomas Callan.
R. M. Clark.
W. H. Coleman.
Cecil H. Desch.
Jas. Faill.
Robert Hamilton.
T. H. P. Heriot.
S. H. B. Langlands.
James Lawrence.
W. G. McKellar.
J. McFarlane.
G. T. Purvis.
James Reid.
James Robertson.

Hon. Secretary and Treasurer:

G. S. Cruikshanks, Royal Technical College, Glasgow.

Liverpool Section.

Chairman: John Gray.

Vice-Chairman: E. C. C. Baly.

Committee:

A. Carey.
P. de G. Coghill.
J. Findlater.
J. Harger.
R. D. Masson.
E. L. Peck.
H. E. Potts.
A. T. Smith.
Frank Tate.
W. P. Thompson.
G. Carruthers Thomson.
Stuart J. Willcox.

Hon. Treasurer:

Edwin Thompson, 25, Sefton Drive, Liverpool.

Hon. Local Secretary:

Alfred Holt, The University, Liverpool.

London Section.

Chairman: A. R. Ling.

Vice-Chairman: H. E. Armstrong.

Committee:

Julian L. Baker.
W. A. Bone.
T. F. Burton.
A. W. Crossley.
E. V. Evans.
J. T. Hewitt.
W. R. Hodgkinson.
E. Grant Hooper.
H. A. D. Jowett.
C. A. Keane.
W. J. Leonard.
J. W. McDonald.
J. Gordon Parker.
R. Seligman.

Hon. Local Secretary and Treasurer:

T. D. Morson, 14, Elm Street, Gray's Inn Road, W.C.

Manchester Section.

Chairman: J. H. Hoseason.

Vice-Chairman: W. Thomson.

Committee:

J. Allpass.
E. Ardern.
E. F. Armstrong.
J. Baddiley.
L. Blundell.
Bertram Hart.
J. Huebner.
A. Lapworth.
E. F. Morris.
A. Worthington.

Hon. Local Secretary:

L. E. Vlies, Belmont, Gowan Road, Alexandra Park, Manchester.

Newcastle Section.

Chairman: H. Peile.

Vice-Chairman: T. W. Lovibond.

Committee:

P. P. Bedson.
C. Budde.
S. H. Collins.
W. Diamond.
J. T. Dunn.
F. C. Garrett.
T. Hardie.
G. P. Lishman.
J. H. Patterson.
H. D. Smith.

Hon. Local Secretary:

E. F. Hooper, 10, The Elms West, Sunderland.

Hon. Treasurer: W. Gemmell.

New England Section.

Chairman: S. W. Wilder.

Vice-Chairman: (vacant.)

Committee:

F. E. Atteaux.
C. G. Bird.
D. J. Danker.
W. C. Durfee.
C. H. Fish.
C. L. Gagnebin.
R. Hütz.
H. P. Knapp.
W. D. Livermore.
L. A. Olney.
W. K. Robbins.
B. E. Schlesinger.
H. J. Skinner.
W. S. Williams.

Hon. Treasurer:

Frank W. Atwood, 216, Milk Street, Boston, Mass., U.S.A.

Hon. Local Secretary:

A. A. Claflin, Avery Chemical Co., Lowell, Mass., U.S.A.

New York Section.

Chairman: J. Alexander.

Committee:

C. Baskerville.
Carleton Ellis.
W. M. Grosvenor.
Martin H. Ittner.
D. W. Jayne.
A. C. Langmuir.
H. S. Miner.
Gilbert Rigg.
Allen Rogers.
C. E. Sholes.
Utley Wedge.
M. C. Whitaker.
E. A. Widmann.
H. Wigglesworth.

Hon. Treasurer: Frank C. R. Hemingway, Bound Brook, N.J., U.S.A.

Hon. Local Secretary:

P. C. McIlhiney, 50, East 41st Street, New York City, U.S.A.

Nottingham Section.

Chairman: John White.

Vice-Chairmen: S. R. Trotman and John White.

Committee:

T. H. Adams.
L. Archbutt.
M. Barrowcliff.
F. H. Carr.
R. M. Caven.
B. Collitt.
R. Duncalfe.
J. H. Dunford.
F. Stanley Kipping.
C. E. B. Merriman.
A. Smith.
J. T. Wood.

Hon. Treasurer:

S. J. Pentecost, Lenton Works, Nottingham.

Hon. Local Secretary:

J. M. Wilkie, 38, South Road, West Bridgford, Nottingham.

Sydney, N.S.W., Section.

Chairman: H. G. Smith.

Vice-Chairman: C. E. Fawsitt.

Committee:

R. W. Challinor.
F. A. Coombs.
J. D. Granger.
R. Greig-Smith.
G. Harker.
A. B. Hector.
Loxley Meggitt.
S. E. Sibley.
B. J. Smart.

Hon. Local Secretary and Treasurer:

T. U. Walton, Colonial Sugar Co., O'Connell Street, Sydney, N.S.W.

Yorkshire Section.

Chairman: J. W. Cobb.

Vice-Chairman: W. McD. Mackey.

Committee:

A. M. Anty.
James Bedford.
B. A. Burrell.
S. H. Davies.
J. Evans.
C. P. Finn.
W. M. Gardner.
A. G. Green.
C. H. Hardy.
F. W. Richardson.
J. J. Thompson.
Geo. Ward.

Hon. Local Secretary and Treasurer:

T. Fairley, 17, East Parade, Leeds.

PROCEEDINGS

OF THE

THIRTY-FIFTH ANNUAL GENERAL MEETING,

EDINBURGH,

JULY 19—21, 1916.

The Thirty-fifth Annual General Meeting of the Society of Chemical Industry was held in the Hall of the University Union, Teviot Place, Edinburgh, on Wednesday, July 19th, 1916.

At the outset the Chair was taken by the Lord Provost of Edinburgh, Sir ROBERT INCHES, who said :—

"It gives me very great pleasure to come to the opening of the Annual General Meeting of the Society of Chemical Industry and, on behalf of the Corporation, to offer you a hearty welcome to the capital of Scotland. I recall the fact that your Society visited Edinburgh in July, 1894, when Sir James Russell was the occupant of the Civic Chair. The meetings on this occasion will take the form of a Congress on the progress which has been made in British Chemical Industry since the war began. To demonstrate to some extent the real progress which has been made, there will be an exhibition of certain classes of chemical products, some of which were not made in Great Britain prior to the war, while in other cases these exhibits are designed to show the great progress that has been made. While Edinburgh is not a great industrial centre, there are a number of important chemical industries in the district, amongst which may be mentioned glass making and paper making, and one or two new industries which have been started since the war began. Specimens of the products of these industries are also to be on exhibition. A Section of the Society for the East of Scotland was formed in Edinburgh a little over a year ago, and at the end of its first session it has now the honour of welcoming the members of the Society to Edinburgh at this time."

The PRESIDENT then expressed to the Lord Provost the cordial thanks of the Society for the great honour he had done them in attending the meeting and welcoming them. He felt that the compliment was one which the Lord Provost desired to pay not only to themselves but to the great and important industry which the Society represented. He was sure that reminiscences of the first meeting of the Society in Edinburgh, to which he had referred, had greatly influenced them in arriving at the determination to come again.

The LORD PROVOST thanked the President for what he had said and left the chair, which was taken by the President, Dr. CHARLES CARPENTER.

The Acting Secretary then read the Minutes of the Meeting which took place at Manchester last year, and these were confirmed and signed by the President.

On the motion of Mr. E. V. EVANS, seconded by Mr. WHELDON, Mr. J. W. Tait and Dr. H. G. Rule were elected Scrutators for the ballot in respect of the election of Members of Council.

REPORT OF COUNCIL.

The Report of Council was then read, as follows :—

During the year the Council has held 11 meetings, Accounts Committee 10, Publication Committee 24, Information Bureau Committee 10, Annual Reports on Applied Chemistry Committee 4, Triple Joint Committee 3, Special Joint Committee 2, and Catalogue Committee 2, also a Conference on Paper Supplies.

The number of Members now on the Register is 4059, as compared with 4017 last year. Since the last Annual Meeting 301 new Members have been elected, and the losses have been 259.

The losses by death amount to 62, viz. :—J. M. Aitken, J. W. Aylsworth, C. Barzano, John Brock, H. Brunner, W. Cairns, M. Cannon, C. A. Catlin, A. R. Clarke, Bryan Corcoran, Arthur J. Dickinson, Wm. B. Duffus, Peter Dunn, J. L. Foucar, Elton Fulmer, John Fyfe, W. B. Gerland, Guido Goldschmiedt, John Grindley, Arthur Harris, Jos. W. Harris, Arthur Haydock, Thos. Hill-Jones, Christopher Hodgson, Edward Jackson, Wm. G. Johnston, Georg E. Kind, E. Lequin, Ivan Levinstein, Vivian B. Lewes, John G. Lyon, G. D. Macdonald, Isidor Magnus, N. H. Martin, Raphael Meldola, A. Dominguez Miralles, Walter Nelson, Andrew Noble, T. L. Patterson, A. R. Pechiney, Kenneth Pelmore, D. J. Playfair, Henry Pollard, Edward Rhodes, F. J. Richardson, Henry E. Roscoe, John Salamon, J. I. Smail, Ewing Smith, F. O. Smithers, W. M. Sowerby, David Spence, W. Stanley, F. W. Stoddart, A. Vorisek, G. Wachtel, W. R. Waterfall, G. Weddell, E. W. Wheelwright, E. E. Wilkinson, J. Murray Wilson, Corbet Woodall. Sir Henry Roscoe was the first President of the Society. Mr. Levinstein was President from 1901 to 1903, and Prof. R. Meldola was President from 1908 to 1909. Major J. L. Foucar died of wounds, and Messrs. Jos. W. Harris and Walter Nelson were killed in action.

Four Ordinary Members retire from Council, and to fill the vacancies thus created, eight nominations have been received, a ballot will therefore be taken.

The following Chairmen of Local Sections retire :—Prof. J. Watson Bain (Canada), Prof. Henry Louis (Newcastle), Dr. W. M. Grosvenor (New York), Mr. John White (Nottingham), Prof. C. E. Fawsitt (Sydney), and Mr. F. W. Richardson (Yorkshire). The following have been elected to succeed them :—Mr. T. H. Wardleworth, Mr. H. Peile, Mr. Jerome Alexander, Dr. R. M. Caven, Mr. H. G. Smith, and Prof. J. W. Cobb. Dr. Alex. Rule, Secretary of the Liverpool Section, retired shortly after the last Annual Meeting, and was succeeded by Dr. Alfred Holt. The Council desires to express its thanks to the retiring Officers for their services to the Society.

The Balance Sheet and Annual Statement of Accounts, which have already appeared in the June 30th number of the Journal, will be laid before the Meeting.

The Journal in 1915 contained 1276 pages of text as compared with 1230 in 1914.

The Committee appointed in November, 1914, to consider the foundation of a Permanent Bureau to assist and advise in the consolidation of Chemical Industry in the Empire, has been actively engaged during the past Session on the necessary preliminary work. A register of the members of the Society and their occupations, on a more elaborate scale than the List of Members, published annually, is nearly completed, and the Committee has had under consideration the formation of a register of chemicals and allied manufactures, and of the manufacturers of chemicals and chemical plant, based on the classes in which abstracts are arranged in the Journal. The Committee also proposed that steps should be taken to stimulate the manufacture of chemicals not made in this country by drawing together the manufacturers in their respective classes : to collect and distribute information from foreign countries as to the supply of and demand for chemical products, raw materials, and plant, and to obtain reports of new markets, fiscal changes, and patent regulations ; and to encourage inquiries from Government Departments, British Dominions, Consular Agents, etc.

as to the demand for and supply of chemical products, plant, and raw materials. As it appears possible that some of these matters are such as will be dealt with by the proposed Association of Chemical Manufacturers referred to below, it has been decided to defer further action for the present.

On November 4th a joint meeting of the Councils of the Chemical Society, Society of Dyers and Colourists, and this Society was held to consider the best methods for promoting co-operation among chemical manufacturers themselves, and between them and the teachers in Universities, Colleges, and Technical Schools, and also for initiating and prosecuting researches in connection with the scheme of the Advisory Council for Scientific and Industrial Researches. On the recommendation of this meeting a Triple Joint Committee of the three Societies was appointed, and later drew up a scheme for carrying out these objects. This scheme was submitted, on May 23rd, to a meeting of representatives of over 100 of the principal chemical manufacturers, at which it was decided to form an Association of British Chemical Manufacturers.

The President and Council of the Royal Society on May 22nd convened a conference to organise scientific effort in this country. At this conference a Conjoint Board of Scientific Societies was constituted, for the furtherance of the following objects:—Promoting the co-operation of those interested in pure or applied science; supplying a means whereby scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; and discussing scientific questions in which international co-operation seems advisable. The Society of Chemical Industry is represented on this Conjoint Board by Sir George Beilby and Sir Boverton Redwood, Bart.

The Council has addressed to the Advisory Council for Scientific and Industrial Research a request for a grant in aid of a research to be carried out by Mr. J. Huebner at the Municipal School of Technology, Manchester, on the changes which cellulose undergoes during certain technical operations. The request has, however, not yet been granted. It is unfortunate that there should have been hesitation in supporting a research which promised to be of considerable technical value and was put forward on the deliberate recommendation of the Council of this Society.

During last year a Joint Committee of the Chemical Society and this Society was appointed to receive suggestions and inventions in connection with the prosecution of warfare on land, for transmission to the Inventions Department of the Ministry of Munitions. This Committee furnished to the Ministry suggestions which there is reason to believe were found useful.

The Society has been in communication with the Royal Commission on Paper and Pulp Supplies with a view to the removal of the restrictions on the consumption of paper by Journals of Learned and Technical Societies, but the Commission was unable to grant any relief in this respect. It has therefore been necessary for the Society to condense as far as possible all matter appearing in the Journal.

The Council has approved a scheme for the issue of periodical Reports of the Progress of Applied Chemistry. These Reports should tend to increase the value of the Journal by presenting a series of expert reviews of the various industries.

A Committee of the Council, appointed on the motion of the Liverpool and Manchester Sections, is engaged in the preparation of a catalogue of scientific and technical Journals and Patent literature to be found in the Libraries of this country. It is hoped that this catalogue will shortly be available for the use of members.

The Council has appointed a Committee to report and advise the Board of Agriculture on the disabilities under which manufacturers are labouring owing to the present method of estimating the fertilising value of slags from their solubility in citric acid.

A large number of copies of the August 31st issue of the Journal were lost when the S.S. "Hesperian" was sunk by a submarine. The Council arranged for a special reprint of this issue to replace the lost copies.

The changes made in the character of the Annual Meeting at Manchester last year, involving the substitution of the reading and discussion of papers dealing with subjects of great general interest, for many of the functions of a purely social character, were eminently successful, and the Council notes with great satisfaction that the Committee of the Edinburgh Section has arranged the programme on similar lines this year.

An invitation to hold the next Annual General Meeting in Birmingham will be laid before the meeting.

In order to bring the Council into close touch with the Sectional Committees, it was decided to hold two meetings of the Council each session in provincial centres; the February meeting of the Council was accordingly held in Liverpool. It was also decided to hold in each Session conferences of the Chairmen and Secretaries of the various Local Sections.

Messrs. H. Hemingway and D. Lloyd Howard were elected to fill vacancies in the Council caused by the resignation of Sir Hugh Bell and the election of Dr. Charles Carpenter to the office of President, and Sir F. L. Nathan has been elected to fill the vacancy caused by the death of Mr. N. H. Martin.

Messrs. E. V. Evans and W. J. Rees and Prof. G. T. Morgan have been elected members of the Publication Committee, and Messrs. D. L. Howard, T. D. Morson, and A. Gordon Salamon members of the Accounts Committee.

Mr. C. G. Cresswell, who had been Secretary of the Society since 1884, having resigned, the Council has awarded him a superannuation allowance of £300 per annum. In response to advertisement for a successor, the Council has received ninety-eight applications, and after consideration of these decided to appoint Dr. J. P. Longstaff at the salary of £600 per annum.

Dr. J. T. Dunn moved the adoption of the report. As a former member of the Council he had some knowledge of the way in which the business was conducted. He had a very pleasing recollection of the meetings and of the devotion of the members to the work. During the present year the Council had had an unusually arduous time and it was a matter for congratulation that the Society had a body of men who had so devoted themselves to the interests of the Society.

Mr. F. H. Carr seconded the motion, and endorsed what Dr. Dunn had said of the arduous nature of the work of the Council. The effect of that work was sincerely felt and appreciated by the members.

The motion was put to the meeting and adopted unanimously.

Report of Hon. Treasurer.

The Hon. Treasurer, in presenting the financial statement, said that the balance sheet as printed in the Society's Journal of June 30th differed very little from the preceding ones. In 1914 there was an excess income over expenditure of

£894 15s. 2d., and in 1915, of £997 14s. 5d. So far as the investments were concerned there was that unfortunate element which accompanied most investments, namely, depreciation, and, unfortunately, that depreciation had not ceased. The valuation of the investments in 1914 was £18,693 4s. 8d., a depreciation of £2314 15s. 7d., or 11% on the purchase price. The valuation in 1915 was £19,755 18s. 1d. and the depreciation £2913 4s., or nearly 13%. The investments were increased by the purchase during 1915 of £1700 of war stock at 4½%.

The depreciation was considerable, but it compared very favourably with that shown by some mercantile concerns as well as in institutions in which investments were treated much as in our own. In the case of one undertaking in London, managed by financiers of note, the depreciation had been no less than 16½% for 1915. They were frequently reminded in the Council that they should progress, but progress was impossible without money, and the question of means was one which concerned the Council very much and gave the officers most concerned a considerable amount of anxiety. The Council had great pleasure in submitting the accounts, and hoped that they might be favourably received by the Society.

The PRESIDENT said that the amount of attention given by the Hon. Treasurer to the financial affairs of the Society had been found of the very greatest value by the Council. So long as the balance sheet bore upon it the two statements, one showing the various investments and the other the valuation at which they stood at the moment, it could not be regarded as other than a true and fair statement.

Mr. W. F. REID moved the adoption of the balance sheet and accounts, and at the same time proposed a hearty vote of thanks to the Hon. Treasurer, who had taken so much care in preparing the report. He had rendered yeoman service to the Society in his very careful and accurate conduct of their financial affairs. Very few realised the work which he had to do. When it was considered that there were over 4000 members, each member had to pay a subscription and there were several entries for each man, that all that money had to be dealt with and operated upon a number of times, it would be realised that he had an enormous amount of detail to carry out, especially during the early part of the year, and they ought to be deeply grateful to a man of his commercial ability for the devotion with which he applied himself to their affairs. When presenting his financial statements to the Council he always put into their minds the thought that however much they might wish to extend the scope of the Society's operations, they were necessarily limited by the financial aspect. It was a matter of great gratification to them that the Council was able to present so favourable a balance sheet as it had done. He had much pleasure in moving the adoption of the accounts and the vote of thanks to the Hon. Treasurer for the work which he had done on behalf of the Society.

Mr. R. D. PULLAR, in seconding the motion, emphasised the request for a special vote of thanks to the Hon. Treasurer. As one who had been present at the first Annual Meeting and at many since, he thought the Society was to be congratulated on having such a Treasurer. They had had during all those years continuity in the management of their finance, and he felt sure that their finance was in perfectly safe hands.

The resolution was carried with acclamation.

The HON. TREASURER briefly thanked the meeting for their vote.

PRESIDENT'S ADDRESS.

The PRESIDENT then read his Address as follows:—

I must preface the brief remarks I desire to address to you by a well-deserved acknowledgment of the obligation under which the Society finds itself to its youngest, the Edinburgh, Section who are our hosts to-day. I believe we may regard our gathering in such circumstances as a happy augury for the future. As we run over the names of those large cities of the Kingdom where it has been our custom to hold these meetings, they stand out most prominently as centres of industry and commerce where Art and Science have found modern dwelling places. But the "Athens of the North" claims our homage essentially as an ancient seat of learning, spiritualistic rather than materialistic, a more congenial soil for the study of *belles-lettres* than for researches in dye-stuffs. If Art and Science mutually need inspiration from each other, then our meeting together in Edinburgh cannot but be fruitful in good results.

Foremost among our thoughts here must be consideration of the relationship between the educational and the industrial problems. Three aspects of this seriously concern us. First, I would place the need of recognition by the professors of learning of the necessity to the Country of a Cultured Industrialism. Second, the acceptance by Industry of the faith that only through Science can it develop and prosper. Lastly, but not least important, the understanding by statesmen that neglect of these principles will be as deadly to the nation as disregard of its health or morals. When the effect of bounty-made sugar in damaging what was once a flourishing British industry was pointed out to Gladstone, he retorted "make jam." He would not have uttered that remark had his knowledge of industry been comparable with his mastery of Greek. And this takes us straightway to the root of our difficulties, "Does the education of our statesmen properly fit them for the posts they are destined to occupy in the management of this great Empire?"

How many of them would not have given Gladstone's answer to a similar question put to them two years ago? It came as a rude shock when but a few weeks after war was declared, they woke up to the fact that whatever our jam resources may have been we were lamentably deficient in powder. Fate had unhappily made it impossible for us to rely upon the same source of supply as we fell back upon in our last great struggle. Of what help to our statesmen was familiarity with the Trojan War, the Punic wars, or any of the great conflicts of ancient times, in the mortal combat in which we have been engaged for the past two years? The industrial sciences are now the dominating factors, not cleverness in classics, and slowly the nation is becoming alive to this fact. Is it not time, then, that our educational houses were set in order, and that the atmosphere with which they are permeated and by which the best of the nation's youth is so largely imbued, was charged with other ideals? Is there not in our mother tongue an adequacy of classic thought and expression to provide exercise and food for the developing mind?

Now this is where the Edinburgh Section of our Society can play an important part. The University is celebrated throughout the world, and attracts students from all parts. It possesses the great advantage that the city has a substantial voice in its counsels. What a step forward would be gained if it could be inspired to take upon itself the responsibility of placing Science in the forefront of its teaching; if among all the older institutions it set the example in a change which sooner or later is bound to come over the spirit of teaching, if we are to hold and maintain our place among the nations! Surely Physical Science deserves, nay, demands, to-day a place in the scheme of education, along with that of morals, and coupled with such languages that one may read first-hand its story-books, and find inspiration in the records of its far-reaching discoveries and the paths followed by explorers in their seeking. Its meditations, too, are always healthy, never morbid, whether pursued in the laboratory or the study.

The suggestion has been put forward that the mental characteristic of our race does not fit it to become expert in the science of organic chemistry. In my humble but considered opinion this is a fallacy. I believe there is no reason why we should not attain eminence therein as we have in, let us say, seamanship or shipbuilding. Our youth, however, needs an apprenticeship on land, as earnest-compelling as that afloat, where carelessness brings speedy retribution. There are no doubt many scores of students who have a natural capacity for organic chemistry, had but fate willed its exercise, or there had been its atmosphere in our educational centres as of sea-salt at our ports. But, it will be asked, will our manufacturers avail themselves to the full of the services of skilled chemists; are they not already too often disappointed by results? Certainly they will be disappointed again and again, if they only call them in when in trouble and expect them to wave successfully a magician's wand over their recalcitrant processes. There are two main difficulties to be encountered in transferring laboratory work to the large scale. One is its economics; the other its practicability. Most people are aware that to extract gold from sea-water is a proposition financially faulty. Chemists need too often to be reminded that though a process may be pretty it does not attract a manufacturer unless it is sound. Some of the most beautiful productions of the lathe are those in which from a block of ivory are fashioned a whole range of objects one within the other up to the very core. But the utility of such an operation is easily thrown into the shade by the output from a simple piece of apparatus used for making circular the treads of railway wheels. As part of the training of chemists, careful attention should be given to the matter of costs, by setting problems for research in which definite prices are allowed for the raw materials to be used. In addition to this, values should be fixed for the various operations involved, such as distillation, ordinary or vacuum, filtration, crystallisation (whether from water or other solvents), centrifuging, and so on. The chemist would thus be trained in the laboratory to the importance of price questions which are certain to arise in the course of his work. He might also be counselled to listen patiently to the so-called practical man, whether leading hand or otherwise, who may be entrusted with the charge of carrying on the large scale work. There is every probability that he may learn something from him, just as there are circumstances at sea when we would feel safer in the hands of a local fisherman than the captain of a Cunarder. The other important factor in setting up large scale and modern processes is the increasing need for the engineer to take an important share in their development. Not only must the process itself be theoretically sound, but industrially sound also. Heat, power, and labour absorbed together with the scale of adaptation and the nature of the plant employed, are matters upon which the trained engineer is peculiarly fitted to give valuable advice with a view to reduce output costs to their lowest level. The engineer may, indeed, be regarded as a no less needful adjunct to the chemist in such circumstances than is the surgeon to the physician in problems pertaining to health. How many chemical inventions have failed to mature because of engineering difficulties attending their development? The mutual obligation to each other of the Chemical and Engineering sciences is an increasing one, and of which a very good example is the synthetic production of nitrogen compounds.

There is yet a third factor to be considered in the pursuit of efficiency, namely, the workmen. For twenty-seven years the undertaking with which I am chiefly associated has practised a system of co-partnership with its employees, very much on the lines of that described in one of the papers read at our last Annual Meeting. The manufacturer who seeks the highest chemical yield and the highest mechanical yield stops short of his goal if he overlooks the part played by labour and does not aim at its highest efficiency also. The chemical worker is as necessary to the well-being of the State as the sailor or the soldier. Yet how many go to their work with the same alacrity and cheerfulness as the latter to their death? The reason is not far to seek; they share the responsibilities and advantages of progression, and their duties and rights are recognised in the supreme councils of the nation. In industry such ideals are unfortunately a long way from attainment. It would take many inventions and much wisdom in management to do for industry what its own labour could, were it but imbued with the idea of how much could each industrial unit turn out, instead of how little. The Company to which I have referred has gone a long way in the direction of realising such hopes, and to-day of its 6800 workpeople, over 6000 are shareholders. Anticipating the not unusual criticism, may I add that while in France no similar undertaking is working under these conditions, they have been largely applied in many other industries. Two practical examples of utility happening within the past fortnight may be interesting. The one is of a leading hand who, expressing the hope that we had made a wise choice in the appointment of a new manager, remarked that all his life's savings were invested in the business. The other is of a corporal just returned from the front where he had been since the outbreak of war, who brought in French notes all his savings of pay to be invested in the Co-partnership. I should like before leaving the debatable ground of Capital and Labour to refer to a practice which, I believe, would be found useful by all employers. It is that of holding inquiries into every industrial accident by juries of workmen (in fatal cases after the coroner's verdict has been given). This has been found very helpful in reducing the number of cases, as well as their seriousness. It must be remembered that efficiency is not only concerned with raw material, but with each unit of human life employed. Necessarily, it is the former point of view rather than the latter which has largely dominated the work achieved by our Society in the third-of-a-century of its existence, and it is interesting to note how the history of Chemical Industry in this Country has been recorded in the pages of the Journal. Its earlier volumes describe the triumphs of those technologists whose names are familiar to us as household words—Weldon, Siemens, Mond, Beilby, Chance, Hurter, Gilchrist, and many others. In later years the progress made by other countries grows more in evidence, outstanding examples being synthesis of indigo and of ammonia, though a notable exception is provided by the labours of Messrs. Cross and Bevan, whose work on cellulose laid the foundation of a large industry.

That the Society has "done its bit," in the parlance of the hour, in the making of the history of Applied Chemistry cannot be doubted. Might it have taken a larger share? It is not easy to answer such a question, despite the opportunities given by time for the acquisition of belated wisdom. Perhaps its greatest opportunity for what I will call original work might be regarded as not only the bringing together of the expounders of theoretical and the practitioners of technical chemistry, but to have made them such friends that each has gathered understanding from the other. Now, surely, there never existed so suitable a problem for a round table conference as that of the utilisation of the fuel supplies of the Kingdom. No one could possibly quarrel with the description of our coal resources as being the most important of our capital assets. Yet the bulk of the Country is busily engaged either in squandering that capital or bartering it away and living on the proceeds. If water power be looked upon as a national heritage, and such a view is finding increasing favour throughout the world, the arguments in its favour apply with greater force to the deposits of coal, for these are limited despite their greatness, while the falls are inexhaustible. Parliament has already placed under authority our tidal rivers, the use of which is regulated for the common good. Should the development and utilisation of our coal resources be left unrestrictedly to the individual or group of individuals acquiring mining rights, generating energy, or warming their dwellings, or should such matters be subject to State supervision and control? Should the payment of two or three pence per ton be the solitary factor deciding whether or not the nation's coal leaves its shores to be worked up into by-products by the nation's competitors in industry? Could not the large demand for fuel required for metallurgical purposes abroad be met by the export of coke instead of coal, leaving the by-products to be utilised and handled here? Has the time come when the raw coal exported should pay substantial duties to the State, and every user at home be required to satisfy the authorities before he can obtain quantitative licences for its consumption? Will a democratic parliament ever follow the example of an autocratic government and prohibit the combustion of raw coal in our cities and towns? Now that we are at last receiving encouragement in thinking Imperially, problems which seemed stupendous show themselves easy of solution, and what is more, they will compel attention and decision. Certainly that of coal utilisation may well commend itself to our Society. It may be asked "Is not this the case with all matters pertaining to the welfare of Chemical Industry?" I do not so regard them. Take for example, free trade or scientific tariffs; or the attitude of the State in labour matters or in special legislation. While such subjects may be proper ones for discussions by a Society such as ours, it clearly is not in a position to speak on them with a united or even an authoritative voice. It is mainly for this reason that there has recently come into being a new organisation in the shape of an Association of British Chemical Manufacturers. Owing its being to the Chemical Society, and its development to our own, we may describe it as by pure out of applied science, and I believe it will prove worthy of its parentage. Its proposed constitution provides the fullest powers to work with kindred associations on the one hand towards industrial efficiency, and on the other by the encouragement of training and research. And its formation will certainly relieve the Imperial Parliament from such a time-wasting occupation as discussing what restrictions should be placed upon the producers of coal tar who propose utilising its distillates for the preparation of other substances.

If, however, our constitution as a Society does not provide us with facilities for handling problems such as these, there are untilled fields of usefulness ready for the ploughshares of our endeavours, and they are not being neglected. The Council has recently adopted a scheme for the preparation by competent authorities of annual reviews of the progress made in the various branches of chemical industry, classified under the headings familiar to readers of the Journal. Such additions to the Society's undertakings are, however, bound to necessitate expenditure, but I cannot think members would regard with disfavour these and similar proposals even if they entailed a small increase in the annual amount of their investment in its funds. May not indeed this meeting of ours be considered as giving the opportunity once a year, to those attending it, for expressing their technological faith and belief in that science of Applied Chemistry which takes the discoveries of the laboratory and welds them into those might-wielding creations needed by mankind in the evolution which is his birthright? If we are sincere in that belief, and in the share we are to take in its dissemination and propagandism, can we not look forward to one day building our own meeting-house? One of our most able members has already urged upon us the undertaking of such a duty. Those professing the healing art have a worthy home where under one common roof are to be found lecture rooms, a library, a laboratory, and even a tea room, a rendezvous for all engaged in the many branches of medical and surgical knowledge. Many years ago a countryman of this "bonnie" land expressed to me his admiration for the faith the designer of the North Western Railway had in its future when he planned the monumental gateway to it which we know as Euston Station. May it not be hoped that those who live by or through the Chemical Industry of Great Britain will not lightly put aside consideration of the possibilities such a proposal holds out? We want Physical Science, of which Chemistry is after all but a part, recognised as entitled to a place in the teaching of the schools throughout the kingdom. We want provision made for its deeper study by technical and secondary institutions wherever industry is established. We want chairs of chemistry, organic as well as inorganic, at all our Universities, new and old; and the need of these things we must press unceasingly upon those who are entrusted with the duties of Government. But we must build our own temple to the Science among whose votaries we claim to number ourselves, and Chemistry is no less worthy of such honour than are her other sisters in the Arts and Sciences, whose "Cinderella" she has been so long.

Presentation of the Medal.

The President said that he had a very pleasant duty to perform in recognising important work which had been carried on in chemical industry. The special part which this Society was created to fulfil was to promote applied science and especially the application of chemical science. One of the privileges possessed by the Council was that of recommending from time to time that the Medal of the Society be awarded to some person who had shown conspicuous ability in the domain of applied science, and he had much pleasure in announcing that in accordance with that power the Council had decided to award its Medal to Mr. C. F. Cross for his conspicuous services to chemical industry. He specially mentioned, concerning Mr. Cross' work on paper, the value of the fact that he was one of the first clearly to point out the importance of maintaining the quality of paper, especially in those books and documents which were intended to be permanent records; his other great work in cellulose was of course familiar to readers of the Journal through the various papers which he has contributed. On those grounds the Council were unanimously of opinion that he well merited this award. There had been one difficulty and that was that the power of the Council was confined to awarding one medal in any year, and that medal must be awarded to one person. In this particular case, with reference to much of the work done by Mr. Cross, he was the first to desire recognition of the fact that he had been associated with Mr. Bevan for a very long while. Unfortunately, however, they had only one medal and therefore must bestow it on the person whom they believed to be primarily the person responsible for the great work carried out in the joint names of Messrs. Cross and Bevan.

The President thereupon handed the Medal to Mr. Cross.

Mr. CROSS said that the honour which had been conferred upon him in such extremely generous terms, struck right home, and he wished he could find words adequate to convey the emotions which were raised within him. In their own work the only thing which interested them was the truth, the whole truth, and nothing but the truth, and therefore he would be very sorry to claim anything beyond what justified the selection of the Council for this honour. He therefore mentioned that he had had the co-operation not only of his partner, Mr. Bevan, and also of his some-time partner, Mr. Beadle, but of his assistants who from time to time had thrown themselves devotedly into this work, and notably Mr. J. F. Briggs. In regard to the development which had taken place in connection with the artificial silk industry, he indicated what was particularly due to co-operative work on the part of his colleagues. He had been joined in 1897 by Mr. Stearn and his assistant, Mr. Topham, men whose technical work was of ideal thoroughness. Both of them had been, he believed, associated with the late Sir Joseph Swan, in the early days of the incandescence lamp, and what had attracted them to the cellulose problem in the early days was the search for "carbon" for the filaments. They had soon found viscose satisfactory for that purpose and then turned their attention to its use for making textile threads. Between them they had excogitated a thoroughly mathematical conception of the several processes therein involved, namely, the drawing forward at a particular speed, the necessary twist required to enable the compound thread to be handled in the winding and other operations; the integral solution of this complex problem was the vortex of a centrifuge, and the discovery gave a new impetus to the production of the thread. The method was still largely used, and it was only due to those two men to recognise the extreme importance of the work which they had done and which had had the greatest possible effect in developing this industry.

He also mentioned the pioneer work of the Société Française de la Viscose. They had made a success in thread, in film (drawn by a continuous machine and finished in one process), and in massive solid forms of cellulose, by contrast with the meagre results obtained in Germany; they had gone very much further ahead and with very much greater speed and to very much greater final success. In this country the artificial silk was in the hands of the firm which was Samuel Courtauld and Co. and is now Courtaulds Limited. Superimposed upon the chemical industrial side of the work of that firm, there had been a large contribution of true textile invention, which had had the greatest possible importance in regard to the development of the industry and a commerce which was now world-wide. Looking back over the vista of years he was particularly aware of the difficulties which they had encountered, especially that of being between the cross fires of the commercial or financial man whose watchword was secrecy, and the scientific man, whose disinterestedness, perfectly natural and spontaneous, led him always to wish to publish in order that he might communicate what he had found in his laboratory to his fellow scientific men. It took another form in the question whether inventive science was really at root individualistic or socialistic. Possibly it would always remain more individualistic than socialistic, because the source of discovery was in the imagination and emotions, and due to primary contact with things, and he did not know that any corporate body was able to claim much in that respect. They, as disinterested chemists, were always most anxious to take counsel with their brother chemists, and give them the benefit of anything that had impressed them, just as they looked to hear of any new discovery by others at the earliest possible moment. In thanking the President and the Society, he assured them that they felt nothing more than that they had but made a beginning. He thought they might claim to have made a strong beginning, but it was only a beginning. The British textile industry was the most important in the world and the work which they had been able to do must contribute more and more and in an increasing way to the progress and development of the old country.

Professor ARMSTRONG, in proposing a vote of thanks to the President for his address, with the request that he allow it to be printed in the Journal, said that as a Member of the Council he also desired to express their gratitude to him for his conduct in the chair during the past year. The address was full of most valuable constructive allusions. Thus the expression which the President made use of at the outset in saying that what the country needed was a Cultured Industrialism, did absolutely sum up the situation. If they could bring culture in its truest terms into industry they would be saved. Matthew Arnold had summed up the situation years ago in stating that what the country needed was to get *Geist*—a true intelligence. The President remarked that the mastery of Greek was not all that was required: it was a little distressing to see in the papers that, after all the appeals to the country to reform its educational system, a Senior Classic and a Cleric had been appointed as Headmaster of Eton; no more unfortunate step could have been taken, in view of the need of an example to the public schools of what was required. Much had been said of late by Lord Cromer and others as to the value of humanistic studies. Chemists were frequently characterised as opponents of humanistic studies. No more preposterous assertion could be made. Most of them had gone through the classical mill, which had ground so many to pieces; they therefore could appreciate the position of the classic, but he had not the faintest understanding of the position in which the student of science stood. The ordinary humanist, looking at flowers such as were on the table might be struck by their beauty but he had not the least conception how much more they meant to the instructed eye: the volumes o organic chemistry that flashed into view wheneve the complexity of their colouring matters and o the processes involved in producing them were thought of. The President had said that physica science demanded to-day a place in the scheme o education, along with that of morals: but wa not the true teaching of science the way to develop morals? Mr. Cross had spoken of the scientifi man as an idealist and a worshipper of truth bu it was because there had been so little true scienc taught that we were in our present positio Such science must be brought into the industrialis of the future. But it would be useless to teac science more if use were not made of it whe occasion called for it: from this point of view it was most unfortunate that the charge of industrial research had been given into the hands of a poet as chairman and of a gentleman, as chief secretary, whose qualifications were only literary. The President had referred to the connection of chemistry with engineering. He had himself set a wonderful example by entering into association with the chemist and perfecting the process of gas purification from which such admirable results were now obtained. We must realise that the future of industry in this country depended as much upon the workmen as upon the masters and that the workmen should be educated to understand the issues before the country. The support of the workmen would doubtless be required in forcing the Government to take suitable action in questions such as those of fuel economy and of the dye industry. The Society had cause for special congratulation in having had such a President during the past year. Those who had been present at Council Meetings knew with what extreme urbanity and tact he had presided at the meetings. There had been very difficult situations to deal with and he had helped to an extraordinary extent. The Society was very fortunate in that it was to have him as President for a second year. He trusted that the step would form a precedent for appointing Presidents for two years. During the past year it had been decided to prepare and print reports of progress in the various branches of applied chemistry. The idea of these reports was primarily due to one of the latest acquisitions to the Publication Committee, to a colleague and fellow worker of the President, Mr. Evans. In moving the vote of thanks he had no hesitation in asserting that no President had ever done greater service to the Society.

Mr. Thomas Fairley, in seconding the motion, said he thought that the President's address was somewhat unique in its extreme comprehensiveness. Professor Armstrong's reference to flowers reminded him that the Author of Christianity itself had said, "Consider the lilies how they grow": that was really an exhortation to study science. Our very best thanks were due to the President, and they welcomed him anew as President for the coming year.

Professor Armstrong put the vote to the meeting and it was unanimously and cordially agreed.

The President thanked the members for their appreciation.

Mr. H. L. Terry proposed, and Mr. F. W. Atack seconded, the appointment of Messrs. Feasey & Company, Chartered Accountants, as auditors for the ensuing year at the fee of 30 guineas. The motion was unanimously agreed to.

Place of Next Annual Meeting.

Mr. W. J. Rees, on behalf of the Birmingham Section, extended a cordial invitation to the Society to hold the next Annual Meeting in Birmingham. Since the last Annual Meeting at Birmingham very important changes had taken place and undoubtedly those changes would considerably enhance the usefulness of the meeting. The Section would use every endeavour to make the next Annual Meeting, if held in Birmingham, as successful as the last.

Dr. G. S. Cruikshanks seconded. The invitation was put to the meeting and accepted unanimously.

The President then proposed a vote of thanks to the Committee of the Edinburgh University Union for the use of the building. They could not have found a more suitable hall for the meeting. It was convenient in itself and conveniently placed, and they were under a great obligation to the University Union. He therefore proposed that the very best thanks of the meeting be given to the Committee for their great kindness in placing their hall and buildings at the Society's disposal.

Mr. E. F. Hooper seconded, and the motion was carried with acclamation.

Result of the Ballot.

The scrutators appointed for the ballot in respect of the election of officers for the ensuing year, then reported that as the result of the ballot Mr. E. V. Evans, Mr. E. Grant Hooper, Mr. R. D. Pullar, and Dr. Alfred Rée had been elected Ordinary Members of Council.

A vote of thanks to the scrutators concluded the meeting and the members adjourned for lunch, which was provided by the Edinburgh Section in the Dining Hall of the University Union.

Wednesday Afternoon.

FUEL ECONOMY: A NATIONAL POLICY REQUIRED.

BY HENRY E. ARMSTRONG.

I had no intention of raising the coal question again at this meeting but as I have been asked to fill a vacancy I will venture very briefly to sum up the position in a few propositions.

1. The time for discussion is past—what we need is constructive action. Will this Society take its share, a preponderant share, in dealing decisively with all issues in which Chemical Industry may fairly be considered to be concerned? A wait-and-see policy is no longer possible—some decision must be taken without delay. Up to the present, the outcome of my appeal to the Society at Newcastle has been disappointing; no attempt has yet been made by the Sections to discuss the various issues constructively and the only practical proposal that has been put forward is that of the London Section urging the Council to take the matter into consideration. After several postponements, at the June meeting the Council resolved that each of the British Sections be asked to nominate a representative to a Committee to consider the attitude to be taken by the Society on the question of Fuel Economy. I trust therefore that the matter is now in train.

2. The situation is daily becoming more and more serious. On general grounds of economy, we must desire to utilise our Fuel supplies henceforth in as complete and provident a manner as possible—individual users are sure to move in this direction but there are many ways in which success can only be achieved if concerted and public action be taken. The organisation of power schemes in important industrial areas is probably one of the first subjects to be considered: fortunately considerable experience in this direction has already been gained, especially on the N.E. coast, which can be applied usefully without loss of time.

3. At the moment, not only is coal dear beyond all expectation and procurable with difficulty but we are in face of an absolute shortage of liquid fuel for internal combustion engines and of a shortage of the dyestuffs that are made from various products of the destructive distillation of coal, in the latter case, partly because of a lack of raw material. It is clear that it would be advantageous to carbonise far larger quantities in ovens or retorts and that in future the utilisation of coal will have to be considered not only from the point of view of securing a maximum output of heat energy—it should not be forgotten, also of minimising the nuisances created by the emission of smoke and of acid products—but from the far more comprehensive point of view that coal is to be regarded, not merely as a source of energy but as the raw material

from which both liquid fuel and the primary materials required by the dyestuff industry and other branches of organic chemical industry are derived—not forgetting the high explosives which are playing so dominant a part in the present war; also as the potential source of vast quantities of ammonia, invaluable as a cereal manure, as well as of not a little sulphur.

It is certain that we have little moral right to use coal simply and directly as fuel: from this point of view, should we not memorialise Government at once to foreshadow legislation prohibiting the use of raw coal, as a fuel, at no distant date? I am told that the use of raw coal was stopped in Germany at an early period of the war.

4. Only enthusiasts will think of electricity and gaseous fuel as the sole sources of heat energy; the sane will continue to regard solid fuel as requisite for domestic and manufacturing purposes—in the latter case, at least as a material to be gasified locally. From this point of view, soft coke is necessarily to be regarded as the solid fuel of the future; yet if such be the conclusion, a situation will soon be created that must not be overlooked. Obviously if gas and soft coke be the fuels of the future, the town gas industry, as at present conducted, will need complete reconstruction—the gas works will be called upon to produce both gas and soft coke and to serve as the primary source of fuel supply in its district; moreover, it will almost necessarily be run in conjunction with the supply of electricity. Already the Brighton Corporation have made arrangements for the installation of a coking plant alongside their electrical works, the gas to be used in firing the boilers of the latter; it will be but a small departure to obtain an Act forbidding the use of raw coal in the district which will make the soft coke produced of special value to the town.

5. In my Newcastle paper, I referred to the production of soft coke as still problematic; I was not then aware what had been done to improve Mr. T. Elwell Parker's process, which gave a coke of unexceptionable quality though on far too small a scale to be practicable. In the interval, a gas fired fireclay oven has been devised in which coking can be effected on a satisfactory scale. I am informed that in Germany probably a dozen such plants are in operation which have been erected since the war began, and that the design of these is based upon information derived from the experiments made in this country. Similar plant will soon be in operation in this country near Barnsley, in the centre of the South Yorkshire Coal Field; this will be run in conjunction with an electrical works and a tar distillery. Such being the case, it would seem that the experimental stage is past and that all that is required is independent study by competent authority of the plants referred to when they are in operation.

6. But there are many problems connected with the economical use of coal which must be fully inquired into. It is essential that both the funds and the machinery for such inquiry should be provided without delay. The appointment of a central National Fuel Board to initiate and supervise all necessary inquiries would seem to be the first step that is called for and I venture to think that no better way of obtaining funds can well be suggested than that I have already proposed—*i.e.* a small tax on all coal raised in the country. I hope the Society will be prepared to take action in the manner suggested.

DISCUSSION.

The PRESIDENT said that Prof. Armstrong had put his finger on a very weak point, namely, that many tons of coal were used the whole of the nitrogen of which was absolutely wasted. It was very difficult to foresee the universal use of gas or electric heating, and, in the intermediate stage, some form of solid fuel might be used. How was that to be obtained? The break-down in the coalite experiments had been very unfortunate in many respects. The fundamental idea of Mr. Parker was to carbonise the coal in small cells, and in itself was an admirable one—but when he had put it into practice he was handicapped by the fact that he had been brought up and trained as an iron-founder and so naturally turned his thoughts to making his cells in iron.

Dr. E. F. ARMSTRONG urged that there was still a great deal to be done by manufacturers in economising coal. The best incentive to economy was an increase in price, and from that point of view the present increase—disastrous as it was to many—was a great incentive to economy in the future. The firm with which he was connected had made it a practice for many years to employ a highly skilled chemist entirely to look after their fuel and water supply, and that policy had been more than justified by results. It was a policy worthy of being imitated very largely in British industries, not so much chemical industries, but engineering industries in particular, and by many others of our great industries. He mentioned a case of one firm who had benefited greatly by the installation of a CO_2 recorder. It was only the largest firms who could afford to have an expert for themselves, but it might be possible for half-a-dozen firms in a neighbourhood mutually to engage an expert to look after their fuel and water problems, by which he was sure great economy might be effected.

Mr. R. H. CLAYTON said that in Manchester quite recently they had obtained statistics as to what the losses due to smoke amounted to; they were so large that he thought he was quite justified in the view that the smoke problem was the most important of all fuel questions. The question of fuel economy in cities could best be dealt with by each city itself, and each corporation should have a Committee to deal with the heating of the house and the combustion of fuel, which was, to his mind, of as much importance as looking after the sanitary arrangements. Each city could work on a system of heating or several systems of heating. If in every town a department were established as suggested, he was sure that systems of heating would be evolved which would give far better results than any legislation suggested by Professor Armstrong.

Mr. A. MACDONALD asked how the ash in soft coke was to be got rid of. In Glasgow they had been deeply interested in clearing the smoke from the atmosphere, and one member of the Council was experimenting with a view to producing a coke which would be useful for house fires, but he had found that it contained an excessive amount of ash and had low heating power. The same trouble had been found in similar fuel prepared by a small works in London.

Mr. R. MACLAURIN said that the fuel to which Mr. MacDonald had referred was made from cannel coal, hence the large percentage of ash. With a coking coal a smokeless fuel containing not more than 7 or 8% of ash was readily obtained. The chief difficulty he had experienced in the experiments he was conducting at the Glasgow Corporation's Electricity Station, Port Dundas, was in getting a fuel that would not spark. The sparking was due to the coke dropping while red hot into water. By drying, or avoiding quenching the coke in water, a satisfactory smokeless fuel was obtained. In the low temperature carbonisation of coal by his process very satisfactory yields of oil were being obtained. The oil was fairly fluid, and after separation of a resinous portion would be suitable, he thought, for lubricating purposes or for Diesel engines. The oil contained ractically no benzene nor toluene, as was to be xpected in a low temperature process. An nexpected result, however, was the almost entire bsence of illuminants in the gas made. In some xperiments the coal was carbonised by a current f hot water-gas, without any external heating, nd he had found that the mixed gas given off rom the coal in this way seldom contained more han 0·4% of olefines; had the coal given off 000 or 5000 cub. ft. of gas of 700 or 800 B.Th.U., he olefines should have amounted to fully 4%. n other low temperature processes he was coninced that considerable decomposition took place, iving rise to the illuminants present in such gas. he absence of illuminants in his process convinced im that smokeless fuel would be manufactured ore economically in electricity stations than at as works. His plant was in two parts. When orking for power gas and smokeless fuel, air and team were blown into one chamber where they urned the fuel added to ash and, the gas passed om this chamber into a second chamber, which as practically a large water sealed producer, 0 ft. high by about 8 ft. diameter. The current f hot gas completely carbonised the coal being dded to this chamber. The smokeless fuel was rawn out at the bottom through a water seal. this plant there was no difficulty in carbonising niformly one ton of coal per hour. The gas made both chambers, after cooling and scrubbing, as available for gas engine running or boiler ring. When smokeless fuel was not desired e fuel could be burned to ash in both chambers, d gave practically the same yield of power gas an ordinary producer, but the quantity and ality of the oil recovered were much enhanced.

Mr J. G. **Roberts** said that in the pottery trade did not think there was a plant in existence using s firing which had been an unqualified success. e two biggest plants that he knew of had been andoned. For pottery firing a long and innsely hot flame was needed, and good coal was quired to get that flame. The regenerative stem of heating had not been profitably applied the heating of pottery and the expense of pairs became very great.

Mr. W. F. **Reid** said that he thought the probition of the use of solid fuel was quite impracticle at present. Public opinion was not yet ripe that. They must first try to educate public inion to the great evils and probably the injury health due to the consumption of coal. A great al had been done in reducing the amount of oke from coal. As a member of the Council the Coal Smoke Prevention Association, he said at they were quite satisfied with the progress at had been made in London and other large ies—especially with regard to the elimination fogs in London. The use of more gas had had ne influence, but so also had the expression of blic opinion and in a few cases the action taken local authorities. Dr. Haldane had recently onounced the opinion that the particles of rbon contained in smoke were distinctly benefil to the lungs of those who breathed them, and was now endeavouring to prove that it was neficial to inhale particles of carbon to prevent berculosis. His own belief was that it was the ry substances that were so injurious.

Mr. W. F. **Cooper** expressed the opinion that trouble really was that there was no one in rliament who really understood the subject.

Dr. J. T. **Dunn** said that some progress would achieved if consumers as a body could be suaded that it would pay them to buy coal a calorific basis. Good coal was high in price. t with ordinary inferior coals, the price ninished very rapidly, so that it did not pay sell the latter. That was the reason why se coals were not in many instances worked. Sale on a calorific basis would, he thought, enable colliery owners to work those at present unworked portions of the seams with greater prospects of getting some remunerative price. There were many advantages in low temperature carbonisation processes, but it was not possible to have all the advantages at once. In the ordinary process of gasworks, a very small proportion of the nitrogen was recovered, but low temperature processes, where the solid fuel produced was burnt directly, as in domestic grates, recovered a smaller proportion still. If, however, the solid fuel was consumed in a low temperature gas producer, a greatly increased yield of ammonia could be obtained.

Mr. W. J. **Rees** agreed that the purchase or sale of coal on a calorific basis would be advantageous. He did not think it was the purchaser but the colliery proprietor who stood in the way in that connection. If such a scheme could be brought into operation successfully, it would be to the mutual benefit both of the colliery owner and the user of the coal.

The **President** remarked that the origin of Dr. Haldane's experiments was that he had found that miners as a class were particularly free from tuberculosis, and, having regard to the dusty conditions in which they were working, he was led to believe it might be due to the coal dust. The fog question was more important still. The fog caused the rise in mortality, and the discomfort, and he thought that most of the troubles arising from the imperfect combustion of coal were not due to "smuts," but to the products of distillation.

Professor **Armstrong** in reply, said that he wished to make it clear to this Society that it had a mission which it could fulfil. There was now a golden opportunity for it to take up this subject and make it their own. They should be put in a position to approach Parliament on the subject and urge our views upon them. The whole subject must be dealt with from a practical point of view and proved by results. Great credit was due to a man like Mr. Elwell Parker for conceiving the idea and spending so much time in experiments on a subject of which he knew nothing—that was the type of man who started things in this country; but some concerted effort should now be made to work the problems out. They could be worked out in a very few years, he was sure. The original coalite process was a low temperature process conducted in such a way that the products were carried off immediately, and there was practically no benzene or toluene in the tar but a good deal of carbolic acid of much higher quality than was produced in any other way. The real source of benzene in those processes was not the tar but the gas. The gas produced was very rich and if stripped it gave a satisfactory amount of benzene, leaving gas of a high calorific value which needed dilution to be used for ordinary steam-raising purposes. He now felt highly confident that the work had been taken in hand in such a way that there was every prospect of good results being attained. His own view was that the gas industry ought to take the matter very seriously into consideration.

RECENT IMPROVEMENTS IN BY-PRODUCT COKE OVEN PRACTICE.

BY G. P. LISHMAN, D.SC., F.I.C.

It must be said at once that since the introduction of the direct processes there has been no great change in coke works practice in this country.

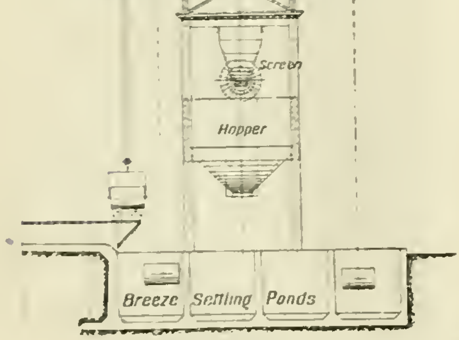
The high wages paid in coke works have led to numerous labour saving devices, and it is largely with items of this kind that the present notes are concerned. Most of these appliances have been in use in odd places for some years. What may be regarded as "recent," however, is the general adoption of a number of them in conjunction with each other on recent plants.

Size of ovens.—The most important advance on these lines is undoubtedly the increasing size of ovens, and this involves some special problems which will have to be faced by all makers. Since with a larger oven any given output of coke can be obtained in fewer operations increased efficiency certainly lies in this direction. In America 16-ton ovens have been built by the Solvay Co. for some time. These ovens are built of a silica brick and are run at a very high temperature, coking in 16 hours. I have no particulars as to the life of them, but with such an output the cost of re-building can very soon be made up. The largest oven working in England to-day is the Collin at Middlesbrough. These are 3·1 × 0·5 × 11 metres. The 72 ovens make 3000 tons of coke per week. The Solvay Co. have also completed a battery of 12-ton ovens in England, and the Simon-Carvès Co. have a battery of 11-ton ovens ready to start. These large ovens, besides being cheaper to work, involve less capital outlay, and the quantity of inferior coke on tops or ends is proportionately reduced. I am informed that in Germany an oven 3·5 metres high is now working.

Charging apparatus.—Where it is not necessary to compress coal most of the constructional firms are adopting levelling machines and the electrically driven coal loading car. This is a machine consisting of a steel under-frame carrying four hoppers which contain one full oven charge. It runs along the oven tops on rails in charge of one man, and by its means the whole laborious process of tub-pushing, which requires a number of men, is dispensed with. The only drawback to it is that it means the collecting main being on one edge of the battery.

Coke handling.—There is now commonly some mechanical arrangement for this purpose. The chief varieties are:—

(1) The inclined car discharging into elevated screens fixed or shaking. This is probably the cheapest way to load coke, but it is sometimes difficult to arrange for storage.



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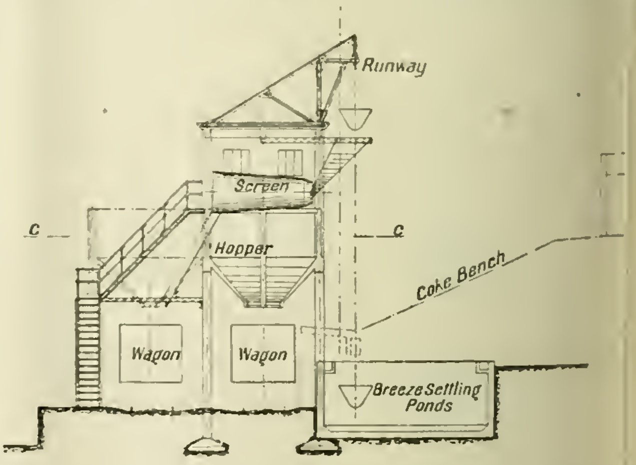

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(2) The inclined bench and coke conveyor. It is usually a tray conveyor which rises up an incline at the end of the battery and delivers to the screens. Coke conveyors are improving and are becoming more popular than formerly.

(3) The Goodall Quenching Car, though not common, has been repeated several times. This consists essentially of a revolving table into which the coke is discharged from the oven ar quenched by a series of sprays fixed over tl table, and also by sprays in the quenching hoo which is part of the car, and through which tl coke passes on its way to the table. Wh quenching is complete the coke is discharged ov shaking screens into railway wagons. The balla and breeze are caught in special hoppers al forming part of the car, and the mixture is empti at intervals into separate trucks. A useful pla for handling breeze which is carried down by tl quenching water has been put up by Simo Carvès Ltd. at one of their recent plants. Tl consists as shown in the sketch of a small telph which elevates special bogies into which tl breeze is filled by hand and carries it to a revolvi screen. On arriving at the screen the coke automatically tipped and the coke passes throu the screen where it is separated into three sizes.

(4) The enclosed type of car as used at Vien Gas Works (Koppers Gas Oven) has not yet be seen in this country. This is an enclosed chamb running on rails, carrying its own motor and pum The water is used over and over again, the pun drawing it through an eight-inch flexible sucti pipe from a trough running along the batte under the car.

The adaptation of ovens to the supply of lighti gas has been extended, but so far not nea sufficiently. The heating of ovens by produ or blast furnace gas can be done quite sat factorily, and yet most of our plants consume th own high-grade gas, many of them taking t whole of it. Regenerative plants are still a sm minority in this country, the value of gas as by-product not being even yet fully recognised.

Economy has been effected in many plants means of door-lifting winches attached to rams and coke quenchers, so that raising a lowering of doors is carried out mechanical In this country they are always worked from t ram motor, but American practice condemns t and works them from an independent mot It is certainly undesirable to multiply clutch This improvement has been more or less for on us by the increasing size and weight of do required for the newer and larger ovens. T Collin plant at Middlesbrough has a very arrangement on the hearth side, the travel of quenching hood and the lifting of the doors done by a special electrically driven mach operated from the hearth level.

Mechanical ascension-pipe cleaners have introduced lately with some success, and also split ascension-pipe. The latter is in use Consett. The pipe is made in two halves to tudinally, the halves being held together by bolts passing through lugs. Hinges and pins may be used on one side with advantage. The faces of course have to be machined, but a narrow fillet is enough for the joint. When the two sides are separated a pipe which might otherwise take all day to clean is done in a few minutes.

High-speed turbo-exhausters are now very common in new plants, though the Otto Company has reverted to the drum type, placing it before the benzol scrubbers, and leaving most of the plant under suction.

With regard to by-product plant it cannot be said that there is any really important improvement to record for the last few years. The direct process has come to stay and the different varieties are too well known to be described here. There are two similar semi-direct processes, however, which have just started working in England. These two processes are both working successfully making excellent salt and an account must be given of them, not because they are better than others, but because they are newer. They are both modified Mont-Cenis processes, one run by the Semet Solvay Co. (Marr's patent), the other by the Collin Co. The great point in connection with all direct and semi-direct processes is to avoid making too much mother liquor and it is in the schemes to this end that the various designs differ. In the Solvay process benzol is extracted from the gas before the ammonia. In this way the re-cooling of the gas after the saturator is avoided. Whatever the drawbacks of such a process may be, and none appear to have shown themselves yet, it is certainly a saving both in capital expenditure and in cooling water. After leaving the benzol scrubbers at 20—25° C. the gas is led to the saturator, receiving on its way ammonia-steam from the still which deals with the condensed liquor. The steam on coming into contact with the gas is suddenly cooled down to an equilibrium temperature of about 45° C. and an amount of water-fog is formed which if carried on to the saturator would by diluting the bath tend to prevent the crystallisation of salt and produce too much mother liquor. This water fog is therefore extracted from the gas by passing t through a special separator which is understood to be of the nature of a Pelouze tar-extractor. This apparatus drains back into the still and the gases saturated with water, but no longer supersaturated, pass forward to the acid bath. Owing to the heat liberated in the reaction the gas emperature at the bath outlet is 55°—60° C. The gas is still saturated and when it is considered hat each cubic metre raised 10° C. will carry away 63 grams of additional water it is obvious hat there is no fear of excess mother liquor. In practice water is added to the bath all the time. The liquor feeding the still is preheated in a heat exchanger by waste liquor coming from the still.

In the Collin process the benzol scrubbers come after the saturators which involves re-cooling of the gas. The method of drying the gases coming rom the still is also different. The vapour from he still can join the gas by either of two pipes and he amount passing each way can be regulated. One of the pipes leads straight to the gas main while on the other is a liquor heater which serves to dry the ammonia-steam. This is simply a ubular heater of different form altogether from he original Mont-Cenis heater and dryer. In this way the ammonia-steam is prevented from supersaturating the gas with water and the water fog which is extracted in Marr's process is in this case prevented from forming. The gas temperatures are practically identical in the two processes and n each the rock-salt difficulty has been found and overcome. Hot water everywhere is the cure and the process admits of considerable quantities being used. Also it is well to have a lead steam pipe in the saturator and give it a boil up once a week. In addition the acid should be run in up to 18%, worked down to 8 or 9% then made up again. Continuous working at one acid strength is apt to lead to rock-salt.

In connection with the direct process one of the problems which presents itself where benzol is recovered is the removal of naphthalene during the cooling of the gas. After the saturator direct process gas, though perfectly free from tar, contains anything from 10 to 20 grams of naphthalene per cubic metre. Its temperature is about 80° C. It can be cooled down to 55 in tubular coolers in the ordinary way, but coolers after that rapidly become blocked with naphthalene. Three methods are used for overcoming this: (1) Duplicate plant up to the benzol scrubbers, one part being steamed out while the other is in use. It is desirable to duplicate even the gas main to the scrubbers and to keep it as short as possible and give it plenty of size as it is always liable to block.

(2) The Otto method of direct cooling in a tower by contact water sprays. The quantity of water required is very considerable, but where this is available the contact method is the simplest and best. The naphthalene is washed down in granular form and may be skimmed off the water as it flows through troughs.

(3) Simon Carves, Ltd. have patented a process which consists in spraying the gases with creosote oil which dissolves the naphthalene and the oil when saturated is pumped into crystallising pans from which the liquid oil is subsequently run off and used again. The circulating oil naturally mixes with the condensings from the gas and the complete and continuous separation of the oil and water in special tanks is part of the process. In warm weather the naphthalene does not separate very well, but the process is quite effective.

For the rest our recent changes are but small matters and may be summed up very shortly.

Ammonium chloride. Where the coal contains sodium chloride a good deal of the ammonia can be recovered as ammonium chloride: sometimes 30% of the salt made can be got as chloride. The direct process lends itself well to the recovery of ammonia in this form as in the washing of the gases with hot liquor the chloride is extracted. A saturated solution is obtained which is evaporated to obtain a crude salt. The salt, a fair colour at first, soon turns black. It has been found that if the dark salt is heated for some time to a temperature just short of volatilization and redissolved in water, the carbonaceous matter is rendered insoluble and after settling and filtering a clear liquid is obtained from which a permanently white salt is produced by evaporation. This method has also been patented by Simon Carves, Ltd., but I hear there is now another process in which the same result is produced in one evaporation.

Naphthalene.

Mr. Middleton, of Consett, has rigged up a useful little subliming plant, a short description of which may interest some who have stocks of dirty naphthalene. It consists simply of two old Lancashire boiler tubes, 3′ diam. A bridge is built in the usual position, and a few coils of steam pipe laid in the furnace area serve to volatilise the naphthalene which sublimes over into the rest of the tube and nearly fills it up. A small outlet is left at the other end for observation. After first sublimation the naphthalene is slightly yellow, but on re-subliming a pure white product is obtained. No live steam is used.

The number of by-products manufactured at coke works is being extended. Carbolic and cresylic acids and pure naphthalene are made at one plant in Durham. Pure benzene and pure toluene are made at certain places, but most coke works refineries go no further than "Government benzol" and toluol containing 75% toluene. More pure products ought to be manufactured. Pyridine is still wasted on all coke works. Also cyanogen.

Briquettes.

The making of coke ballast into briquettes is a useful line, plant for which is to be started at Crook, Durham. 7% of pitch and 3% tar are to be used.

Pitch coking.

This has been tried at several plants with varying success. Some have used 7 or 8% of pitch and taken no harm, while others find the ovens stick if only 2 or 3% is used. Evidently one should proceed cautiously in this matter when experimenting, the result appears to depend on the nature of the coal.

Dry cleaning.

Another interesting point is the "dry cleaner" in use at New Brancepeth. It is found that dry coal when crushed in an ordinary bar type disintegrator may be divided into two qualities by means of a riddle. The crushed coal is passed through a screen with $\frac{3}{16}''$ holes. Coal passing through will contain 6% ash while the coarser part contains 30 or 40%. This is returned to the washer.

Lampblack.

This is made from surplus gas at a certain plant, but the exact method is kept a fairly close secret. It is understood that a number of gas jets burn under a revolving plate, and the deposited carbon is scraped off.

The time allowed for the preparation of this paper has been very short, and much has been omitted. It must be confessed that progress on the chemical side is very scanty, and this is not surprising, seeing that the industry has no research laboratory in the whole country. It is unlikely that we can go on making the same products indefinitely. Already we waste several substances: there are others which might be made if it could be done cheaply enough. In the past we have depended on Germany for our progress, and it is up to the owners of coke ovens to see we do not have to do so in future.

I am very much indebted to numerous friends, who have sent in particulars and suggestions for these notes.

DISCUSSION.

The PRESIDENT explained that owing to the difficulty of export large quantities of pitch were lying in the yards of the various tar distillers. Some relief was being obtained by mixing it with the coal and re-distilling it. The ash of coke produced from the carbonising of pitch was very low indeed, so much so that the clinkering and attention that the fires required were very much reduced.

Mr. G. S. COOPER mentioned that the Ebbw Vale Company had one hundred 11-ton ovens using a quick burning coal and for some time had produced from 5000 to 6000 tons of coke per week. The adaptation of ovens to the supply of lighting gas had not developed to a very large extent in this country. There were only two places of any importance using coke ovens for making lighting gas. In Middlesbrough the scheme had been a very great success; they were able to keep the price of gas at pre-war level, and also to make a very considerable profit. The other instance was Leeds. An enormous amount of gas had been wasted in the past in coke-oven plant; if the gas were used in gas engines it would give probably two or three times as much power as by using it under steam boilers. In Germany particularly there had been a good deal of co-operation between the iron and steel industries and the coal industries, and it was owing to that co-operation that they were able to carry on certain sections of their work at such high profits. At the Birmingham Corporation Gas Works a battery of coke ovens was used to supply the town gas, and the ovens were heated by means of gas made in Mond producers. Dr. Lishman had said with regard to the Otto Company that high speed turbo-exhausters were now very common in new plants, although the Otto Company had reverted to the drum type, placing it before the benzol scrubbers, and leaving most of the plant under suction. The general practice was to work the plant under pressure, and he had heard of two instances lately where there had been serious explosions in plant worked on suction. One of the advantages of the direct recovery process was the economy of heating, and the original semi-direct process on which all others were more or less based had one point which had not been adopted in other processes—the gas was first cooled and then heated again. That gave an unsaturated gas, permitting the free use of water to get over the rock salt difficulty. The naphthalene trouble was also at once eliminated.

Mr. H. L. TERRY asked whether the lampblack was equal in its general physical characteristics to the lampblack that came from the United States.

Dr. LISHMAN replied that most of the new plants were working under suction without any trouble. The advantage of working under suction was that it was possible to use the slow speed exhauster, which required less power.

In reply to a question, the PRESIDENT said it was difficult to say why gas from by-product ovens was not more largely used in the gas world. It probably arose from the fact that the large producers of gas were not in close proximity to those using coke. It had been proposed to get over that by piping the gas, but there were difficulties in that connection that had not so far been overcome. The gas supply in Middlesbrough was in the hands of the Corporation, and they had entered into a contract with large producers of gas in the coke ovens in the neighbourhood. The scheme had been extremely successful. In Germany several groups of towns in the neighbourhood of coke ovens were supplied with gas from them. The difficulty here was that the large producers of furnace coke were not sufficiently near the towns to make the process attractive, but there was also the other more or less technical difficulty that arose in the case of Middlesbrough, namely, that they were under an obligation to maintain a continuous supply of gas throughout the whole town, while they had taken upon themselves the responsibility of transferring that responsibility to a private firm, the firm owning the coke ovens. But in that case they relied on the fact that they had a water-gas plant which they could bring into use fairly rapidly.

WASTE IN COAL PRODUCTION.

BY HENRY LOUIS.

At a time when the subject of fuel economy i being brought so prominently before our notice it is important to have before our eyes a complet review of each and every operation connecte with coal in which waste occurs, and in whic therefore the introduction of more economica methods is at any rate possible. The waste an losses connected directly with the getting of coa are by no means the least of the various forms o loss, and I propose in the present paper to lay before you a brief account of some of the principal forms in which such waste occurs. A clear conception of the nature of such losses is obviously the first step towards their avoidance.

The coal output for 1913 is given by the Home Office as nearly 287½ millions of tons, and it is important to note in the first instance how much of this total output is actually available for use by the nation at large, and in the second place how much other coal has been sacrificed in order to obtain this output. Put in somewhat different words, the first named portion of the investigation refers essentially to the saving that could be effected above ground in dealing with the coal after it had been brought to bank, and the latter to the saving that might be effected in the underground operations of the colliery.

From the total output of coal there is first of all to be deducted the coal used in what is generally spoken of as colliery consumption. Obviously a certain proportion of the coal raised in the country is consumed in raising it; in some districts, some or all of the colliers are supplied with free coal, which is sometimes included under the head of colliery consumption. This is however not a correct way of looking at the matter, because the coal thus supplied to the men should be looked upon as being a portion of their wages paid in kind instead of in cash, and hence this coal is sold or given in place of money, and should not be included in colliery consumption properly so-called. The only objection to the practice of giving free coal, at any rate from the standpoint of the present discussion, is that such coal is apt to be, and as a rule is used very wastefully, and that if the men had to buy the coal and pay for it, more economy would be observed, and a considerably smaller quantity of coal be made to answer the purpose.

Colliery consumption properly speaking should be restricted to mean the coal used in generating the power necessary to work the colliery. It would not be difficult to arrive at the amount thus consumed; all well managed collieries keep a careful record of their own consumption, and in some districts attempts have been made to obtain approximate statistics for the entire district. It would however need a proper inquiry backed by due authority to obtain figures for the country as a whole, because it is precisely those collieries where the consumption is greatest that will be the least willing to supply such figures. A certain amount of difficulty may arise from the fact that the coal thus used is of inferior quality, and not infrequently unsaleable. Within late years efforts to use inferior coal have been multiplied, and in many cases have been attended with marked success; I know cases where the whole of the power required to work a colliery is now being obtained from material which a few years ago was thrown on to the waste tip, and the use of inferior coal in gas producers is contributing to the extended employment of such material. There is still, however, too great a tendency amongst colliery managers to consider that if power is generated from an unsaleable material, there is but little need to exercise economy in its consumption. Such a view is one that should not be allowed to obtain, and it has only arisen owing to the fact that the calorific value of the fuel consumed is too often disregarded and its money value alone is taken into account. It naturally happens that many collieries are so situated that they necessarily produce a certain amount of impure and dirty coal, the money value of which is less than the cost of marketing it, and the assumption is often made that such coal is therefore worthless; that it has however a very definite value as a fuel is shewn only too conclusively and too unpleasantly by the burning pit heaps that may be seen in any colliery district. Definite information as to the quantity of coal burnt for colliery consumption is not obtainable, and a very rough guess is all that is possible at present. From my own observations I am inclined to think that the colliery consumption of the country is somewhat of the order of 7% of the output, or say about 20 millions of tons. It is evident that if groups of collieries would combine to erect central gas producer plants, using low-grade coals, from which power could be distributed to the various pits within a reasonable radius, the saving that could be effected both by the utilisation of the by-products and by the substitution of inferior for better-class coal in the generation of power, would amount to a very large annual sum.

In many districts vast quantities of fine coal dust accumulate in the screening plants and lie there until periodically, when the nuisance becomes too great, they are cleaned out and the dust thrown away. I have been in colliery heapsteads in South Wales where the dust was literally ankle deep. Such coal dust is in many cases quite fine enough to be used direct for firing boilers or furnaces, and is well adapted for this purpose; it could be readily and cheaply cleaned and graded by the use of some form of pneumatic dressing machinery, such as has been erected in several of the Westphalian Collieries. Nothing of the kind has been attempted, as far as I know, in this country, and this valuable article continues to be thrown away. Here again is a source of economy which in some parts of the country would be decidedly important.

Turning next to the underground operations, the waste of coal in the pit may be considered under two heads, namely more or less accidental and more or less deliberate. It is practically impossible to win the whole of the coal in any seam; some is always lost, owing to the waste in undercutting, the crushing of ends and of odd portions of pillars, and the leaving of barriers and shaft pillars. The intention is always that a shaft pillar shall be robbed when the rest of the pit has been worked out, but it frequently happens that by the time that the latter occurs, much of the coal in the shaft pillar is so crushed that it cannot be won. As regards barriers they are in part left deliberately, whilst in other cases the intention is ultimately to win them as far as possible, though here again this cannot always be accomplished. The waste in undercutting is being gradually decreased by the use of coal-cutting machines instead of undercutting by hand, owing to the fact that the machine makes a much narrower cut than is possible with the pick, and is often able to undercut in clay, where the hewer would have to cut in coal. More might no doubt be done in the substitution of machines for hand-labour, but the subject is a difficult and a complex one, and I do not intend to suggest that the indiscriminate use of coal-cutting machines is in all cases to be recommended. Nevertheless it ought not to be forgotten that our coal reserves are a national asset, and that the interests of the nation at large should receive some consideration as well as the immediate profit that the colliery owners draw from their operations.

The crushing and loss of some portions of the seam are almost inevitable on any system of working; such loss is no doubt less when the coal is worked by longwall than by bord-and-pillar, but here again the best system of working any given seam does not depend upon this consideration alone, though I would urge that the national aspect is too often entirely neglected. Upon the whole there is no doubt that the use of the longwall method is extending, and that loss in working is decidedly less than it was, say 50 years ago, and there is every reason to hope that still further improvements in this respect may be looked for. Improved methods of stowage, such as the well known hydraulic methods, may also be helpful in this matter. An important fact to be borne in mind is that a colliery is after all not a philanthropic institution, and that no colliery manager is going to extract small remnants of coal pillars when the cost of doing so is greater than the cash value of the coal, and further that his costs depend largely upon the prices of pit timber, because the removal of such small portions of coal is rarely possible except by the lavish use of pit-props. That the price of these has risen lately to formidable figures is well known, the main reason being that for many years afforestation has been wholly neglected in this country. What little has been done has been due to the enterprise of a few individuals, and it is impossible to acquit of blame in this respect some semi-public bodies, such as the Ecclesiastical Commissioners, who hold vast areas of land. They prefer to get the maximum immediate revenue out of their lands, say by letting them as grouse moors, instead of contenting themselves with a lower immediate return, and planting timber, which would in the course of time not only yield a handsome income for themselves, but prove an important advantage to the industries of the nation. The need for cheap timber if the maximum output is to be obtained from a given area of coal may not at first sight be very obvious, but there is nevertheless a very close connection between them. As regards the leaving of barriers between adjoining properties, this has in the past been a very serious source of loss, and is still to-day, though it is to some extent decreasing owing to the growing tendency of colliery companies to amalgamate, and for large companies to absorb smaller ones, so that ever larger areas are being controlled by one interest; even so there is room for much improvement, and possibly legislation on the subject might not be altogether out of place. I hold the view that although coal in this country belongs rightfully to individuals, it constitutes as a whole a national asset, and the nation is entitled to protect itself against undue waste. As to the proportion of coal that is left in the ground, here again nothing more than a very rough guess is possible. I estimate the proportion as something of the order of 5% of the coal existing in the seams, so that the total quantity is formidable enough. It may be as well to point out that the coal thus left in the ground, cannot be, as has sometimes been asserted, looked upon as a reserve that future generations may be glad to utilise. On the contrary, coal thus left behind cannot be won afterwards, and must be looked upon as irretrievably lost to the country.

A source of loss that may properly be referred to at this point is that due to "gob-fires," that is fires underground originating in the spontaneous ignition of small coal left behind in the worked out portions or goaf of the coal seams; such fires often spread to the coal seam proper, and large areas of coal have thus at times been lost. The question of the best means of preventing such gob-fires is now attracting much attention, and excellent work upon it has been done within the last few years in the Research Laboratory of the Doncaster Coal-Owners. It has been attacked mainly from the standpoint of the chemist, the object being in the first instance to find out what are the causes and conditions that favour the spontaneous ignition of coal, and in this way to arrive at the proper remedy to be applied. There are good grounds for saying that the theory of the subject is beginning to be well understood, and that the colliery manager ought, in the light of the scientific information thus given, to be able to keep losses of coal due to gob-fires within very narrow limits in the near future.

In addition to coal thus accidentally left behind in the pit, there are many cases in which coal is deliberately left behind or thrown back into the goaf.

In many parts of the country where non-coking coal is produced all small coal is left underground on the plea that it would cost more to bring it out than it would fetch in the market. This coal is not mere dust, for in many cases nut coal is sacrificed in this way; in parts of Nottinghamshire I have seen coal loaded underground with a fork with 1½ inch tines, all coal under 1½ inch being thus thrown away. It need hardly be said that this coal was quite as good from the point of view of heat production as the coal that was sent up the shaft and much of it could have been used at once for firing boilers. How much coal is lost in this way it is difficult to say, but these are cases where the coal thus wasted amounts to over 20% of the output. The same is also true of many parts of South Wales.

Again there are many cases where only the better portions of the seams are being won, the rest of the coal being left behind and lost, simply because it is of somewhat inferior quality, though it is as a matter of fact quite capable of being utilised. Take for example a statement from the Mines Report of 1910, referring to the Barnsley Seam, worked at a number of mines in the Doncaster district:—"at several of these mines nearly one-half of this fine seam is left unworked, the 'top-softs,' about 4 feet thick, being left to fall in the goaf. This part of the seam is not of such high quality as the better portion, and that is the chief reason for it being left unworked. . . . To lose practically 40% of this seam is also a national loss." A number of analyses of the Barnsley Hard and of the Barnsley Softs from the Doncaster district have recently been published in some of the papers issued by the Doncaster Coal-Owners Laboratory, and these show practically no difference in chemical composition. It is quite certain that as regards calorific value there cannot be any serious difference between the two classes of coal.

In the Barnsley district proper, a certain thickness of the seam, sometimes amounting here to more than 40% of the whole, the "Top-Softs" and the "Bags" as the upper portion is locally called, is very generally left behind in the goaf. Apart from its softness, it is a good coal; a sample recently tested in my laboratory gave a calorific power of 13,400 B.T.U. and 3·8% of ash.

In Fifeshire the Great Seam 6 feet to 8 feet thick consists of about 2 feet of Ironstone, about as much common coal, and then about 3 feet of Cannel or Parrot coal. The latter alone is worked, all the rest of this fine seam being left behind in the goaf.

In Lanarkshire the Ell Coal, about 6 feet in thickness, is worked, and the Head Coal, about 2 feet in thickness, left behind in the goaf.

These few examples, taken somewhat at random, will serve to exemplify the nature of the loss of coal that is here discussed; in most cases the coal thus left behind must be looked upon as totally lost; in others it may be in part recovered. Thus some of the areas in Lanarkshire above referred to are now being worked over again, with the object of recovering as much as possible of the Head Coal previously rejected, but obviously such an operation can never be a very satisfactory one. In many districts where there is one particularly good or especially valuable seam, this is often worked out before any other seams are touched, without regard to the fact that such working damages other seams less valuable to-day, but nevertheless containing coal of quite good quality. The result of this damage is that a certain proportion, or possibly in some cases the whole of these other seams is rendered unworkable, and great loss of coal is thus brought about.

It is practically impossible to present any figures shewing the amount of coal lost to the nation as the result of this deliberate waste, but it certainly amounts to enormous quantities in the aggregate. It is not easy to suggest any remedy for this loss; some authorities favour legislation, and the imposition of heavy taxes upon coal left behind has been suggested. This can hardly be looked upon as a scientific solution of the problem, and undoubtedly a better remedy would be the invention or the elaboration of methods of utilising these inferior coals, which would give them a value sufficient to make it worth the while of colliery proprietors to work the whole of their coal. Some of these difficulties are unquestionably connected with our systems of mineral ownership, under which two seams within the same area may be let to different people, each of whom works for his own interests alone regardless of the interests of the neighbour above or below him. The importance of the question is very great and it undoubtedly deserves the fullest possible investigation from every standpoint, there being probably no portion of the entire subject of coal economy that promises more valuable results.

I wish to state definitely that the all important question of safety is in no wise involved in the considerations here submitted, or rather that the reform of most of the sources of waste that I have indicated must result in increased safety for the coal miner. The diminution of gob-fires is obviously a case in point. Again, if it were possible to turn to good account the accumulations of fine coal dust, which constitutes such a grave danger in most of our collieries owing to the disastrous explosions to which it may give rise, the removal of this dust from the workings might readily become a source of profit instead of a loss as at present. It need hardly be said that such coal dust could, as has already been pointed out, be employed directly for firing, and that its cleaning and subsequent utilisation should present no insoluble difficulties. The coal left behind in the goaf is naturally also a source of danger to the coal miner, and in this way again the successful utilisation of inferior coal would contribute to the safety of our collieries. The subject of safety is one of such supreme importance, that I have thought it advisable to refer specially to the fact that decrease in the present waste of coal would mean, if anything, a corresponding diminution of the risks to which the coal miner is exposed.

My object in submitting this paper has been to bring before the Society some information as to the nature and magnitude of the losses involved in the getting of coal as an integral portion of the investigation of the problem of fuel economy, and incidentally to point out that although these are essentially problems for the mining engineer, yet it is highly probable that the assistance of the chemist will have to be invoked before their complete solution is arrived at.

In conclusion, I should like to direct attention to an admirable address delivered in the beginning of this year before the Second Pan-American Scientific Congress at Washington by George Otis Smith, Director of the United States Geological Survey, upon "The Public Interest in Mineral Resources," a sentence from which aptly summarises my views on this subject:—"The Governmental duty to the mining industry first of all is to promote use without waste." This is exactly what we ought all to aim at.

Discussion.

The President said that Professor Louis had given a very vivid bird's eye view of what was happening in the collieries more or less throughout the country. The magnitude of the losses that were going on in one direction only—that is in the amount of fuel used by the collieries—showed how fundamentally important the coal question was, and that it was one to which a Society concerned in chemical industry should give attention.

Professor Armstrong asked if there was not a great waste of pit props owing to the fact that no precautions were taken to prevent decay.

The President then quoted from a letter which had been received from Mr. Wallace Thorneycroft, as follows:—

"Professor Louis inadvertently refers to the great seam as being in Fifeshire, whereas it is one of the East Lothian seams which has been worked for over 500 years. Unfortunately the Lanarkshire Ell Coal is rapidly approaching exhaustion. If there was any virgin area of this seam 6 feet thick, I do not think there would be very much left below ground nowadays.

"Twenty years ago the East of Scotland was a great offender with regard to small coal left belowground, but now there are very few collieries at which it is not all brought to the surface, washed, sized, and sold as nuts, peas, etc., leaving only the gum—that is all that passes through about ¼ in. mesh, to be burned at the collieries for steam raising purposes. By this system the small coal is put upon the market and its calorific value made available in a very convenient form, probably the best possible.

"I do not think there is any district where this system is not applicable, and if that be so, I do not quite agree with Professor Louis that a large sum annually could be saved if groups of collieries combined together to erect by-product gas producer plants from which the power produced would be distributed. The gas producer capable of dealing with this wet gum has yet to be designed. It has often been tried, so far without success, and this is one of the points of contact where the mining engineer welcomes the assistance of the technical chemist.

"There are many other points of contact between the two professions; Professor Louis has referred to some of them, and any one wishing to pursue the subject further should refer to the Report of the Royal Commission on Coal Supplies published in 1905 (Cd. 2353, price 4d.), and also to the detail evidence given by the best men of the time (1901—1905) on each subject. A study of the subject will, I think, reveal the fact that it is the consumer of the coal rather than the producer who is the more wasteful.

"Professor Louis says that the calorific value of unsaleable fuel is too often disregarded, and this to some extent is the case, but I do not think the mining engineer can be blamed for not spending capital to reduce the consumption of fuel he cannot sell. If, however, he has a surplus of such fuel and the technical chemist can evolve a process by which by-products can be extracted from such fuel of sufficient value to warrant the necessary capital expenditure, and supply sufficient power to work the colliery, then a true economy would result, although the consumption of fuel for colliery purposes would probably be increased.

"This point seems to raise the important question of what is really meant by fuel economy. The ultimate success or failure of any process must always depend upon whether or not it will pay, and not whether so many tons less fuel are used.

"It is true that our coal reserves are a national asset, and it is equally true that a colliery, or for the matter of that any industrial concern, is not a philanthropic institution, and if such concerns were run on principles economically unsound the effect on the interests of the nation at large would be very quickly disastrous.

" True scientific investigation let us have to the full, including inquiry into whether any known process has not been adopted by the industrial world, and if not, why not, but I think that a word of warning is not out of place lest we rush headlong into enterprise that is economically unsound.

" Professor Louis touched in passing on the benefits gained in one branch of his subject by amalgamation of small concerns. I venture to suggest that it is in the national interest to encourage the tendency to amalgamate in all branches of industry. More large concerns with interests spread over wide areas would hasten the adoption by the industrial world of ideas evolved by the scientific world."

A MEMBER asked whether the nationalisation of railways, resulting in lower rates, would not aid in the working of low class material.

Mr. W. F. REID said that on account of the war pit props had become difficult to obtain, and it seemed quite impossible for us to produce sufficient for our own needs. He asked for information with regard to the utilisation of other material than timber for pit props. He believed that concrete had been used.

The PRESIDENT said that the use of concrete as pit props had always struck him as introducing a very interesting problem, because concrete took the place of timber in many respects.

Professor LOUIS, in reply, said that Professor Armstrong was perfectly right in saying that pit props had been wasted. But they were not being wasted to-day; they were much too precious. For a long time pit props had been delivered in this country at a very low price, and the result had been wastefulness. The price had been trebled since the war began, and people had been forced to economise. He was afraid it was hopeless to expect to be able to use re-inforced concrete instead of timber. The pit prop made of wood gave way gradually, and it gave some warning; but when concrete failed, it went all at once, without warning. In addition to that, it was awkward to set, and was inelastic. The problem was a most difficult one, a very curious combination of elasticity and rigidity being required. He believed it would be possible to produce a steel prop that might take the place of wood, and such props had been used. He was pleased that Mr. Thorneycroft, one of the leading authorities on coal mining in Scotland, agreed generally with the views that he had put forward. He agreed that the amalgamation of smaller concerns into larger ones was bound to be beneficial to the interests of the nation at large. From his experience of other countries, he was utterly opposed to any idea of nationalisation either of railways or of mines as a means of saving money. Few people who had had experience of Government Departments recently would think that Government administration ever led to economy. In Germany, in a district where the collieries were practically all nationally owned, the system had proved a failure from an economic standpoint. Wages were lower there and costs higher than in the privately owned collieries in Germany. He was convinced that the nationalisation of railways could never lead to economy in any way.

THE SHALE OIL INDUSTRY.

BY D. R. STEUART.

Oil shale, the foundation material of the manufacture, is mined in much the same manner as coal. The principal marketable products are shale spirit, lamp oils, internal combustion engine oils, fuel oils for the Navy, oils for gasmaking and gas-enriching, lubricating oils, solid paraffin, still coke, and sulphate of ammonia.

There are now four refining companies, Young's, Oakbank, Broxburn, and Pumpherston, with a total capital of about £3,000,000. The men employed are 10,000, including miners. Besides these there is a private company at Philpstoun (Ross & Co.), making crude oil and ammonia.

The works now existing all lie in one shale-field situated in West and Mid Lothian. The centre of the field lies some 12 miles west of Edinburgh. It stretches from the Frith of Forth at Hopetoun southwards for 16 miles, with a width varying from three to eight miles or so.

The shale measures are situated geologically in the Calciferous Sandstone series and lie under the Carboniferous Limestone and above the Old Red Sandstone. About a dozen different seams have been worked in the Upper Division of the Calciferous Sandtsone series, which is some 3,000 feet in thickness. The shales worked are often five to six feet thick.

Paraffin oil manufacture started in Scotland in 1850 at Bathgate to work the Boghead or Torbanehill mineral, which yielded 90 to 120 gallons of crude oil per ton. It was exhausted in a dozen years and oil shale was used. It yielded 45 to 18 gallons per ton, with ammonium sulphate 35 to 70 lbs. per ton. Many thin seams of shale are found all over the coal fields of Britain and these were retorted in the early bright days of the industry. There was a considerable manufacture in Wales for some years. But foreign competition put all out of existence many years ago, except those situated in the Calciferous Sandstone. A hundred small works have been killed off in Scotland, representing a loss of some millions of pounds. The larger works were increased so as to be worked more economically and have continued to exist, sometimes paying dividends and sometimes not. The through-put of shale has always kept increasing, and last year was 3,000,000 tons, or, to be particular, 2,992,676 tons, according to Home Office figures. New oil fields may still be found in Britain. Oil shale has been discovered in the Western Islands in Raasay and Skye; there is an outcrop on the Northumberland coast; and we have always the Kimmeredge Clay stretching across England from Dorset to Lincoln and Norfolk with its thin seams ot oil shale, yielding a very sulphury crude oil.

All over the world and through a great range of geological age there are abundant rich seams of oil shale ready to be worked when needed, and these give a certain world-wide interest to our little Scottish Oil Industry. There is, however, no necessity for exhausting all the resources of the world in this generation.

The mining of the shale is always getting more expensive. The easiest got at happened also to be the best and so now we have to go further and fare worse: we have to expend more money to get a shale which is poorer. It is more friable than the richer shale and gives a larger proportion of smalls. The shale in the retort is subjected to a current of steam to preserve the oil from breaking up, and also to create and protect the ammonia from decomposition. The presence of smalls in the retort prevents the free passage of the steam and endangers the local fusing of the spent shale and the destruction of the retort. To prevent loss of smalls we need special retorts to distil it either for oil or gas, and so keep it out of the ordinary retorts.

As it does not pay to carry the shale any distance to the retorts, the crude works with refinery are situated on the field of shale and each refinery has several crude works over its shalefield and sends the crude oil to the refinery by railway tank. The setting point of the crude oil is from 80° and 90° F., and pipe lines are little used.

In the crude works the shale is retorted, producing: Crude oil, ammoniacal liquor, permanent gas, and spent shale.

The spent shale is not utilised at present; but I imagine a little enterprise and capital might produce from it products of value. Spent shale is more friable than clay and so more easily amenable to chemical reagents, but the heat it has been subjected to has made some constituents more difficult to dissolve.

The permanent gas is used as fuel for the retorts. Sometimes no other fuel is used; but generally producer gas from coal is required to help. The Pumpherston Company, at their Deans Works, distil the coal needed in Mond producers, recovering the ammonia, and the result is, I understand, most satisfactory. The first cost of the plant is a little heavy to a struggling company.

The ammoniacal liquor is distilled in vertical column stills in the ordinary gas works way. Milk of lime is introduced into the liquor to volatilise the fixed ammonia after the volatile mmonia, the carbonate, and the sulphide, have een distilled off. The ammonia gases are passed nto saturators in which they are caught either by resh sulphuric acid, when the crystals collect in a vell and are lifted by a steam ejector and sent o the centrifugal to be dried; or by acid that has een recovered from the vitriol tar of the oil efinery. We use the oil of vitriol twice over the refinery and then recover it for making lphate. The sulphate made from the recovered cid is got as a solution. When this solution is eutralised by the ammonia, organic bases are set ee and rise to the surface as a tar, and this tar tains the sulphide of arsenic and also the oxide iron. The settled solution is evaporated down a vacuum pan and sent to the centrifugal. ith care we get a good coloured salt. A slight cess of ammonia is used to set free all the iron ide. When approaching neutralisation and after some ammonia escapes through the solution; t the gases are passed through a vessel above here the next charge of acid is lying and thus e last trace of ammonia is caught. Neutral nmonium sulphate solution does not produce a od crystal and also, on heating, ammonia is ven off, so a small quantity of clean acid is ded to the liquor before evaporation to prevent ss of ammonia. Sometimes the sulphate is not t through a centrifugal but into a bin to drain y. It takes a week or so, and meantime the terial has become a solid rock and has to be arried and passed through a grinding mill on way into the bags.

The large amount of steam passed through the orts produces a weak ammonia liquor, about 1% ammonia against 2½% in gas works. So it is t so suitable for making concentrated liquor; d the proportion of sulphide is high and it is refore expensive to make into pure ammonia ution. The Government prefer that we make centrated liquor so as to relieve sulphuric d for munitions of war.

f it had not been for the ammonia our industry uld have ceased to exist long ago. In the early s burning oil was the principal product and manufacture gave the common people a good ap light for the first time, and its continuous stence has kept the price of lamp oil down I sure to less than one-half of what it would erwise have been. When this country was ded with foreign lamp oil the retorts were nged to make heavy oil and solid paraffin. and by when these came in in great quantities retorts were lengthened to increase the sulphate mmonia. The yield of sulphate was trebled. But with gas works, gas producer plants, iron works, coke works, all producing ammonia, and with Niagara and the waterfalls of the world harnessed up to create combined nitrogen from the atmosphere, there is nothing left to fall back on. Except, perhaps, that we may educate our farmers to use more ammonia and so increase the demand. No doubt the home-made sulphate of ammonia is a better and safer manure than foreign nitrate of soda, if only it be applied at the right time and the soil be kept neutral with small doses of lime. Nitrate tends to kill off the beneficent microbes in the soil that produce plant food, and ammonia encourages their increase. Nitrate is easily washed out of the soil. A field at Rothamsted by last winter's rainfall lost nitrate equal to 7 cwt. of nitrate of soda per acre. About 1880 when Peruvian guano got scarce the price of sulphate was £22, some even £24 per ton. By 1890 nitrate was imported in such quantities that the price fell to £8 per ton and I never expected to see £10 again. Nevertheless the demand increased in proportion and the price got for many years was £12 to £14. With Government and Parliament taking an interest in science I think the demand may increase with the supply and a price got that may keep this industry still in existence and able to pay a dividend.

The retorts are built into great benches about 60 feet high. The upper part of the retort is of cast iron and the lower part is of firebrick, with flue around in which the permanent gas is burned. Steam is introduced at the bottom of the retort and the distillation is upwards. There is a large hopper on the top to supply the shale as required, and mechanical arrangements below to take away the spent shale at a certain rate. So the movement down the retort is continuous, and about 4 tons a day are passed through each retort. The section is circular, tapering from 2 feet diameter at top of metal to 3 feet at bottom; or the section is oblong. In the metal part the oil is distilled out at as low a temperature as possible. The brick part is an ammonia and gas producer and is heated as highly as is possible without fusing the ash; and in this the fixed carbon is burned in steam and the nascent hydrogen produced unites with the nitrogen to form ammonia. The products of distillation are first passed through a water condenser, a tower in which water for the steam boilers is heated; then through great benches of vertical 4-inch pipes; then through scrubbing towers, of water to catch the ammonia, and of heavy oil to catch the light spirit. The gases are then caught by a fan which produces a slight vacuum back to the retorts, and a pressure in front to drive the permanent gas back to the retort flues. The condensed crude oil and ammonia liquor run together to a separator, where they instantly separate and each is run into its receiver. I sometimes think that in both water condensers and scrubbers we might get helpful suggestions from the gasworks; but we are all very conservative.

The crude oil has a specific gravity from 0·865 to 0·880 according to the shale, the form of retort, and the temperature of working. We have much to learn yet as to the best conditions.

The refining consists of fractional distillations; and treatments with oil of vitriol and with caustic soda solution; cooling and pressing of heavier oils for solid paraffin; and refining the solid paraffin by sweating. Two companies make candles. The distillations are always in the presence of more or less steam, more or less superheated. We have continuous distillation through boiler stills, with residue stills attached temporarily, in which the heaviest oil is distilled to dryness. Much valuable coke is got from the crude oil residue stills; and while coking great quantities of very rich gas are given off for illumination or for fuel. This gas was allowed to escape into the atmosphere for many years in spite of the work of Beilby and McArthur, but is now saved; and light spirit is got from it. Dephlegmators are used to help the fractionation of the oils but might be more used. Fractional condensation might also be more used both at the shale retorts and the oil stills.

The oil of vitriol carries down, as a black tar, the bases like pyridine, the more unsaturated hydrocarbons, sulphur compounds, a proportion of phenols and benzenes. Besides these there seem to be substances held in colloidal solution which are precipitated by the acid. The amount of oil of vitriol is limited so as not to take out the olefines. The acid seems to have little polymerising influence. The caustic soda solution takes out as a black tar phenols, sulpho-acids and any definite acids present. The acid tar is washed free from acid with hot water, settled and burned as fuel under the stills, blown into a spray with superheated steam. The soda tar is made slightly acid with vitriol tar water, settled, and burned also. The tars have never been thoroughly examined. Some definite organic bases have been separated and examined, some also of the phenols: but there are indefinite compounds in the tars we know nothing about, and being easily decomposed might perhaps be the foundation for useful compounds. In the phenols we have large quantities of most valuable compounds that ought no doubt to be separated and utilised as antiseptics. Over 20% of the crude oil is got as tar, easily and cheaply used as fuel oil, and therefore quite valuable; but no doubt many of the substances present if separated would be very much more valuable. Two of the Companies make their own oil of vitriol.

One good result of the war is that it has forced us to causticise the soda for ourselves. The war has greatly increased the price of our products, but it has at the same time greatly increased the cost of metal materials, wood, coal, labour, etc., We have difficulty in getting coal enough to keep us going, difficulty in getting materials forward in time, difficulty in getting men to do our repairs, etc. Many hundreds of our best experienced men from mines and works have joined the army, replaced to some extent by any kind we can get. Oil works working in three shifts is not the most suitable situation for women, but we do what we can, and have women in the offices, candleworks, and other possible places. After all we cannot keep the works going at the full pace that pays best.

It has been suggested that if oil shale gets scarce the Scotch companies should tackle the question of getting the same products from peat. That is a difficult problem; but it is satisfactory to know that in Ireland at Portadown there is a successful production of power from peat gas.

References.

In this Journal for 1897, the history of retorting is given by Beilby, p. 876, by Henderson, p. 981. Retort is described by Bryson, p. 990, by Crichton, p. 988. Refining 1889, p. 100. Ammonia from shale—Beilby, 1884, p. 216. Paraffin cooling, 1885, pp. 321, 653.

DISCUSSION.

The PRESIDENT said that it was interesting to hear that Mr. Steuart held out hope that the leading oil companies would cease to engage in ruinous competition and would meet together and unite their skill for the common good, and he hoped that those expectations would be realised. He had every reason to believe that the gas works were deeply indebted to the shale oil industry. Many years ago he had visited Broxburn, with some prominent gas engineers, and it was a matter of very considerable discussion amongst them as to how far the methods that had been adopted successfully at Broxburn should not be applied in connection with gas practice. In the end it came about that one man closely associated with the oil industry (he thought it was Mr. Young) co-operated with the gas engineer in charge of one of the corporation undertakings with the result that they had evolved a vertical retort, embodying many features of the retorts used in distilling shale.

Mr. R. MACLAURIN suggested that, as the continuous application of sulphate of ammonia was rather harmful to the soil, it might be a good thing to send out a mixture of ammonium sulphate and calcium carbonate.

The PRESIDENT said that some of the difficulties which had arisen from the use of sulphate in past years had been owing to the belief that it could be used alone under all circumstances, but that belief had not been well founded. Of late years a large proportion of the sulphate of ammonia in this country had been more or less in the hands of the Sulphate of Ammonia Association; the origina idea was to do the same with sulphate of ammonia as was done by the Nitrate of Soda Association and it had worked exceedingly well. They had realised that it was not possible to administe doses of sulphate of ammonia everywhere in th same way, regard having to be paid to the characte of the soil; that had now been systematised an special mixtures for different soils and different crops were recommended.

Mr. STEUART said that there was a tendency fo rather too much sulphuric acid to be applied t the soil as dissolved phosphate, etc., resultin in finger and toe of turnips, among other things But when the soil was treated with small dose of lime either in the form of carbonate or causti to keep the soil neutral, then full value would b got from the ammonia. If sulphate were applie to acid soils the bacteria caused the destruction o part of the ammonia. If it were applied early i the year, with the soil neutral, the ammonia woul be preserved and not washed out by the rai as with nitrate of soda. The farmers very ofte made the mistake of not applying sulphate earl enough. Properly used, sulphate of ammoni was a better and safer manure in every way tha nitrate of soda.

On Wednesday evening the members wer entertained at a Social Meeting by the Loc Section, in the Dining Hall of the Universit Union. Music was provided by Mr. Constantin, and Dr. Inglis Clark.

SECOND DAY.

THURSDAY, 20TH JULY, 1916.

THE INFLUENCE OF THE EUROPEAN WA ON THE TAR DISTILLATION INDUSTRY.

BY W. H. COLEMAN.

In order to show how the outbreak of war h reacted on the industry, I would direct yo attention to the following table in which I hav gathered together the quotations for the mo important tar products given in the first issue the Journal of Gas Lighting for each quarter of t year commencing January, 1914. I have tak the highest figure in each, and only one quotatio for each article, in order to avoid confusion:

Immediately after the outbreak of war pric were so irregular that for several weeks no quot tions were given, but by the beginning of Octob 1914, they were being issued again. It should noted that the quotations for crude tar, Octob 1914 and January 1915 were based on the liqu products only. It is unnecessary to say any more about the quotations for tar, as they are governed by the prices of the products.

TABLE I.

		1914.								1915.								1916.					
		Jan. 6.		Apr. 7.		July 7.		Oct. 6.		Jan. 5.		Apr. 6.		July 6.		Oct. 5.		Jan. 4.		Apr. 4.		July.	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Crude tar	per ton	31	0	29	6	28	3	17	3	18	6	25	0	25	6	24	3	22	6	20	0	19	3
Pitch	per ton	39	6	37	6	32	6	—		—		18	0	23	0	21	6	16	6	15	6	15	6
90% benzol	per gall.	1	0		10½		9		10		9		10½		11		11		11½		11½		11¾
50/90% benzol ..	per gall.		11		10½		10½		10¼	1	4	1	4	1	4	1	4	1	4	1	4	1	4
90% toluol	per gall.	—			11		11	1	3½	2	4	2	4	2	4	2	4	2	3	2	3	2	3
Crude naphtha	per gall.		5¼		5¼		4¾		5		5¾		5¾		6½		7		7		7		7
Solvent naphtha ..	per gall.		9¾		9¾		9½		10	1	0	1	7	1	11	2	0	2	1	2	0	1	10
Heavy naphtha ..	per gall.		9½		9½		9½	1	0	1	0	1	1	1	3	1	3	1	3	1	3	1	3
Creosote	per gall.		3¼		3¼		3¾		3½		3 7/16		3½		3 1/16		3		2¾		2⅝		2½
Heavy oil	per gall.		3⅞		4		4⅛		4½		4½		4		4		4		4		4		4
60's carbolic acid ..	per gall.	1	1½	1	1	1	2	2	2	3	0	3	5	3	6	3	6	3	5	3	4	3	4
95% cresylic acid ..	per gall.	1	1	1	0	1	0		8	1	4	1	6	2	3	2	6	2	6	2	8	2	8
Crystal carbolic ..	per lb.		3½		3⅛		3⅛	—		1	4	1	3	1	6	1	6	1	4	1	4	1	3
Naphthalene salts ..	per ton	60	0	60	0	60	0	55	0	65	0	75	0	80	0	80	0	80	0	80	0	80	0
Anthracene A	per unit		1¾		1¾		1¾		2		2		2		2		2½		2½		2½		2¼

Taking the items in their order, the price of pitch fell considerably; this was due to the stoppage of exports. According to the Bulletin issued by the Commercial Intelligence Department of the Board of Trade in October, 1914, during the year 1913 pitch to the value of over one million pounds sterling was exported and of this, £297,000 worth was sent to Belgium, £472,000 worth to France, £119,200 worth to Italy, and practically none to Germany. The greater part of this pitch was used for the manufacture of briquette fuel, and as the whole of the coal-producing districts of Belgium and the most important districts of France are in the enemy's hands, some considerable time will most probably elapse before these markets are again available, and very considerable stocks must have accumulated. Several proposals have been made to find outlets for the surplus of pitch; amongst others it has been proposed to mix a proportion of pitch with the coal charged into the gas retorts. So far the reports as to the results obtained are somewhat conflicting. The most complete report published up to the present is contained in a paper which was read at Birmingham on June 24th last by Mr. E. W. Smith, M.Sc., chief chemist to the Birmingham Corporation Gas Department. From a consideration of his figures it would appear that so far as gas works pitch is concerned, this method of disposal can only serve as a means of reducing stocks, and is not likely to continue after the present trouble is over. It has also been suggested that non-coking coal might be rendered fit for coking by adding a proportion of pitch before charging into the ovens. So far as I have been able to ascertain no results have been published, and it would at first sight seem to be unlikely that any great success can be hoped for, since most coking coals lose their coking property when exposed to a temperature of about 400° C. It is possible that low temperature pitches, such as those obtained from producer and blast furnace tars, may be more suitable for this purpose than those from gas works, and coke oven tars, as they have been obtained at a lower temperature. It is, however, well worth while giving some time to the investigation of this proposal as, should success be obtained, it would open out very considerable possibilities.

There is, however, one direction which I think holds out considerable promise and that is the extension of the briquette industry. Very large quantities of slack coal are produced and used as fuel and if the slack were washed, the nuts being used for fuel direct and the fines (duff, smudge, dross, etc.) briquetted, we should not only obtain an increased permanent home market for our pitch, but we should utilise our coal resources in a better way and should contribute to the reduction of black smoke.

The very large quantities of coke breeze might also be usefully formed into briquettes and utilised. The production of briquettes in the most important European centres in 1909 is given below:—

Belgium	in 1909 produced	2,707,390	metric tons.
France	,, ,, ,,	3,061,300	,, ,,
Germany	,, ,, ,,	18,748,713	,, ,,
Great Britain	,, ,,	1,511,645	,, ,,

In the case of Germany the greater part of the briquettes were produced from brown coal.

The most recent figures for Great Britain are:—

1913	2,213,205	long tons.
1914	1,840,465	,, ,,

I have dealt somewhat at length with the question of pitch as it forms by far the greater proportion of the crude tar and presents I am afraid the greatest problem for the future.

Turning next to benzol and toluol both have appreciated in value. The former is in demand not only for the production of synthetic phenol and consequently for picric acid, but it has served as the starting point for the production of synthetic toluol, and has taken the place of a considerable quantity of petrol as a motor fuel for which purpose it is excellently suited. Toluol of course is the starting point of trinitro toluol or T.N.T. and the demand has been so great that not only are practically all coke oven works recovering all the benzol and toluol possible by washing the gas, but the process has been extended to the gas works. When the demand for high explosives decreases, other outlets for these products will have to be found, and although the revival of the colour industry in this country will require large quantities it is probable that we must look to the use of both benzol and toluol as motor fuels to absorb the balance of the very large quantities that will be produced. In admixture with alcohol they offer one of the best solutions to the questions of providing a home made fuel for internal combustion engines.

The naphthas have advanced considerably in price, but they will probably fall back to their old position again.

Creosote has suffered somewhat, but has, I think, a fairly bright future as a fuel for engines of the Diesel type in addition to its ordinary uses.

Carbolic and cresylic acids have risen very considerably not only because they form the starting point of picric acid and trinitro cresol, but because of their value as disinfectants. With the ending of the war they are likely to revert to their former position, and it is to be hoped that further research will show that the synthetic resins of the Bakelite type produced by condensation of phenols with formaldehyde and the so-called synthetic tannins formed by the condensation of sulphonated phenols with formaldehyde have a bright future.

Naphthalene has risen considerably and will probably maintain a fairly high level especially as the extension of vertical retorts will tend to decrease its formation.

Turning from the products of distillation to the works where the process is carried out, you will find in the next table the number of tar distillation plants registered separately under the Alkali Act, which I have taken from the reports of the Chief Inspector. For the figures for 1915 and 1916 I am indebted to the kindness of His Majesty's Chief Inspector, Mr. Curphey.

TABLE II.

Year.	Number of separate tar distillation plants.
1906	174
1907	184
1908	188
1909	191
1910	195
1911	205
1912	221
1913	234
1914	250
1915	296
1916 to 30th June	356

The rapid increase in the number of works during the last few years has been due not only to the erection of tar distillation plants at coke oven works, but to the installation of tar dehydrating plant at the gas works for the production of refined tar for use in making and surfacing roads. These plants are mostly small and of the continuous type. The systems of Wilton and Hird appear to be very successful in solving the question of the production of refined tar on the spot where it is required, and saving considerable unnecessary carriage.

In conclusion let me say a few words as to the future, and I will confine myself to the actual tar industry and leave the question of colours to abler hands than mine. Since its birth in this country the methods employed in separating the fractions have followed very largely on the original lines, and the industry has suffered from a lack of co-operation among the workers. I quite realise the difficulties in the way of such co-operation, but I feel sure if we are to recapture the fine chemical and colour trade from Germany, we must be prepared in the future to give a good deal more scientific attention to the tar industry than has been the case in the past. I will briefly indicate some of the work which might be undertaken by a combination of those engaged in the industry.

A central research laboratory might be established where many questions could be thoroughly thrashed out, some of the most urgent are:—

The cause of corrosion in tar stills.

Is the present method of separating the fractions the best in view of the products required.

An investigation of creosote oil and of the lesser known bodies in the distillates with a view to finding uses for them.

An investigation of coal gas pitch to find means for rendering it less brittle when cold and raising its melting point, so as to render it, if possible, more suitable for replacing natural asphalt.

The standardisation of the methods of testing coal tar products.

Meetings might also be held from time to time to discuss ways and means of preventing useless competition and conferences might take place with representatives of the gas making and coke oven industries to discuss questions of mutual interest.

Many other suggestions might be made but the whole can be summed up by saying that our great need is organisation and co-operation, so that we may take advantage of all opportunities of improving the prospects of the industry.

DISCUSSION.

The PRESIDENT said that co-operation was needed in distilling tar, as in so many problems, he found some difficulty in understanding why the continuous method of distillation had not made greater progress in this country. It was so simple, and almost automatic in action. The regularity with which all the operations were conducted was an exceedingly good example of what should be aimed at.

Mr. E. F. HOOPER stated that the prices given in the paper were not commercial prices in the ordinary acceptation of the word. Benzol or benzene in its various grades probably would yield a very much higher price than was indicated. The prices given were the prices at which the Government required benzol to be delivered. That applied also to other products, but he thought that Mr. Coleman might have indicated the value of naphthalene at a considerably higher figure. He did not think with regard to the question of the disposal of pitch in the future, that they need trouble as to the necessity of putting the pitch back into the retorts. There was not much doubt that after the war was over pitch would again find its normal level in the ordinary manufacture of briquettes; and if the price of coal remained at its present high price, probably as much pitch as could be made would be required not only in England but abroad for the conversion of more or less low value duff and very small coal into high grade fuel in the form of briquettes. The bulk of the coal won abroad yielded a much larger percentage of small coal than that raised in England. Neither the gas companies nor tar distillers need fear but that pitch would resume its normal condition very shortly after the termination of the war. It was to be hoped that the war had resulted in some uses being found for products of which very little was known at present, such as solvent naphtha and creosote products. There could be little doubt that research work in that direction would discover products of considerable value. If there were a little more openhanded interchange of ideas in that class of work, no doubt great improvements might be made in connection with these particular products.

Mr. R. MACLAURIN said that he had found with low temperature pitch that the change from softness to brittleness came very quickly, and was evidently accompanied by decomposition, because a large volume of fume was evolved. Experiments he had made indicated that by the use of solvents it might be possible to obtain different products from high temperature coal tars. When a low temperature tar was treated with weak sulphuric acid or paraffin oil, and the cresylic acid or carbolic acid separated, the light portion could be used directly for lubricating purposes. A resinous mass also separated, which could be used for varnish-making. Probably in higher temperature tars the aromatic hydrocarbons to a large extent dissolved the resins, and it was possible that pitch was actually resinous material soluble in aromatic hydrocarbons. It was possible that the resins formed in low temperature tars were somewhat similar to bakelite, and might be formed by the phenols combining with aldehydes after the tar had left the retort. In the low temperature tars obtained by his process, he found that in the portion soluble in caustic soda there was a little cresylic acid, practically no carbolic acid, and a very large quantity of resinous material.

Mr. W. Irwin thought a better idea might have been obtained of what might be called the open market value of certain tar products by the prices which could be obtained in the United States. Whilst the Government was now paying 10d. and 11d. per gallon for benzol here, in the States 4s. was being paid. In the case of the other products, the prices were much in the same proportion. With regard to the first question put by Mr. Coleman, it was difficult to say if the present method of separating the fractions was the best, because tars varied so much that no general statement could be made. That there ought to be more co-operation was a good suggestion, and in no industry would it pay better than in the tar industry.

Dr. C. H. Desch suggested that the constitution of blast-furnace tar should be added to the subjects calling for investigation. The custom seemed to be to treat blast furnace tar as an inferior variety of gas tar. It did not contain several very important constituents of gas tar, but practically nothing had been done to determine whether it contained other constituents which might be utilised. The fractions were not used, he thought, to the best advantage. It was a subject which had not received any thorough investigation. It was practically a local industry, but in some districts it was of quite considerable importance.

Mr. W. Newton Drew was rather surprised that the new Association of Chemical Manufacturers had not been mentioned. One of its most valuable functions would be, he presumed, to form sections—*e.g.*, a section of tar distillers, to deal with the subject in a co-operative way from every point of view. He was afraid that the British nation had not a very great genius for co-operation. Most of the triumphs of the past seemed to have been made by individuals, but if we were to do great things in the future we must co-operate and we must even give each other wrinkles with a certain risk that we might thereby suffer some loss; in no other way could we reach the level of the enemy and surpass him.

Mr. G. Stanley Cooper expressed the opinion that one of the greatest bars to co-operation was the fear of showing others the work we were doing. Until more mutual confidence was shown he was afraid co-operation would be very limited.

Mr. J. K. Hill mentioned that in the Corporation Gasworks at Widnes a large amount of tar was decomposed in retorts and the gas produced was added to the coal gas. It might be possible to distil pitch without attempting to mix it with the coal.

Mr. J. T. Dunn emphasised what Mr. Hooper had said about the possible uses of pitch in the future. In some of the larger Northumberland collieries where more and more complete methods of washing and separating the coal had gradually been adopted, briquetting plant was being put down on a very considerable scale with the view of avoiding the whole of the waste of fine coal. He contrasted the remarks that had been made urging the necessity for co-operation, with the request on the programme of the Edinburgh meeting, to members attending the meeting not to visit works where there were industries in which they were personally interested.

The President said that probably the insertion of such a request to members was the only way in which permission could sometimes be obtained to visit works. When face to face with a body of foreign manufacturers, we must sink our jealousies, even although we had to give away a little of our knowledge to each other, in the hope that we should gain a great deal in our competition with highly organised producers. We must teach each other how to fight the common antagonist in industry. A great deal of advantage might be obtained from collaboration or unity of purpose between those who produced the tar, and those who distilled it. At the present moment there was none, or very little indeed; the tar producer had no regard as to whether the article would give the best products. If some of his defects could be pointed out to him there would be mutual benefit. At one time the works with which he was associated had made tar containing hardly any benzol and much free carbon. By adopting more scientific methods they had been able largely to increase the benzol and substantially to reduce the free carbon.

THE EXTRACTION OF TAR FOG FROM HOT GAS.

BY G. T. PURVES, A.M. INST.C.E.

The question of completely removing tar fog from hot gas has arisen only in comparatively recent carbonising practice. It is seemingly an operation of considerably more difficulty than complete extraction from cooled gas. Up till about the advent of direct and semi-direct ammonia recovery the methods in use for effecting the removal of tar fog were determined almost solely by the need for maintaining a minimum standard of purity and illuminating power of the permanent gas, and that as cheaply as possible. The question of tar values did not arise. The tar extractors proper were placed late in the series of plant units through which the gas had to pass. On this account the bulk of the tar was separated before the tar extractor was reached and the gas and its remaining tar content cooled to about atmospheric temperature. As a result the extraction of that remaining tar fog was a comparatively easy operation. In direct recovery the gas must be freed from tar fog before it enters the saturators, thus reversing the order of arrangement on the older indirect system. It was on account of the inefficiency of the tar separation from the hot gas that Brunk's direct ammonia recovery process was a commercial failure.

Now consider the treatment of the gas during the cooling. As the crude gas passes through the collecting main and connections, etc., up to the outlet of the condensers its temperature steadily falls, and the motion of that part in contact with the metal surface is retarded. In this way the gas with its accompanying tar particles tends to roll from the centre of the stream on to the metal surface. The contact between tar particles and this surface must thus be very gentle. So that, since the bulk of the tar is usually separated during this period, we are led to the conclusion that if the proper means are applied tar extraction should entail the expenditure of little energy per ton of coal carbonised. Yet we will see later that in the separation of tar fog from hot gas the expenditure of energy is very considerable.

Though the bulk of the tar is removed in the plant before the completely cooled gas reaches the tar extractors proper this is merely incidental to the cooling and is little the result of special provision having been made to increase the efficiency of extraction. Repeated bends in the mains by suddenly changing the direction of gas flow increases the separation, and so also does causing the gas to impinge on water cooled tubes set transversely in a cooling chamber. The fundamental factor in tar extraction, however, appears to be the control of the cooling, and in order to get the maximum tar separation in the mains the gas must be cooled as early as possible to as near the minimum temperature required as is practicable. This is particularly important where hot tar extraction is to be carried out: for the fog which is formed just before the extractor is entered is very difficult to remove. It should be advantageous to cool the gas to practically the extraction temperature, then pass it through a long main carefully insulated to prevent further cooling, and then into the extractor. The behaviour of gas carrying freshly formed tar fog seems to me to present considerable analogy to a colloidal solution. If we had here a true suspensoid we could readily understand the difficulty of extracting the freshly formed fog. Lowering the temperature of the gas materially below that at which the fog is formed certainly facilitates extraction. Wm. Young proposed to promote the separation of tar by condensing naphtha vapour on the fog particles, and you will remember Aitken proposed to send the gas at 190° F. into a settling chamber, and to keep it there as long as possible at that temperature. These methods of procedure all illustrate the analogy and I think suggest the ideal treatment the gas should receive during the cooling. The temperature named by Aitken is not much above the water dew point temperature of the gas when wet dross is being carbonised, and it would be interesting to know if he considered the fog formed at this temperature the most difficult to extract. In any case on direct recovery plants the application of a settling chamber must be at least just above the water dew point temperature. Reference has already been made to the separation of tar particles by contact with the sides of the main. In this way the surface becomes coated with a film of tar oil, and as Young and others have pointed out, this facilitates the removal of the fog. When the gas temperature falls below the water dew point and the main surface gets coated with water, there is not the same adhesion to the tar particles. From this it might be inferred that after the dew point was passed the tar separating power of the mains would decrease. Against this however there is the fact that as the condensation of aqueous vapour reduces the volume of the gas the concentration of tar particles will increase, and also more light fog will be formed. I have noticed that the tar does seem to settle out more readily during aqueous condensation. When gas has been completely cooled light oils separate out, and probably condense to some extent on pre-existing fog. The lightest hydrocarbons, since they are not in sufficient quantity to more than saturate the gas, are removed solely by solution in the existing fog. These influences increase the mass of the fog particles, and so make the extraction easier. In the case of extraction from hot gas these actions have not occurred, and this is probably one of the factors contributing to the difficulty of extraction.

In order to see why hot tar extraction is so difficult we must consider the altered conditions of working. Some of the contributing factors have already been referred to. Direct ammonia recovery from hot gas has so far been applied only at coke oven plants (in this country at least). In these plants washed dross is used, and the coal when charged into the ovens usually contains from 9 to 13% of added water. This water is of course present in the gas as vapour at the fog extraction temperature, thus greatly increasing the volume. One might anticipate, as so much water accompanies the coal, and so cools the oven walls, that the outstanding effect of increasing the proportion of water would be the production of thinner tar possibly more difficult to extract. This is not my experience. The most notable effect is the increased amount of pitchy matter which is deposited in the collecting main—not necessarily an increase of pitch made per ton of coal. The increased dilution of the gas by steam will have little effect on the volatility of the pitch product. This will readily settle out, and so the fog formed later on should be lighter. But at the higher dew point an increased amount of the lighter tar will be retained in the gas as vapour, so counteracting the effect on the fog of the reduced pitch content. It is therefore not probable that the presence of so much water in the coal will make the fog extraction more difficult by the production of a lighter tar fog in itself. It might be, however, that under these conditions the fog particles are smaller, but it is very difficult to get experimental evidence in regard to this. We do not know how the composition of the individual fog particles is related to that of the bulk tar collected, but the rapidity of the cooling, and the time the fog particles exist as such in the gas will have a material influence on their composition and consequently on the difficulty of extraction.

On indirect recovery plants where the gas is completely cooled such a machine, as a Livesey Washer or a Pelouze and Audouin tar extractor, which gives a very simple scrubbing action, effects satisfactory extraction for the works purpose. They are not suitable for treating hot gas, however. At Auchengeich we have a baffle chamber on the Pelouze principle, and I find it of little or no use for extracting the tar.

The solution of the problem of hot tar extraction, with a reasonably small expenditure of energy lies in the treatment the gas receives before it enters the extractor. It being practically impossible to completely remove freshly formed tar fog—at least without a very large expenditure of energy—so the fog must first be brought to a suitable condition for extraction after which the type of tar extractor used is of secondary importance. An electrical method of modifying the condition of the fog is applied at the coking plant of the Semet-Solvay Coy., Detroit. The crude tarry gas is here passed through an intense ionizing field where according to the theory the resulting ions in their violent motion cause impact between the tar particles. "Because of this impact or for some reason as yet unknown agglomeration results and the dense tar mist is almost entirely dissipated leaving a relatively few large tar drops in its place.*" The tar is not extracted in this ionizer but in the tar extractor through which the gas passes next. It was found that the Pelouze and Audouin machine became a very efficient tar extractor after the gas had been treated in the ionizer. The electrical energy used in the ionizer must be added to that required for forcing the gas through the Pelouze and Audouin extractor. So that while this method may give very efficient extraction the consumption of energy will still be very considerable. The most satisfactory method of getting the fog into a suitable condition for extraction appears to be controlling the cooling of the gas. The design and arrangement of the gas mains at the Auchengeich plant are such as to make the cooling and detarring of the gas a very difficult matter but such results as I have been able to get indicate that this method should be satisfactory.

The ordinary devices used for fog extraction being ineffective, special methods have been applied, which give a much more intense scrubbing action. In the Simon-Carves direct recovery plant the heavier fog is separated in a "Cyclone" extractor into the inlet of which a jet of ammoniacal liquor is forced. This unit acts in the same manner as do bends on the mains. The principal extractor however, which removes the lighter fog is a "Dynamic" separator, the vanes of which revolve at high speed. The peripheral speed is said to be over 200 ft. per second. I have no experience of this type of extractor, nor do I know the details of its design. But I have passed crude gas at 80° C. through a five fan turbo-exhauster running at up to 2000 revs. per minute, and although the extraction was not complete the bulk of the fog present was certainly removed, and this exhauster was not specially designed on the lines of a dynamic extractor. The result of this test inclines me to the view that with such an exhauster working on cooled gas special tar extractors might not be necessary. The energy required in a dynamic extractor is said to be 1 H.P. per 12,000 cubic feet of gas per hour—presumably crude gas passing through the separator. When carbonising wet dross the volume of crude gas produced measured at the dew point will not likely be less than 20,000 cubic feet per ton. So that on a 360 ton plant the energy required per day will be about 600 H.P. hours. The method of extraction patented by the Otto Hilgenstock Company was to scrub the gas with a spray of tar. A cluster of sprays were used in Germany, and were so arranged that any particular number of them could be used at once. This practice was not exactly followed by the Otto Company in this country. The plant they erected at Auchengeich has four sprays, and provision is left for adding two others. These sprays can be worked singly or two sets of two in series. They are served by a motor driven centrifugal pump, the capacity of which is 120 cubic meters of tar per hour at high pressure, and they are designed for treating the gas from 360 tons of coal per day. Before handing over the plant the Otto Company abandoned the use of tar, and used instead a mixture of tar and liquor. They also used only one spray. I prefer to use liquor as free as possible from tar and a much smaller volume than that given above. The energy required at present per day is 360 H.P. hours. These figures show, in the designer's view, at least the magnitude of the difficulty of completely removing the tar fog from hot gas. Other methods of extraction are in use, but I will not refer to them.

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* Journal of Gas Lighting, Nov. 10, 1914.

Following on the treatment of the gas as regards rate of cooling I have made experiments, with a view to saving energy, on the spray extractor itself, varying the dimensions of same, the nature of the liquid used, and the pressure and volume of the liquid not always, however, with gratifying results. As you are aware, the spray is applied inside a tapered pipe which is narrower at the top than the bottom: the spray and the gas both passing downward through this pipe or throat. Unless the throat is partially drowned with an excessive amount of liquor the extractor does some work as an exhauster, and so a considerable saving s effected at the exhauster proper. This shows that the spray is pushing the gas in front of it, when, for efficient scrubbing, it should pass through he gas beating out the tar particles in its passage. From this we conclude an excessive amount of iquor is being used. And a saving in energy will be effected by reducing this volume provided we can suitably apply the smaller volume to get the same extracting efficiency. Now consider the action of the Pelouze tar extractor, where the gas divided into small streams flows against an obstructing surface. We see that the efficiency of extraction will be determined by the fineness of the gas streams, and their relative velocity to the obstructing surface. It will come to the same hing if we consider small obstructing surfaces to be driven against the gas, with the same relative velocity, so dividing it into small streams. The fficiency will be increased if these obstructions are made smaller and placed closer together, and t the same time driven faster. We would very oon reach the limit at which the machine would be practical to construct and maintain. But this onstruction we are seeking is precisely what we have in a spray extractor. Thus we see the factors which determine the extracting power of the spray, and the lines along which increased efficiency must be sought. It is to be noted this pulverising of the spray is quite contrary to the practice of pumping relatively enormous volumes of liquor down the throat. The velocity of the particles of spray is determined by the pumping pressure. The fine subdivision of the spray is influenced by the pressure, but more particularly by the design of the spray nozzle. While considerable evidence is available regarding the discharge of liquid in solid jets from sharp edged orifices, there does not seem to have been much work done on the sprays formed when using orifices which cause the jet to burst. Experiment is therfore required to find the type of nozzle which will give the best spray. It is on the lines indicated that I have been experimenting, and while the results so far are very promising, I have not yet got sufficient data to refer to in more detail. As a result, however, I am hopeful that efficient extraction will be got with a further saving of possibly 70—90 % in energy.

Tar extraction from hot gas apart from producer plants is practically limited to the relatively few carbonising works adapted for direct ammonia recovery, but the number is increasing, and I am convinced that before many years have passed direct ammonia recovery will be almost general, at least on new carbonising plants. While hot tar extraction is an essential in direct recovery, it is also the key factor to a further lucrative possibility in carbonising, *i.e.*, fractional collection of tar. It is to be expected that in future the recovery of benzol and its homologues will be carried out at gas and coke works to a greater extent than hitherto. This leads to the question what is to be the standard practice? Are we to distill the tar, produced in bulk by completely cooling the gas, for one portion, and wash the gas for the remainder, or will we adopt the more rational practice of simply washing the gas, and in this manner recover the whole benzol content in one operation? If the latter course is adopted the tar fog must be removed from the hot gas, and probably the ammonia recovered by a direct or at least semi-direct recovery process. When direct ammonia recovery is practised a small tar fraction is separated when the gas is completely cooled prior to washing with creosote. This fraction consists of naphthalene together with phenols and some heavy naphtha. We have thus a marked step towards complete fractional collection of tar, and it is surely a natural development to complete the fractional collection. It appears to me that all the arguments which justify the production of ammonium sulphate direct instead of through the intermediary of a crude liquor also justify the production of tar products in primary fractions without the intermediary of a crude tar. Further than this, there is the question of the nature of the tar products themselves to be considered.

As I have already suggested tar has been treated at the carbonising works literally as a by-product. Little or no attention has been given in practice to varying the manner of extraction for the purpose, if possible, of modifying or increasing the value of the tar products themselves. Our knowledge to-day of coal tar products and their relative proportions is limited in great measure to the products resulting from what is really a semi-destructive process of distillation. One tar distiller informs me that he is satisfied that distillation of the tar increases the content of naphthalene and free-carbon, and also increases the bulk of the pitch fraction. Now that the refining of tar constituents and the production of derived products is receiving so much attention, it is surely of prime importance to examine our methods of recovery and preliminary treatment, and see whether or not the highest commercial value is developed from this important carbonisation product. If the primary distillation of crude tar is to be avoided we must resort to fractional separation of the fog from the hot gas. I have already put forward some views on fractional collection of tar, and do not propose to more than refer to it here, nor will I attempt to examine the effect of distillation on the tar products, but one or two figures relative to the subject may be of interest.

The tars produced in the modern vertical retort differ greatly from those produced in horizontals and coke ovens. They in fact mark a step towards those produced in so-called low-temperature carbonisation, and to which we may soon be giving much more attention. In order to get some fresh figures I distilled under exactly similar conditions samples of these five tars :—

	I.	II.	III.	IV.	V.
	Heavy tar from direct recovery plant (coke ovens).	Tar from horizontal retorts.	Tar from Wilson continuous-intermittent vertical retorts.	Tar from Glover-West continuous-vertical retorts.	Tar from Woodall-Ducklam continuous vertical retorts.
	%	%	%	%	%
First runnings up to 110°C.					
Oil..................	trace	2·6	1·3	2·6	3·5
Water..............	7·0	2·2	1·7	3·4	7·1
Light oil up to 210° C. ..	1·5	5·2	4·5	8·7	6·7
Carbolic oil up to 240° C.	4·0	13·0	10·9	12·9	7·7
Creosote oil up to 270° C.	8·4	9·1	12·1	8·6	8·6
Anthracene oil up to 350°C.					
Water	—	0·5	0·5	0·1	0·6
Oil	19·6	20·6	27·0	20·4	27·1
Pitch	58·6	46·0	40·6	41·5	37·2
Loss	0·9	0·8	1·4	1·8	1·5
	100·0	100·0	100·0	100·0	100·0

I. and II. contained both naphthalene and anthracene. III., IV., and V. showed no precipitate of naphthalene on cooling the oils. IV. and V. appeared to contain only a trace of anthracene, but the fraction when cold was semi-solid on account of the separation of solid paraffin. No. III. had not so much paraffin, but had a distinct amount of anthracene.

These tars so widely dissimilar are mixed at the tar distillery and submitted to a uniform treatment. It may not be practical for tar distillers to deal with the different types of tar separately, but there does seem good reason for giving them selective treatment, and if fractional collection was adopted at the carbonising works each tar could receive the fractional separation most suited to its composition. Both anthracene and solid paraffins are valuable products, and well worth recovering, but when the tars are mixed the one substance fouls the other. Vertical retort tar, particularly when mixed with other heavier tars, might be expected to suffer more from decomposition during distillation, since it has not been cracked to the same extent during carbonisation of the coal. Specifically light tars yield more gas when they are being distilled. I tested three samples of the gas evolved during the distillation of a 20-ton charge. The first sample was taken when spirit was just commencing to come over. It was mostly air and steam and contained little hydrocarbon gases. The other two tests were as follows :

	II. Still head temp. 170° C. after 10½ hours firing.	III. Still head temp. 225° C. after 26 hours firing.
	%	%
Absorption by 10 % sulphuric acid	7·2	15·9
CO_2, H_2S, and SO_2, etc...	8·4	20·2
C_nH_m (by bromine)	2·1	2·5
CO	6·7	3·4
H_2 *	33·1	25·9
CH_4	31·0	22·9
N_2	12·0	9·0
	100·5	99·8

* The result of combustion was calculated as if only hydrogen and methane were present.

These tests are not of much significance, the volumes of gas not being known, but it seems unlikely that after 26 hours firing and at this temperature that the gas evolved was simply dissolved in the tar.

These notes are not a complete statement of the problem of hot tar extraction, but they are a record of some of the conclusions we have arrived at, and may be of interest to others working on the same problem.

Discussion.

The **President** said that the paper dealt with an important aspect of the recovery of ammonia by the direct process. The success of that process depended upon the completeness with which the tar fog was extracted before the absorption of ammonia took place. It was surprising that in a works carbonising 360 tons of coal a day 360 horse-power was required to work the tar sprays. He would have thought that the horse-power required under these circumstances would be something like five or six for a similar quantity of coal per day.

Mr. R. H. **Clayton** asked what method was used to estimate the tar fog in the gas. To get an accurate test of the tar fog they had found it necessary to take the samples one third of the way through the main. To prevent tar fog being formed due to further cooling, a glass tube was inserted into the main with the orifice pointing downwards, so that the tar would not drop into it from the top, the tube was filled with cotton wool and gas sucked through. Afterwards the cotton wool was extracted with benzol and the amount of solid material calculated, allowance being made for the free carbon. By this method it was possible to test the gas in the main at the exact temperature, with the conditions unaltered. Working with the Livesey washer at 2 in. back pressure, they had obtained 95% efficiency. The Pelouze apparatus gave 98% efficiency when worked at 4 in. back pressure. For water-gas the highest efficiency was obtained with a Crossley fan, but that was only when the peripheral speed reached a certain limit. None of these, however, gave the desired result, as it was not possible to get a spent oxide free from tarry matter—it always contained 3 to 4%. The figures that Dr. Carpenter had called attention to, 360 tons of coal requiring 360 horse-power, were, he agreed, enormous.

Mr. R. **Maclaurin** said that he was using just now a plant dealing with two million cubic feet per day—that was the gas from about 20 tons of coal—and the horse-power used for pumping all the water and all the acid liquor required, and running the centrifugal scrubbers, was always below 5 horse-power. His difficulty had always been to get anything past the scrubbers at all. Petrol had been added to increase the illuminating power of the gas, but all the petrol had been absorbed in the scrubbers. The gas left the plant at about 212° F. and passed through two centrifugal scrubbers, 10 feet high by 4 feet in diameter, working at about 500 revs., and these scrubbers could scrub two million cubic feet of gas per day, quite effectively. His own results indicated that all the oils and all the ammonia were extracted by the time they left the second scrubber; that he attributed largely to the rapid swirl in the scrubbers. Regarding the fractional separation of the oils, he had found the heavy paraffins had been carried forward into the second scrubber. Naphthalene would be even more troublesome to get rid of, since it would almost certainly be carried forward, and that might be the reason of the very large horse-power required in the case Mr. Purves had been dealing with.

Mr. **Purves**, in reply, said that in direct recovery processes an excessive amount of energy was used for tar extraction. The 360-horse-power hours which he at present found necessary was, in his opinion, too much. The method he used in testing was to collect the tar, at the fog extraction temperature, on tightly packed wool and the efficiency of the different tests was compared by the appearance or weight of the tar deposits. At no time had he got a test absolutely free from tar. The tests were made at the bottom of the extractor. Fog extraction became easier when the gas temperature fell below the water dew point. Mr. Maclaurin's figure of 5 horse power per hour (equal to 120 horse-power hours per day) was, in his (Mr. Purves') opinion, high for treating the gas from 20 tons of coal (that being the amount Mr. Purves understood was carbonised).

THE BRITISH COAL TAR COLOUR INDUSTRY AND ITS DIFFICULTIES IN WAR TIME.

BY C. M. WHITTAKER, B.SC.

On the outbreak of war in August, 1914, the manufacture of coal tar colours as an industry in Great Britain received a sudden and unaccustomed attention which was almost overwhelming to the few British chemists actually engaged in it. When it was realised that the trade was practically monopolised by the Germans, a perfect flood of ill-informed statements, exaggerations, and absurd suggestions were published in the newspapers and journals of this country.

I will just deal briefly with some of the commonest mistakes which were made with reference to the German coal tar colour industry during the discussions.

The most frequent mistake was in regard to the amount of capital which the German firms were supposed to employ in their industry. It was freely stated by Members of Parliament and others that the capital of the German industry was anything from one to two hundred millions. This was, of course, absurd, but such statements did not make any easier the task of those who were endeavouring to establish an adequate British industry. The export value of German coal tar colours throughout the world was for the year 1913 £11,349.100; add to this the German home consumption at a generous estimate of £2,000,000, making a total turn-over of £13,349.100. The capital of the German industry was £13,500.000 in 1913, showing that the total annual production was approximately equal to the capital. Those who talked about one and two hundred millions capital never stopped to explain how a dividend of from 12—25% could be paid on this capital out of an annual turn-over of £13.500.000.

Another point with which I wish to deal is the supposed dependency of Germany on outside countries, particularly Great Britain, for many of the important raw materials of the coal tar colour industry. Such a state of dependency was no doubt existent in the earlier days of the industry, but the modern coke-oven recovery plant has argely altered that state of affairs, as the following official figures for the year 1913 of the imports and exports of important raw materials connected with the industry show. In considering these figures I would ask you to bear in mind the fact that Germany's export represents the surplus after all the requirements of her home industry have been satisfied. Starting with benzol, toluol, etc., Germany exported 41.287,000 kilos. and imported only 6,709,600 kilos. These products do not give much of an opening for crippling tactics. To these figures ought to be added 7,264.700 kilos. aniline oil and salts exported by Germany against a negligible import of 156,100 kilos.

In 1913 Germany imported 4.155.200 kilos. of carbolic acid and exported 3.601,700 kilos., an adverse balance of roughly 500,000 kilos. It was well known by the tar distillers that the Bayer Co. were making an onslaught on the British market with synthetic carbolic acid which would have effectively reduced the amount of pure carbolic acid distilled from coal tar in this country. It must also be remembered that Germany will have made enormous quantities of synthetic carbolic acid during the war, so that under no combination of circumstances could its industry run short of carbolic acid after its experience of production during the war.

Passing on to naphthalene, Germany imported 5.248.700 kilos. and exported 6.151.110 kilos., in addition to 3.106,400 kilos. of naphthols and naphthylamines.

I now come to anthracene, of which Germany imported 1,286,000 kilos. and exported 277,400 kilos. There the balance is decidedly against her, and it is the only important raw product for colour manufacture in which Germany is deficient. It is the starting point for alizarin and many of the most important vat colours, which latter have added so much to the prestige of the German firms. It must, however, be remembered that bromine enters largely into the constitution of many vat colours, which gives Germany an effective counter against the withholding of anthracene.

Another point which was freely discussed as one of the virtues of the German firms was their service of technical chemists to demonstrate processes in the dyehouse. The Germans were not alone in supplying that service. I have had charge for fifteen years of the experimental dyehouse of Read Holliday and Sons, Ltd., now merged in British Dyes Ltd. During that period we have supplied, and are still supplying similar technical service in many dyehouses of different trades. One of our most recent services was to show a firm how to get 33% better value out of a dyestuff which they had used continuously for 18 months and which they had been consistently running down the drains for that period. In peace times there was often a difference between the British and German technical experts, namely, the Germans were given access to many places denied to the British.

I now propose to pass on to the handicaps under which the British coal tar colour industry has been and is labouring.

One of the greatest handicaps has been the shortage of chemists. On the outbreak of war I doubt if there were twenty British chemists who had had actual up-to-date experience in the manufacture of coal tar colours on the commercial scale. Of those who had had experience some had their energies diverted to the manufacture of explosives to the detriment of coal tar colour manufacture. It was an inevitable result of the close inter-relation between high explosives and coal tar colours. No complaint is made of the diversion of this energy, but it requires to be stated as one of the definite handicaps of the industry during war time. There was no reservoir of trained chemists from which to draw, so that University trained men of good theoretical knowledge but no practical experience have had to be taken, and naturally some time must elapse before they become adapted to their new conditions. The outbreak of this war, bringing in its train the enormous demand for supplies of high explosives on a scale hitherto not contemplated, illustrated how closely inter-related was the manufacture of coal tar colours and high explosives. As everybody is aware, the two high explosives most largely in use are picric acid (or trinitrophenol) and trinitrotoluol. The latter requires similar apparatus to that which is used for making compounds like nitro-benzol, so essential in coal tar colour manufacture. The engineering trade has been so much occupied in connection with the supply of munitions that it has been difficult to get delivery of the plant for the necessary extensions. For the same reasons there has been a shortage of the skilled fitters necessary for the erection of the plant and of men to erect the necessary buildings. In fact the shortage of labour confronts one at every turn. The increases in the prices of copper and lead, which enter largely into the apparatus used in coal tar colour manufacture, have also added enormously to the cost of such plant.

The lifeblood of the coal tar colour industry is sulphuric acid, fuming sulphuric acid, and nitric acid. It is the misfortune of colour manufacture that it is impossible to make any colour without the use of nitric and sulphuric acids, the latter being required in various strengths of fuming acid from 70% down to 20% SO_3 and D.O.V. These self-same acids are also indispensable for the manufacture of the two high explosives lyddite and T.N.T. It is a matter which admits of no argument that the demand for acids for the manufacture of high explosives must take priority over their numerous industrial uses. In that fact you have the greatest handicap of the British coal tar colour industry, because, as is well known by every acid consumer, the supply of acids is nothing like equal to the demand.

Amongst the raw or primary products of the coal tar colour industry the four most important are benzol, toluol, naphthalene, and anthracene.

The distribution of one of these products (viz. toluol) is controlled by the Government. The amount of toluol to be distilled from coal tar has very definite limits, which are relatively small, so that the reason for this control is obvious. Benzol is the starting point for the manufacture of synthetic carbolic acid, of which so much is being made at the present time owing to the demand far outstripping the production of carbolic acid distilled from coal tar. This is being converted into picric acid. Benzol is also being used in large quantities for conversion into dinitrophenol from which picric acid is also being manufactured. Naphthalene and anthracene are free markets. The control of one of the chief primary products is, however, a heavy initial handicap on the output of coal-tar colours.

Since the commencement of the war I have been in a specially favoured position to diagnose what is passing in the minds of many colour consumers. One common thought which is very prevalent is, "We can understand you not being able to make some of the German specialities such as Indanthrene, Alizarin Sapphirole, etc., nor do we expect you to do so immediately, but we cannot understand you not being able to supply such old colours as Bismarck Brown, Benzopurpurine 4B, etc., the constitution and method of manufacture of which have been known for so many years." That is quite a reasonable attitude to adopt and my lecture will, I think, show completely the reason. Such colours are not being made freely at the present time, not through inability of British chemists to manufacture them but owing to the fact that the necessary products are not available, since they are required for more important processes.

The surplus of benzol and toluol which is set free by the Government after all their requirements for explosives purposes have been met, has a preferential call on it before it can be used for general colour manufacture. Next to explosives it is the first duty of the British coal tar colour industry to supply the various colours required for the varied equipments of the British, Colonial, and Allied Governments. People outside the trade have very little conception of the numerous colours required by the Governments; they vary from Mordant Brown and Sulphur Black down to Methyl Violet for typewriter ribbons and Soluble Blue for ink for the Stationery Office. The huge demand for khaki uniforms required by the military authorities for the equipment of the troops caused a corresponding demand for mordant yellow, brown, and green, blue, or black. The demand at the outset for these colours was overwhelming. Mordant Yellow was very scarce at the beginning, but the demand for this product has now been more than fully met. Seeing that salicylic acid is a constituent of all mordant yellows and is in turn derived from carbolic acid, you will readily understand why it was scarce. Mordant Brown never caused any difficulty as the supply was and is more than sufficient to meet all requirements. The supply of Mordant Green has also been very large. You may have seen in the scarce Press that the dyes being supplied by the British firms were not anything like as good as those of the German firms, but I wish to state most emphatically that khaki uniforms dyed with mordant yellows, browns, and greens of British manufacture are equally as fast to light, exposure, and wear as any similar cloth that was previously delivered to the British Government dyed with German colours. The British firms have every reason to be proud of their products for this purpose, and the day when it is necessary to stipulate German colours in British khaki specifications is past.

Sulphur yellows, browns, and blacks have also been supplied in very large quantities by the British firms for the cotton equipment of the armies such as cotton webbing, tropical uniforms, trench capes, ground sheets, etc., and here again the colours supplied have not been behind German colours for fastness to light, exposure, washing, etc. Not only have all the British requirements been met, but large quantities of British-made dyes have been used in Australian, Canadian, Belgian, French, Russian, Italian, and Serbian equipments. I do not give these facts as a handicap on the British industry, rather is it intensely proud of its achievements in this direction under such difficult conditions; but I do put it forward as a definite reason why many colours have not been made which would otherwise have been made had not the energies of the British chemists been so largely occupied in producing explosives and equipment colours.

Now let us examine a few of the products derived from benzol and toluol, which are so important for coal tar colour manufacture, and you will notice how the whole path is beset with a continuous demand for nitric and sulphuric acids. The primary step in the manufacture of coal-tar colours from benzol is to convert it into nitrobenzol. From nitrobenzol one proceeds to aniline oil and salts which have numerous uses. They are consumed in large quantities for the production of Aniline Black on the fibre both in dyeing and calico printing. Aniline oil has always been most extensively made in Great Britain, so that the shortage is not due to any lack of manufacturing experience but mainly due to shortage of acid. It would be tedious to detail all the uses of aniline oil but it enters into the manufacture of numerous colours, including Acid Orange, acid blacks, acid reds, Magenta, soluble blues, nigrosines, and indulines, whilst in the form of dimethylaniline it is required for the important basic colours Auramine, Methyl Violet, Methylene Blue, and Malachite Green; it has also been largely supplied for munition purposes. *p*-Nitraniline is a very important derivative of aniline obtained with the aid of the inevitable nitric and sulphuric acids. It is consumed in large quantities for the production of Para Red by the cotton, calico printing, and paint trades, whilst it enters largely into the production of many important colours, including blacks; it is also extensively used for coupling on the fibre with suitable direct cotton colours; it is, in addition, the intermediate stage in the production of *p*-phenylenediamine, which is used in colour manufacture and by the fur trade for producing a black on furs. Aniline is also the starting point for phenylglycine, which is the primary product for one of the two processes used on the large scale for the production of synthetic indigo.

By the alkaline instead of the acid reduction of nitrobenzol, one arrives at benzidine, which is such an important base for the making of a large number of the popular direct cotton colours, such as blacks, blues, greens, violets, oranges, etc. Benzidine base has been made in this country in normal times, so that here again the present shortage is not due to the inability of British chemists to manufacture the product, but to inability to get a sufficiency of the necessary materials.

Another important product from benzol is dinitrobenzol, which is the starting point for *m*-nitraniline used in wool colours, and *m*-phenylenediamine. This latter product is of the utmost value in colour manufacture and enters into the constitution of numerous important colours such as:—

Mordant browns for wool which have been used in enormous quantities for military uniforms; sulphur browns for cottons, which have been extensively used in the dyeing of all cotton khaki equipments, such as tropical uniforms, cotton webbing, etc.; it is also required for direct cotton blacks and browns, Chrysoidine, and Bismarck Brown. You will therefore see that this product is in enormous demand, whilst it must not be forgotten that the production of the equipment colours must take precedence of all other colours. This is the explanation why such common colours as Bismarck Brown, Chrysoidine, and cotton blacks and browns are in such limited supply; again not due to the inexperience of British chemists but to lack of the necessary products.

Another product from benzol which is of the highest importance is dinitrophenol. This product is used in the manufacture of sulphur colours, which are consumed in enormous quantities in peace time and which have been used so largely in Government equipments. It is fortunate for the cotton trade in particular that the manufacture of this important intermediate product and of sulphur colours was so firmly established in this country prior to the war. I do not think it is an exaggeration to say that sulphur colours have been produced in larger bulk than any other class of colour since the war broke out. The production, huge as it has been, has not been enough to satisfy the legitimate requirements of the trade, but here again the shortage has not been due to lack of experience or plant, but solely to lack of material and labour.

It is fortunate for this country that the manufacture of dinitrophenol was firmly established, because it has been used in an alternative process for the manufacture of picric acid other than direct from phenol; it has therefore increased the production whilst easing the pressure for synthetic phenol.

The amount of phenol distilled from coal tar being utterly inadequate for the amount of picric acid required by the authorities, large quantities have had to be made synthetically by caustic fusion of sodium benzene-monosulphonate.

Carbolic acid plays a most important part in colour manufacture and the shortage of this product has been a very great handicap to the colour industry. Phenol enters directly into many colours, and is one of the generators of Chrysophenine, the direct cotton yellow which is so largely used and has been so badly missed.

o-Nitrophenol, which on methylation and alkaline reduction yields dianisidine, is another important derivative of phenol because dianisidine is the base for Cotton Sky Blue, the absence of which has caused much inconvenience to cotton dyers and has caused famine prices to have been paid for any existing stocks of this colour.

Salicylic acid is another important derivative of phenol both from a medicinal and a colour point of view. It was not made in this country prior to the war, but its manufacture is now firmly established. It is largely used both medicinally and in the manufacture of colours of the highest importance, including fast chrome blacks, reds, oranges, and yellows, also direct cotton reds and greens. The great shortage of these colours has been influenced by the scarcity of this product due to the phenol being required for the manufacture of explosives.

The other derivatives of benzol which I propose to mention are resorcinol, made by the caustic fusion of benzenedisulphonic acid; this product enters into the constitution of many direct cotton colours and also colours of the Rhodamin class; another derivative is chlorobenzol from which are derived some of the fastest chrome colours for wool extant, amongst which may be mentioned the fast chrome blacks which are fast to potting.

In the manufacture of picric acid for explosives purposes it is inevitable that some is produced which will not pass the Government specifications. This is liberated by the Government for the purposes of colour manufacture. For the last fifteen years picric acid has played an important part in colour manufacture.

Toluol is of vital importance as a starting point for colour manufacture, and the restrictions on its use are responsible for the lack of many colours which are absolutely essential for the dyeing trades. *Ortho-* and *para*-nitrotoluol are obtained by direct nitration of toluol. From *o*-nitrotoluol tolidine base is obtained by alkaline reduction, and from it are made many direct cotton colours of large consumption. I will content myself with mentioning one, viz.:—Benzopurpurine 4B. This is the reason why such a common and popular colour is not being made at the present time.

There has been a great dearth of direct cotton yellows in the colour market, but the reason is very simple. In peace times there were three main classes of direct cotton yellows used, viz.:—

1. Chrysophenine, which is made from diaminostilbenedisulphonic acid (a toluol derivative) coupled with two molecules of phenol and the product ethylated; both the products are required for explosives, hence no Chrysophenine.
2. Primuline and the fastest class of Direct Cotton Yellow which are derived from dehydrothio-*p*-toluidine; these require *p*-toluidine.
3. The Sun Yellow or Stilbene Yellow class which require *p*-nitrotoluol for their manufacture.

The direct cotton yellows form an excellent example of the handicap imposed on the coal tar colour industry by the diversion of toluol for explosive manufacture. The last two classes of yellow have always been extensively made in Great Britain so here again the plant and experience is available but not the material.

Toluol derivatives are also required for the manufacture of sulphur blues and greens; this accounts for the limited supplies available, which are insufficient to meet the legitimate demands of the trade. Toluidine also enters into the manufacture of Magenta and Safranine which are so largely used in the paper trade amongst others, whilst Rosaniline is also required for the manufacture of Soluble Blue so keenly desired by the shoddy trade. Here again the experienced chemists and the plant are available for all these colours which were made in Great Britain in peace times but the material is now lacking.

Dinitrotoluol leads to *m*-toluylenediamine, which is so largely used as a developer for diazotised cotton blacks and as a component of direct cotton oranges and blacks.

Among the other derivatives of toluene which find extensive application are benzyl chloride, benzaldehyde, and ethyl- and methyl-benzylanilines.

I now pass on to the last mother product with which I propose to deal, viz., naphthalene.

The uses of naphthalene in colour manufacture are multitudinous, but I only propose to deal with those derivatives of major importance. Naphthalene has no limiting restrictions on its sale like benzol and toluol.

Naphthalene has four primary derivatives, viz., α- and β-naphthylamine and α- and β-naphthol, of which the α-naphthylamine and β-naphthol are the more important. α-Naphthylamine has always been largely made in this country. β-Naphthol used to be made in this country but was not being manufactured on the outbreak of war. The manufacture has now been resumed and there are several naphthol plants on various scales working in this country at the present time.

α-Naphthylamine is a most important constituent of acid blacks, chrome blacks, and sulphoncyanines—all three classes of colour of enormous bulk consumption.

Naphthionic acid, the 1.4-monosulphonic acid of α-naphthylamine, is largely used in the production of reds, both acid and direct cotton reds; it enters into the constitution of Benzopurpurine 4B. Neville and Winther acid, the 1·4-monosulphonic acid of α-naphthol, is also of considerable importance in the manufacture of acid reds and direct cotton blues.

β-Naphthol is itself used to an enormous extent in what are known as the insoluble azo or ice colours such as Para Red, Naphthylamine Claret, etc., whilst it is also largely used as a developer for the ingrain colours on cotton.

The manufacture of large quantities of naphthalene derivatives is not limited by any shortage of naphthalene, but it is seriously limited by the shortage of sulphuric and nitric acids.

The following four acids of the highest importance require fuming acid in their commercial production.

H acid. Aminonaphtholdisulphonic acid 1 : 8 : 3 : 6: used in acid blacks, cotton blacks, cotton navies, and cotton blues.

Chromotrope acid. Dihydroxynaphthalenedisulphonic acid 1 : 8 : 3 : 6: used in producing a full range of acid reds of easy levelling powers and good fastness to light which by treatment with bichrome are turned to fast navy blues.

Gamma acid. Aminonaphtholsulphonic acid 2 : 8 : 6 : used very largely in direct cotton colours, notably the "BH" class of blacks.

Aminonaphtholdisulphonic acid 1 : 8 : 2 : 4: used in the production of bright blues.

The following important acids do not require fuming acid but may be made with ordinary sulphuric acid.

Phenyl peri acid. Phenyl-α-naphthylamine-δ-sulphonic acid: used for sulphocyanines.

G salt. β-naphtholdisulphonic acid 2 : 6 : 8 :	used for scarlets, bordeaux, etc.
R salt. β-naphtholdisulphonic acid 2:3:6	

I have not touched on anthracene and the alizarin and vat colours, the manufacture of which has not up to now been developed in this country except the manufacture of Alizarin Orange, Red, and Blue. Here nature has imposed an additional handicap on development, due to the fact that practically all the bromine originates in Germany. Bromine is largely used in this branch of colour manufacture.

I have now finished what must have appeared to many but a mere catalogue. However I have felt it necessary to show the large number of products which are required in the coal tar colour industry before a start can be made with colour, and to give an adequate idea of the handicaps which the state of war has imposed on the coal tar colour industry. The shortage of acid in this country is in course of being rectified, and there is no after effect of the war which may be prophesied with more certainty than that there will be an abundant supply of acids in peace time. Plant for the manufacture of colour on a scale never hitherto attempted in Great Britain is being erected as fast as is humanly possible. Research also is being organised on a scale hitherto not attempted, so that the neglect of research may not in future be counted against the British firms as one of their sins of omission. In fact when the colour consumers of this country come to weigh the efforts which have been made for them by the staffs of the colour firms of this country—from the directors down to the humblest colour tester—they will, I think, be amazed at the success of those efforts. The present time does not allow of this to be done because calm judgment cannot be formed when the minds of the consumers are distracted by the shortness of supplies. It may be of interest to mention that it has been necessary in Germany to advertise for *p*-nitraniline in the technical journals, which shows that colour supplies in Germany are far from normal.

The task before the British industry is inestimably difficult because you will no doubt be aware the Germans have formed a huge combination with eleven millions pounds sterling capital to fight the British efforts, which at first they treated with contempt. On what lines the Germans will be allowed to compete, the future will decide. This opposition is most formidable, formed as it is of the great German colour firms with forty years experience behind them. Nevertheless the British chemist is being given a chance for the first time to fight the German chemist with anything like equality of opportunity. Speaking for my own colleagues, we welcome the fight in order to show that British chemists are equal to German chemists. I have little doubt but that the other chemists engaged with other firms do so likewise.

The fight will be a stiff one—none know this better than those few British chemists who battled against the Germans in peace times. In the past the British firms fought in a very antagonistic atmosphere; in this respect some scientific societies were not entirely free from blame. Let us have a sympathetic atmosphere in future; let authors who read papers on colours illustrate their experiments with British colours. They will find samples just as readily furnished by British firms as by German firms. What the British industry requires is sympathy and patience—the handicap of forty years is sufficiently heavy to warrant consideration. If we must have criticism do not let it be destructive criticism—anyone can furnish that—but let it be constructive criticism founded on knowledge.

Discussion.

The President said that the paper was to be regarded as being an authoritative answer to the criticisms which had from time to time been levelled at the organisation responsible for making up our dye deficiencies. It was interesting to learn that the difficulties with which the manufacturers were confronted did not arise from their lack of knowledge or from their want of skill, but almost entirely from the fact that the primary products, the coal tar distillates, were required for the purposes of the Army and Navy.

Mr. H. N. Morris said that no reference had been made to the valuable assistance that had been given this country in the supply of dyes by the Swiss manufacturers. He suggested that something more might be done in the way of co-operation with the Swiss manufacturers, who had had so much more experience than we had in this industry. We could not expect forty years' experience to be acquired in one or two years. Mr. Whittaker had referred almost exclusively to the German competition, but he pointed out that after the war we should have very serious competition from America, and possibly from Japan. American manufacturers had been able to take full advantage of the shortage of colours and intermediate products in this country and had been free from war taxation. Some of them had been, and were still writing off out of the extraordinary profits made out of consumers in this country, all their capital expenditure, so that they would be in a very strong position as compared with our manufacturers. Mr. Whittaker had referred to very valuable work done in synthetic dyes such as Bismarck Brown, Chrysoidine, Indulines, etc.; it was true these colours were being used in large quantities, but he suggested these would not be permanent products. Nowadays consumers would use any dyestuffs they could obtain. These were not the colours that the Germans made a profit out of; their large profits were made out of patented colours. What would be the position at the conclusion of the war with regard to all the patents for the best of the colours? When the patented colours come on to the market again they would be in great demand, and most of the colours now being made would be almost unsaleable. Immediately after the outbreak of the war it had been proposed to our Government that if they would grant the use of all enemy patents in this country, either free or with a reasonable royalty for the duration of the war, and for a certain period after the war, the manufacturers in this country would lay down plant and put capital into the industry, and there would be no need of any Government subsidies. This proposal had not been adopted. He agreed with Mr. Whittaker that German chemists were not better than University trained British chemists: their only advantage was that they would work for a much lower salary. The question of intermediate products was of the highest importance, and co-operation among manufacturers of these products would be necessary to prevent over-production. Unless we had adequate organisation and co-operation between manufacturers both of colours and of intermediate products, and unless we had more equitable arrangements with regard to patents, we were in danger of losing the industry again after the war.

Mr. W. P. Thompson said that a licence could be obtained to work enemy inventions patented in England by applying to the Board of Trade. He had done so in a number of cases and thought there was no difficulty. Further, it was invariably understood that those licences were to continue practically for the life of the patent afterwards, so that there need be no fear that a license would end when the war ceased.

Mr. A. G. Bloxam said that the present position was that the licence was to last until the end of the war and then, if necessary, it was to be reconsidered with the view to adjusting any question of royalty as might seem fair between the parties, but that condition, as he understood it, would depend upon the behaviour of Germany with regard to German patents owned by Britishers. If Germany would not adopt the same attitude and continue the licence on what was determined to be a fair royalty, the British Patent Office would refuse to reconsider the licence, which would therefore continue throughout the life of the patent.

Mr. W. P. Thompson thought there was no doubt that when the time came the question would be not as to whether the Germans would reciprocate, but whether the English would reciprocate.

Dr. A. Ree disagreed with the remarks made by Mr. Thompson. One of the principal reasons why our industry in aniline dyes and similar products had suffered was the fact that our patent laws had favoured Germany rather than this country. From the beginning some of the ablest of our patent agents and some of the most eminent of our lawyers had been specially retained by German firms to help them. We had suffered from that for a great many years, and he was very sorry that, under present conditions, after the experience they had had since the war began, Mr. Thompson should make a statement which he considered to be contrary to fact, viz., that our Patent Office had been the reverse of conciliatory and that Germany, on the contrary, had done everything to try and meet us. At the time of the agitation which the Manchester Chamber of Commerce had conducted for many years, they had an amount of opposition on the part of certain professional elements which had done an infinite amount of harm to this country. If they had been able to carry out the proposals made by Manchester some 15 or 20 years ago he was certain that many of the difficulties they had met with since the war broke out in regard to the supply of colours, high explosives, etc., could have been avoided. Compulsory working would have been the best way of dealing with the situation. Alternatively he was satisfied that, if we had followed the example of Switzerland 30 or 40 years ago and granted no chemical patents, it would have been the best thing for this country. The Swiss in the early days of the aniline colour industry had been helped very much by the fact that they were able to use any inventions without paying royalty. He understood that it had been largely owing to pressure brought by the German Government on the Swiss Government that the Swiss had finally introduced a patent law.

Mr. R. D. Pullar said that, as a member of the Users Committee which had had a good deal to do with the Government action in promoting British Dyes, Ltd., every possible method of doing this was most fully and carefully considered. The proposal about patents did not come before that Committee, but every suggestion brought before the Committee had been most carefully considered. The question of dye patents was only a very small part of the proposals for protection which had been brought before the British Government. It had been said that dye manufacture was a key industry, and ought to be treated as an exception to the ordinarily accepted policy of the Government, but it was necessary to take a wider view than that. It was impossible to protect the dye industry by itself. Had that been done, there would have been a number of other industries asking for similar privileges, and that would have been a difficult situation in view of the many complicated questions arising out of the war. It seemed to him that if British chemists and British dyers could not proceed on excellence they could not proceed at all. As a user he would be only too glad and too willing to give every possible preference to British dyes, but a mere tariff to shut out German dyes would not, in his opinion, produce the desired result. It would only give rise to a series of complications and difficulties which were not now foreseen. If British colour manufacturers got a fair field and no favour they would be able to hold their own at least. It ought to be generally known that British dyes had actually been sold in Germany previous to the war. Complaints had been made about the quality of dyes that had been issued to the trade by certain British firms; he thought it was not fair in war time to expect the exact standards which had been a feature of imported colours.

Mr. W. F. Cooper asked what was going to happen to British Dyes, Ltd., after the war. What safeguard had they that after the war they would be able to continue—at least without a considerable subsidy from the Government? There was also the question of the supply of bromine. The Germans had the power to make such regulations as they liked with regard to the supply of potash or bromine.

Mr. J. K. Hill said that if we were successful in the war we could make terms one of which might be to impose a tax on German industry.

Mr. Fryer said that German and Swiss manufacturers took a great deal of pains to find the exact tint necessary in each industry, whereas in the past their experience had been that the British colour makers had only offered a certain standard product. Continental producers would send a range of 10 or 15 samples, with a notification that if they did not suit they would be prepared to go further into the subject, and if a sample of the raw material were submitted they would find out the most suitable dye for it.

The President said that one of the most important matters with which the Association of Chemical Manufacturers would have to deal would be the mutual arrangement of the manufacture of intermediate products and others of a similar character. The suggestion of Mr. Morris was an appropriate and practical one. It would be necessary to decide which were the firms that in respect of plant and other advantages were in the best position to make these intermediates economically. They would have to be encouraged to manufacture in competition with the cheap supplies coming from elsewhere, and that elsewhere, as Mr. Morris pointed out, was not only Germany. One large firm of colour makers had just recently made arrangements to establish themselves in Switzerland. He did not see how cases of that kind were to be met, where an industry was established in a friendly country.

Mr. Whittaker, in reply, expressed the opinion that co-operation would lead to the formation of trusts. It was not through any oversight that he had not mentioned the Swiss manufacturers, but his subject was the difficulties of the British coal-tar colour industry. It was the simple colours, to which Mr. Morris had referred, that the trade wanted now; these colours had a very large consumption and were not patented. He was inclined to support Dr. Ree on the subject of patents. He had had experience of the difficulties and obstacles put in one's way by the German Patent Office. They referred one to references in books about fifty years old and they said the invention was covered by subjects which seemed to bear no relation to the dye. The service of British colour firms had been criticised to their detriment as compared with others. His own experience had been that many firms had given preference to the foreign manufacturers, but they hoped that after the war that would be different.

THE PRODUCTION OF ALKALOIDS AS AFFECTED BY THE WAR.

BY D. B. DOTT.

For some time after the outbreak of hostilities, alkaloids and other fine chemicals which were chiefly produced in Germany found their way into the United Kingdom, through the neutral countries, including America. Switzerland, which does a considerable manufacturing business of her own, is in a favourable position for sending into Italy things which have really been produced in Germany. By this time, no doubt, such indirect importation has been reduced to a minimum and we are mainly dependent on what we make ourselves, or import from allied or friendly countries. The conspicuous effect of the war on the production of alkaloids in this country, has been to greatly increase the demand for, and therefore as far as possible the output of, those articles which British manufacturers were already producing. Presumably the same holds true of manufacturers in allied and neutral countries. This increase has been mainly caused by the exclusion of Germany as a source of supply. Although Britain has for long been a producer of opium alkaloids and quinine, and more lately of caffeine, strychnine, emetine, and veratrine, Germany has been a larger manufacturer of all these bases, except morphine, while the preparation of atropine and most of the rarer alkaloids has been almost entirely in German hands. But the medical requirements of the Army are also responsible for the increased demand. Comparing the prices of alkaloids in May, 1914, with those of May, 1916, we find a rise in every instance, varying from 63% in the case of morphine hydrochloride to 700% in the case of atropine sulphate, the average increase of price in eight of the more important alkaloids being 237%. Atropine has scarcely been made in appreciable quantity in this country and Belladonna root is scarce and dear. It ha been reported that the *Hyoscyamus muticu* grown in Egypt and India yields 1% of alkaloi and over. If a sufficient supply of that dru could be imported, it would be an additiona inducement to British manufacturers to take u the preparation of atropine. On the other han there is no scarcity of opium, or of cinchon bark, or of nux vomica. It is only in a fe instances that there is difficulty in getting th raw material. The use of emetine has greatl increased of late, a fact which is explained by th extended administration of the alkaloid for treatment of dysentery. The war is responsible fo the rise in cost of freights, and for the enhance price of many of the necessary solvents, th Government having commandeered or limited th supply of several of the latter. These are amon the causes of increased prices.

According to the best information available, th making of alkaloids in this country, which we formerly made almost exclusively in German has not as yet attained considerable proportion Manufacturers are fully occupied with supplyin the increased demand for their standard product With a reduced staff and a limited supply labour, the conditions are not favourable f embarking on new processes. The difficulty i obtaining delivery of newly-devised plant another obstacle. At the same time, there doubtless a good deal of laboratory work bei done with the purpose of taking up the preparati of alkaloids and other compounds as soon conveniently practicable. In the near futu many compounds which we have been accustomed to import from abroad, will be prepared in British works.

It has been suggested, and the matter has been discussed in some of the journals, that we ought to do more in the way of growing medicinal plants in this island. I believe many individuals have been making private experiments in their own gardens, but nothing of an extensive nature has yet been done. Our climate and soil do not seem to be well suited for almost any of the alkaloid-yielding plants.

Seeing that some of the alkaloids have been synthesised, it naturally occurs to one that the present time would be very favourable for the production of such of those as are in brisk demand. With atropine selling at 170 shillings an ounce and cocaine at 23 shillings, the time seems opportune for the artificial preparation of these bases, should a practical working process be known. It is an interesting fact that there is no such synthetic alkaloid in the market. There are evidently difficulties connected with the complexity of the process, expense of materials, or the poverty of the yield, which prevent the published methods giving remunerative results. If the artificial production of those highly-priced alkaloids cannot be made a financial success, it seems very unlikely that morphine and quinine, with their more complicated structures, and much lower prices, could ever be produced at a paying cost, even should the secret of their synthesis be discovered. Notwithstanding much elaborate and ingenious research the synthesis of the two most important alkaloids remains still unaccomplished. But while the synthetic preparation of the natural alkaloids remains a matter of academic interest, useful results have been obtained in the discovery of substitutes having a comparable if not equal pharmacological value. Thus the phenylglycolyl ester of methylvinyldiacetonalkamine is used as substitute for atropine under the name euphthalmine, and has a strong mydriatic action. Cocaine is the benzoylmethyl ester of ecgonine. Hydroxy-acids having a similar constitution to ecgonine having been prepared, it is found that when converted into benzoylmethyl compounds, they produce local anæsthesia like cocaine, and are known as eucaines. One of these is the benzoyl ester of vinyldiacetonalkamine. It is the lactate of this base which the Pharmacopœia includes as benzamine lactate. But the synthetic anæsthetic which is proving of most general value is novocaine (*p*-aminobenzoyldiethylamino-ethanol hydrochloride). Scarcity of any of the natural alkaloids must tend to increase the use of synthetic ubstitutes, if they are at all comparable in action. Therefore one effect of the war is to act as an ndirect stimulus to the production of artificial alkaloids.

THE MANUFACTURE OF SYNTHETIC MEDICINAL CHEMICALS AS AFFECTED BY THE WAR.

BY FRANCIS H. CARR.

For two years now we frequently have been met y the question "Why do we not manufacture his or that in England?": and in no other section f the wide field of Industrial Chemistry has the uestion been as persistently or as pertinently sked as in that of Synthetic Organic Drugs. lthough it is not my intention to attempt to eal with the answers given to this question, nor hould I expect the members to bear with me if I d, it may be recorded to the credit of English hemists that even in the case of very complex ganic compounds they have rarely, if ever, plied with a *non possumus*.

It is, of course, incorrect to suppose, as many ave done, that no synthetic organic drugs were manufactured in this country before the war. One might mention the names of firms who were already doing important business on these lines; chiefly, however, these firms manufactured drugs required in small quantities, and in the selling of which there happened to be little or no competition. Of the important drugs which were not manufactured here one may enumerate the following:—antipyrin, aspirin, salicylic acid, phenacetin, chloral hydrate, salol, phenolphthalein, saccharin, veronal, sulphonal, trional, eucaine, and novocaine. When we consider that the total imports of products of this class amounted then to the value of over a million pounds annually, we must admit that we were doing a very small proportion of business in this country.

When war broke out the situation was by no means easy, but its necessities evoked an energetic response. Many difficulties have been encountered such as that of obtaining a sufficient number of trained men, both chemists and engineers, that of procuring plant, and above all the fact that in practically all large concerns the works organisation has been employed at least in part in making supplies peculiar to the needs of the war. In view of these disabilities the achievements have been both remarkable and substantial. In many instances manufacturers, assisted by high prices, have not only produced the substances required, but have done so in good yield and of good quality. But this fact alone is not sufficient to argue the case for any established commercial success, because in many instances it is necessary for such success that the by-product of some other chemical manufacture should be available at a low cost, and this other manufacture is not yet in all cases established here.

Also, intermediate products which are required in larger amounts for other manufactures, particularly dyes and photographic chemicals, are required for synthetic drugs in smaller quantities. Economic manufacture will only be established in such instances when these intermediates are produced on a larger scale for all consumers.

Notwithstanding these aspects, we may say that an industry already developing before the war has since grown to considerable proportions. Organic antiseptics, antipyretics, sedatives, local anæsthetics, and diuretics of purely English manufacture are now available to medical men. How great the need of them was, is proved by the extraordinarily high prices which have ruled.

The time is not ripe for entering into details of the exact extent of the present development; at least we know that it is substantial, giving evidence of great vitality, and that for its own sake as an industry, as well as for reasons of British national independence, it must be proceeded with and preserved. Nevertheless, the development has been that of an exotic, and we are confronted with the problem of deciding by what hardening process the new growth can be rendered suitable for the free air of an open market.

It is axiomatic that an industry requiring so much skill on the part of its workers, so much experience in direction, and so much perfection in machinery and detail, will need in the beginning very careful attention before being turned into the playground among the bullies of competition; but it must be fitted for this playground as soon as possible, and when it gets there we must ensure that the prefects take every care to secure the newcomer fair play.

Germany's huge sugar industry was built up largely as a result of war, on account of Napoleon's edict closing ports to British products. It was fed by State subsidies from the time of Frederick the Great. We cannot help reflecting how invaluable the ability to manufacture sugar has been to Germany in this war, quite apart from its economic value.

Is it too much to believe that of very much greater importance to the State will become the synthetic organic industry of the future? If we but consider the progress of synthetic chemistry during the past half century in conjunction with such achievements as the large scale production of synthetic ammonia, indigo, and caffeine, the imagination is filled with pictures of the potentiality which awaits the organic industry of the future.

We chemists know that the power we are to-day fighting in Germany is largely chemical power. Convincing proof of this will be available when, after the war, we shall be enabled publicly to demonstrate the almost incredible extent to which chemical science has played a part in both offensive and defensive warfare, as well as in the supply of the necessaries of life. The perils to which our initial technical inferiority to Germany exposed us should surely carry conviction to the rulers of this nation. It will not do so unless assisted on our part by the reiterated expression of our faith. The public memory is apt to be short, and it may readily be forgotten how profoundly we were affected at the outbreak of war by our dependence on external sources for supplies of organic medicinal chemicals.

Even though medical science is as yet merely in the earliest stage of its development, it is in a large measure reliant upon synthetic chemicals for the relief of pain and for the cure and prevention of disease, as well as in surgical treatment. The substance salvarsan affords a powerful illustration of our dependence upon Germany before this war.

Syphilis is a scourge following in the wake of every war, and salvarsan is the drug of greatest importance in its treatment. Except for the immediate intervention of Messrs. Burroughs Wellcome and Co., in England, and of Messrs. Poulenc Frères, in France, the Allies would have been at a great disadvantage in having no supply of this potent remedy. Yet, important though chemical science is to-day in the treatment of disease, its present importance is not comparable with that which awaits it when pharmacology has advanced but a few steps further. Our industries must keep pace with these advances. No longer can we be satisfied to be externally dependent for supplies of vital importance. The war has—not too soon—removed the scales from our eyes.

The opportunity is unique. Great Britain, the home of coal-tar and the birthplace of chemical industry, is at least as favourably situated as any country for the manufacture of organic chemicals. Furthermore, if given time, the industry can be established upon a basis of complete independence suitable for the conditions of free trade. But it is our duty to admit frankly to-day that some form of protection is of vital necessity during the coming ten years, while we develop a complete organisation and rectify educational shortcomings. Without this protection, what has already been accomplished will rapidly and completely be demolished by competition from abroad. There can be no doubt that the industry unprotected would become the butt of German heavy artillery, and would suffer even greater damage than did dyes, glass, chlorine, etc., before the war.

The recent announcements of the combination of all leading German chemical works will not have escaped attention—a declaration of war on the chemical manufacturers of this and the allied countries is definite and unmistakable. Enough is known of German methods to make it obvious that for no object will German industry and organisation, directed from the highest quarter, and financed from the nation's purse, be more ruthlessly employed after the war than to recover, consolidate, and extend the hold formerly possessed over the world's chemical industries.

In fact the successful prosecution of this object will be recognised by our enemies to be one of greater material importance than the recovery of her lost colonies and European territory.

Important though protection is, nothing is more certain than that without similar combination, organisation, and national assistance no form of protection will, by itself, enable the British chemical industry to hold its position in the world's markets and eventually in its own.

No opportunity should be lost of impressing upon the nation and its rulers the fact that the possession of a powerful and self-contained chemical industry is of the same degree of importance as that of a great engineering industry has proved to be.

We must not content ourselves with educational reforms and grants in aid of research, desirable though they are, alone they will avail nothing. Our conservatism, as a nation, affects the question doubly, for our capitalists and bankers have little ability to face failures without rebuff and discouragement, while at the same time we require the pressure of necessity, such as arises from prohibiting imports, to make us enter into new competitive undertakings. An illustration of this was afforded by attempts which were made many years ago to establish the synthetic production of camphor in this country. Preliminary plants were erected, and good and capable men were managing them. Initial difficulties were, of course, encountered —what chemical venture, indeed, can be without them? Considerable quantities of excellent camphor were sold for pharmaceutical and manufacturing purposes; nevertheless after a comparatively short time, and long before the merest suggestion of technical failure should have been entertained, the drop in the price of camphor which foreign manufacturers aimed as a blow at the new industry put fear into the hearts of those responsible for it. It was then abandoned with serious loss of money to those pioneers to whom, in a happier issue, we should have been as a nation indebted. Had the State then realised, even as well as it does to-day, that its ultimate prosperity depends upon the application of science to practical ends, surely such an undertaking would not have been allowed to be dropped until it was finally proved to be valueless. Having accomplished its purpose, it is easy for a combination such as that which dumped camphor at a low price more than to recover losses by subsequently raising the price.

It may be anticipated that German competitors will adopt a variety of skilful manœuvres to combat the new developments in this country, such as charging high prices for intermediate products, offering low terms for finished products on long period contracts, systematic dumping, etc.

Surely there is no more urgent requirement of the Association of Chemical Manufacturers than that it should bring together the smallest and largest workers in this field frankly to discuss the measures to be taken to ensure their future progress; and that it should bring such influence to bear upon the Government, either directly or through the Board of Trade, as will secure the necessary legislation. It must here be said that the absence from amongst the Board of Trade committees, dealing with post-war problems, of any to deal with the chemical industries is of ominous import. Never was the need of a united chemical "voice" more imperative than now.

An immediate decision to extend for a period after the declaration of peace the prohibition against the importation of German chemicals would have a far-reaching effect by giving confidence to capitalist enterprise. It would also give time for the State Policy affecting our future fisca relationship with Germany to develop before any tariff protection is adopted. There is already evidence of internal competition sufficient to make healthy rivalry and to ensure that prices will drop to a reasonable level, though the high prices which have ruled are the less to be regretted because they have brought a flow of capital into the industry.

No doubt prohibition of long standing would bring about stagnation and do damage to certain trades, but it does not follow that an extension of the *status quo* for a fixed time would not be of great advantage. Medicinal drugs are not raw materials in any proper sense of the word, and high prices of drugs at least have the advantage of deterring the public from consuming too much of some of them.

Should any tariff be imposed the money derived therefrom ought to be devoted exclusively to research and education. Above all, any protective measures must be framed with the knowledge that scientific efficiency in production will determine in the long run which nation shall be strongest, and therefore an industry protected during its growth must be in a position ultimately to support itself unhelped.

Technologists must rely upon efficiency and not sympathy. After all, the extent to which official sympathy and financial aid will be forthcoming will be largely determined by the evidence the units of the industry give of their ability and determination to organise and co-operate. Detailed statistical information will be required regarding the nature and quantity of German pre-war exports to this and other countries, so that the extent of the ground to be covered can be approximately ascertained. Representatives of each branch of chemical industry must define the extent of their requirements from other branches, which in their turn must co-operate.

We look to the Association of Chemical Manufacturers to take the lead in these matters and to set afoot the necessary organisation to prevent overlapping and gaps, to arrange by mutual concessions that too many do not manufacture the same chemicals, and to secure the manufacture of those chemicals not already provided for. A further function of the Association will be to call upon certain branches of chemical manufacture to supply those raw materials, such as sulphuric anhydride, chlorsulphonic acid, carbonyl chloride, phenylhydrazine, acetoacetic ester, phosphorus pentachloride, etc., even though—on account of he smallness of the quantities at first demanded—uch undertakings could be regarded as business propositions only by those far sighted observers whose motives are tempered by regard for the hemical industry as a whole.

Similar co-operation with the dyemakers in egard to the manufacture of intermediate products s imperative. Take, for example, the manucture of ortho- and para-aminophenol—possible tarting points for a great number of synthetic hemicals—or one might mention dimethylniline, dimethyl sulphate, β-naphthol, phthalic nhydride, and so on. If we all continue merely o fulfil our own requirements of all these products, e shall find ourselves on the rocks. Such bstances are required by the makers of dyes, rugs, and photographic chemicals, and they can, course, be made with much greater economy on he large than on the small scale.

We must organise in a new spirit—not driven ereto by the greed for personal gain or because e wish slavishly to copy Germany, but because the strength it gives; and we must be willing o give and to receive assistance with a view to tional economy. Unless we can marshal our rces to effect this economy we cannot enter into mpetition with countries thus organised, nor ll Great Britain worthily retain her supremacy nong the nations unless her manufacturers preare to carry on the business of production by combining, where necessary, to secure such economy.

Whether or not the manufacture of synthetic drugs will develop to a large industry able to hold its own in the world's markets, will be determined by the dye industry. For the demand for synthetic drugs, as well as for artificial perfumes and photographic chemicals, is small by comparison, and their manufactures bear a relation to the dye industry somewhat similar to that which the latter bears to the coal tar industry. With a large dye industry the supply of intermediates would be assured.

At the conclusion of war the new coke oven plants that have been established will, we hope, be available to supply immense quantities of by-products, and means must be adopted to prevent them being too largely exported. Now, we need immediately to organise our means of converting these by-products to intermediates for the use of the whole country. There surely will be factories in plenty as well as suitable workers from our high explosive plants whose experience will fit them well for such operations as sulphonation, nitration, and reduction on the large scale. What a golden opportunity it appears to be.

It may be regarded as outside the scope of this paper to deal with the scheme of industrial research which is administered by the Special Committee of the Privy Council; there must be already an immense number of important investigations for which the Committee is providing. Nevertheless, so badly are we placed in this country with regard to supplies of cheap alcohols, acetone, and acetic acid, and so important are these to this country in time of war and to the branch of industry in question at all times, that the hope is expressed that some action will be taken (if it has not been done already) to promote industrial research in these connections.

Cheap and pure methyl and ethyl alcohols lie at the very foundation of fine chemical manufacture. No one other obstacle has barred our progress in this industry so much as the Government restrictions on their use. Mr. Thomas Tyrer, to whom for his classic work on this subject we are all immensely indebted, has put the case so forcibly and well that in recent years we have been disposed to adopt a *laissez faire* attitude in this matter because there is so little new to be said. Such an attitude, correct in scientific matters, is unfortunately apt to be misinterpreted by the official mind to mean that our grievance is assuaged. Such is far from the case.

Alike as solvents and for their use in the synthesis of organic compounds, both methyl and ethyl alcohols are daily necessities and must be used in large quantities. The restrictions make industrial methylated alcohol dear, while the impurities added for methylating purposes are a constant source of trouble in decomposing one's product, and giving objectionable residual substances: we are consequently not only put to a disadvantage as regards cost, but also as regards quality of our manufactures.

If the authorities will remove the duty from pure methyl alcohol (or shall we call it carbinol, to obviate official confusion), and allow pure methyl alcohol to be used in methylating—and it is an effective ear-mark—nearly all difficulties will be overcome. It is difficult to see how the revenue could be appreciably affected by the change, especially if a system of inspection by men of chemical knowledge were adopted at the same time.

The procedure in factories concerned with the manufacture of synthetic drugs differs from that in most other factories because of the intermittent or discontinuous nature of the work. The same worker may not be engaged on the same operation for many weeks or even days in a year, and consequently that "rule of thumb" knowledge, so invaluable in other cases, is less to be relied upon here.

Great care and attention to detail are called for, even on the part of those workers who have no useful knowledge of chemistry, and serious losses may occur from want of care. These circumstances lead me to call attention to an aspect of the education question, which has attracted less notice than some others. The type of worker required may be compared to a city clerk, a knowledge of physics and handicraft taking the place of shorthand and typewriting. Reference to the matter here is justified only by the fact that workers of this skilled type would be of the greatest assistance to most other industries. A great national need exists, and is felt particularly in our work, of a better product from our primary and secondary schools. Much can be done by improving the curriculum in them and by extending the leaving age. Is it not possible that compulsory attendance at continuation schools for 8 hours a week up to 18 years of age may be enacted in this country immediately after the end of the war? I would further propose that employers work youths of this age for correspondingly less hours. We have in this country many institutions at which the attendance is scandalously small; to what extent they would provide the necessary accommodation others must decide. The deduction to be made is that for the establishment of efficiency in all works, and in particular those dealing with such a large variety of products requiring care, judgment and attention to detail, as is the case in the manufacture of synthetic drugs, it is of the utmost importance to have a better supply of workers of great diligence and capacity for understanding. While the training of such men must inevitably be done in part in the factory, the factory is not the school and cannot take its place. Intimately connected with this question of the personnel of the workers in our factories is that of the remuneration and prospects offered to those engaged in them—a large subject, on which time does not now permit me to dwell.

I conclude with an expression of hope that those concerned in the manufacture of synthetic drugs may rapidly progress in friendly relation with one another until the day when they will be able to compete fairly and squarely in the world's markets.

THE MANUFACTURE OF FINE CHEMICALS IN RELATION TO BRITISH CHEMICAL INDUSTRY.

BY C. A. HILL AND T. D. MORSON.

The fine chemical industry, owing to the widely distributed nature of its products, is no bad example of the importance of chemical industry as a whole to the community at large. It provides medicines needed for the health of the civil population, and necessary for the conduct of the war, both for the treatment of the wounded and for maintaining the health, and therefore the efficiency, of the fighting men. It provides reagents necessary in Universities, schools, research laboratories, private analytical laboratories, and those of munition works, where the testing of explosives is only one out of innumerable instances which might be cited. The ramifications of the fine chemical industry, and the dependence of other industries upon it, are intricate and far-reaching.

The problems to be solved in, and the salient factors governing, the manufacture of fine chemicals, differ markedly from those affecting heavy chemical manufacture. In the case of the latter the supply of "raw" materials, which frequently occur naturally, the transport and freight of both the "raw" materials and the manufactured products, cost of fuel, power and large plant, are all-important; in the former, on the other hand, the cost of labour is often only a small percentage of the total cost of production; in fact, the prices of the articles manufactured are usually so high that transport and fuel problems become relatively insignificant, while the "raw" materials necessary are so multifarious as to constitute a problem wholly different from that of a works requiring few "raw" materials only, but in enormous quantities. Moreover, the "raw" materials in the fine chemical industry are not "raw" in the same sense, but are the finished manufactured products of other industries.

A classification of fine chemicals is difficult to make, inasmuch as the same substances, and of almost the same degree of purity, may be used for medicinal, analytical, and technical purposes, but for convenience sake we divide fine chemicals into three groups:—(1) Reagents. (2) Pharmaceutical. (3) Technical.

The 1st group includes chemicals for analytical, research, and teaching purposes; the 2nd comprises all chemical substances used for medicinal purposes—(A) the well-known inorganic salts and substances; (B) the lesser-known but considerable and growing group of metallo-organic compounds, *e.g.*, bismuth tribromphenol and metallic salts of organic acids; and (C) the organic synthetic bodies, and substances extracted from plants and animals, of which the vegetable alkaloids and glucosides are important groups; while the 3rd group embraces all other pure chemicals used in the arts and industries, including such widely different products as flavouring essences, perfumes, and photographic chemicals. In considering the 3rd group it frequently happens, owing to the growth of an industry, *e.g.*, kinematography, that a demand for a particular chemical attains a scale so large as to be beyond that usually associated with fine chemical manufacture; and thus this industry passes imperceptibly into the larger or heavy chemical trade.

1st Group. Reagents for analytical or research work are made, perhaps more than any other class of chemicals, rigidly to specification. A very slight alteration in the specification, being only a slight raising of the standard of purity, may involve a complete change in the process of manufacture from that which suffices for a product sufficiently pure for nearly all purposes, and may double or treble the cost of production. In the manufacture of chemicals of extreme purity the choice of utensils for the manufacturing plant forms one of the greatest difficulties.

2nd Group. In discussing the 2nd group in the foregoing classification, it is to be borne in mind that the manufacture of many pharmaceutica chemicals is upon a large scale, so that here as with many technical chemicals, the manufacturer has problems presented to him similar to those obtaining in the larger or heavy chemical industries. In these cases, questions of the design of plant, including the materials used in the construction of it, present difficulties which are all their own and peculiar to each individual case

It is indisputable that the manufacture of fine chemicals must be undertaken in a systematic and thorough manner and upon a large scale to hav any hope of success, the immense number of products and the dove-tailing of processes rendering this a *sine qua non.* Especially is this true of th synthetic organic substances used in medicine for it is here that the dove-tailing of processe most closely applies. One product hangs upo another; the raw materials for one syntheti substance are a by-product in the manufacture o another; this dove-tailing of processes, and also o materials, being in fact a dominating factor The business must be on a large scale to enable it to be carried on profitably, and except in certain favourable instances, which are to be regarded as exceptional, the manufacture of synthetic chemicals cannot profitably be attacked piecemeal.

Utilisation of by-products incidental (we had almost said accidental) to the manufacturing process, has been brought to a fine art in Germany. Many products thus occurring, as it were by chance, have been put upon the market and have come into, or been forced into, use. As has been said by one of us on another occasion :—" If a German factory is producing on the large scale a certain chemical compound, and in the manufacture of that compound a by-product is obtained for which there is no obvious outlet, the research staff ancillary to that factory sets to work to find an outlet for that by-product ; it may itself be put on the market and boomed as such, or it may serve as the raw material for the preparation of some other substance. One cannot resist a lurking suspicion that British physicians and British patients have been prescribing and consuming synthetic remedies, merely because by chance something occurred as a by-product in a German factory and an outlet had to be found for it." The demand for many of these German synthetic products during the war has led to unprofitable attempts to synthesise them *de novo*. " Lysidine," a synthetic remedy which has been in some demand since the beginning of the war, will serve as one out of a host of possible examples. The synthesis of this substance depends upon ethylene chloride and ethylidene chloride, which occur as by-products in the manufacture of chloral. Sporadic efforts, though useful and profitable as an emergency or temporary make-shift in war time, are useless for the permanent establishment of the fine chemical industry.

When we speak of the " establishment " in this country of the fine chemical industry we intend no disparagement of those British firms who in the past have been manufacturers of fine chemicals. It is surely not in dispute that the German fine chemical industry has been more systematic, more thorough, more developed, and more successful than the British. The industry in analytical reagents has been mainly in German hands. It is the fine chemical industry in this sense which we have in mind when we speak of establishing the industry in this country.

3rd Group. For the purpose of illustrating the important relation between the Fine Chemical and Allied Industries, certain well-known examples may be taken.

The photographic industry is a considerable consumer of fine chemicals for technical purposes. The manufacture of such salts as the iodides, bromides, silver nitrate, gold and platinum chlorides has been established in this country for many years. When one turns, however, to the manufacture of organic chemicals employed mainly as developers, one is faced with the fact that these have been entirely manufactured abroad. It is unnecessary to discuss here the reason for this condition of affairs, but it is sufficient to indicate that the manufacture of photographic organic developers is peculiarly, though not altogether, dependent upon a ready supply of intermediate products of the coal tar colour works. The aminophenols form the starting point in the manufacture of many of the most successful developers, while a reference to catechol, hydroquinone, and pyrogallol will serve to illustrate our point of the close connection in this respect between he dye and photographic chemical industry. As laboratory operation the preparation of any of hese is not particularly difficult ; as an economic roposition, however, the manufacture of this class f photographic chemical is largely dependent on the extent to which the necessary raw materials are themselves manufactured in this country.

The enormous development of the kinematograph film manufacture has still further increased the technical demand for fine chemicals. For this branch of the photographic industry, in addition to the chemicals already referred to, there is an enormous demand for collodions of various kinds, for amyl acetate, for urea and for succinic and sebacic acids and their esters. Another branch of the photographic industry is photo process paper manufacture, which has its special requirements of fine chemicals, gallic acid being of importance. This substance is required to some extent in medicine, but its use in the dye industry, ink manufacture, and the textile and photographic trades is far greater. Ample supplies of photo process paper are needed in shipbuilding, engineering, aeroplane-building, and munition work, but the manufacturers have been handicapped by the shortage of gallic acid and potassium ferricyanide, neither of which substances was being made in this country on a commercial scale at the outbreak of war.

The incandescent gas mantle industry provides us with another example of the technical demand for fine chemicals. The process of impregnating the mantle requires certain kinds of collodion as well as salts of thorium, cerium, and zirconium. Here, as also in the manufacture of metal filament lamps, the manufacturer of pure inorganic salts plays his part. Tantalum, osmium, tungsten, and molybdenum, once the treasures of the chemical curio collector, have become the servants of our daily existence. To take another example, the ceramic industry makes its own particular demands upon the fine chemical manufacturer. While certain pigments, such as the ultra-marines, Paris green, and chrome yellows—largely used in the ceramic and similar industries—have attained an importance which enables them to be manufactured on a very large scale, there are others whose preparation may still be classified under the heading of fine chemical manufacture, and of these cobalt blues, cadmium yellows, and vermilion reds may be taken as types. Another group of fine chemicals in this class is that of the artists' colours, the manufacture of which is a highly specialised branch of this industry. The employment of ionone in perfumery, of vanillin in confectionery and perfumery, and of terpineol in soap manufacture, gives some idea of the wide field covered by this section of the industry.

This very brief survey of some of the uses of fine chemicals in the allied industries will serve to call to mind others to which we have not space to refer. If it suffices to prove that the manufacture of fine chemicals in this country must be encouraged because of its importance to allied chemical industries, then our purpose is achieved.

Interdependence. While the selling side of the fine chemical industry, from consideration of the multifarious purposes to which fine chemicals are put, demonstrates how important it is to other industries, the production side exhibits the reverse view of the relation. The difficulty in obtaining raw materials, especially organic reagents, necessary in the manufacture of fine chemicals, brings home the fact that this industry cannot develop as a separate and self-contained branch—but is indeed directly dependent upon the steady progress of the coal-tar colour industry. Thus we have a fair illustration of the interdependence of the various branches of chemical industry upon one another.

We have stated that the manufacture of synthetic medicinal chemicals is dependent upon the intermediate products of the coal-tar colour industry ; without it not only medicines, but artificial perfumes and photographic chemicals, cannot economically be manufactured. If the manufacture of fine chemicals is to be established in this country upon an economical basis, it is essential that the manufacturers should have readily available sufficient quantities of such reagents as liquid chlorine, sulphur dioxide, sulphur trioxide, phosphoric anhydride, the chlorides and oxychloride ot phosphorus, acetic anhydride, acetyl chloride, carbonyl chloride, the chloracetic acids, monochlorotoluene (benzyl chloride), acetoacetic ester, phenylhydrazine, and a host of other organic reagents which are essential in the manufacture of synthetic remedies.

No doubt a fine chemical works should manufacture many of its own reagents, but to carry this beyond a point is uneconomical. The manufacturer of acetylsalicylic acid is hardly to be expected to make his own acetic anhydride or acetyl chloride. These and many other organic reagents and solvents are most economically made on a very large scale, and are outside the province of the fine chemical industry. The newly formed Association of British Chemical Manufacturers should prove most useful here in avoidance of wasteful duplication. Allocation of manufactures up to a point makes for efficiency without, of course, eliminating competition. We may depend upon getting all the competition needful for the good of our souls from abroad without manufacturing it in this country.

The Past. In considering the reason why the fine chemical industry has in the past been peculiarly German in contradistinction of the heavy chemical industry where Great Britain has held her own, there occurs to one's mind the marked reluctance in the past on the part of British chemical manufacturers to take up the manufacture of any product unless there were already to hand or likely to occur a large outlet for it. Among fine chemicals we find this illustrated by the alkaloids, quinine, morphine, strychnine, and caffeine having been continuously and successfully manufactured in this country, whereas the alkaloids of less importance, considered from the point of view of total monetary value involved, such as atropine, eserine, aconitine, hydrastine, and hyoscine, have been largely in German hands.

Business enterprise has been a factor no less important than technical knowledge, as is shown by the fact that supplies of drugs grown all over the world, including even our own Colonies, have been "cornered" by German syndicates, the drugs being sent to Germany to be worked. It is only necessary to mention Egyptian henbane, and also Russian wormseed, the manufacture of santonin during recent years having been under the exclusive control of a German syndicate.

The Present. When we consider the present position we should not lose sight of the fact that a war of such magnitude as this one would have brought about a scarcity of chemicals, even if Germany had been a neutral nation. Further than this, the time, though favourable from the point of view of the cutting off of German supplies is, from considerations of scarcity of labour and materials, as unfavourable as possible to the establishment of any new industry.

It has taken nearly two years for the manufacture of British salicylates to attain a scale and degree of perfection that entitle it to be regarded as "established." Now that this country is self-supporting in regard to its salicylates and acetylsalicylates, it may be hoped that this industry will never again be a German monopoly.

The special difficulties which obtrude themselves so fiercely under war time conditions serve one useful purpose, in so far as they accentuate difficulties which are really inherent to the trade under all conditions, and thus show them up so that they cannot escape discovery and cannot fail to be comprehended. Moreover, the abnormally high prices obtaining temporarily for many products enable manufacturers to acquire their experience in new processes without the financial loss usually to be associated with such ventures. Many difficulties are merely incidental to the war, such as raw materials of quite an "every-day" nature being unobtainable or obtainable only with great difficulty and in limited quantity, or in a less pure condition than under normal conditions, not to speak of the labour difficulty and the slowness of building operations.

The Future. What we are really called upon to consider most seriously is the position of the fine chemical industry in this country after the war; for while much can be done now by way of making a start, the real establishment of a British fine chemical industry upon an adequate scale cannot take place until the national resources in materials, plant, labour, and chemical knowledge are freely available. A supply of technical chemists—true technologists—and of skilled technical labour, will have to be furnished by our Universities, Colleges, and Technical Schools, and no doubt as the industry grows the demand for such technical men will be met by an adequate supply. It must not be complained by the manufacturers, on the one hand, that the supply is not forthcoming, nor pleaded by the teaching institutions on the other hand, that the industry must first provide a field, *i.e.*, that the demand must precede the supply. The two processes must go hand in hand, and since it may take a generation to put the thing upon a proper basis, both manufacturers and teachers should begin at once.

Key Industries. A healthy expansion of chemical industry generally in this country will tend to counteract the effects of over production of certain chemicals when there is a return to normal conditions. The large plants which have been set up in various parts of the country during the present war for the production of explosives as well as other chemicals especially for war purposes, including all the preliminary and intermediate products in the manufacture of these, may be rendered permanently useful if all branches of chemical industry, including that of fine chemicals are elaborated, and thus provide further outlets for the output of these large plants. For example sulphuric acid and nitric acid are now produced in quantities far in excess of the country's pre-war requirements; while liquid chlorine is also being produced in quantities far in excess of the pre-war period. The manufacture of synthetic pheno should be perpetuated. When the price of coa tar phenol rises beyond a certain figure, the synthetic product comes into use, and manufacturers of salicylates are thus always assured of a supply of their parent substance at a reasonable price.

Many of these are "key" industries and should be placed upon a permanent basis. It has been stated that no value should attach to the idea o a key industry. Practical experience, however proves otherwise. We cannot do better than quote the words of M. Henri Hauser, Professeur à l'Université de Dijon:—"We have seen during this war that the absence of certain industries of a fundamental order has prevented the pursuit in the same country of other industries which utilis the products of the first class. How is it possible to make dyes or explosives when phenol canno be made and when no more of it reaches you from abroad? There are key industries, and th nation which allows such industries to die ou from its midst loses the key which opens the doo to others. Every industry is in relation to th industry immediately above it in the scale of pro duction. To lose one such key means losing a once the means of opening the doors of the floo above; eventually it means losing the keys of a the floors." Thus phenol and benzol are the key to the coal tar dye industry, which in turn is the key to the manufacture of many organic fine chemicals.

The importance of chemical industry generally to all industries, and therefore to the national welfare, may be obvious enough to any chemist, but it is not yet understood by the official mind. On the whole, it must be said that the several Government Departments charged with the control of various materials have secured for the chemical industries supplies which have proved fairly adequate, at all events in most cases. Especially useful to the medicine industry has been the N.H.I. Commission—a department which is characterised by business management and absence of red-tape—in avoiding an actual famine in such medicinal necessities as alcohol, glycerin, and sugar. But it is remarkable that manufacturers of important chemicals for contracts direct with the War Office have often had to beg and scrape for their materials, *e.g.*, sulphuric and nitric acids, instead of these being readily forthcoming or even actually reserved. It has to be stated that the importance to the community of the fine chemical industry—especially a supply of reagents—has not been borne in upon the Priority Branch of the Ministry of Munitions. Whether one sees the situation as Gilbertian or merely as sad, it is certainly incongruous that a manufacturer should be bombarded by the War Office, Government experimental laboratories, and munitions works with clamorous demands for reagents and other fine chemicals, while the Priority Branch of the Ministry of Munitions denies the licences necessary in order that these demands may be met.

It is an interesting comment on the importance which is attached to Chemical Industry by the public and official mind to reflect that no Board of Trade Committee has yet been appointed to inquire into the after-war conditions with which the chemical trade of this country will be faced. Committees for the Textile, Iron and Steel, Electrical, Shipping and Ship-building Industries have already been appointed, and have made recommendations as to the steps which should be taken to meet the new conditions arising out of the war. We have endeavoured to indicate that to these industries, as well as to many others, it is vitally important that a flourishing chemical industry should exist in this country. Certainly as regards fine chemical industry it seems highly desirable that a Board of Trade inquiry should be instituted to inquire into the problems with which the whole industry is faced, and to receive the views of representatives of the trade as to the steps which should be taken to meet the new conditions.

The committees referred to have realised that there are "key" industries in respect of their particular groups of industry, and they have indicated some of those "key" industries. Is it not of importance that a similar decision should be arrived at in respect of Chemical Industry?

No organisation has existed hitherto among British fine chemical manufacturers such as to enable them to speak and act as an important branch of chemical industry.

The time has arrived when such a voiceless condition should cease. It is to be hoped that the fine chemical manufacturers will now form an association which can represent this branch of the industry in the councils of the "Association of British Chemical Manufacturers," to which reference has just been made, and become an affiliated section of the parent body. If such an organisation can be evolved, having the whole-hearted support of the large majority of the fine chemical manufacturers in this country, determined to sink their petty jealousies of each other, then a large field of highly useful work lies before it. Our growing chemical industry, which aims to place us in an independent position industrially among the nations of the world, must be given a fair chance. National and Imperial interests demand that the enormous and essential trade in fine chemicals shall never again be allowed to fall into the hands of our foreign competitors. The fight for international trade in the future will have to be waged, not by individuals, but by groups of manufacturers.

Discussion.

The President said that in each of the three papers there was a note of warning with regard to the great importance of this country building up a self-contained chemical industry in the same way as it already had done an engineering industry. The man in the street knew perfectly well the importance of the engineering industry, but he did not realise the equal importance of our business in chemicals—whether heavy or fine chemicals. The papers had presented a very clear expression of the important part that the fine chemical industry played in the matter of economy in the nation. Their development could only be attained by organisation among the manufacturers themselves, by sinking their petty jealousies and working together for the common good.

Mr. Thomas Tyrer said that the papers were full of suggestiveness. The necessity for co-operation could not have been more emphasised. The need for pressure on authorities was great. Officials of Government Departments were very different beings when one met them socially—full of sympathy, full of admiration for one's operations and suggestions, but when approached in an official capacity people more difficult to convince he did not know. His name had been associated with the question of alcohol: it had not been forgotten. An official had told him recently that manufacturers had got all they wanted, and quoted the Society's Journal, referring to a notification inserted after careful revision by the authorities themselves and with their knowledge, and, therefore with their permission (see this Journal, Dec. 15, 1914, p. 1119). The methylated spirit approved by the authorities was supposed to be suitable for every purpose, but it was not. The Committee on which he had had the honour of sitting had made a good fight, and Mr. Montagu—now Lord Montagu—had fought very strongly for the fact that this was an industrial question. His influence and that of Lord Rotherham, who was there in the interests of labour, had had its effect. Sir William Crookes had stated that by supplying the product at a reasonable price and under reasonable conditions, the amount of business diverted from Germany would be incalculable. A large number of denaturants, suitable for many purposes, was available. Methyl alcohol had been branded as a poison, but the authorities to-day said it was not a poison. When American "alcohol," as it is called, was introduced, it was described as "wood alcohol." It was said that it had a toxic effect only upon those in the habit of getting drunk every day. That was not so. He had observed its effects, and had become convinced that it was a poison. If so, why make it dutiable? The Committee recommended the word "suitable" to qualify a denaturant, but who has to decide what was suitable? The officials on the whole were sympathetic and prepared to adopt suggestions of manufacturers. Dr. Dobbie, as well as his predecessor, Sir Edward Thorpe, had realised their obligation to protect the revenue, but that did not close their eyes to the possibilities of the needs of the nation. The lay officials wanted the money and did not care about science or manufactures. The matter had been allowed to remain idle for the moment, because of the want of application of the word "suitable," and also because people had become content to remain under the influence of German cheap chemicals. Those who could have made their own reagents had deliberately bought chemicals from German agents and had labelled them with their own labels. We must insist that not only should chemicals be marked "Made in England," but that the maker's name should be put on the label also and that he take the responsibility. We must do as we did before, namely, approach the Government in the matter. The present Colonial Secretary had then been Chancellor of the Exchequer, and he was intensely sympathetic. He might be able to convince the present Chancellor that in our colonies a most valuable source of alcohol, in the shape of molasses, was being thrown away. In one particular district they were throwing 250,000 tons of molasses a year into the nearest river, or if not into the river into a specially constructed furnace, and in Mauritius 40,000 tons was being wasted. A very important work had been resumed which was stopped by the proclamation of war. Under the ægis of the International Motor Transport Council the question of alcohol for motor work had come up, and the figures obtained as to the amount of raw material which was at present wasted and which could easily be sent home to some central depot were very large. That work had been interrupted, but Sir Charles Bedford and himself were continuing. The authors deserved hearty thanks for emphasising the fact that fine chemical manufacturers could not succeed unless there was co-operation.

Mr. H. M. **Ridge** proposed that use should be made of this occasion to crystallise out of the large mass of general discussion some concrete suggestions which could be put by the Council to the appropriate Government departments. He believed that if any of our fine chemical manufacturers had seriously attempted to import fine chemicals on a large scale into Germany before the war, they would have been met with the difficulty of finding a heavy tax on these materials.

Dr. E. F. **Armstrong** thought that the need for co-operation amongst the manufacturers of fine chemicals was the main point to be insisted upon. Unless they were prepared to work together and pool their interests, the future was very dubious. The opinion of the public of the other big co-operations that had been brought about lately through the war, had been that they were going to strengthen our industries very much. From his own knowledge of Germany before the war, he could find no words to convey an idea of the tremendous competition to be met by English firms in the future. Our makers of fine chemicals must strive honestly to produce their chemicals openly labelled with the name of the manufacturer and of the highest state of purity. A good deal of the English materials had not come up to that standard in the past. The alcohol problem had been brought to the notice of a good many on account of the war; many people were using alcohol in enormous quantities—far more than they had done before the war. All those who had to deal with Government officials during the next few months must tell them frankly the truth, and be very definite in explaining facts to these officials, especially what a very important thing it is for our industry that we should have duty-free alcohol. This country with its Colonies could produce alcohol very cheaply, and then they would have a raw material which would enable them to build up a very wonderful industry. With reference to Mr. Carr's statement about the education of the factory lad, it was worth while for the manufacturer to select two or three out of every dozen lads in the laboratory and send them at the firm's expense to continue their education. His firm had done that for many years and the policy had been highly successful. They insisted on the whole of their employees, both male and female, attending evening classes up to the age of 18.

Mr. J. G. **Roberts** expressed the opinion that the product of the modern secondary school was far better educated than formerly, but to expect that that boy coming into the works was going to do the work of a man was another question altogether. The importance of training boys had been recognised in some industries, and in some North Staffordshire coal mines they had adopted this policy, with the result that a different type of young men was growing up, men who were far more able to adapt themselves to changing or more complex conditions of working, and who were more amenable to reasonable discipline.

Mr. W. F. **Reid** suggested that the Society might pass a definite resolution to the effect that British chemical industry can only succeed if the Government secure for it as cheap a supply of raw material as any competing nations have. That would include not only alcohol but other materials, such as a number of drugs from which alkaloids were produced. They must not lay too much stress simply on the alcohol question. Mr. Tyrer had done yeoman service in that direction, but it must not be forgotten that many people in high Government offices were strong temperance advocates, and the word "alcohol" to their minds meant something which people should be prevented from having and the manufacturer should not have unless he were subject first to the most stringent restrictions. Certain substances were used as a means of producing revenue, and the great fear Treasury officials had was that that revenue might be diminished. The officials who knew the importance of the subject had not a free hand, whilst those above them who ought to help did not do so because they did not understand anything about commercial or industrial matters. Methyl alcohol was a substance of very great importance in modern fine chemistry, and could be used on a very much larger scale if it could be obtained. We could make it in this country and perhaps make it cheaper if we had not obstacles imposed by our own Government. We should insist upon the raw materials of production being brought into this country at as cheap a rate as it was possible to get them. Other industries had insisted upon duty being put upon raw materials exported from India to enemy countries, and that duty would prevent our alien enemies competing with us. If the same thing could be done in regard to our raw materials we should not rouse the opposition we might do by the free use of the words "import duty" on a manufactured article. Without that being done, he did not see how we were to prevent our materials being cornered by foreign nations.

Professor H. E. **Armstrong** said that Mr. Tyrer had raised the question of methyl alcohol: surely this was one the Society was able to deal with. He ventured to assert that there was no evidence that methyl alcohol was a poison in any other sense than that in which ordinary alcohol is a poison. He had carried out a very large amount of experimental work with these alcohols and asserted that there was no real case that could be put forward to justify Mr. Tyrer's statement. What was referred to was probably not methyl alcohol. He was very glad to hear fine chemical manufacturers come forward and say that there must be co-operation. They should at once go to the new Association of Chemical Manufacturers and say that they want to co-operate with those who were their competitors. But would they all agree to meet as practical men? Only recently at the Council, when the question of a Bureau of Information was under consideration, it was said that the great difficulty would be to get manufacturers engaged in different branches even to disclose what they were making. It had been suspected that many were not making the products they were selling but were putting their labels on other people's material. That had been done systematically for years past. It seemed that we had the matter in our own hands. It had been said that we must educate the public and politicians: in reality the Society required to educate itself. It was useless to go to Government officials—who did not understand our language—and put these things before them if we were not prepared to carry them out. There had been a vast amount of dishonesty with regard to chemicals. What was the meaning of the word "pure"? For instance, "pure zinc" merely meant zinc that would not show arsenic in a particular test, and that had been true generally. The only person who for many years would supply pure chemicals was Kahlbaum. Unfortunately, Kahlbaum had deteriorated most seriously in recent years, so that the name had not stood for purity latterly. Why had no Kahlbaum come forward in this country? It was not always possible to make things on a big scale or to make things that were going to pay straight away. Everybody now was rushing to make salicylic acid but we could not live on salicylic acid alone, some arrangement was required. We must alter our nature, think less of ourselves so to speak and take on a more patriotic attitude if we were to develop industries.

Dr. W. Rintoul said that after the outbreak of war the research laboratories at the Ardeer factory of his company had begun to find great difficulty in securing several chemicals that were required, and they had had either to stop the work or to make them. They had decided on the latter course and had been successful. Realising that possibly others were in the same predicament, nd that it was not much more trouble to produce the substances on a double scale, they had carried ut their experiments on a larger scale, and were gradually developing that idea. They had found t difficult to rely upon the purity of materials ought, and had decided to print an analytical eport of the substance on the label of the bottle ontaining it. They would welcome any chance f co-operation with other manufacturers to revent overlapping. Right at the beginning hey had come across the alcohol difficulty. To btain trained assistants in their laboratories hey had inaugurated a scheme whereby they ook boys from elementary schools as apprentices t a comparatively small wage, they having to ign a contract for three years probation, during hich time they had to take certain classes. he earlier classes were taken by the School oard officials, but the later classes were held n their own laboratories and conducted by their wn staff. That scheme had been running for ome three years, and this year they had made rrangements for the classes to be affiliated with e Royal Technical College, Glasgow, so that ey might be recognised by the Board of ducation. If at the end of the three years the oys had proved satisfactory in their classes and their laboratory work, they were promoted to boratory assistants.

Mr. Rutherford Hill supported what Mr. yer had said as to the toxic qualities of methyl cohol. Both methyl alcohol and ethyl alcohol ere narcotic poisons, but methyl alcohol was mething like three times as toxic and the mptoms were quite distinctive (Harnack; armaceutical Journal, Apr. 13, 1912, p. 484). There were two things which prevented a supply of cheap alcohol in this country. The first was that it was made a source of revenue to the State by taxation, and, secondly, it was extensively used as a beverage. In consequence of those conditions there were Government restrictions even on the size and shape of a building to be used as a factory for alcohol and as to the size and capacity of the apparatus. In America there were no such restrictions, with the result that the Americans were able to produce alcohol at a very much lower price than we could. Government Departments should be got to listen a little more ungrudgingly to manufacturers who approached them along the lines of that legislation. If that could be done it would solve a great many difficulties. Mr. Dott had referred to the movement for the growing of medicinal plants in Britain. A great deal of nonsense had been talked in that connection. In Scotland, at any rate, they had not the soil nor the climate for the cultivation of medicinal plants. But in India there was such a variety of soil, elevation, and climate, that many medicinal plants could be grown to great advantage which were indigenous to this country as well as to Germany and Austria. He referred to such plants as belladonna and henbane. In considering co-operation and organisation of British industries they should have regard to securing raw materials from British Imperial sources and not allow them to be absorbed by foreign States. The synthetic drug industry was closely associated with the production of dyes, and there should be collaboration between the two. When German dye manufacturers obtained a by-product which was of no use, they tested its physiological properties and then put it on the market under some fancy name. One result of the shortage of these drugs had been to open the eyes of the medical profession of this country to the fact that many of these drugs could be dispensed with.

Mr. Fryer said that he had been associated with Dr. C. A. Keane in working out a method of obtaining novocaine. One of the first substances required was ethyl bromide, and they were compelled to manufacture this. The yield obtained by the published method was quite small, but a little investigation showed that that yield could be increased from two to two and a half times. That had probably been known in Germany although no information had come to this country; he suggested to the makers of fine chemicals that if that kind of information could be pooled it would be of great advantage.

Mr. H. L. Terry said that recently in Manchester there had been several mysterious cases of poisoning which had been eventually traced to methyl alcohol.

The President said that the discussion might be summed up by saying that through the three papers there had run the words co-operation, co-operation, co-operation. They had found it to be most difficult to interest the British manufacturer in novelties. A German manufacturer who took up a certain class of work did not ask whether one were going to buy by the hundred, thousand, or million. He assumed that one had a very good reason for making inquiry for a certain article and he did his best to make it.

Mr. F. H. Carr quoted an instance where his firm had tried to get pure methyl alcohol to make formaldehyde, and after months of correspondence an official had asked why they could not use ordinary alcohol. With regard to Professor Armstrong's remark that manufacturers must be prepared to make things even in small quantities and not insist on large quantities being made, his point was that we must co-operate so that each should manufacture on the largest possible scale, so as to make it possible to meet foreign competition.

Mr. C. A. **Hill** said that the trade in products such as Kahlbaum had made, had been very largely in German hands. No one was more keenly alive than himself to the uses and abuses of the word "Pure." His answer on that point was that chemicals ought to be sold to a definite specification, whether they were for analytical purposes or medicinal purposes.

THE PAPER MILL CHEMIST IN WAR TIME

BY J. F. BRIGGS.

The request for a contribution to the discussion on the progress of British Chemical Industries during the war period opens an enquiry as to the position of paper manufacture as a chemical industry and consequently that of the chemist in the paper mill.

Papermaking is capable of being carried on quite successfully without any serious knowledge of chemical principles, and I have heard it denied in the trade that it is a chemical industry at all in the generally accepted sense. It is, therefore, not surprising to find that the majority of paper mills offer but little attraction to highly qualified men in the profession, and the future prospects of the paper mill chemist are not generally such as would give him access to the higher positions. It is this somewhat pessimistic appraisement that we have to combat. It is true that chemistry in papermaking can show few tangible achievements which strike the imagination, such as are recorded almost daily in many other industries which more definitely maintain the ascendancy of the chemist. Nevertheless, the training of the chemist in habits and outlook is such that, even in the paper industry, those directors who have sufficient insight to select a qualified man and sufficient breadth and energy of mind to use him as an intelligent participator in the working policy of the concern, can handle no more promising raw material, and need never regret a somewhat unusual step. On the other hand, a paper mill chemist, engaged in the competitive labour market and left unsupported to seek his own level in the mill, may find, apart from some necessary but uninspiring routine work, but little scope for his chemical activities.

In the paper mill the chemist may find himself the only representative of any kind of scientific perspective, possibly the sole professional advocate of practical economy, in which case he must not expect to be popular, but sooner or later his time will come. In general terms it may be said that the practical industrialist bases his activities mainly on past experience, the commercial man on expediency, whereas with the chemist these are merely useful accessories; the end—if there ever is an end—is the formulation and co-ordination of first principles. Any theory, even a wrong theory provisionally adopted, is better than no theory at all. The chemist must be prepared to travel a long way outside chemistry in the process of "making good" in a paper mill by the application of his special habits of thought, and on his ability and on the opportunities afforded him in this his future position may depend.

To many the war has brought opportunities in various degrees. Both past experience and expediency in some cases have had to come under drastic re-adjustment, and on these occasions a mind trained to work from first principles may render valuable assistance. Especially must the chemist be prepared to think ahead, to gauge the probable tendencies and ultimate effects of rapidly changing conditions, and to suggest possible lines of action.

When the war broke out, business in the paper trade remained very slack for a considerable time. The intelligence department of the mills had to concern itself with the problem of capturing German trade, chiefly in the form of specialities hitherto exclusively in the hands of enemy countries. As a general rule, this movement, which helped to fill up a slack time, was a failure for various reasons. Some mills lost money in experiments, others in filling their books at unremunerative prices. When the turn came, all thought of German specialities collapsed; the public found it could do very well without them. It then transpired that the real volume of German trade to be captured was just in the ordinary kinds of paper, which had been held abroad simply on the ground of price.

However, as regards the specialities, I must mention one striking exception which interests us all as chemists, namely, the capture by the Kentish hand paper mills of the German trade in laboratory filter papers. Although without inside information of this movement, I know that it represents no mean achievement, and must express appreciation of the vigorous readjustment of the practical mind required to give eve approximate satisfaction, at so short a notice to the rigorous demands as to texture and purity built up in the course of decades by the Germa monopolists. The hand paper mills of the South of England represent a link with the past no merely sentimental, and it is to be feared that an important portion of their trade will be the firs to suffer from any general wave of economy suc as must rule for many years after this war. Let u chemists, therefore, resolve to support an encourage this new outlet in every possible way not to be beguiled in future by the attractiv little novelties offered from abroad, but to mak our requirements and suggestions known throug the apparatus dealers to the home manufacture so that they may consolidate and extend the enterprise to the production of all those specialiti for which there is any serious demand.

As to the British paper trade in general, record of progress in the sense of new development is hardly to be expected. With restrictions of a sorts on every hand, the papermaker can only thankful to find himself alive. In many case new trade and opportunities due directly to th withdrawal of German competition have had to abandoned for lack of materials. The Unit Kingdom is not, and probably never can be, sel supporting in the matter of raw materials f papermaking, and the best that can be work for in the future is the concentration of the production within the Empire. Although cannot be asserted that the existence of such condition at the present time would material have eased the situation—the dislocation is t far-reaching—still the paper mill chemist directly concerned to do what in him lies promote the use of British Empire pulps. Th possibilities are few but large, and the obstacl economic rather than technical. While wo pulps from Canada must obviously take the fi place, bamboo pulps from our Eastern possessio come easily second. Already before the w bamboo pulp of excellent quality manufactur in French Indo-China was established in t European market. The development of t bamboo pulp industry in British India, when comes about, will have owed its technical ba in no small measure to the systematic investigati of Mr. W. Raitt, acting under the Government India. Raitt's report may be taken by the pap mill chemist as an admirable model of the appli tion of scientific principles to technical proble of this order.

The most obvious concern of the paper chemist, not only now, but as far as can be s into the future, is economy, and so long as the war lasts, it is not merely relative economy of production costs to output which is required, but actual economy of material resources; paradoxically it may even happen that material economy is only to be obtained at an increased cost. No economy is more difficult to enforce than that which demands a change of ingrained or traditional habits, but there is no more effective means of enforcing it than an actual shortage of materials.

The shortage of bleaching powder brought about by war conditions has affected some mills severely, and it behoves those mills which are still receiving supplies to use them in the most sparing manner. In paper mills working esparto and wood pulps two systems of bleaching are in vogue; the quick warm bleach system and the slow cold bleach system. If the former consumes slightly more bleach than the latter, it saves in time and plant, and, when carefully carried out, with bleaching powder at normal prices, the warm bleach process is quite a defensible proposition. But owing to human frailty an excessive temperature is the rule rather than the exception; the working man reasons that if a little heat is a good thing, more must be better, and it is one of the chemist's most difficult tasks to urge moderation in the use of steam. So difficult is this that in the majority of esparto mills the attempt has been abandoned, and the enlarged plant adapted only for cold bleaching represents the most modern practice. Another occasion for excessive bleach consumption arises when the output of the mill overtakes either temporarily or permanently the capacity of its bleaching plant; the machines must be kept fed with bleached pulp, and the process is hastened at the expense of economy. These are some of the reasons why the expected consumption of bleach determined in the laboratory may be exceeded in the mill.

In these abnormal times it is not possible for a mill working the warm bleach system to make the large additions to its plant necessary for the more economical utilisation of the bleach, yet the paper mill chemist anxious for economy may be able to effect useful savings. A study of the published time-curves representing the rate of exhaustion of bleach liquor shows that the reaction at the early stages is really very rapid, even at ordinary temperatures. It is at this stage probably, when the concentration of chlorine is relatively high, that the stimulus of heat is least necessary and most harmful; the fibre is then capable of exhausting chlorine faster than it can receive it, and hypochlorous acid may be lost in the air or otherwise wastefully expended. The most economical results with the warm bleach system with least disturbance of existing conditions are obtained in the following manner:—Run the mixture of bleach liquor and pulp for an hour and a half at the ordinary temperature, then proceed with the gradual admission of steam through a small perforated pipe extending right across the floor of the engine in front of the roll, of such a size that the maximum temperature of 100° F. (38° C.) is reached only after one hour; shut off the steam and allow the bleach to exhaust itself at that temperature. In this way economical results comparable with those of the cold system can be obtained in 3½ to 4 hours; any more rapid effect than this is likely to be purchased by an undue expenditure of bleaching powder.

Another principal chemical operation in the paper mill is the sizing process. In the economy of resin size such progress has been made in the last ten or fifteen years by the efforts of competitive size vendors that little margin now remains: the number of mills which consume size wastefully is now probably extremely small. In the consumption of sulphate of alumina, however, there is still room for considerable economies. Every paper mill chemist knows perfectly well that the quantity of sulphate of alumina consumed in acidifying a soda-boiled, bleached pulp may be as large as, or larger than, that usefully employed in precipitating the size. This knowledge is utilised in many of the rag paper mills where the stock, after bleaching, is soured by a weak vitriol treatment and the basic calcium compounds deposited therein are cleared out. Yet in most, if not all, esparto mills, where the necessity is still greater, this obvious economy has been neglected until the scarcity and high price of alum cake caused by the war has forced the question to the front.

The souring of the pulp is an operation which must be made as far as possible "fool-proof," because a slight trace of free acid in the finished paper would be disastrous to the sizing, and bring the process into discredit. For the communication of the following simple but effective method of bringing the process under safe control, thanks are due to Messrs. Tullis, Russell and Co., of Markinch, who make it public for what it is worth in the interests of national economy—to themselves its adoption has been worth from £15 to £20 per week. Instead of vitriol, nitre cake is employed in spite of the trouble involved in dissolving it. The nitre cake solution is made up at a density of about 60° Tw., and sufficient is added to the pulp in the beaters, before sizing, to make the whole definitely acid to litmus. The quantity is so regulated that the acidified pulp becomes alkaline again after the size is in, and, provided this condition is fulfilled, no harm can result. The margin allowable for unavoidable variations is fairly large, and although the personal attention of the chemist is required for fixing the amount of acid to be added to each type of pulp, the continuation of the procedure may be entrusted to the ordinary attendants. The predominant alkalinity of the size spreading through the acidified pulp preserves the liberated resin in the state of emulsion, and the danger of clotting which might result if the order of treatment were reversed is avoided. When the size is mixed with the stuff, sufficient of the ordinary sulphate of alumina solution is added to restore the definite acidity to litmus. In the case of bleached esparto and wood pulps, a saving of from one-half to two-thirds of the usual consumption of sulphate of alumina may be effected.

In conclusion, a word may be said on the question of investigations of a non-remunerative order. It is desirable that the mill chemist should formulate mental pictures of the intimate nature and mechanism of all the materials and reactions with which he has to deal. Without the resources of a University laboratory and possibly in an unsympathetic environment, such work, of necessity done at odd times and often spoiled by more urgent calls, is apt to be of the kind described as "scrappy." Granted that the manipulative details are tedious and connected results of serious scientific value not readily obtained, nevertheless let this be no discouragement; the paper mill chemist must resist the temptation to sink into a rut of routine: let him keep his mind young by thinking everything out on theoretical lines and putting his conceptions to the test quite apart from the question of immediate utility. Every wise director will encourage this form of mental exercise, as time and opportunity permit, because by doing so he ministers to the spiritual as well as the material needs of his business. There are still plenty of subjects for pure and semi-pure research work among the every-day objects of the paper mill. The chemical nature of lignocellulose in its various manifestations, the proximate composition of raw esparto, the relationship of esparto and wood celluloses to the normal cotton cellulose—very little is known about these complex subjects, and much of that is probably quite wrong.

Discussion.

Mr. **Allan Smith** agreed entirely with most of Mr. Briggs' statements. His own experience had been principally in wood pulp, and the suggestion Mr. Briggs had thrown out that esparto should be dealt with in the same way as wood was a very practicable one. There was probably no one firm now using esparto in sufficient quantities to enable them to have a plant which could be worked in that manner. Those materials must be worked in large quantities. In England the largest digesters he knew of had a capacity of 25 cwt., while on the Continent it was a common practice to have 15-ton digesters. It was just as easy to deal with a big unit as a small one.

Mr. **W. F. Reid** suggested that our paper-makers should produce a pure form of pulp for the manufacture of collodion and explosives. The Germans now made the bulk of their nitrocellulose from wood pulp, and, so far as he was aware, the manufacturers in this country had not devoted themselves to the production of the pure pulp.

Mr. **Smith** said that the wood cellulose industry would never become a profitable business in this country. It must be in a locality where timber was abundant and water-power cheap.

Mr. **Briggs** agreed with Mr. Smith as to the wood pulp. The same argument did not apply to esparto, because esparto could not be manufactured into cellulose. The reason that the cellulose made by the paper makers was not pure was that the paper maker was only a cellulose maker in a subsidiary degree. So long as he obtained from his machine a sheet of white paper free from dirt he did not care whether the cellulose was pure or not.

THE ANNUAL DINNER.

The Annual Dinner was served at the Balmoral Hotel, Princes Street, and was attended by a large number of members and guests. The function being of an informal character there were no speeches. Following the loyal toasts, Mr. Tyrer gave the toast of the Edinburgh Section, to which Dr. Longstaff briefly replied, and the toast of the President was proposed by Prof. Irvine.

Third Day.

Friday, July 21st.

THE OVERHAULING OF OUR PATENT LAW.

BY J. W. GORDON, K.C.

In the current number of the Quarterly Review Lord Parker, writing of the industrial problems which will come up for solution after the war, refers among others to the problem of the Patent Law, and says :—

"We should endeavour to encourage new inventions and to secure that new inventions when made shall be brought into use at the earliest possible moment. Our patent laws are justified by the desirability of encouraging new inventions but it is very doubtful whether they have that effect, while they are often used to prevent new inventions being utilised at the earliest possible moment. In this connection we should reconsider and overhaul our patent laws."

Of this text I gladly avail myself to clear the ground to-day of much matter of unprofitable argument. In the course of prolonged discussion of this topic I have learnt that it is exceedingly difficult to make the majority of people believe that our patent law needs to be overhauled at all, and that the difficulty is still greater, with the majority of that minority which accepts this general proposition, to induce them to view the matter from the stand point of the public interest.

Your interested hearer is generally either some inventor with a grievance because his patent turned out to be invalid or an infringer who thinks that no patents ought to be granted at all or an enthusiast with a fad. To have the point of view of the public defined and the need for improvement asserted by a Judge having the professional and personal authority of Lord Parker, is so great an advantage in opening this discussion that I do not propose to go beyond this dictum along that particular line.

It is not possible, however, to leave the point in these quite general terms. For the successful discussion of a remedy it is necessary to have a definite idea of the mischief to be remedied, and therefore, I will venture to add by way of illustration of the point involved, an example of the mischievous operation of our patent law. The palmary example is the case known as the Levinstein Case—the story of which has often been told, but may for the sake of the moral involved be briefly told again.

The Levinstein Case was brought to trial in 1883—the same year in which Mr. Chamberlain's Patent Act passed the Legislature—and it may be said therefore to belong to an earlier period of patent law administration. That is perfectly true, and in drawing inferences from the facts of that case certain modifying circumstances must therefore be borne in mind. But the modificatons are so small and the main facts so striking that the case remains still the best possible example of the mischief which calls to-day for remedy.

Shortly stated, the facts were these. The Badische Aniline Company had patented a sulphonic acid dyestuff yielding brown and yellow tints. The invention was original and the patent perfectly good. It was not commercially valuable because the colours produced had no vogue and consequently no market. Four years later Levinstein independently invented another dyestuff of similar chemical constitution, which was of a red hue and had a great vogue under the name of Blackley Red. To what extent if at all he had been guided in his experimental work by the Badische specification I do not know. That he had made an original contribution of importance to the whole result is evidenced by the fact that his Blackley Red was made by a secret process the secret of which was unknown to the Badische chemists. Although chemical tests enabled them to discuss the analytical nature of the new substance they were wholly in the dark as to its synthesis. That from the point of view of synthesis it was something quite different from the invention which the Badische people had made was proved by its remarkable hue. But the poverty of language obscured this distinction and enabled the patentees to set up a claim which in terms covered the red dye as well as the brown. This claim was upheld, the patent right enforced, and an injunction granted to restrain Levinstein from manufacturing Blackley Red. No injunction was required to restrain the patentees. They were restrained from manufacturing it by the fact that they did not know and were unable to discover how it could be manufactured. In the whole result therefore the red dyestuff could not be manufactured at all in this country. The only dye maker who was enabled by knowledge to produce it was disabled by law, and this extraordinary situation emerged. A patent which had been granted to secure the establishment within the realm of sulphonic acid dyestuffs was so manipulated as to prevent the establishment of the manufacture or, to be more precise, was used to suppress that manufacture when it had been established here. You may doubt, if you like the soundness of the law which brought about that result, but you can hardly, I think, doubt that the Judge who pronounced the judgment expressed a wholesome sentiment when he formed the following sentence in his judgment :—

"I cannot come to this conclusion, I must honestly say, without some regret. I think Mr. Levinstein has employed great knowledge, great skill, and great perseverance in finding out these processes, but I am sorry to say that the law compels me to inform him that these processes cannot be used in the production of this colouring matter, seeing that the production of this colouring matter is protected by a patent."

A word or two must be added as to the sequel of this case. The defendant was a man of resource and did not allow himself to be coerced into submission to his trade rivals. He established the manufacture, which continued to be secret, in Holland, and Manchester manufacturers of cotton goods continued for many years thereafter to send their fabrics to Holland that they might there be dyed with Blackley Red. A large industry, the commercial value of which may, if I have been correctly informed, be estimated in millions of pounds, was then transferred from Lancashire to the Netherlands in order to vindicate the patent rights of a German firm in respect of an invention of which the intrinsic value was less than half-a-crown, was, in fact, a negative quantity. It needs no argument to produce the conviction that such a result is preposterous and the law which brought it about was unsound. This conviction had indeed established itself in the minds of thinkers conversant with the Patent Law before this date. The action was tried, as I have already said, in the same year—1883—in which a Patent Law Amendment Act was passed and one of the Clauses in that Act was designed to eradicate this very mischief. It was thereby provided that in certain cases, of which the Levinstein case was typically one, a patentee might be compelled to grant a license to a person whom, for want of a better word, I may perhaps be allowed to call an intending infringer—thus substituting a license to use the invention for an injunction to prevent its use. It will therefore be understood that inferences drawn from the law and the facts of the Levinstein case must be cited only with due regard to changes which the Act of 1883, and subsequent Acts of Parliament, have introduced into the Statute law. If those changes had produced their intended effects they would very greatly have modified the situation, but in fact they have one and all failed of their purpose and in the result have scarcely modified the situation at all. Injunctions are still granted as freely as in 1883 and with equal disregard of consequences. The whole machinery of compulsory licensing and compulsory working has with something like a maximum of effort produced a minimum of result. To discuss the reason of that fully would expand this paper to an inordinate length, but in order that I may not seem to dogmatise let me indicate in a word what I take to be the vice of all this recent legislation. It is superficiality. The system of compulsory licensing is in theory admirable, but the mode which the Legislature has devised for bringing it into operation is so complicated and circuitous as to be impracticable. The child has been strangled in its own swaddling clothes. So again with compulsory working. Superficially it looks perfectly sound—the logical outcome and necessary corollary of a system of patent grants. But when you come to work it out in practice you find that, like many other counsels of perfection, it is "far too rare and good for human nature's daily food." You cannot formulate a rule of practice under this head that does not require to be hedged about with exceptions. You cannot formulate your exceptions at all but must always be prepared to add to them at discretion, and so by the time you have elaborated a working scheme you find that you have created a codeless mass of dicta fit to serve no useful purpose but only to be an instrument of oppression. These are mere hints, but I dismiss these topics without more ado because the one topic to which I desire this evening to direct attention seems to me to be immeasurably more important.

The illustrations which have just been submitted of the injury suffered and the remedy proposed both point to the injunction to restrain infringement as being the real source of the mischief. This I believe to be the case, and my contention is that if the jurisdiction to grant injunctions were subjected to proper control we might with advantage repeal all the complicated enactments touching compulsory licenses and compulsory working for those things would automatically settle themselves.

For the discussion of this proposition it is necessary to have a clear notion of what is signified by an injunction. The subject is so highly technical that a word or two of explanation may not be out of place.

It should, then, be premised that the administration of the law proceeds along two main lines—the civil which is concerned with questions of property, and the criminal which is concerned with questions of conduct. The two departments cannot be wholly separated for the possession of property implies duties, and duty and interest are sometimes in conflict. Hence arises a third branch of law, neither purely civil, nor strictly criminal, but in which both interest and duty come into question. This is known among us and in the British Dependencies and America as Equity, and from time immemorial it has, among ourselves, been administered by the Lord Chancellor and by his puisne judges known originally as Vice-Chancellors, and in our own times as judges of the Chancery Courts or Chancery Division of the High Court. A complicated nomenclature has somewhat obscured the distinction between these three jurisdictions. Thus, the criminal and purely civil law has been administered by what are known as Common Law Courts and are ordinarily spoken of collectively as the common law. On the other hand the civil law and equity are administered together so far as possible as one system by the High Court and are commonly spoken of together as civil business of the Court in contradistinction to its criminal business. Finally, the term "civil law," used in a technical sense, is employed by legal writers to describe that body of law, founded upon the ancient law of Rome, which prevails largely on the Continent of Europe and has deeply coloured our own law of probate, admiralty and marriage. In contradistinction to this term the expression, common law, is used to signify our indigenous law not embodied in statutes. Thus, both the terms common and civil law are ambiguous, until defined, in the language of English lawyers and ideas are apt to be hazy in consequence. But we may speak of criminal law, common law and equity in a perfectly intelligible sense of the words as covering the whole ground of jurisdiction. Roughly, criminal law is concerned with the restraint of bad men, common law with the regulation of the conflicting interests of good men or men not necessarily bad, and equity with the adjustment of those difficulties which arise out of the conflict of interest and duty. Thus, the criminal law is concerned with conduct almost exclusively and very little with property, the common law with property and its rights almost to the exclusion of motives and ulterior consequences. Equity is concerned with both and comes into play only when both are involved. It takes cognisance of conduct as affecting property and controls the exercise of proprietary rights in the interests of recognised duty. It thus has affinity with both the other systems and it is out of this affinity that the injunction—a characteristic invention of the equity courts—has arisen. A wrong of which the criminal law will take account is a crime and as such punishable by fine or imprisonment or both. A wrong with which the common law is concerned is a tort if no contract is involved—or a breach if it grows out of a contract. In either case it is remediable by damages. A wrong of which Equity will take cognisance is a breach, it may be of trust, it may be of duty, and is remediable either by performance or failing performance by damages. Performance is the characteristic equitable remedy and to secure performance coercion must in most cases be resorted to. The injunction is a contrivance for enabling the court to exercise such coercion by converting a breach into a crime and so investing itself with the coercive powers of the criminal law.

This is, obviously, a very dangerous kind of remedy requiring to be used with studied moderation and careful regard to the public interest; for the indiscriminate use of injunctions would evidently result in an absolutist system of government under which our duties would be settled for us, not by general rules, but by special directions issued by Judges who would enforce obedience to their slightest dictum by the penalty of imprisonment at the discretion of the Court. This arbitrary element in the injunction has always made it unpopular with English lawyers, and at one critical period in our history a Court—the Star Chamber—which founded its procedure on injunctions was swept away by a torrent of popular indignation. For something like three hundred years after that event the injunction remained an exceptional remedy reserved for exceptional occasions, and to my thinking it is a mark of decadence in English law that in our own times this powerful instrument of oppression should have been introduced once more into common use. That, however, opens up a much larger question than the one which we are considering to-day, and it is more to the present purpose to point out that in certain branches of the law resistance against this innovation has been successfully maintained down to the present time. Thus, for instance, the injunction is practically unknown in the Commercial Court, and at Common Law the employment of injunctions to enforce the recovery of money due under a contract has been placed under strict regulation by the statutes abolishing imprisonment for debt. In all questions touching commercial contracts the courts exercise arbitral, not arbitrary, power and the restriction has been found to be essentially important for the public well-being.

Building upon the lessons of experience thus enforced one may point to the sound rule touching the maintenance of patent rights. For there can be no conceivable reason for adopting a sharper rule of law for the enforcement of patent than for the enforcement of contractual rights. So long as a patent gave to the patentee an unqualified right to prohibit the use of his invention by anybody whom he did not choose to license, there was much to be said for the injunction seeing that only by an injunction could that right be enforced. But no such unqualified right is given by any existing patent. All patents now are subject to the subsisting, although ineffective, rights conferred upon the public by the compulsory licensing and defeasance clauses of the Patent Acts. Thus, the theory of patent law has been reformed, but an unreformed system of administering the law has reduced the theoretical reform to something very like a nullity. A demand for further reform has arisen. The Paris Conference has recognised it and has included in its resolutions one to the following effect:—

"The Allies undertake to convene a meeting of technical delegates to draw up measures for the assimilation, so far as may be possible, of their laws governing patents, indications of origin and trade marks."

The demand, as you have seen, has been formulated in this country by no less an authority than Lord Parker, and it may reasonably be supposed that at no very distant date the matter will engage the attention of the Government and of the Legislature.

It thus becomes a matter not only of interest but of urgency to consider the question of patent law reform and to take stock of the proposals which will be pressed upon the attention of Parliament. In arguing for the consideration in this connexion of an improved rule concerning the granting of injunctions, I hope to engage the interest of the Society in this reform and perhaps its support of a definite proposal on the subject.

In framing the terms of any such proposal two considerations should be borne in mind. There is, first, the mischief, already illustrated by the Levinstein case, due to the indiscriminate issue of injunctions in support of patent right and, in the second place, there is the consideration—not less important—of the case in which a patent right cannot be exploited to the best advantage of the public save as a strict monopoly of the patentee. This latter case may be illustrated by the telephone monopoly. To render efficient public service the telephone system—like the inland telegraphs—must be a monopoly. Even if no question of patent right were involved the telephone monopoly would be justified on the same principles upon which gas and water works are made monopolised industries. The original telephone system was in this country built upon patents, and there seems to be no reason why it should not during its experimental stages have been protected by injunctions based upon patent rights. Sooner or later, if the system succeeded, it was sure to become a monopoly. The original patentees, if able to carry the undertaking to a successful issue, would naturally, and very properly, become the undertakers of the business. If they proved unequal to the task and a new telephone authority had to be set up it would be easier to expropiate one than a dozen different undertakers. It may well be that in a case such as that good cause could be shewn for the protection of the patentee by an injunction. But that is a widely different thing from the indiscriminate granting of injunctions without any regard to the public interests involved, and it is this indiscriminate use of a very dangerous weapon which constitutes the mischief now under discussion.

Assuming that point to be sufficiently clear, I pass now to consider briefly what is the remedy. Many remedies have been proposed. These are:

1. The compulsory license introduced into our law by the Act of 1883 and re-enacted with modifications by the subsequent statutes of 1902 and 1907.

2. The compulsory working obligation copied from the Continental code and incorporated in the Act of 1907.

3. The penal clauses of the 1907 Act which deprive a patentee who makes an improper use, in certain specified ways, of his monopoly of his right under the patent to an injunction and award of damages against an infringer.

This is a sufficiently formidable array of remedies but they have proved to be almost wholly ineffective. Various reasons must be assigned for this result.

To take them in their order:

1. The compulsory license remedy would probably have met the whole difficulty, and is certainly, if I may offer the opinion, the most promising remedy that has ever been proposed. But the sound rule against circuity of procedure was set at naught when the scheme was originally embodied in legislation: and Parliament, instead of investing the Court, when trying a patent action, with the power to give a remedy in the form of a compulsory license, devised a circuitous procedure of sending the Defendant to the Board of Trade, thus establishing a conflict of jurisdiction and aggravating the cost of litigation. To carry on the two causes at one and the same time would be embarrassing to both parties to the litigation, and it is not surprising that under these conditions the plan, notwithstanding its excellence, has failed of good effect. Half-hearted attempts were made by the Patents Acts of 1902 and 1907 to remove the clog. The first mentioned made matters definitely worse by sending the petition for a compulsory license to the Judicial Committee of the Privy Council—a most respectable but withal a most impracticable tribunal for that purpose. By the Act of 1907 the Supreme Court was at last made the tribunal for deciding a question of compulsory license, but by a positively whimsical incongruity the jurisdiction of the Supreme Court was limited to the hearing of petitions presented to the Board of Trade and referred by the Board to the Court. Thus the fatal clog of the circuitous procedure has been assiduously preserved through all changes of the law, and the draughtsman has been allowed to nullify the measures which Parliament has approved for the remedy of this mischief.

2. The compulsory working obligation. This is a remedy borrowed from the Continental systems of Patent Law, which appears, on superficial consideration, to be the obvious thing. If a patent is granted in order that the patentee may introduce an invention into use, what simpler and more logical than to make the bringing of the invention into use a condition of the continuance of the grant. But, tried by the criterion of experience, this remedy is found to be logical indeed—but not remedial. To begin with, merely repealing the patent does not set the manufacture going. If it did a better remedy still would be to grant no patents at all. Then the condition of compulsory working is always and necessarily qualified by a imit of time within which the patentee is not to be harried by the compulsory working condition. But no fixed and invariable time limit will meet the case. How far it is from meeting the case may be illustrated very strikingly from another provision of our patent law. No British patent right can run for more than fourteen years. But n certain cases a renewal may be obtained at the expiry of the fourteen year period. That is only when the patentee has been quite inadequately remunerated because he has failed to bring his nvention into sufficient use. Of course the ailure must be through no fault of his own. But he failure which constitutes a ground of forfeiture need not be through any fault of his own. The ame failure to exploit the invention may at one tage be a ground of forfeiture and at another stage a ground of renewal of the patent right. In ruth the verbal logic is misleading. When you ook behind mere texts and consider the essence of a patent grant, it is a contrivance for producing he effect of which Lord Parker speaks, *i.e.*, for ecuring the bringing into use of new inventions t the earliest possible moment. If then a paricular grant fails to accomplish this end the eason is that it has been granted to the wrong atentee and the congruous remedy would be, not o repeal the grant, but to expropriate the grantee nd put some better patentee in his place. This is substantially what the compulsory license does. The repeal of the patent only destroys the proprietary interest which was created to promote the use of the invention. It is a doctrinaire measure devised to deal with one particular kind of obstruction, and adapted to that end. But as that particular form of obstruction is by no means the most serious difficulty by which the introduction of new inventions is beset, the remedy has not unnaturally proved to be worse than the disease. If the power to veto the use of an invention were taken away from patentees the mere existence of dormant patents would be no mischief at all.

3. The penal clauses of the Act of 1907 do not call for any special notice here. They are very special matters intended to repress particular abuses of patent right and except in so far as they are covered by what has just been said under the last head, they do not substantially affect the present discussion.

The conclusion of the whole matter appears to me to be this. Our patent law could be easily reduced to an extremely simple form, in which the patent grant might be expected to produce a maximum of public advantage, by reducing the grant to a qualified monopoly which would in all cases confer upon the patentee the right to grant licenses but only in exceptional cases the right to restrain by an injunction the use of the invention. This reform is urgent, and if carried out it might be accompanied by a repeal of the intricate legislation and vexatious penalties of the last Patent Act. The patentee would then be in this position, that by promoting the use of his invention he would be turning his patent right to value whereas he could derive no profit from it by suppressing the use of the invention within the Realm. When that is his position the patentee will no longer be able to do any mischief, while the power for good will remain intact. When once that position is reached we need not trouble any more about penalising patentees. They will be the servants and not the masters of the public.

In conclusion I should like to submit the suggestion that here is a subject which a special Committee of the Society of Chemical Industry might be most advantageously appointed to consider. It closely concerns the industries in which you have a special interest: it is a live question upon which legislation will almost certainly arise in the not distant future: first, to form, then of formulate, and, finally, to enforce your views on this important subject would be the fitting task of as strong a Committee as you could appoint. May I beg forgiveness for venturing to suggest the scheme and to commend it to your favourable consideration.

THE INFLUENCE OF PATENT LAWS UPON INDUSTRY.

BY WALTER F. REID, F.I.C.

(Chairman of the Institute of Inventors.)

At this critical moment in our history it is well to consider whether and how we are handicapped in our competition with other countries by the laws which control our actions and our industries. All civilised communities have found it necessary to regulate the conduct of individuals by a more or less complicated system of regulations, the main point of which should be that isolated units of our social system may not injure the community as a whole. Until recently we prided ourselves on giving more freedom to the individual than other nations, many activities carried out in other countries by the State being here left to individual effort. In the past, individualism had its advantages; but speed of communication and rapidity of transport have so altered the conditions of intercourse between nations that collective action must be substituted for individual effort, if we are to maintain the position to which we deem ourselves entitled. In an ideal community it might be possible to arrange the division of labour so that each would perform the task for which he was fitted. By "labour" I do not, of course, refer to the narrow-minded, horny-handed variety; but to every activity necessary for the good of all. Failing such utopian conditions the best alternative seems to be for the community, as represented by the State, to hold the balance fairly between the various classes of workers so that none of them may be handicapped in their efforts for the common weal. If there is one class of workers to whom humanity in general is most indebted, it is the inventor. All our comforts, our means of subsistence, our industrial appliances, our weapons of defence have been at one time new inventions. Technical education really consists in transmitting to the possible inventors of the future the inventions of the past and present. Those who have been and are teaching research work are beginning to find out that work is none the less scientific when it has a definite object in view that may benefit mankind.

But research, although an important step in advance, is not the final one. Before research can be of use the inventor must intervene and apply the results to some existing or new industry. The researcher may himself be an inventor; but this is by no means always the case. Perhaps the majority of modern inventions are more or less based on work done by others than the inventor whose name becomes known in connection with the subject. It has been truly said that the inventor is born and cannot be evolved by any process of education any more than a good painter, musician, or author can be produced by such means. What can be done, however, and this is where technical education and practical experience are so important, is to teach those who have the inventive faculty what others have previously done or are doing, so that a valuable gift may not be wasted in the duplication of work already done. In patent specifications and recently in the records of the Institute of Inventors there are numerous cases where different people have evolved the same idea, and such repetitions will no doubt continue; but they may be diminished by technical training. Again, an invention may be apparently perfect and yet, when put to the test of experience, it may not effect the purpose in view. Ericsson, the celebrated inventor, took a house infested by rats and evolved a rat-trap that was described as a marvel of ingenuity, but the rats would not go near it and the inventor remarked: "These little beasts have brains altogether too big for their heads." Very few inventors are endowed with the business faculty and, from the natural point of view, this is an advantage. Business men are very numerous, good inventors very scarce, and, if it could be done, it would be better for inventors to allow others to apply their inventions and themselves to continue the use of the faculty with which they are endowed. The "instinct of contrivance," as it has been called, is irrepressible, and very few inventors indeed can resist spending the money gained by one invention on some new one. Edison spent most of the money gained in electrical work on a gigantic scheme for the utilisation of the magnetic iron ore of New Jersey. When it failed, a financial friend told him that the amount spent was £800,000; and Edison replied: "Well, it's all gone, but we had a hell of a good time spending it."

As a rule the inventor receives but a very small fraction of the wealth which he is instrumental in creating. The popular notion that inventors become wealthy monopolists is erroneous. Only 4% of the patents taken out are continued to the 14th year and only 52% remain in force even at the end of the 4th year. The great undertakings connected with such names as Dunlop, Welsbach, Marconi, Nobel, and many others are combinations of shareholders, some of whom have very small holdings, and their success depends, not on patents which may have long since lapsed, but on sound commercial management. Inventors have undoubtedly created great industries, found employment for many millions of workers, and added to the comfort and working capacity of their country. But what does that State do for them? In return for an exorbitant fee they are granted a patent which, contrary to a popular belief, is not a monopoly at all, but merely a license for litigation. The Government having secured his money, renders the inventor no help should his rights be assailed and leaves him to fight his own battle should anyone attempt to rob him of the fruits of his labour. In view of the enormous advantages accruing to that country in which new industries are originated and developed, it would be an excellent investment of public money to pay all a patentee's fees and expenses; but what do we find a short-sighted Government department doing? A tax yielding a net profit of about £100,000 per annum is levied on inventors, and, to do this, a staff costing last year £145,613 is maintained. The total amount paid to the Patent Office last year in fees was £275,000. A large portion of the expenditure is incurred in making useless searches through the patent specifications of the last 50 years, a search which is of little use to the patentee and is looked upon with ridicule by capitalists of any experience in patents. When we consider that an inventor can derive no profit from a patent until it has been at work for some time the folly and hardship of adding to his difficulties at the beginning by heavy taxation become evident. Patents were formerly issued by needy sovereigns in want of money; are we now much better off than in the days of the Star Chamber?

Truly the Patent Office is one of the greatest of the many failures of the Board of Trade and British inventors can have no chance in competition with their foreign rivals until it is completely re-organised. Commercial men are crying out for a Ministry of Commerce; but industrial and technical interests are even more concerned in having a government department to deal with in which the officials are not incapacitated by the defects of their education and by hidebound official habits from dealing intelligently with the pressing needs of the day.

Some of the most useful inventors are working men whose daily occupation makes them familiar with processes and machinery. From the experience of the Institute of Inventors I have no hesitation in saying that many valuable inventions are lost owing to the lack of means of men who are thoroughly familiar with their subjects, but wish to protect their ideas before disclosing them. Some short-sighted employers object to their workmen developing new ideas; such firms soon lose ground and ultimately succumb to the rivalry of others who keep more up to date. Their workmen, seeing no scope for their inventive ability, leave and take their experience and ability with them.

The present war has shown how dependent we are upon the inventor, even for our national existence. It is a war of wits as much as of men and money, and without the hearty co-operation of chemical experts and especially of the members of our Society, Great Britain might have been in a very serious position. Our officials had been thoroughly warned, but the majority of them are so lacking in scientific and technical education, that they could not fully realise the importance of the warnings given. We have suffered heavily in consequence and have not yet fought our way out of the inferior position in which we found ourselves at the outbreak of war. As one of your Representatives, I called the attention of the President of the Board of Trade to the serious position we were in, in 1906, as regards explosives, and some action was taken in connection with the Patent Law.

When the war is over an industrial contest will begin for which we are ill prepared. Our present enemies and future trade rivals found a most efficient weapon against us in our own patent law. Their patents are now being carefully nursed and profits collected for them, and when peace is declared the old state of affairs will continue, if we do not stop it. In my opinion the whole management of the Patent Law Office should be re-organised. It should have as its head a man of the highest scientific and technical training, preferably one with some knowledge of English words and their meanings. If he has some experience of British industry so much the better. A mere university training is quite insufficient for the head of an establishment dealing with complicated technical and industrial matters. The inventor should be treated sympathetically and not merely as an individnal from whom excessive fees are to be extracted. Practically the only advantage which the patentee derives from the Patent Office is the excellent and well-managed reference Library, the best of its kind with which I am acquainted. Our Society is endeavouring to get similar libraries established throughout Great Britain; they would be extremely useful to inventors and technical men generally. There are many free libraries throughout Great Britain, but most of them seem to have become purveyors of cheap and not altogether healthy-minded novels.

If we assume that the inventor is entitled to have his ideas protected, the question next arises, how is this to be done? In the first instance, he should be consulted when alterations in the Patent Law are being made, which has not hitherto been done. Every other interest has been fully represented on such occasions, but not the inventor himself, the chief party concerned and the one who supplies the funds. One injustice of the present system is that if a patentee does not pay a fee on a given date, his patent lapses. An inventor may be deprived of the fruits of years of labour, perhaps through the carelessness of an agent. Soon after the outbreak of war, the Institute of Inventors approached the Board of Trade asking that patentees who, on account of the interruption of business caused by the outbreak of hostilities and the consequent action of the Government, should be unable to pay their renewal fees, might have the payment suspended until the conclusion of war. Nothing was done by the Board of Trade; but several echnical societies have since taken action in the ame direction, notably the Institution of Automobile Engineers, which passed the following esolution:—"That in view of the conditions rising from the war, precluding very many Patentees from deriving any benefit from the monopolies granted to them, the Government be espectfully but very strongly urged to grant Patentees the option to suspend their Letters Patent until peace is declared."

In view of the members of the Society of Chemical Industry being seriously affected by the resent state of affairs, our Council might well ssociate itself with the action taken by similar odies. The Board of Trade have power under the Act to prolong a patent; but what is wanted is a declaration that a patent may be suspended during the war.

There are many other points in which chemical industry is handicapped by the existing Patent Laws; but time will not now permit of reference to them all.

THE DISADVANTAGES OF THE PRESENT PATENT LAW.

BY W. P. THOMPSON.

The main disadvantages of the present law are first, that a vast number of patents suffer an untimely death through the heavy annual taxes which the inventors often find it difficult to pay; secondly, the tremendous law costs at present necessary in fighting patent actions; third, the unsatisfactory way of assessing costs and damages in these actions; fourth, the opening left to fraud, and useless expense, caused by our system of provisional protection; fifth, the uselessness and, indeed, pernicious nature of the compulsory working laws as at present existing; sixth, the shortness of the duration of patents; and seventh, a patent, other than a convention patent, cannot be taken out by the assignee.

First.—The Annual Taxes.

This, of course, is only a very small thing to wealthy chemical manufacturers, but to poor inventors it is a very serious matter. In 1883 when the taxes on applications were lowered to about one-fifth of their previous amount, leaving the annual taxes the same, the net income of the Patent Office was only very slightly reduced, and I am firmly convinced, from my own experience, that if the annual taxes were reduced to say £1 a year, the loss to the Government would be infinitesimal, if any. I say this from the fact, that every year I meet with a vast number of cases of men who have not brought their inventions into a thoroughly satisfactory condition of profitable working, and they prefer to abandon the patent sooner than pay these taxes (though believing that their patents are still valuable), but they would have paid the tax, if it had been only £1. The result is the invention, not having been brought to a financial success, is dropped, and it is no longer to the interest of anyone to take it up. These dropped patents are a rock on which many valuable inventions by other parties have been wrecked, as the examiners, of course, refuse any claim which may appear in these patents, even though the abandoned patent may not be strictly workable in the form in which it has been filed.

Second.—Cost of Patent Actions.

The tremendous costs of English courts are proverbial, and patent cases are more costly than others, owing to our Judges, and very frequently the lawyers also, having very little acquaintance with science. The difference, indeed, between the cost of German patent law, and of English is extraordinary. My firm has taken patent cases to the highest court of appeal in Germany, against Krupp of Essen, the Associated Glass Manufacturers of Germany, Siemens & Halske, Deutsche Rheinische Eisenwerke and numerous others, and in nearly every instance (in these four mentioned cases especially) we won against German subjects, and the costs granted were so liberal that our net agents' and lawyer's bill hardly amounted to £15 in any case, and in several instances we never received the bill from my lawyers at all, they being satisfied with taxed costs. On the other hand, in the one or two cases which we have lost, we have been astonished at the very small amount of costs incurred even in fighting to the Supreme

Court of Appeal, nothing approaching what they would have cost in England, while at the same time the decisions were models of scientific accuracy, a striking contrast to the decision in numerous courts that we have taken cases to in Great Britain. Take, for instance, the case against Krupp. The five judges who finally decided the question were a lawyer, a metallurgist, a chemist, and two other highly scientific men. Part of the attack of Krupp was "that the invention, as set forth in the patent, was unworkable." We stated that it was being carried on on a large manufacturing scale in England, and if they would appoint a commission to take evidence there, we could easily prove it. The court at once appointed the metallurgical judge to go across to England, and each of the parties was invited to appoint an expert to go with him or meet him there. The Judge examined the works minutely, with a copy of the patent specification in his hand, cross-examined the employees, etc., in presence of Krupp's expert and the patentee, and asked these to say anything further that they wished. He came back and at once informed the court that it was being largely worked in England exactly as it was in the patent, and therefore that that ground of Krupp's attack failed. Fancy an English judge doing this!

Now in Liverpool, the cotton brokers or a long time groaned under the heavy law costs which were incurred in their litigations, and finally they entered into a combination whereby in all cases they had to refer their trade disputes to an arbitration Court of their own, and there is probably not a single cotton broker in Great Britain that would like to go back to the old arrangement. It is very rarely that these actions cost more than £5, whereas, fought out in a Court of Law, they would probably cost hundreds.

Now if your new organisation can act on this plan or the Chemists in the British Isles would combine together to put all their patent cases to arbitration of a special Court of their own, in a similar way, that Court being empowered to call in an expert as an assessor, and one neutral lawyer or patent agent, if thought advisable, each side being only allowed to bring evidence of fact, and one single advocate, a chemist, lawyer, or patent agent, the cost would be found to be trifling, and the chances of a rightful decision enormously increased. In the German Court of Appeal in patent cases, they pick from among their body (according to my experience) one lawyer, and four scientific men, more or less acquainted with that particular line of science, with power to call in an assessor. Neither side is allowed to call scientific experts, *qua* experts. The Court does this if necessary. The result is that law actions there cost much less in shillings than in England they do in pounds, and the decisions are much more satisfactory. In Germany an ordinary court has no power to judge in a case of infringement or validity of a patent—the matter must be brought before the Patent Office Court, and from that, on appeal, to the Supreme Court of the Patent Office.

Third.—Assessing costs and damages.

In an action in Great Britain, the patentee can either apply for damages assessed on the amount of profit which he can prove he would have made if he had manufactured the infringing articles himself, or the profit which the infringer himself has made on the transactions. In either of these cases he has very formidable difficulties to contend with. If he chooses to take the profit which the infringer has made, the infringer contrives to lessen the amount of profits by an immense bill for experiments, for works charges, oversight, travelling, advertisements, etc., and the costs of proving this are often greater than the costs of the trial in the first instance. I have known of one case which took ten years before the assessment was finally completed, and it ruined the winning party.

If, on the contrary, the inventor applies for the damages to be assessed according to the profits which he would have made on the proved infringements, he has enormous difficulty, first in ascertaining the particulars of these infringements, and secondly, in proving that he would have got each order if the infringer had not taken it. On one occasion where the House of Lords decreed damages in a case in which I was engaged, and in which we elected to take the profits which we would have made out of the infringements, there was, we were satisfied, more than £25,000 profit made. We finally compromised for £5000, finding it impossible to get hold of many of the customers of the infringer, and of getting other customers to admit that they would have given us the order. In several foreign countries there is none of this trouble, as the infringer has to pay the value of the infringing articles, or in some instances two or three times this amount. If some simple arrangement of this nature could be enacted, a vast amount of legal fees and other expenses and also of actual fraud would be obviated. At present, but for the extravagant costs of patent actions, it would always be at least equally advantageous to risk an infringement action as to pay royalties.

Fourth.—Provisional protection.

Except in Great Britain and some of her Colonies, there is no country who has adopted our system of provisional protection, and even some who had adopted it, afterwards abandoned it. In all the rest of the world a complete specification is filed at start, but in nearly all the principal countries additional improvements can be added in a separate application, to date as of the date of such application, but to be covered by the patent.

Provisional protection has been productive of a very large amount of fraud, notwithstanding the efforts of the Patent Office, who have become extremely careful in this matter, and of patent agents, to prevent it, and the only advantages (if advantages there be) in this provisional protection system are two: 1st, that it gives the patent agents and the lawyers a large amount of work, and an opportunity of extracting fees; and 2nd, that a schemer who has thought of an idea but not developed his invention can apply for provisional protection, and so get six months (formerly nine) during which he can work it out, or, if it be in a rather favourite field of invention, find in the meantime what other people are doing, ignorant of his protection, and then cover these other men's inventions in his complete. I will give two illustrations. An inventor came to our firm, and asked us to enter a provisional specification of his own drawing up, in which the member of our firm, who took it in hand, could hardly understand a single sentence. He, however, did not like to take the responsibility of refusal, so filed the application. The Patent Office promptly rejected it, saying it was all rubbish, and he must file a proper specification. At that time there were nine months provisional protection during which he could do this. At the end of about eight months he brought a thoroughly satisfactory specification, and it was allowed as of the original date, and a week or so afterwards brought some excellent drawings and a complete specification minutely describing the invention. Now it so happened that at the time he first called on us, we had in our office an invention of Mr. Edison, the American inventor, the drawings and specification being all made out ready for filing on the day of issue of the American specification (for at that time to file it on that particular day was very important). Mr. Edison had let it be generally known that he had a very valuable invention for a given purpose, but did not give details to the public—only described what it would do. Our client, therefore, had drawn up this bogus specification, embracing every word descriptive of the invention, which Mr. Edison had published, and if it had not been that he had accidentally come to Edison's own patent agent, who recognised the drawings, he would have obtained the prior rights to Edison's invention. As it was, we refused to complete the patent, or to give up the specification and drawings, but sent the whole account to the Patent Office with full particulars. The Patent Office absolutely refused to allow this man to have a patent. On another occasion a patentee brought me an invention which looked very good, but was too complicated. Near the end of the period of provisional protection he brought a very great improvement on it, and asked whether I could complete the patent on this improvement, instead of on the original design. On examining the provisional specification, I found I had so generally worded it, and had put so many suggestions in it, that it practically covered the new invention about as well as it did the old, and I obtained a patent for him on the new invention. He then came to me and wished me to oppose another man's patent, on the ground that it had been previously patented by himself in the aforesaid specification. I opposed this other man's patent, and got it refused. Afterwards indubitable evidence was obtained, that my client had not invented it at all, but had stolen the invention from the other, who had published his invention a little before my client completed his, and before he came to me with the new invention. Nothing, however, resulted, as the rightful inventor did not care to go to the expense and danger of a suit-at-law. Had the first patentee, in either of these cases, been obliged to file a complete specification at start, as he would have had to do in any other country but a British one, the fraud would have been an impossible one.

Fifth.—Compulsory licences.

By the Act of 1883, any interested person could go before the Board of Trade, and on showing a *prima facie* case that a patent had not been worked in this country during the previous three years as much as it had been worked abroad, the Board of Trade would call upon the patentee to make his defence. A day would be set apart for hearing the parties, when the Board of Trade could decide whether a licence should be granted, or not. This was a very cheap, simple, and satisfactory procedure, but unfortunately it had the very great defect of not putting money into the lawyers' pockets; in fact, in one or more of the first and only cases that were tried under this clause, no lawyer was engaged, or at any rate only on one side. Accordingly a law "for simplifying and cheapening the process" was passed, namely, the applicant had first to prove the matter before the Board of Trade, and then with the latter's consent bring an action before the Privy Council (about the most expensive Court in England). So expensive was this procedure, that no case was decided under it, and the present working clauses are a slight modification of this act, which also have fortunately proved practically unworkable. I say "fortunately," as had they been carried out as anticipated by their author, a man would have had practically to decide whether he would have an English patent without rights abroad or no rights in England. Fortunately a decision of Judge Parker, almost straining the law, saved the situation, as five different countries were passing or had passed retaliatory measures. This Act was passed at the instigation of the Manchester Chamber of Commerce, of which Ivan Levinstein was chairman. Previously many "working" Acts, as they were called, had been passed in other countries but had sunk into desuetude as impracticable. It was sufficient in most countries if the inventors worked them at all, and in one or two only sufficiently to fulfil the reasonable demands of the country.

At the time when these Acts were passed, there were two working laws in existence in other countries, which had given satisfaction. The first was the Swedish one, by which if any interested party proved to the Patent Office, that any patent three or more years after grant was not being worked sufficiently to satisfy the reasonable demands of the country, he and the inventor were heard by the Patent Office (or by the Court after 1902), and such authority could oblige the patentee to grant the applicant a compulsory licence. This was an exceedingly cheap procedure, and has ever since the day it became law, namely, 16th May, 1884, given general satisfaction. The other Act was the present Canadian Act, by which the applicant has the option of either working the invention in the realm sufficient to supply the demands of the country, within two years of grant of the patent, or within six months of grant of putting his patent under the Compulsory Licence Clause, whereby any person applying to the Patent Office, giving him full notice, and satisfactorily proving that the invention was not sufficiently at work and that he was a suitable party, could be granted a compulsory licence on such terms as the Patent Office saw fit, the royalty of course to be paid to the inventor, who was fully heard. The procedure in both instances is remarkably cheap. In both these procedures (Acts) there is an appeal on points of law, but they have the defect of the English Act of 1883, that they bring little or no fees to legal practitioners.

Sixth.—Duration of Patent.

Great Britain has, with the exception of a few smaller countries, the shortest duration of patents of any country, and the tendency in new laws abroad is to extend the time rather than lessen it.

The United States grants patents for 17 years, and without any annual taxes, and there is a project of law before the legislature, to extend the duration. Belgium grants them for 20 years. Most other countries grant them for at least 15. It is found continually that the patent is just beginning to pay well near the end of the 14 years, and in Great Britain we have a costly procedure for extending the life of a patent usually for three to seven years. If the patents were granted for 20 years, as in Belgium and the United States, there would be no need for this procedure, but in that case again, a great field for law charges would be cut off!

Another valuable improvement in force in nearly all countries would be to allow assignees of patents to apply for patents. We can do this in the case of convention patents.

And now a few words on the temporary rules during the war. My firm has applied for compulsory licences for many patents of Alien Enemies, and in every case in Great Britain, in India, and in Australia, where they have the same law, they have been allowed on fair terms, and Mr. Runciman and the Board of Trade have repeatedly intimated that it is their intention to continue these licences for the duration of the patents, but these licences are theoretically liable at any time, even during the war, to be revised or rescinded on good cause, but I am still confident that these licences will continue to the termination of the respective patents.

Discussion.

The President expressed some doubt as to the authority of an official to give a verbal assurance to licencees in regard to the period of their licences. It would have been more satisfactory had some official intimation been given through public channels. He was interested in the suggestion made by Mr. Gordon, which on the face of it had the great advantage of extreme simplicity—that was, that instead of granting monopolies we should grant the power to issue licences. The question of licences would then become a matter of negotiation, and, as Mr. Gordon suggested, the machinery involved for applying for injunctions would be brought into use. In commercial matters Arbitration Courts had very largely taken the place of appeals to Courts of Law, and with very great success. The new Association of Chemical Manufacturers included in its articles the provision that it might have the power to act as arbitrator or to appoint arbitrators.

Mr. A. G. Bloxam said that our Patent Law came into operation under an Act of James I., dated 1623, and we had never got away from that Act. That was, he thought, one reason why the Patent Law at present was a source of dissatisfaction to chemical manufacturers. One clause in the Act of 1623 which was still on the Statute Book allowed the King to exempt from the iniquitous practice of granting monopolies, monopolies granted for 14 years for new manners of manufacture. In those days it had been very difficult to establish a new manner of manufacture, and from the cases which had been published it would appear that the establishment of a new manner of manufacture then had consisted not in applying an invention made in this country, but in going abroad to acquire knowledge of what others were doing, and applying that knowledge over here. He submitted that we should regard the patent system not only from the point of view of its being advantageous to the inventor in enabling him to start a new industry, but from the point of view of the public. The alternative to a patent system must be secret working. The Patent Law persuaded a man to part with his secret and did away with the trouble which always occurred from secret working. He had been asked recently what would have been our position if the Salvarsan patent had never been published. It might have been difficult to determine the constitution of Salvarsan by mere analysis. It was commonly stated that a patent specification did not disclose the invention. He did not think that was quite just. It was exceedingly difficult to write a specification in any case, and it was almost impossible to compel or even to ask the inventor to put in everything that must be done to ensure the best result. Although there were probably cases in which the specification was not fairly drawn, he thought that those cases were far from being in the majority. Taking the view that the real basis of the Patent Law was the publication of inventions, there was considerable reason in the injunction, for it seemed common justice that the inventor should remain under the same advantage which he would have if he were to work secretly, and that advantage was a monopoly, and not merely a license to grant licenses to others. Mr. Gordon did not, he thought, favour compulsory licences in general, but only as an alternative to the injunction, and one of his reasons was that in the past the application for a compulsory licence had been an intricate and costly operation. Within the past few years it had been found possible even in disputed cases for the Comptroller to constitute a satisfactory Court of first instance. He did not, of course, suggest that he should be the final Court.

Dr. A. Rée said, looking at the case from the point of view not only of chemical industry but of the public in general, it seemed to him that a patent was granted to an inventor not only for the benefit of the inventor but quite as much for the benefit of the State. That had been the original intention of the Act. He thought we had not sufficiently considered the interests of the State in this matter, and it was the interests of the State more particularly, he thought, that had actuated the Manchester Chamber of Commerce when 33 or 34 years ago they had begun their agitation with regard to the reform of the patent law. At first it was proposed that the procedure in regard to the granting of compulsory licence should be altered, and there were one or two Acts—the last one in 1902—which had given what seemed at the time to be benefits and advantages that might accrue to the British manufacturer and to the State. Unfortunately, legislation carried in those days proposed procedure which was so complicated and so costly that he believed that during a period of something like 20 years up to 1913, only one application for a compulsory licence had been brought into the courts, and that was the case of Mr. Levinstein, who had brought an action for the granting of the compulsory licence, which had proved to be very costly. It had been felt by the Manchester Chamber of Commerce that it was very unfair and unreasonable that the inventor should be put to great expense before he could obtain a compulsory licence, and it had been partly with the view of altering that that the Manchester Chamber of Commerce had begun an agitation in favour of compulsory working. Compulsory working, he believed, obtained in practically every industrial country of the world, with the possible exception of the United States, where high duties rendered it unnecessary. There had been very strong opposition on the part of the patent agents. He believed that one great reason for that was that a much larger number of important patents were taken in this country in respect of chemical inventions by German firms than by English firms. Naturally these foreign firms considered that it was directly opposed to their interests that compulsory working should be introduced into this country whereby they had to manufacture in this country in return for the protection of thei invention for fourteen years. It was not until about 1906 or 1907 that they had succeeded (thanks to the quick perception of Mr. Lloyd George) in getting the legislature to realise th position in regard to foreign patents. Mr. Lloyd George had said "*A patent is a monopoly grante by the State for adequate consideration and th State is entitled to see that the adequate consideration is given. It is a very valuable asset whic the community gives in return for something i expects, and it is entitled to say that if it has not g its share of the bargain it will revoke the whol of the monopoly which it has conferred.*" Tha was practically what Section 27 of the Paten Act of 1907 effected. The Mersey Chemica Works and others had been started in order t carry out the provisions of the compulsory workin clauses of the 1907 Act, and in several cases, a all events, actual manufacturing had been commenced. He mentioned as an instance the case o indigo. The indigo used in this country up to th beginning of the war and for some months afterwards had been almost exclusively, if not exclusively, produced in this country, at the work of the concern which to all intents and purpose was the German firm of Meister, Lucius, un Brüning. The remarks he had made on th previous day were more particularly in referenc to the fact that Mr. Thompson had been in th past and was apparently even to-day in favou of compulsory licences and strongly opposed t compulsory working. He thought that the question of whether compulsory licences or compulsory working was the best in the interests of the country had been thoroughly thrashed out during the last 8 or 9 years, and he believed that the community generally, including not only business men and manufacturers, but also the great body of working men, realised that compulsory working would mean the bringing of industries to this country and the employment of labour in a large way. If we were going to adhere to or return to compulsory licences—and we had practically returned to-day to compulsory licensing—all that was generally obtained was the paper on which the invention was described. Most of those who had had any experience during the last year or two with regard to patent specifications, especially those dealing with dyestuffs and the intermediate products for their manufacture, had realised that there must be something radically wrong in the way those specifications were allowed to be drawn up. The large German chemical manufacturers employed the greatest skill so to draw up these specifications that the most expert in this country were often unable to carry out the invention even on a laboratory scale. Every inventor naturally felt that he wanted to give away as little of his invention as possible, but if we were going to grant the greatest possible monopoly to a foreigner he should do something in return. How many of the important German patents had actually been worked on a commercial scale in this country for the last 20 or 30 years? Very few indeed. The case of indigo was an exceptional instance, where the firm had not only carried out their legal obligations but had also observed the spirit of the Law. Their directors must have come to the conclusion that it was reasonable for them to do something for the State that granted so great a monopoly. That was, however, an solated instance. As a rule it took several years before an invention was worked out to such perfection that it could be said to be a success. If for 14 years we gave the foreign inventor permission to carry out his invention abroad only, and not here at all, he thereby practically always secured a permanent monopoly. The compulsory working hat was provided for in Section 27 of the 1907 Act would have met the difficulties of the case, and it was most unfortunate that Mr. Justice Parker—now Lord Parker—should have given a decision in 1909 in a case with regard to the evocation of patents, which resulted in the annulling of that Section 27 of the 1907 Act so ar as its useful purposes were concerned. Lord Parker had practically decided that before any pplicant could obtain a revocation of patent on he plea that it was not worked in this country, he must prove to the satisfaction of the Court that the nvention was not worked on an adequate scale in his country. It was impossible to get such proof by nybody who wanted to work the patent unless he hose to go about it in a very disreputable manner. Now, Lord Parker's main plea in that case was, he believed, that it was unfair that the man whom you attacked should be called upon to prove your case; that it was contrary to the principles of he law of this country. There were many cases, ome of which Dr. Rée instanced, in which an pplicant could call upon the person against whom e was proceeding to prove that he was or was not oing what was alleged. In June, 1914, a deputaion of the Association of Chambers of Commerce ad waited on the President of the Board of Trade, ith a view to induce the Government so to modify e wording of Section 27 of the 1907 Act, that the terpretation of that Section would be the one at had obtained before Lord Parker had given s decision. So far nothing had been done.

Early in the 'nineties his old firm had started the anufacture of aniline colours, and some three or four years after they had started the most powerful firm in Germany had tried to deprive them of the fruits of one of their inventions by upsetting the patent which they had secured in this country. Although they were then a small and unimportant firm their opponents had not succeeded in their endeavours. Later, for working a patented process of producing certain valuable dyestuffs, they had required certain products that had been patented by a German firm in this country, but which the same firm had been unable to patent in Germany. That German firm had refused to supply them with those products, and ultimately, after a lengthy correspondence, the whole case had been submitted to the Board of Trade, and it was largely owing to the evidence they had been able to bring forward at the time to the Solicitor of the Board of Trade that the 1902 Act, or rather those clauses of the 1902 Act that related to the then compulsory licences of a new order, had been passed. Dr. Rée contended that if we could not have something like compulsory working, if no satisfactory substitute could be found—and he was certain that compulsory licensing alone would not do—then in the best interests of this country and particularly of the chemical industry in this country, it would be far better not to have any chemical patents at all.

Professor H. E. ARMSTRONG said that the real subject to be discussed from the point of view of chemical industry was whether or no patents were in any way a help to industry. German manufacturers had long ceased to bring infringement actions against one another in this country. They had realised that they were wasting their money in competing against one another and that they had better pool their forces and compete only against the foreigner. If that condition prevailed formerly when there were two or three groups, now that there was only one group there would be absolute unanimity. The question was whether there should not be an agreement among manufacturers here that they would not fight with one another but combine together. The result would probably be that the Germans would take out very few patents in future but rather tend to secret working, since they were all combined together; they would not need patents as protections against one another and if England insisted on a patent being a complete disclosure of the invention, it would be absurd to take out patents. The late Dr. Mond, he believed, had arrived at the conviction that patents were detrimental to industry rather than helpful. From the point of view of the patent being a complete disclosure of the invention, he ventured to think that Dr. Rée had gone too far in what he had said about the lack of *bona fides* on the part of a large proportion of inventors. What had happened was probably very much what Mr. Bloxam had indicated—there had been difficulty in making a complete disclosure. He contended that an invention was not complete when made and could not be so. To make it complete the patentee should eventually disclose what had been learned in carrying out the invention. As a rule, the inventor was not doing much more than handing on an idea he had got from somebody else and improving it a little, perhaps. The people who often really did the work were the exploiters of the invention, who carried it into practice and made it a commercial success. Another direction in which we should move was in the matter of blocking patents. In developing these undoubtedly the enemy had adopted tactics of extraordinary cleverness. They would not make a direct attack upon an important invention but would study the subsidiary operations and take out patents which stood in the way of development along the lines of these. That was the worst form of interference with patents at the present time; it was very often of far more consequence in the end than a mere patent for the improvement of the primary invention. He agreed with Dr. Rée that the firm of Meister, Lucius, and Brüning undoubtedly had taken a high moral view of their obligation under our Act, in setting to work to make indigo and other things in this country. Mr. Gordon ought not to have quoted the Levinstein case or at any rate he ought to have quoted it accurately. He said that the Blackley Red was made by a secret process: that statement had been made over and over again but it had never been proved and there was not, in fact, a secret process. He said further that the Badische chemists had been wholly in the dark as to its synthesis but this also was untrue. Having been in the case all through, said Professor Armstrong, the facts were all known to him.

Mr. Gordon, in reply, said that Mr. Reid complained about the revenue which was drawn from patent fees, which he stated amounted to £275,000 a year, and that he regarded as a serious burden on the inventor. Actually it was a small proportion only of the £275,000 that came from the inventors. The great bulk of those fees was paid by patentees whose patents had run for many years. The British system of patents was more liberal in respect of fees than any system in the world, because it granted a patent free from anything in the way of fees except the original application fee of £1, and the sealing fee of £4, for a period of 1 years. It was true that in America the period was longer, but the original fees were much heavier. At the end of four years the renewal fee was only £5, and at the end of 14 years there was a renewal fee of about £50, but it was no hardship to pay such a fee. By the end of that time, if the invention was not of a paying nature it ought to be surrendered in the public interest. Mr. Bloxam had suggested that the injunction was the proper way of protecting a patentee, because the advantage of the patentee under his patent grant ought to be as nearly as possible the same as he would secure if he were successfully working in secret. That did not seem to be self-evident. If an inventor were working his invention as a secret process, he was working it under very difficult conditions. He had to secure secrecy of a very large number of workpeople and others: he had to confide his secret to so many people that the possibility of keeping it a secret for any considerable period imposed upon him a very serious obligation. He was relieved of all that inconvenience by the patent system, and the community got some advantage corresponding to the advantage the patentee got by his patent grant. Therefore the advantage was not necessarily the same under the patent system as it was under the system of secret working. With regard to the view that compulsory licensing did not meet the case and that compulsory working did, Dr. Ree was labouring under this difficulty that the only compulsory working which we had actually in use in this country confessedly, in his view, did not meet the case, and, therefore, when he said that compulsory working would meet the case he was speaking of some other system of compulsory working which at present we had not in operation.

Dr. Ree: From 1907 to early in 1909 up to Lord Parker's decision, it worked exceedingly well.

Mr. Gordon: Those manufacturers had started on a certain view of the operation of the law, which was not upheld when the question came to be tested in Court, and the law, of course, was the law that operated.

Dr. Ree said that that had happened owing to the careless wording of Section 27.

Mr. Gordon, continuing, said that such things very constantly happened. That complaint was one which lawyers were constantly making about every Act of Parliament. Language was not a sufficiently plastic instrument to express all that was meant. Something which looked the simplest in words often turned out to be the least effective when it was put into use; that, he thought, was the case between compulsory licensing and compulsory working. Compulsory working, he agreed, looked to be much simpler and much more effective, but so far as he knew compulsory working had always proved in practice to be very difficult and very ineffective and very impracticable. He suggested that a Committee of this Society might be appointed to go into the matter. It had been suggested that under a compulsory license one only got the written specification. That difficulty might be overcome by making it a condition that the patentee should also give his personal assistance to the licensee.

Mr. W. F. Reid said, with regard to doing away with patents, especially in connection with the chemical industry, that no suggestion could be more injurious to the progress of our industry than the abolition of any reward to any man who might have power to invent new processes or new apparatus. In that event the inventor would not remain in this country but would go to a foreign country where he could get something for his brains and intelligence. In regard to Patent fees, Mr. Gordon had not said that the price for the whole term of the patent was £100 in this country, whereas the same and very much better protection was obtained in the United States for, say, £20. A lot of their trouble and a great deal of expense had been due to the drafting of these laws by men who were accustomed to legal language and who did not know how to express their ideas plainly. If those who really understood the subject were to debate some particular subject of legislation, and the results of their discussion were written down in ordinary language, laws could be produced which would be more satisfactory and more easily understood by the people than those made by Parliamentary draftsmen. The description which Mr. Thompson had given of the simple method prevalent in Germany of deciding these questions, threw great light on the advantages that the German chemical manufacturers had in such matters. In conclusion he quoted the following words of Lord Justice Moulton, "The true remedy is that you ought to protect the monopoly of every inventor who acts reasonably and punish those who act unreasonably. No patent ought to be used for the purpose of checking work in the country itself."

Mr. W. P. Thompson, replying to Dr. Rée's contention that a great number of works had been started in consequence of this law, said that the Institute of Patent Agents had gone through those lists, and could find only three or four works that had really been started in consequence of this law. With regard to Mr. Justice Parker's ruling, what he had said was that no one had a right, unless he could give really good *prima facie* evidence that there was a good case, to force any man into the box and have his whole business brought to the public notice; and that therefore the other side must give a reasonable and good *prima facie* case, and since then there had been none brought forward. Nothing had been said in answer to his contention that compulsory licensing was sufficient. In some countries in which there had been compulsory licensing everybody had been satisfied. At the present time there was hardly a country, with the exception of Russia, where an invention could not be officially worked for from £5 to £10, and especially in the case of France and Belgium.

THE PROGRESS OF THE BRITISH RARE EARTH INDUSTRY DURING THE WAR.

BY SYDNEY J. JOHNSTONE, B.SC. (LOND.)

Under the term "Rare Earth Industry" is included the manufacture and utilisation of certain of the so-called "rare earths," the more important of which aro thoria and ceria, whilst those in less demand include the oxides of didymium, zirconium, and tantalum.

Thorium salts. The most important of the industries depending entirely on an adequate supply of thorium nitrate is the manufacture of incandescent gas mantles. These consist essentially of a fabric of ramie, artificial silk, or cotton, impregnated with a solution consisting principally of thorium and cerium nitrates in the ratio of 99 to 1, certain other inorganic salts being used to harden the ash skeleton. It is unnecessary, however, to discuss here the nature and function of these latter salts or the process of making mantles.*

The British industry has undergone several extreme changes during the past two years, varying from a serious shortage of most of the necessary raw materials at the outbreak of war to the present position, which is full of promise for our future independence of foreign raw materials.

During 1913, the estimated consumption of incandescent gas mantles, in the United Kingdom amounted to about one hundred millions, and of these probably about sixty millions, valued at nearly £200,000, were imported from Germany. In addition, thorium nitrate to the value of £41,544 was also imported.

More than 10 years ago certain firms in Germany obtained a monopoly of the most important deposits of monazite sand, the raw material from which thorium nitrate is produced. As a consequence they were able to control the thorium nitrate market, and the United Kingdom was thus almost entirely dependent on German supplies of the salt. The importation of thorium nitrate from Germany ceased on the outbreak of war, and prices n the United Kingdom rapidly rose from 22s. to about 75s. per kilo., one firm being able to dispose of its stock, held in reserve for such contingencies, at 90s. per kilo. Those incandescent mantle makers whose reserve supplies of the salts were small were hus faced with an early stoppage, as little was obtainable from France, and practically none from he United States, and the only possible sources n the United Kingdom were waste mantle ash and a small quantity of monazite sand.

This serious shortage of thorium nitrate led British chemical and incandescent mantle manuacturers to look into the question of obtaining dequate supplies of monazite sand in order to make thorium nitrate in this country.

The only known deposits of monazite sand of ny commercial importance are those worked on he coast of Brazil and in Travancore, India, the atter sand being of considerably greater value n account of its higher content of thoria.*

For several years prior to 1914, however, the whole of the output of monazite sand from Travancore, amounting to 1300 tons per annum, and equivalent to at least 2300 tons of the best grade f Brazilian sand, had gone to Germany for treatment. The lease for working these deposits had een granted to the London Cosmopolitan Mining ompany by the Travancore Durbar with the approval of the Government of India. This concession was limited to the extent that its transfer could only be made to a British Company. Shortly after the concession was granted the Travancore Minerals Company was formed to work the deposits, and the Company contracted to sell the whole of its output to a German firm. An investigation made soon after the outbreak of war showed that the whole of the Preference shares and 11,000 of the Ordinary shares in the Travancore Minerals Co. were held in trust for the Auer Gesellschaft of Berlin. After consideration, the Secretary of State for India decided that certain conditions must be observed in the future working of the Company, the principal of which is that all seven Directors must be British born, one of whom is to be nominated by the Secretary of State for India, who may also direct his election as Chairman. The voting rights of the enemy shareholders were reduced, the capital increased from £10,000 to £100,000, and the British holding increased,and the German contracts cancelled. These restrictions are of importance for insuring that the control remains in the hands of British born subjects, but a further condition is of vital importance to the industry. It has been embodied in the following undertaking which has been accepted by the shareholders in respect of future transactions *:—

"The Company will be ready at all times to sell monazite sand direct and at a fair price to any *bona fide* British firm that may desire to purchase the material in reasonable quantities for the purpose of manufacture. The Company further undertake that they will give no preference in the matter of price to any purchaser or purchasers of very large quantities, but that the price per ton for all purchases of lots of 10 tons and upwards shall be the same, free at the mine. The Company clearly understand that if in the opinion of the Secretary of State for India, the control of the Company has passed, at any time, out of British hands or if, in the Secretary of State's opinion, there is grave danger, at any time, of British control being lost or jeopardised, or in the event of any breach of this undertaking, power is reserved to cancel the concession."

In addition to the above Company a second one, called Thorium Ltd., has recently obtained a 20 years' lease to work 150 acres of land in Travancore for monazite sand, the royalty payable being £3000 per annum. This Company is now actively engaged in exporting the sand and converting it into thorium nitrate at their works near London.

The other commercial sources of raw monazite sand are those situated on the coast of Brazil and in the interior of Minas Geraes, Espirito Santo, and Rio de Janeiro. The coastal deposits have been worked for many years past and yield a sand which, when concentrated, contains from 4 to 6% of thoria. The right to work these deposits is periodically offered for tender and for many years past the concessions to work the greater number of the important deposits have been held by members of the German thorium ring.

Each of the Brazilian States has a separate export duty on monazite sand, that of the Federal Government which controls all the coastal deposits being 50% *ad valorem.*

The quantity of monazite sand exported has gradually decreased during recent years from 6462 metric tons in 1909 to 1437 metric tons in 1913. Later returns are not available.

There is reason to believe that, prior to the war, the cost of production of Travancore monazite sand containing 8·5 to 9% of thoria did not exceed £4 per ton f.o.b. This material was resold in Germany at about £36 per ton.

During the past year, a considerable quantity of Travancore sand has gone to the United States for treatment, and many of our incandescent mantle manufacturers have had to depend recently on supplies of thorium nitrate from this source.

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* See "The Rare Earth Industry," 1915, Crosby, Lockwood nd Son, London, page 19).

* Monazites from some New Localities," this J., 1914, **33**,55, nd "Bulletin of the Imperial Institute," 1911, **9**, 103.

* Journal of Gas Lighting, 1915 **131**, 284.

It is satisfactory, however, to record that at least four British incandescent mantle manufacturers are making thorium and cerium nitrates, from Travancore sand, in sufficient quantity for their own present requirements.

If we assume that the quantity of mantles used in the United Kingdom during a normal year is one hundred millions, and that each contains on the average 0·5 grm. of thoria, then the annual consumption of Travancore monazite for this purpose would be about 650 tons, assuming 8·5% of thoria in the sand and a recovery of 90%. It is evident, therefore, that the incandescent mantle trade in the United Kingdom is not able, at present, to utilise the thorium nitrate obtainable from a normal year's output from Travancore, and that we must either make a strong bid for a very large share of the world's thorium nitrate and incandescent mantle trade, or see these important resources of monazite sand within our Empire utilised by other nations.

As regards the price charged for thorium nitrate imported from abroad since the outbreak of war, late in 1914 it could be purchased from France at 60s. per kilo., which price was soon reduced to 37s. 6d., but supplies from this source are now practically unobtainable. Large quantities of the salt have been imported from the United States, and in the early part of 1916 contracts could be placed at 40s. During the past month, however, 70s. to 80s. has been asked on new contracts, and delivery could not be guaranteed until October at the earliest.

The effect of the shortage of raw material shortly after the outbreak of war was not noticeable to the general public, as enormous quantities of incandescent mantles were imported from Holland, but it was evident that they were largely German produce re-packed or branded in Holland. A number of the more important incandescent mantle manufacturers brought these facts to the notice of the Foreign Trade Department of the British Government, and an expert was appointed to inquire into the matter. As a result of his inquiries, and the enforcement of the order prohibiting the import of goods containing more than 25% in value of raw material of enemy origin, a number of consignments were condemned. The quantity imported from Holland has now been reduced to a more normal amount. As that country in ordinary times does not produce sufficient gas mantles to supply a fraction of her own consumption, it is difficult to see how any considerable quantity of mantles made in the country and satisfying the above conditions as to origin of raw material could be available for export. It is probable that attempts will be made to get German-made mantles into this country during the war through other channels.

British incandescent mantle makers, on the whole, report that they find it is difficult to keep pace with all the home trade offered, in spite of the reduced consumption for public lighting. Several state that their export trade, particularly to the British Colonies and to South America, has very largely increased.

There are several other substances, such as ramie yarn, artificial silk, beryllium nitrate, fire-clay rings and supports, into the composition of which the rare earths do not enter, but which are of more or less vital importance to the incandescent mantle industry and, therefore, are worthy of brief mention.

According to several manufacturers, supplies of suitable ramie yarn are difficult to obtain, and the price has been more than trebled since the outbreak of war. Supplies of artificial silk are, on the other hand, at present adequate, but the price has been considerably increased.

As regards beryllium nitrate, which is a constituent of the thorium solution used for impregnating the mantles, a considerable shortage was experienced by several firms late in 1914, but the Imperial Institute was able to indicate where supplies of the salt could be obtained, and it is understood that supplies are now obtainable from British chemical manufacturers. The price, however, has been considerably increased.

Fire-clay rings and supports were largely imported in the past by German controlled firms, but it is now possible to obtain supplies of these of good quality manufactured in the United Kingdom by British firms.

There are several industries which use small quantities of thorium, the most important of which is the manufacture of filaments for certain electric glow lamps. These filaments, which consist essentially of an alloy of tungsten and thorium, were formerly imported from Germany, but it is understood that they are now being made in large quantities in this country.

Cerium earth compounds. These are obtained by treating the residue resulting from the extraction of thoria from monazite, and are employed in the manufacture of incandescent mantles, optical glass, pyrophoric alloys, and carbons for "flaming" arc electric lights.

Pure cerium compounds, suitable for use in the manufacture of incandescent gas mantles and optical glass, can be obtained in adequate quantity from British chemical manufacturers. There is, however, a fair quantity imported from the United States.

Prior to the war pyrophoric alloys were made in this country by a firm of German association from a partly manufactured material imported from Germany, but, so far as information is available, the manufacture of these alloys has not yet been started by any British firm, the present supplies coming from the United States.

Carbons for "flaming" electric arcs containing cerium salts were produced by several British firms prior to 1914.

By an Order in Council dated February 23rd, 1916, the export of the oxide and salts of cerium, metallic cerium, and its alloys, except ferro-cerium, was prohibited to all destinations. The export of ferro-cerium (cerium pyrophoric alloy) was prohibited to all destinations abroad, except to British Colonies and Protectorates.

Didymium salts, which are obtained from the same source as cerium and are used for branding incandescent mantles, are being imported from the United States, but the consumption of these is small.

Tantalum. There has been no shortage of the raw material, the mineral tantalite, and it is reported that the pure metal is being made by one firm at least in the United Kingdom for the production of filaments for electric glow lamps.

Zirconia. This substance, which has been much advertised by the Germans as a refractory material, is not being prepared in useable form in this country, the small demand being met by imports from the United States.

It will be seen that in the past this country has had to depend largely on foreign countries for its supplies of a number of articles into the manufacture of which the rare earths enter, and even in the cases where the article was made in this country the manufacturers had to depend almost entirely on foreign countries for supplies of partly manufactured material. There does not appear to be any reason why this state of things should again prevail after the war. All the necessary raw materials are available in adequate quantities within the British Empire, and most of the difficulties in converting the raw materials into appropriate form have been surmounted. The conditions arising out of the war have rendered it necessary for us to commence the manufacture of our supplies, and it is to be hoped that the great progress already made will be continued.

It is quite certain that the powerful German firms who, prior to the war, exercised such a considerable control over the lighting industry, both as regards incandescent gas mantles and incandescent electric lamps, will not accept, without a struggle, the position created by British enterprise during the war. These new British industries may therefore require Government assistance, either direct or indirect, to maintain their position when peace is declared. In that connection it is important to remember that there is no reason to suppose that Germany has exhausted her reserve supplies of Brazilian monazite stored before the war, and even when these are used up she will still hold the concessions to work large deposits of the mineral in Brazil until 1927.

Discussion.

Professor H. Louis said that about three months ago he had returned from an investigation of the Indian monazite deposits, conducted under the ægis of the India Office. There was no doubt whatever but that Britain would now keep a firm hold on these raw materials, and there was no longer reason to fear German competition in that connection in the future. It was not correct to say that Thorium Limited was actively engaged in exporting the sand, and converting it into thorium nitrate at their works near London, seeing that when he had left India about three months ago they had not even commenced to put up their works. It was also incorrect to say that, prior to the war,the cost of production of Travancore monazite sand containing 9% of thoria did not exceed £4 per ton f.o.b. That was a great under-estimate. He had the correct figures but was not at liberty to give them. The passage in which Mr. Johnstone pointed out that the whole of the preference shares and 11,000 of the ordinary shares in the Travancore Minerals Company were held in trust for the Auer Gesellschaft of Berlin, was perfectly correct. The original Monazite Company had been unable to get money in this country to develop these deposits, o that they had had to go to Germany. German engineers had been sent to investigate the deposits, and to find out whether they warranted he advance of money; when they had been assured on that point they advanced the money equired, stipulating that they should have the ontrol of the products. The fact that those nterested in Britain had been too shortsighted or oo timid even to investigate the proposition had iven the Germans an opportunity that they had been shrewd enough to utilise. Once again British pathy had been Germany's opportunity. The uestion of raising funds for this new industry pened the very much wider question of the ttitude of the banks towards industry. When British industry had commenced to develop, bout 100 years ago, the greater part of the anking in this country had been in private ands, and any one who went to private banks or assistance with a sound story was able to et the assistance he needed. It was very ifficult to over-estimate, and very few people dequately recognised, how much the industries n this country owed to the great private Bankers t that period. Since then banking had passed nto the hands of limited companies. The manager of a British limited bank had to act like prudent trustee, and must, so to speak, confine imself to trustee investments. He dared not peculate or risk other people's money as freely s a private banker could risk his own money. In Germany, on the other hand, where the German banker was not restrained by public conscience and was not guided by private tradition, a very different state of things prevailed. In Germany industrial banks were the order of the day, and whereas the German industries could get all the support they wanted from their banks, support of that kind was not to be obtained in this country. Personally he would be exceedingly sorry to see any change in the general trend of British banking, but he saw no reason why, alongside our excellent banking system, there should not be a new system of industrial banking which would make its specific object the supporting of industries, and he did not think that the new Association of Chemical Manufacturers could do any more important or any more valuable work than to consider how a bank of that kind could be formed. To support chemical industries in this country by Government money was a great economic blunder. It would lead to the private financiers getting the good things and the Government the bad ones, and the public would have to pay.

Mr. Johnstone pointed out that Germany had monazite concessions in Brazil, which would last another 10 years or so. The monazite deposits in British India were between two and three times as rich in thorium as the Brazilian deposits, so that we need not fear this competition very much. Furthermore, he had seen it stated on good authority that a French Company had succeeded in securing the pick of the Brazilian monazite concessions. That company was now working the Brazilian monazite beds, and extracting thorium nitrate from them, and he had been told that those deposits were much richer than those controlled by the German interests. Therefore it would appear that in Brazil as well as in India Germany stood a very poor chance of maintaining any hold upon the raw material mainly required for this industry.

Mr. Thomas Tyrer agreed with Professor Louis' statements, and said that the subject of industrial banks was not only worthy of consideration but was now being considered by some of the finest financial experts in London.

The President said that the thorium difficulty had come before the company with which he was connected, and one of their engineers had been sent to South America to obtain some supplies of sand. After spending some time there, and going over a good deal of the coast, he had found that impossible. Later on, they had been offered an interest in some deposits in Carolina, and in that case they had secured the services of a qualified expert, who was highly recommended by the proper authorities. In the end it had been decided that he should go himself to visit the mine. It was a wonder to him that any man calling himself a mining expert should have recommended that place to be developed.

INDUSTRIAL ALCOHOL.

The President then proposed that, in order to give effect to Mr. Reid's suggestion, the meeting pass a resolution authorising the Council to take such action in the matter as they might deem necessary, and suggested that the resolution might be in these terms:—"Having regard to the great importance of alcohol in developing manufactures at present carried on outside the Empire, the Council of this Society be empowered to take such steps as they deem necessary to obtain relief from the present restrictions."

Mr, Tyrer seconded the resolution, which was carried unanimously.

Vote of Thanks to the President.

Dr. Ree referred to the highly efficient way in which Dr. Carpenter had conducted the affairs of the meeting. No man could have conducted the business in so fair and reasonable and pleasant a manner. Everything that Dr. Carpenter had done, he was sure, had met with the approval of the members. He proposed a very warm vote of thanks for what the President had done for the Society in the past and for what he was sure he was also likely to do in the future.

Professor Louis seconded the motion, which was carried with acclamation.

Visits to Works.

On Friday afternoon, the works of the Pumpherston Oil Company, the North British Rubber Company, and Messrs. McVitie and Price's Biscuit Factory were thrown open to members, by the courtesy of the directors. A large number of members availed themselves of the privilege thus afforded, and the visits proved to be of a most interesting character.

EXHIBITION OF DYES, GLASS, PORCELAIN, ETC.

During the meeting there was on view an exhibition of dyes, glass, porcelain, etc., arranged in a large room in the University Union. The primary object of the exhibition was to indicate the progress that had been made since the outbreak of war in the production of these substances, the greater part of the supply of which had previously been obtained from Germany and Austria. Many of these products had not been made in this country prior to the war, while in other cases the progress made is represented by greatly increased output. In addition to the above mentioned, there were interesting exhibits of some of the products of local industries.

A list of the exhibits is given below :—

Section I.—Coal tar dyes.

Messrs. Levinstein, Ltd., Blackley, exhibited a large range of raw and intermediate products, chrome dyestuffs, sulphide dyestuffs, leather dyestuffs, direct dyestuffs, vulcan dyestuffs, and acid dyestuffs.

British Dyes, Ltd., of Huddersfield, also showed a number of intermediate products and dyestuffs, including synthetic phenol and trinitrotoluol.

The British Alizarine Co., Ltd., of Silvertown, exhibited a comprehensive collection of specimens illustrating the manufacture of anthracene dyestuffs. These ranged from crude anthracene and anthracene derivatives to anthraquinone and its derivatives and various anthracene dyestuffs, some of which were shown in solution. Specimens of acridine, chrysene, carbazole, madder root, madder in powder, and garancine were also shown.

Section II.—Glass.

Messrs. Baird and Tatlock, Ltd., London. Beakers and flasks of "Duro glass," also flasks, beakers, Petri dishes, gas shades, mantle protectors, and test-tubes.

Messrs. John Moncrieff, Ltd., Perth. A variety of flasks, beakers, gas jars, crystallising basins, test-tubes, and tubing.

Messrs. Wood Brothers, Barnsley. Flasks, beakers, potash bulbs, graduated burettes and pipettes, and Nessler glasses, in ordinary and high-resistance qualities.

The Edinburgh and Leith Flint Glass Co., Edinburgh. Soft soda glass, X-ray soda tube and bulb, blue enamel rod, platinum enamel rod, "shell" glass for eyes, blue cane, opal glass, glass tube, blue rod, bulbs, stemming tubes, flange tubing, crystal tube, and clear glass rod.

Messrs. James Powell and Sons, London. Specimens of round and triangular enamelled tubes for thermometer glasses.

Messrs. Chance Brothers and Co., Ltd., Birmingham. Specimens of heat-resisting glass globes for high-pressure lamps.

The following notes were contributed to the catalogue of the Exhibition by Mr. R. B. Pilcher, Registrar and Secretary of the Institute of Chemistry :—

The exhibits of glass indicate the progress made by British firms, since the outbreak of war, towards securing a supply of laboratory apparatus and other kinds of glass, enamels, etc., for various purposes, for which we have hitherto been dependent on foreign sources. All of the exhibitors have had the advantage of collaborating with chemists who have given special attention to the chemical constitution and physical properties requisite for satisfactory production.

The initial problems of deciding the formulas for batch mixtures, and of determining the conditions for successful manufacture, have been solved by investigations involving not only the analysis of known glasses, and numerous experimental melts, but the determination of suitable substitutes for constituents not readily obtainable. Many of the exhibits have been made from formulas resulting from the work of Professor Herbert Jackson and Dr. Thomas R. Merton, of King's College, London, working in conjunction with the Glass Research Committee of the Institute of Chemistry, appointed in October 1914. The variety of glasses dealt with covers the wide range shown in the schedule given on p. 815. Since October 1915 the Committee has pursued its investigations with the assistance of grants received from the Advisory Council on Scientific and Industrial Research.

The production of laboratory glass, however, necessitates not only the acquisition of suitable formulas, but provision of materials, moulds, plant, and skilled labour, so that the firms which have contributed, under the stress of prevailing circumstances, to the results achieved, deserve great credit for their enterprise and every encouragement from the users of such apparatus.

The "Report of a Sub-Committee of the Advisory Committee to the Board of Trade on Commercial Intelligence with respect to measures for securing the position, after the war, of certain branches of British Industry" (Cd. 8181) and "Summaries of Evidence" (Cd. 8275) taken by a Sub-Committee of the same Advisory Committee, indicate that the manufacturers have had to cope with very great difficulties, especially with regard to skilled labour, the cost of which represents about 90% of the total cost of production. It appears also from the evidence that manufacturers are apprehensive of competition from German and Austrian dumping, and they have suggested that a tariff duty of 25—30% *ad valorem* should be imposed for five years after the war.

At the instance of the British Science Guild, about 75% of the Universities, technical institutions, and schools have undertaken not to purchase chemical glassware of foreign manufacture for a period of three years after the war, provided that an adequate supply of British manufacture is forthcoming at a price that is, not prohibitive. Chemists are urged, therefore, to insist on being supplied with British made glass.

Laboratory Glassware, Miners' Lamp Glasses, X-Ray Tubes, etc.

The following is a list of the formulæ for laboratory glassware, etc., prepared by Professor Herbert Jackson and Dr. Thomas R. Merton, working in conjunction with the Glass Research Committee of the Institute of Chemistry, with notes as to firms working these and similar formulæ.

Formulas prepared between October, 1914 *and October,* 1915.

Formulas.	Firms working to formulas.
1. Soft glass, suitable for ordinary chemical laboratory ware. (Since modified; *see* No. 13 below.)	
2. A similar glass for ordinary chemical laboratory ware.	Messrs. Wood Bros. Glass Co., Ltd., Barnsley.
3. Resistant glass suitable for pharmaceutical purposes, ampoules, etc.	Messrs. John Moncrieff, Ltd., Perth, and Messrs. Wood Bros. Glass Co., Ltd., Barnsley.
4. Glass for combustion tubing.	
5. Ditto.	Messrs. John Moncrieff, Ltd., Perth.
6. Miners' lamp glasses.	Have been made by Messrs. John Moncrieff, Ltd., Perth, and approved by Home Office.

(NOTE.—Messrs. Ackroyd & Best, of Morley Yorks, are now making miners' lamp glasses.)

Formulas.	Firms working to formulas.
7. Ditto.	
8. Resistance glass.	

(NOTE.—Messrs. John Moncrieff, Ltd., of Perth, are making a similar glass to the formula of the British Laboratory Ware Assoc.).

Formulas.	Firms working to formulas.
9. Alternative for combustion tubing.	
10. Soft soda glass, suitable for tubing and X-ray bulbs.	Messrs. James Powell & Son, Whitefriars Glass Works, London, E.C. Messrs. Frank Tomey & Co., Borough Flint Glass Works, Victoria Road, Aston, Birmingham. Messrs. Wood Bros. Glass Co., Ltd., Barnsley.
11. Ditto. (Alternative, *see* No. 14 below.)	
12. Lead glass suitable as an enamel for sealing platinum into soft glass.	The Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.
13. Soft glass suitable for ordinary chemical laboratory ware. (Alternative to No. 1.)	Messrs. John Moncrieff, Ltd., Perth; and Messrs. Wood Bros. Glass Co., Ltd., Barnsley.

(NOTE.—Messrs. Baird & Tatlock (London) Ltd., are making laboratory ware from glass closely resembling this formula.)

Formulas.	Firms working to formulas.
14. Soft soda glass of fine working quality and suitable for tubing X-ray bulbs, etc. (Alternative to No. 11.)	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.

Formulas prepared since October, 1916—*under Grants from the Advisory Council on Scientific and Industrial Research.*

Formulas.	Firms working to formulas.
(I.) 15. Blue enamel for sealing metallic wire into glass.	The Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.
(II.) 18. Opal glass which does not lose its opal character on repeated working in the blow-pipe flame.	The Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh. Messrs. James Powell & Son, Whitefriars Glass Works, London, E.C. Messrs. Frank Tomey & Co., Borough Glass Works, Victoria Road, Aston, Birmingham. Messrs. Wood Bros. Glass Co., Ltd., Barnsley.
(III.) 16 and 17. For the manufacture of electric light bulbs.	Messrs. Wood Bros. Glass Co., Ltd., Barnsley.
(IV.) 19 and 21. High temperature thermometer glass and ordinary temperature thermometer glass.	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh. Messrs. James Powell & Son, Whitefriars Glass Works, London, E.C. Messrs. Frank Tomey & Co., Borough Glass Works, Victoria Road, Aston, Birmingham.
(V.) 20. Leadless opal glass suitable for working with certain thermometer glasses to form the enamel backing.	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh. Messrs. James Powell & Son, Whitefriars Glass Works, London, E.C. Messrs. Frank Tomey & Co., Borough Glass Works, Victor Road, Aston, Birmingham.
(VI.) 22. Glass of the same physical properties as fluor crown. (6781)	Messrs. Wood Bros. Glass Co., Ltd., Barnsley

(NOTE.—Messrs. Chance Bros. & Co., Ltd., Birmingham, will probably make this glass in the near future.

Formulas.	Firms working to formulas.
VII.) 23. Glass having optical properties and chemical composition similar to one known as "Prism Crown."	Messrs. Wood Bros. Glass Co., Ltd., Barnsley.

(NOTE.—Messrs. Chance Bros. & Co., Ltd., Birmingham, make similar glass.)

Formulas.	Firms working to formulas.
III.) 24. Glass similar in optical properties and chemical composition to a glass described as a "Heavy Flint."	Messrs. Wood Bros. Glass Co., Ltd., Barnsley.

(NOTE.—Messrs. Chance Bros. & Co., Ltd., Birmingham, make similar glass.)

Formulas.	Firms working to formulas.
(IX.) 25. Glass for the "shell" of artificial human eyes.	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.
(X.) 26. Ruby glass suitable for making veins in artificial human eyes.	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.
(XI.) 27. Glass suitable for making the lens of an artificial human eye.	Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.
XII.) 28. Soft glass suitable for filling in brass caps of incandescent electric lamps.	Messrs. A. C. Cossor, Ltd., 59, Clerkenwell Road, E.C. Edinburgh & Leith Flint Glass Co., Norton Park, Edinburgh.

Formulas recently reported and about to be communicated to various firms.

III.) 29. A new enamel glass suitable for sealing in various metallic wires including copper, iron, and nickel. This enamel glass makes a satisfactory joint with soft soda glasses and with many lead glasses.

IV.) 30. A modification of "eye shell" glass. (Alternative to IX.—25).

XV.) 31. A formula for an opal glass intended for small electric bulbs with opal backing. A bulb blown from the glass remains clear on cooling, but can be "struck" opal by re-heating to a lower temperature. By heating the front part of the bulb to a rather higher temperature this portion goes clear again and remains so, thus leaving an opal reflecting back.

I.) 32. A formula for a batch mixture suitable for making a white bottle glass.

II.) 33. Two formulas for lead glass of high density, such as is required for efficient X-ray shields. It is considered necessary that sheet glass for this purpose should have a specific gravity of not less than 3·8.

Section III.—Porcelain.

Messrs. Doulton and Co., Ltd., London. Basins, crucibles (including Gooch and Rose crucibles), combustion boats, filter discs, Büchner and Hirsch funnels, capsules, spatulas, staining troughs, scalpel supports, water bath rings and covers, desiccator plates, acid dishes, filter baskets, wax embedding troughs, mercury troughs, steam jacket for Beckmann's boiling-point apparatus, ash trays, bee-hive shelves, test-tube draining stands, arsenic plates, arsenic porous pots, and anaërobic boxes.

The Worcester Royal Porcelain Co., Ltd., Worcester. Basins, combustion boats, crucibles (ordinary, Gooch, Liebig, and Rose), capsules, casseroles, Büchner funnel, filter discs and cone, pneumatic troughs, combustion and pyrometer tubes, unglazed tube.

Section IV.—Filter papers.

Messrs. W. and R. Balston, Ltd., Maidstone. Ten grades of Whatman's filter paper, equivalent to C. S. and S. Nos. 575, 589 (white, black, and blue ribbons), 595, 597, 598, 602, and 604, and Dreverhoff 207).

Messrs. H. Allnutt and Son, Maidstone. Samples of commercial filter paper.

Messrs. Evans, Adlard and Co., Ltd., Winchcombe. White filtering circles (equivalent to C. S. and S. Nos. 595, 597, 598, 602, and 604), grey circles, embossed white circles, crinkled grey circles.

Section V.

British Laboratory Ware Association, Ltd., London. Glassware: Beakers, flasks, funnels wide-neck bottle, tapered adapter, glass tubing. Porcelain: Crucibles and lids, including Gooch and Rose crucibles, capsules, boats, casseroles, porcelain for the dyeing industry, for cooking, and for gas and electric furnaces, steel analysis, etc. Porous ware for battery and bacteriological purposes; fireproof ware for electric furnaces and electrical purposes generally. Pure nickel vessels: crucibles and lids, evaporating basins, capsules, spatulas. Filter paper and other filter goods. Whatman filter papers.

Section VI.

Mr. R. Maclaurin, of Stirling, exhibited various products of his low temperature coal distillation process, in which no external heating is employed. Combustion is maintained by an air and steam blast, and the heat is supplied by cooling the power gas. Each piece of fuel is fully 24 hours in attaining a temperature of about 750° C. Provision is made for removing the oils condensing on the upper layers of fuel, so that practically no decomposition takes place.

The exhibit consisted of samples of the smokeless fuel; crude oils; oils separated by treatment with sulphuric acid and with paraffin oil; oil free from resin and cresylic acid, for lubricating; cresylic oil; resinous portion and varnish extracted from this by turpentine; bitumen from resinous portions; light spirit from the oil.

Section VII.—Shale oil.

The Broxburn Oil Co., Ltd., sent specimens of shale, crude oil, ammoniacal liquor, motor spirit, shale spirit, lamp oils, lighthouse oil, "marine sperm," fuel or gas oils, lubricating oils, miners' paraffin, paraffin wax and candles, ammonium sulphate, and still coke.

Section VIII.—Alkaloids.

Messrs. T. and H. Smith, Ltd., Edinburgh, exhibited five different varieties of opium, as well as morphine and its hydrochloride; hydrochlorides of ethylmorphine and diacetylmorphine; codeine; cryptopine; gnoscopine; narceine; narcotine; papaverine; xanthaline and its hydrochloride and nitrate; meconic acid; caffeine; theobromine cantharidine; salicin; veratrine; emetine hydrochloride; cotarnine hydrochloride.

Section IX.

The Lothian Chemical Co., Ltd., Edinburgh. Specimens of trinitrotoluene, cake, lump, and pure recrystallised from alcohol.

The Beaverhall Colour Co., Edinburgh. Cobalt blue, manufactured from Canadian ore.

North British Rubber Co., Ltd. Specimens of erasers.

Section X.

Messrs. T. Morson and Son, Ltd., London. A sample of Roy's glass filter cloth for the filtration of corrosive liquors. (See this J. 1915, 538.)

Obituary.

NICHOLAS HENRY MARTIN.

Mr. N. H. Martin was born at Trebarveth, Cornwall, on May 2, 1847. From 1863 to 1875 he was engaged in various pharmacies in Cornwall, London, and Hitchin, and passed the examination of the Pharmaceutical Society in 1868. In 1875 he went to Newcastle as partner with Dr. H. B. Brady, F.R.S., and on the retirement of the latter eighteen months later he acquired the business of which he was senior partner and director for forty years, and which, under the style of Brady and Martin, acquired a high reputation for scientific pharmacy, and for the supply of pure chemical products and scientific apparatus. He was one of the first to produce gland extracts, which have proved to be such valuable curative agents, and adrenaline was a feature among his productions.

He held a very high position in British pharmacy, and had served on the Council of the Pharmaceutical Society and as President of the British Pharmaceutical Conference. He was also very keenly interested in chemical industry and sat on the Council of this Society for many years, as Chairman of the Newcastle Section, Ordinary Member, and Vice-President, and had been a member of the Publication Committee since 1899. He was Chairman of the Pharmaceutical Section of the International Congress of Applied Chemistry in London in 1905. Martin was a Fellow of the Royal Society of Edinburgh and of the Linnean Society, a Vice-President of the Natural History Society of Northumberland, Durham, and Newcastle, and a Justice of the Peace for Newcastle and also for Durham County.

He died on July 5th, at his residence, Ravenswood, Low Fell, Gateshead, after a severe illness, at the age of 69.

EDWIN W. WHEELWRIGHT.

Dr. Edwin W. Wheelwright was born at Shipley, Yorkshire, on Sept. 11, 1868, and died at Malvern on May 2nd, 1916. He was educated at the Salt School, Shipley, the Yorkshire College, Leeds, and Balliol College, Oxford, where in 1891 he took his degree. He then studied under Prof. von Baeyer and Bamberger, and on his work on the diazo-compounds obtained the very rare honour of Ph.D. (*Summa cum laude*). After acting as demonstrator at Balliol, he entered in 1893 the firm of Messrs. Albright and Wilson, of Oldbury, near Birmingham, as research chemist, in which capacity he acted up to the time of his death. He was a great authority on phosphorus and its compounds, and match compositions, a position that he owed to his own researches continued over a long period of years. As a technologist his distinguishing aptitude was in taking processes from the laboratory into the works; this was all the more remarkable as he had little or no instinct for engineering.

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Manchester Section.

Meeting held at Grand Hotel, on Friday, March 3rd, 1916.

MR. J. H. HOSEASON IN THE CHAIR.

A NOTE ON THE CHROMIUM INTENSIFICATION PROCESS.

BY R. E. CROWTHER.

The so-called " Chromium " process of intensification of silver photographic images came into prominence in 1905 when Welborne Piper and D. J. Carnegie published important details arrived at by the modification of the original formula of Eder (1881).

The process comprises two operations (exclusive of washings), viz., " Bleaching " and re-developing, and according to the constitution and time of action of the " bleaching " bath, more or less intensification may be obtained.

The following formulæ were recommended :—

	A.	B.	C.	Eder's.
Potassium bichromate ...	1 grm.	2 grms.	2 grms.	2 grms.
Hydrochloric acid (1·16 sp. gr.)	0·2 c.c.	1·0 c.c.	4·0 c.c.	6·0 c.c.
Water to	100 c.c.	100 c.c.	100 c.c.	100 c.c.

Bleaching with bath A yields the greatest intensification, baths B and C yield progressively less, whilst the use of Eder's bath effects very little increase of density of the image. The working details of the process and the copious notes of the two authors above referred to leave little to be desired as far as the application of the process is concerned, but the chemical reactions which lead o the excellent and permanent results were not elucidated.

The difficulties encountered when attempting quantitative work with small amounts of silver were augmented by the presence of various compounds which appear to be constituents of all developed and fixed photographic images. Attempts were made to obtain quantitative results by the use of ilver wire, but the action of the " bleaching " baths on the metal in this condition was inordinately low and the quantitative work was therefore abandoned.

Piper has subsequently (private communication) xpressed the opinion that the chromium in the bleached " silver-chromium complex is in the hromous condition, but the existence of a hromous compound which exhibits reduction eactivity of a degree sufficient to decompose water (see " Reduction methods of volumetric nalysis," Knecht and Hibbert, p. 104) in the resence of an energetic oxidiser such as potassium ichromate, appeared to be highly improbable, nd the present author therefore endeavoured to etermine the state of oxidation of the chromium n the complex.

A carefully prepared silver mirror was used as he " image " and the chromium present in the bleaching " baths and in the " bleached " image was determined by means of a solution of titanous hloride. The influence of the hydrochloric acid on he bichromate was eliminated by working against " blank." The mirror showed a metallic silver ontent of 99·83% (mean of two determinations).

It will be evident that if the silver reduces the chromium to the chromous state only half the weight of bichromate will be reduced as compared with that which would be reduced were the reaction to terminate when the chromic condition had been attained.

Using Eder's formula on 0·3190 grm. Ag it was found that 108 Ag = (a) 7·95 and (b) 8·0124 grms. O from bichromate, and that the whole of the reduced chromium passed into solution in the bleaching bath.

Using the formula B above on 0·1316 grm. Ag. the result 108 Ag = 7·9796 grms. O from bichromate was obtained. In this case a proportion of the reduced chromium compound was attached to the silver chloride. After treating the " bleached " mirror with dilute sulphuric acid it was completely soluble in ammonia solution and the acid liquor contained exactly the amount of chromium which the bleaching bath lacked in order to give the result indicated.

Thus intensification was due to a precipitate of a chromic compound. The conditions, when bath A is used for bleaching, are not quite so simple as in either of the two cases cited above. The amount of CrO_3 apparently reduced is always in *slight excess* of that which would agree with theory. The excess was found to be represented by unreduced CrO_3 which is combined with the precipitate, to which it imparts a brown colour and from which it cannot readily be separated without the use of acid washings.

The brown precipitate appears to be similar to that which is formed when a solution of potassium bichromate is reduced at the boil with an amount of sodium sulphite insufficient to reduce that part of the chromium which forms the *bi*-chromate, *i.e.* the CrO_3 in $K_2CrO_4.CrO_3$

The colloidal nature of the chromic hydroxide precipitated under these conditions, the relatively small amount of CrO_3 which is attached to it, and the fact that this amount was governed by the final CrO_3 content of the reacting solutions, point to the conclusion that the brown precipitate is an adsorption compound of either CrO_3 or the bichromate and basic chromic hydroxide.

It has been shown that the brown complex of a " bleached " negative whilst being readily attacked by dilute mineral acids is relatively highly resistant towards a 2% aqueous solution of potassium metabisulphite. In this respect it is quite analogous to the brown precipitate formed by the action of sulphite on bichromate. Further the analogy extends to the action of alkaline photographic developers which reduce the CrO_3 in each complex with a resulting change in the colour of the complex from brown or buff to olive green. Eder's solution in conjunction with titanous chloride titration may be used for the estimation of the metallic silver content of photographic images (developed).

THE PREVENTION OF REVERSAL OR SOLARISATION IN PHOTOGRAPHIC NEGATIVES.

BY R. E. CROWTHER.

Of the various conditions which lead to the formation of a reversed result when an exposed photographic emulsion is developed in the ordinary way, this communication deals only with those which may be conveniently grouped under the term " Over Exposure."

Such over exposure may be constituted by abnormally prolonged action of a light of average intensity or by relatively shorter exposure to a highly actinic light.

The former condition is frequently encountered in the photographing of interiors when the subject includes unscreened windows at one end of the actinic scale and heavy shadows at the other end of the scale; the latter condition may be met with in the photographic investigation of various light sources such as the sun, the electric arc, etc. Jannsen (Comptes rend., **90**, 1447; **91**, 119) observed, when photographing the sun, that as the exposures were prolonged the developed results were positives where they should have been negatives, and also that still longer exposures yielded negative developed results again.

These phenomena of reversal and re-reversal have excited considerable interest amongst photographic experimenters, their cause has been the subject of much speculation, and means for their prevention have been sought by many investigators with varying degrees of success.

The so-called gelatin dry plate process originated in 1871 in some experiments of R. L. Maddox, who prepared a gelatin emulsion which, whilst being very imperfect, was nevertheless workable. Maddox's emulsion contained an excess of silver nitrate and was developed with a plain solution of pyrogallol. In 1873 it was pointed out that removal of the excess silver nitrate and of the soluble reaction products led to improved results, *i.e.*, in the presence of gelatin any other halogen accommodator was not necessary, and that bulk washing of the prepared emulsion could advantageously replace the tedious process of dialysis. The advantage of precipitating the sensitive compounds in the presence of a little gelatin was also first commented on in this year.

In 1878 Chas. Bennett discovered the increase in "speed" which resulted from the preparation of the emulsion at the temperature of boiling water, at which temperature it should be maintained for some time before washing out the soluble reaction products. The use of a little ammonia in addition to heating, or even without heating, the emulsion for the production of greater speed, is perhaps the only published modification of Bennett's process which is of interest, and, although the details of the manufacturing processes of the modern dry plate are well guarded trade secrets, it may be taken for granted that, as far as essential ingredients are concerned, Bennett's formula is typical. The gelatin in the emulsion of the modern dry plate therefore acts both as the emulsifier and the sensitiser. Whilst its properties as an emulsifier leave little to be desired, as a sensitiser it is far from ideal.

The ideal sensitiser would exhibit the following properties:—Absolute stability under temperate, tropical, or frigid atmospheric conditions; power to accommodate the halogens instantaneously, yielding stable compounds having no action on emulsion, developer, or image. Solubility in water and alcohol and a colloidal structure are also desirable characteristics. Such a sensitiser has yet to be discovered.

Various substances are at present employed as sensitisers, *e.g.*, a soluble silver salt is used in printing-out emulsions, its action being to accommodate the halogen liberated by light action by converting it into insoluble silver halide. This is again decomposed by light action, whereupon the accommodation again takes place, and so on, until sufficient silver is produced per unit area to yield a visible image.

Since in the case of negative emulsions the exposures usually given are very much less than that required to yield a printed-out image, it might be concluded that for this class of emulsion the presence of a sensitiser is not necessary. As far as normal exposures are concerned there is no need whatever for a sensitiser provided the halogen be allowed to get away from the silver, as the experiments of Daguerre, Herschel, and more recently those of Dr. H. Weisz (Brit. J. Phot., 1907, p. 960) prove.

There is distinct evidence, however, that long before a visible image has been produced by the action of light on a gelatino-bromide emulsion bromine is liberated and its presence in the emulsion, as would be anticipated from theoretical considerations, retards the further decomposition of silver bromide. Thus a sensitiser confers printing-out speed on an emulsion. It does not necessarily affect the speed of an emulsion in the Hurter and Driffield sense. The H. and D. "speed" of an emulsion is quite distinct from, and probably bears no relation to, the printing-out speed. The H. and D. "speed" is always determined from the results obtained by *exposure and development*, and a moment's consideration will lead to the conclusion that development cannot legitimately be considered as equivalent to a continuation of exposure. In the first place development takes place under conditions (absence of actinic light) which should favour the reverse reactions of those instigated by exposure. Further, the reactions consequent on exposure may be considered as occurring in solid solution and only those portions of the emulsion components which are within molecular distances of each other can react. In a normally dry emulsion there can be little if any migration of silver atoms and the migration of gaseous halogen molecules must be comparatively slow. The conditions may be characterised as unidirectional, there being no evidence of reverse reactions.

In development, solution ionisation and ionic mobility are normal and reactions direct and reverse can proceed in a normal way. Thus, if a gelatino-bromide emulsion be exposed to actinic light in a series of strips for successively increasing periods of time, deposits of silver of successively increasing density are produced up to the limit of the silver contained in the emulsion.

On the other hand, if the deposits be obtained by the combined actions of exposure and development the ultimate densities of such deposits are governed by the concentration, composition, and time of action of the developer.

If the results obtained by exposure and development be represented graphically as a curve the abscissæ of which are log exposures and the ordinates H. and D. "densities" (*i.e.*, weights of silver), we obtain the well known curve which comprises three distinct branches, viz.: (1) a first ascending portion—the normal or first negative portion; (2) a descending portion—the reversal portion; and (3) a second ascending portion—the second negative portion.

It has been stated that Jannsen (Comptes rend., **90**, 1447; **91**, 119) obtained evidence of repetitions of these portions, but although I have given exposures ranging up to 300 hours summer sunshine to a Kodak film emulsion no evidence of any such repetition was obtained on development (see also H. J. L. Rawlins; this Journal, 1891, p. 18). Failing further evidence, therefore, it may be assumed that the second negative portion is the last portion of the curve.

Using a film of pure silver bromide, *i.e.*, free from a sensitiser, there is reason to believe that both the latter portions of the curve, *i.e.*, the reversal and second negative portions, are absent. My experiments with a film of pure silver bromide are not sufficiently advanced to be presented as conclusive evidence, but as far as they have gone they confirm the results obtained by H. Weisz, who found that with such a film exposures long enough to produce a distinct printed out image yielded no reversal phenomena on development. As has been previously pointed out, exposures of very much shorter duration than are necessary to obtain a printed out image give distinctly reversed results on development where a gelatino-bromide film is employed.

These facts possess more than a passing interest to a student of the latent image in a gelatino-bromide emulsion. Hitherto, most of the work which has been done on this question has been concerned solely with the metallic element, to the neglect of any consideration of the influence of the non-metallic component (see however Trivelli, Phot. Korr., 1911, **24**, 182, and Lüppo-Cramer, Z. Chem. Ind. Koll., 1911, **9**, 22—25; also Lumière and Seyewetz, Bull. Soc. Chim., 1908, **3**, 743—750).

The evidence of the later workers seems to support the assumption that the latent image consists of colloidal silver in solid solution in unaltered silver bromide and of loosely combined halogen rather than of silver sub-bromide, Ag_2Br (K. Sichling, this J., 1911, 833, and Reinders, this J., 1911, 446, 927, 1231).

According to this conception the exposure of a gelatino-bromide emulsion to actinic light causes a severance of the bond between the silver and the bromine. Both these components are in an ionised state and hence are chemically active.

The bromine attaches itself to the gelatin in some such way as indicated by H. R. Procter (Chem. Soc. Trans., 1914, 313). According to this worker gelatin forms an addition compound of an ammonium type with the halogen acids. In this case the halogen acid results from the interaction of the bromine on the small amount of water present in a normal emulsion (a perfectly desiccated emulsion is insensitive). Nascent oxygen is also thus produced and this accounts for the tanning action which can be observed in an exposed emulsion. It appears probable that the tanning is effected by dehydrogenation and subsequent quinone condensation of the dehydrogenated products.

The severance of the bond uniting the metal and the halogen necessitates the application of a definite minimum amount of energy; exposures representing less than this minimum may cause a straining of the bond, but on the termination of the exposure normal, *i.e.*, unaltered, molecules remain. In one branch at least of applied photography this inertia of the emulsion has to be considered; thus in stellar photography it has been found that telescopes having object glasses of relatively small diameter are incapable of producing developable images of the fainter stars, no matter how long the exposure, whereas a larger diameter objective produces developable images.

Adopting the nomenclature of E. C. C. Baly, it may be stated that the action of the light opens closed force fields of the silver-halogen molecule, and in order to produce a developable condition the respective atomic fields must be so far separated as to allow of their stabilisation by interaction with suitable contiguous substances. The capacity to resist this action of the light is a measure of the *true* inertia of the sensitive compound which should not be confused with the *apparent* inertia as determined by the Hurter and Driffield system. This latter is determined from results obtained by the combined actions of exposure and development and for a given exposure can be modified by alteration of the development conditions or of the physical condition of the emulsion.

Thus, Sheppard and Mees have shown that, other things being constant, certain developing agents lower the H. and D. inertia of an emulsion and it is further well known that using the same constituents in their manufacture a "ripened" emulsion exhibits a lower H. and D. inertia than an "unripened" emulsion.

Kinoshita (Proc. Royal Soc., 1910, A **83**, 432), has shown that if one molecule of silver bromide in any aggregate of molecules, or grain, is ionised, the whole grain becomes developable and therefore the mere aggregation of molecules which occurs in the ripening process is sufficient to account for the increase in the "speed" when such "speed" is determined from the relationships of the visible developed deposits.

It might at first sight appear that the presence of a reducing agent in the emulsion should, by the more rapid removal of the halogen liberated or ionised by exposure, decrease the inertia, but in this connection it is necessary, bearing Kinoshita's results in mind, to remember that the light energy necessary to produce a developable condition is exceedingly small in amount. Thus, according to the calculations of Nutting the amount of light energy applied to an emulsion which on development will yield unit density (arresting $\frac{9}{10}$ of the incident light) is of the order of 10^{-14} ergs per grain of 3μ diameter or 10^{-7} ergs per sq. cm. of the emulsion. Provided therefore the halogen from one molecule per grain (of 10^{11} molecules) can be accommodated the full "speed" of the emulsion may be obtained. The presence or absence of an energetic reducing agent in the emulsion can make no appreciable difference to the speed of that emulsion.

I have endeavoured to show elsewhere (Phot. J., 1914, 250 *et seq.*, and 1915, 186 *et seq.*), that, as exposure is increased and the amount of halogen liberated is also increased, the presence of an active reducing agent in the emulsion modifies its properties appreciably. When the gelatin itself acts as the reducing agent by virtue of its power of combining with halogen acids, as before pointed out, it is quite efficient for all ordinary purposes.

With increased exposure the further liberated halogen is mechanically held by the gelatin until such exposures as are sufficient to cause the expulsion of gaseous halogen from the film are employed. The development reactions under these varying exposure conditions can be the more readily described if we assume that a gelatino-bromide emulsion has been exposed in three strips; the first strip having received an exposure which develops to a density of unity, the second strip, such as develops to a reversed result, and the third strip, an exposure which yields the so-called second negative.

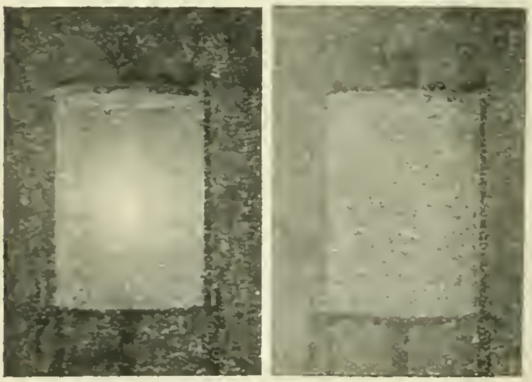
The development of strip (1) results from the electrolytic reduction of each grain in which ionisation has occurred during exposure, the developed density accruing from the reduction of those molecules of silver bromide which were not affected by light.

In the case of strip (2) a small amount of silver —produced by the exposure—generally just discernible as a printed out image—is augmented by a small amount produced by a reaction similar to that occurring in the case of strip (1), but the concentrations of the oxidation products of the development base, and of the alkali halide increases so rapidly by the action of the occluded halogen in the gelatin that rehalogenisation of both deposits commences immediately and rapidly proceeds to a finish, when development is performed in non-actinic light.

This initial development and subsequent disappearance can be readily observed with suitably exposed emulsions when well diluted developers are employed. If development be conducted in actinic light the rehalogenisation is never complete, in fact it has been shown that a developed reversed image may be redeveloped to yield a normal result after exposure to actinic light.

The reactions which cause the rehalogenisation are in all probability exceedingly complex, but that the oxidised products of the developer are the cause seems certain. If, for instance, a small quantity of quinone is placed on a normally exposed emulsion and the image then carefully developed, complete reversal will occur in the areas which were in contact with the quinone.

In this connection it is of interest to recall the fact that Lumière and Seyewetz have made use of the combined action of an oxidised developing base and an alkali halide for the reduction of developed images (this J., 1910, 1228). The somewhat remarkable oxidising power (by dehydrogenation) of bodies of a quinone structure has been commented upon by A. G. Green (J. Soc. Dyers and Col., 1913, 109).



Strip (3). In this case the final developed deposit consists of the silver formed during exposure *minus* that rehalogenised by reactions similar to those occurring in strip (2). Obviously, the longer the exposure the denser will the developed result be, because once the film has taken up its full complement of halogen the remainder of the halogen passes into the atmosphere and is no longer available for the oxidation of the developer and hence for the rehalogenisation of the silver.

The prevention of reversal is therefore dependent upon the effective accommodation* of the halogen, liberated during exposure, in such a way that the developer employed cannot be oxidised by the reaction products of such accommodation. Various substances have been added to the emulsion for this purpose and as far as efficiency is concerned potassium nitrite, as recommended by Abney, is perhaps the most important, but its tendency to crystallise and cause reticulation of the film prevents its use in the case of the gelatino-bromide dry plate.

Other more or less readily oxidised compounds, *e.g.*, manganous salts, quinine, and *m*-phenylenediamine have been tried, but although they undoubtedly improve the results they do not react with the halogen quickly enough to prevent a large proportion of it from reacting with or otherwise being accommodated by the gelatin: this, of course, largely annuls the beneficial effects of the special additions.

The bases used for development are amongst the most active reducing agents which can be used for the accommodation of the halogens and they can be used as sensitisers in a gelatino-bromide or chloride emulsion. With one or two exceptions, however, these developers cannot be employed in emulsions which have to be developed, as their oxidation products, formed during exposure, are, in conjunction with the alkali bromide, exceedingly active rehalogenisers. (The actual composition of the rehalogenised compound is at present unknown—it is completely soluble in a 10% solution of sodium thiosulphate.)

Broadly speaking, the slower a developer acts in the normal way the less is the apparent reversing power of its oxidation products and hence these slow developers are applicable as sensitisers which greatly minimise solarisation phenomena. Compounds of hydrazine and hydroxylamine have been successfully used in this connection (Eng. Pat. 1689 of 1908) but a serious diminution of the "speed" appears to result from their addition to rapid emulsions.

Highly beneficial effects are produced by the addition of one or other of the compounds derived from *p*-phenylenediamine for the use of which, as preventitives of reversal, a patent has been taken out by the author (Eng. Pat. 29,919 of 1912). *p*-Phenylenediamine itself may be employed but the rapidity with which it is oxidised by air forming highly coloured bodies which "slow" the emulsion renders it highly desirable to protect the amino groups. When these groups are so protected the "slowing" of an emulsion by the addition of one or other of the compounds specified in the patent is for all practical purposes quite negligible.

It is necessary, when using plates which have been rendered more or less immune from reversal faults, to develop with care if negatives showing detail in both high lights and shadows are desired. The reasons for this have been discussed more fully in a short communication to the Royal Astronomical Society (J. Roy. Astron. Soc., 1911, 24, [5], 261). In fine, the golden rule of "Expose for the shadows and develop for the high lights" with one or other of the "soft" working developers, should be followed. Ordinary dry plates may be either steeped in the diamine solution or the latter may be applied with a "Blanchard" or camel hair brush, and as alteration in the air is exceedingly slow the plates so treated may be stored under normal conditions until required for use. The two examples accompanying this communication—photographs of an eleven ampere arc—were obtained by exposing in a stereoscopic camera, an ultra rapid plate half of which had been treated (some days previously), with a 1% solution of a substituted paraphenylenediamine. The exposure given was 11 seconds at an aperture of F/8 and development was performed on the uncut plate so that both halves were developed in identically the same way. In this particular instance a developer containing *p*-phenylenediamine hydrochloride and sodium sulphite only was employed, as it had been previously noticed that such a solution yielded excellently graded negatives of subjects showing enormous contrasts. The examples are from "straight" prints from the unretouched negative and show that the *p*-phenylenediamine compounds can be usefully employed for the purpose of minimising the reversal effects of over-exposure.

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* It is remarkable that direct halogen *absorbents* will neither revent reversal nor serve as developers.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

Patents.

Furnaces and kilns for applying and utilising heat of combustion. G. Six, and O. Guttmann and Sons, London. Eng. Pat. 4226, Mar. 17, 1915.

A horizontal muffle furnace is provided with an agitator, the rake fingers of which are splayed at their lower ends and bent in the direction of the exit of the furnace. The rakes are moved reciprocally with respect to the furnace by means of rods or tubes or an endless chain and a motor. The bed of the furnace consists of cast iron plates arranged step fashion. The arrangement is applicable to furnaces for the manufacture of sodium sulphate and hydrochloric acid.—W. H. C.

Liquid fuel furnaces. H. E. Yarrow, Glasgow. Eng. Pat. 17,450, Dec. 13, 1915.

In a boiler furnace burning oil fuel, the lever which controls the oil supply is connected by links to the air doors of the corresponding air-box so that the doors are opened and closed simultaneously with the opening and closing of the oil-supply valve. The mechanism may be locked in the open and closed positions.—W. F. F.

Regenerative-furnace. J. W. Barnes, Youngstown, Ohio. U.S. Pat. 1,186,370, June 6, 1916. Date of appl., June 17, 1915.

The furnace is provided at each end with a gas nozzle projecting into the hearth chamber and with air and gas regenerating chambers. Valves are provided for changing the direction of the flow of the air and the gas.—W. H. C.

Gas burner; Industrial —— and furnace wherein the same can be used. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 100,603, Jan. 15, 1916. (Appl. No. 685 of 1916.)

The injector tube of the burner is mounted on an annular plate and projects into the furnace, while the gas-supply pipe and nozzle are pivoted on a lug projecting outwards from the annular plate, so that the supply pipe is parallel to the plate and the nozzle at right angles. The supply pipe is normally fixed at another point to another lug projecting from the annular plate, by a cotter pin which can be withdrawn, so that the tube may swing outwards to facilitate cleaning of the injector tube. The furnace contains a layer of refractory material below the crucible and slightly below the burner flames —W. F. F.

Furnace. W. P. Brown, London, Ontario. U.S. Pat. 1,184,819, May 30, 1916. Date of appl., Apr. 12, 1915.

The furnace is provided with a grate, smoke outlet, fire-box, and a gas-collecting and separating chamber, located within the furnace at a point higher than the smoke outlet, and out of and above the direct line of draught from the fire-box to the smoke opening. The lighter gases of combustion rise into the gas-collecting chamber, and separate into gases of different densities. The lightest gas is conducted back to the fire-box by a return flue from the chamber, terminating in and encircled by an air inlet flue on the side of the fire-box above the grate, and provided with openings communicating with the fire-box.—B. N.

Gas and liquid coolers and gas scrubbers. W. Yates, and Matthews and Yates Ltd., Manchester. Eng. Pat. 8762, June 14, 1915.

A number of thin discs are threaded closely together on a rotating horizontal shaft in a casing containing water up to the level of the shaft. Air or gas enters the casing by an opening opposite the edges of the discs and passes between them to a similar outlet at the opposite side. Short-circuiting over the top of the discs is prevented by horizontal guide-plates which extend from the side of the casing to the edges of the discs. —W. F. F.

Dust or like matter from air or gases; Apparatus for separating —— and collecting same. G. Dod, Prestwich, and The Imperia Co., Ltd., Manchester. Eng. Pat. 8920, June 17, 1915.

The dust-laden air is delivered downwards into a removable collecting chamber, which is pressed against a stationary upper chamber and is provided with a lever operated by hand for disengaging it from the upper chamber.—W. H. C.

Steam boilers; Preventing incrustation in ——. R. Seabrook, Grimsby. Eng. Pat. 10,930, July 28, 1915.

Brimstone (sulphur) is added to the water to prevent incrustation.—W. H. C.

Boiler-cleaning composition. G. W. Wallace, East St. Louis, Ill., Assignor to Halene Products Co., St. Louis, Mo. U.S. Pat. 1,182,917, May 16, 1916. Date of appl., July 19, 1915.

The composition consists of a solution of naphthalene in a hydrocarbon oil of the "benzin series" having a low specific gravity.—W. H. C.

Mixing apparatus; Chemical ——. J. Dean and B. N. Dodge, Bradford. Eng. Pat. 13,044, Sept. 13, 1915.

A mixing apparatus for chemicals is provided with heating or cooling coils made in the form of jointless U-shaped pipes which depend from the cover of the vessel and are provided with a siphon pipe for the extraction of the condensed water. —W. H. C.

Mixing and kneading machines. J. Lips, Nieder-Urdorf, Switzerland. Eng. Pat. 100,611, Feb. 23, 1916. (Appl. No. 2733 of 1916.)

A mixing and kneading machine has two kneading implements rotatable on crank pins and provided with arms placed crosswise and connected by links with a fixed stud, which takes the stresses due to the resistance of the material being kneaded. The rotating kneading pan is removable and is mounted on a carriage provided with studs, so that it can only be rotated when it is in its proper position in relation to the kneading arms. —W. H. C.

Evaporating apparatus. W. Anderson, Helensburgh, and J. Meikle, Glasgow. Eng. Pat. 15,547, Nov. 4, 1915.

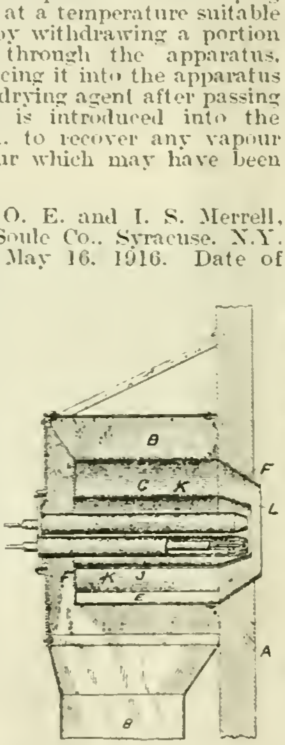
The first unit of a multiple-effect evaporator consists of upper and lower liquid-containing drums connected by vertical pipes, which pass through a flue wherein they are heated by the fire gases. A vapour- and liquor-containing drum is fixed above the upper liquid-containing drum and is connected therewith by pipes. The uppermost drum is also provided with a feed inlet pipe and a pipe which passes through the upper liquid-containing drum and the flue into the lower liquid-containing drum.—W. H. C.

Concentrating aqueous liquids: Process of ——. E. Collett. Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,181,926, May 30, 1916. Date of appl., Nov. 25, 1913.

THE liquid is evaporated by indirect heating and the vapours given off are conducted into the lower part of a drying apparatus charged with a drying agent. The middle portion of the drying apparatus is maintained at a temperature suitable for the drying process by withdrawing a portion of the liquid flowing through the apparatus, cooling it, and reintroducing it into the apparatus at a higher point. The drying agent after passing through the apparatus is introduced into the liquid being evaporated, to recover any vapour other than water vapour which may have been absorbed.—W. H. C.

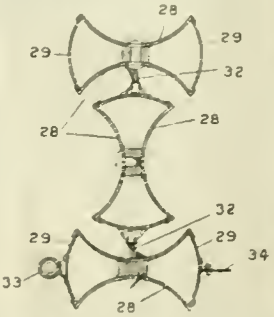
Desiccating apparatus. O. E. and I. S. Merrell, Assignors to Merrell-Soule Co., Syracuse, N.Y. U.S. Pat. 1,183,098, May 16, 1916. Date of appl., Apr. 4, 1910.

AN air whirling chamber, *C*, having tangential inlets, *E*, from the wind trunk, *B*, by which it is surrounded, communicates with a desiccating chamber, *A*, by a conical opening, *F*. It is also provided with a central air pipe, *K*, also having a conical orifice, *L*, the cone being more acute than the cone, *F*. The liquid to be desiccated is sprayed into the chamber by a number of atomisers, *J*.—W. H. C.



Drying apparatus. H. C. Ebel, Hanover, Germany. U.S. Pat. 1,176,706, Mar. 21, 1916. Date of appl., Aug. 10, 1915.

A TALL, narrow, vertical drying chamber is provided with a series of superposed conveyors, each consisting of a pair of oppositely curved troughs, 28, connected by convex longitudinal plates, 29, and circular end plates, and mounted on a rotating shaft. Scrapers, 32, 33, or 34, attached to the longitudinal plates, sweep over the surface of the troughs. Adjacent conveyors revolve in opposite directions, and the material, supplied to the uppermost one, falls into the next lower one, and so on, to a screw conveyor at the bottom. Air, heated in suitable heating chambers on either side of the drying chamber, is passed through the latter.—W. H. C.



Cooling or heating liquids or gases or treating air or gases with liquids: Apparatus for ——. G. H. Walker, Malvern, and H. Heenan, Manchester. Eng. Pat. 8676, June 12, 1915.

IN cooling or heating apparatus consisting of two or more rotary drums formed of a number of convolutions of sheet metal, and mounted on a vertical shaft, so arranged that the gas passes vertically between the convolutions, guide-plates are provided between each pair of drums to collect the drops of liquid from the upper drum, and deliver the liquid as a constant stream to the drum below. A fan or propeller is also provided to create a draught.—W. H. C.

Liquid-cooling tower. G. J. Stocker, St. Louis, Mo. U.S. Pat. 1,187,399, June 13, 1916. Date of appl., Mar. 26, 1914.

THE liquid to be cooled trickles down against a current of air, over a cooling surface composed of layers of parallel, spaced, horizontal slats set up on edge, the slats in each layer being at right angles to those in the adjacent layers. Diagonal vertical slats pass down through the passages thus formed, to bind the structure.—W. F. F.

Raising or forcing liquids or elastic fluids: Apparatus for ——. H. A. Humphrey, London, and W. J. Rusdell, Wolverhampton. Eng. Pat. 8890, June 16, 1915.

IN internal combustion pumps described in Eng. Pat. 11,818 of 1911 (this J., 1912, 626), energy is stored by compression only when the power stroke exceeds the normal stroke in length. The external work is done on the power stroke and the compression of the fresh combustible charge on the following stroke. The lengths of the strokes are maintained within the desired limits by causing the pressure changes in the elastic cushion or cushions to control the supply of combustible mixture. The motion of the reciprocating part of the pump is transformed into rotary motion for the purpose of operating the inlet and exhaust valves.—W. H. C.

Freezing water-bearing strata in boring operations and the like: Process for ——. A. Notzny, Gleiwitz, Germany. Eng. Pat. 16,825, Nov. 30, 1915.

LIQUEFIED air is injected into the strata or into pipes lining the borehole and by its evaporation effects the freezing.—W. H. C.

Tube-mill. D. E. Carlson. Assignor to Chalmers and Williams, Inc., Chicago Heights, Ill. U.S. Pat. 1,183,431, May 16, 1916. Date of appl., July 14, 1915.

A DIAPHRAGM for a tube-mill is formed of two plates adjustably secured together and having overlapping perforations. Projections from one of the plates extend into the perforations of the other plates.—W. H. C.

Pulverising-mill. M. R. O'Shaughnessy, Elmsdale, Nova Scotia. U.S. Pat. 1,185,342, May 30, 1916. Date of appl., July 28, 1915.

A REVOLVING tube mill is divided into compartments by transverse partitions provided with radial convolutions, which increase in depth outwardly. The mill has an axial inlet at one end, an axial outlet at the other, and axial communicating openings in the partitions. The size of the openings increases from the inlet to the outlet.—W. H. C.

Grinding-mill or crusher. C. Goltdammer, Kattowitz, Germany. U.S. Pat. 1,186,476, June 6, 1916. Date of appl., July 31, 1915.

AN upper grinding roller is mounted horizontally in fixed bearings in two parallel frames, and by its rotation drives a grinding ring surrounding and supported by it. Two other grinding rollers are mounted in bearings carried by levers pivoted to the side frames and rest in the lower part of the grinding ring. A surrounding casing is removable in sections without affecting the adjustment of the rollers.—W. F. F.

Bone-black or other filtering media ; Process of and apparatus for revivifying or decarbonising ——. M. Weinrich, New York. U.S. Pats. 1,184,397 and 1,184,398, May 25, 1916. Dates of appl., Nov. 19, and Dec. 13, 1915.

The material is heated in a closed chamber by external means and is then discharged from the perforated bottom of the chamber in fine streams into another chamber where it comes into contact with a current of air ; or it may be passed through a revolving drum heated externally by fire gases and provided inside with perforated lifting blades through which the material is discharged in thin streams against a current of air passing through the drum.—W. H. C.

Colloidal solutions in organic substances not miscible with water ; Process of producing ——. H. Karplus, Berlin. Eng. Pat. 8641, June 11, 1915.

An irreversible colloid is removed from a hydrosol by producing within the latter an amorphous organic precipitate which is soluble in the organic substance in which it is desired to produce the organosol. The precipitate is separated, heated to remove water, and then mixed with the organic substance, when an organosol of the desired colloid is obtained. Organosols suitable for use as pharmaceutical products, lubricants, catalysts, pigments, etc., may be prepared in this way. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 2382 of 1891 ; this J., 1892, 360.) —W. H. C.

Graphite compound [*lubricant*] *and process of making it.* G. Kirkegaard, Brooklyn, N.Y., Assignor to National Graphite Lubrication Co., Wilmington, Del. U.S. Pat. 1,185,682, June 6, 1916. Date of appl., Feb. 12, 1913.

A normally solid lubricant is formed by mixing finely divided flocculent graphite with a partially carbonised resinous (shellac) binder.— W. H. C.

Lubricants ; Method of making ——. C. H. Bierbaum, Buffalo, N.Y. U.S. Pat. 1,186,167, June 6, 1916. Date of appl., Mar. 30, 1914.

Graphite is ground in a dilute solution of asphaltum, and the mixture is diluted with lubricating oil.—W. F. F.

Liquid-heater ; Centrifugal ——. H. Feldmeier, Assignor to D. H. Burrell and Co., Little Falls, N.Y. U.S. Pat. 1,186,175, June 6, 1916. Date of appl., May 23, 1912.

A cylindrical vessel with its axis slightly inclined to the vertical is mounted on a frame and provided with a rotating paddle, while it is surrounded by a heating jacket and by an outer air jacket. These jackets are connected at their ends to annular heads, one of which is mounted so as to slide on the heating vessel. Liquid to be heated enters at the bottom and is delivered at the top into an enlargement of the heating vessel provided with an enlarged extension of the rotating paddle. The heated liquid is finally delivered through an opening in the side of the larger chamber.—W. F. F.

Filter for liquids, especially for sugar juices. Pfeifer und Langen Ges. m. b. H., Elsdorf. Ger. Pat. 291,519, Dec. 23, 1914.

Filter-cloth woven from paper yarn is used : two or more layers of the paper yarn cloth may be used or a layer of paper yarn cloth having a layer of cellulose or paper pulp firmly united to it. Filtration is more rapid than with a filter-cloth made of hemp or jute, a clear filtrate is obtained, and, especially in the filtration of sugar juices, the pores of the cloth are not clogged so quickly.—A. S.

Liquefaction and separation of gases ; Expansion apparatus for the ——. R. Mewes, Berlin. Ger. Pat. 291,751, Oct. 29, 1912.

A narrow clearance space is left between the piston and the wall of the cylinder in which the gaseous mixture is compressed. The use of lubricants is thus rendered unnecessary, and the small quantity of compressed gas which passes through the clearance space to the space behind the piston produces cold by its expansion and thus performs useful work.—A. S.

Thermochemical reactions in closed vessels ; Utilisation of combustible gases produced by —— *as heating agent in the process.* Siemens und Halske A.-G., Siemensstadt. Ger. Pat. 291,782, July 13, 1913.

The gases are burnt by means of surface combustion in a mass of refractory material surrounding the reaction chamber. —A. S.

Fires ; Process for quenching —— *by means of steam and water under pressure.* F. Arledter, Hamburg. Ger. Pat. 291,788, Apr. 5, 1914. Addition to Ger. Pat. 291,380 (this J., 1916, 681).

The quenching agent consists of steam under considerable pressure, which, immediately before use, is mixed with so much water under pressure, that a mist of relatively low temperature is produced. In a space of 1000 cb.m. the strongest fire can be quenched in 3—5 mins. by means of the mist produced from 20 kilos. of steam of 16 atmospheres pressure and 850 kilos. of water, without the use of flame-extinguishing gases, such as carbon dioxide, etc.—A. S.

Centrifugal separator. Jahn und Co., Arnswalde. Ger. Pat. 291,930, Feb. 27, 1914.

An inner perforated cylindrical drum and an outer non-perforated tapering drum are rotated at different speeds. The solids separated from the material under treatment are moved towards a discharge opening at the smaller end of the tapering drum by conveyor-blades mounted on the outside of the cylindrical drum and on a cylinder rotating inside the latter. Rollers movable freely in a radial direction are forced against the inner surface of the perforated drum and press the material which separates thereon, and channels are provided by which the material separated in the inner drum can pass into the field of action of the conveyor-blades in the outer tapering drum.—A. S.

Inflammable liquids ; Storage plant for ——. A. Beretta, Milan, Italy, Assignor to Martini und Hüneke Maschinenbau A.-G., Berlin. U.S. Pat. 1,186,269, June 6, 1916. Date of appl., Sept. 30, 1913.

See Eng. Pat. 22,400 of 1913 ; this J., 1914, 64.

Mill with grinding ring. E. Bouvier, Niederuzwil, Assignor to Gebr. Bühler, Uzwil, Switzerland. U.S. Pat. 1,187,246, June 13, 1916. Date of appl., Dec. 4, 1914.

See Eng. Pat. 24,120 of 1914 ; this J., 1916, 344.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Pitch : Carbonisation of ——. E. W. Smith. Midland Junior Gas Assoc., June 24, 1916. J. Gas Lighting, 1916, 134, 687—689.

Tables are given showing the results obtained by experiments carried out in horizontal retorts with two kinds of coal, with admixture of about 5% of various kinds of pitch, including pitches from coal tar, Mond producer tar, and petroleum. It was found that up to 6% of pitch could be used in horizontal retorts, but that the use of pitch in vertical retorts gave rise to blockages. With medium quality coal, coal tar pitch was estimated to be worth 9s. 7d. per ton less than the cost price of the coal. Considering the results from the point of view of increased calorific value in the gas, the following results were arrived at, the figures representing the cost in pence of enrichment per 1000 cub. ft. by 10 B.Th.U. per cubic foot.

	With rich coal.	With poor coal.
Coal tar pitch	No enrichment	0·65
Mond tar pitch	1·63	0·19
Pitch No. 1 (petroleum)	1·07	0·96
" " 2 "	0·62	0·57
Carburetted water-gas	5·0	
Carburene spirit	1·33	
Cannel	0·50	

—W. H. C.

Coal-gas plants ; Comparison of modern ——. V. Baker. Indiana Gas Assoc. J. Gas Lighting, 1916, **135**, 70.

The records of a number of different types of coal gas plant were obtained and the average results are plotted as curves showing the relation of prime cost to capacity, the relative cost of retort house labour, and the relative carbonising costs of the various types.—W. H. C.

Resinous woods as gas-making materials. Jour. des Usines à Gaz., June 20, 1916. J. Gas Lighting, 1916, **135**, 69.

In an investigation of a committee of the Soc. Technique du Gaz (France), several kinds of resinous wood refuse were tried and it is concluded that none of the materials provides a satisfactory substitute for coal as a gas-making material except under special conditions. The gas has a higher specific gravity than ordinary coal gas and the slits of the flat flame burners have to be wider than usual. A considerable amount of lime is required to eliminate the large percentage of carbon dioxide in the gas. All gas obtained from wood contains acids of the fatty series which are liable to attack the iron of the condensers and other plant.—W. H. C.

Gas-producers using wood ; Practical notes on the construction of ——. V. E. Mojaroff. Rev. Soc. russe de Métal., 1915, **2**, 248. Rev. Mét., 1915, **12**, Ext., 437—139.

The most suitable dimensions of the gas-producers, which deal with logs 1·08 to 1·45 m. long, are :—height, 8 m. for damp wood, and 6·5 to 7 m. for air-dried wood ; the walls of the upper part of the shaft have an inclination of 87°, and those of the lower portion, 65° ; the interior walls bend in slightly towards the ash-pit. The latter should be of small section to avoid waste through the bars, and too high a temperature for the adjacent walls. The gas is dehydrated by being passed through a length of 126 m. of sheet-iron tube. Eight pockets are placed at equal distances for the reception of the condensed water and tar. As much as 7375 litres of water has been obtained in 24 hours from 235 cub. m. of gas, or 73,710 kilos. of wood burnt. The gas on leaving the producers has a temperature of 200° C., falling to about 120° C., 5 or 7 m. along the gas conduit. Here soot is deposited in large quantities, and this has been the main cause of stoppages. If it be removed several times each week through small openings, continuous working over many months is possible.—T. St.

Gas-meters : Life of ——. *Preliminary report of the Joint Committee of the Institution of Gas Engineers and the Society of British Gas Industries.* R. Lessing. J. Gas Lighting, 1916, **134**, 586—591.

Many samples of liquids deposited in meters were examined and were found to contain from 17 to 33% by vol. of hydrocarbons distilling below 200° C. and from 5·6 to 9·3 grms. of naphthalene per 100 c.c. The objectionable odour of such liquids was found to be due to compounds of the mercaptan class. The non-volatile portion of the liquids contained residues of fatty oils, and collagen (a nitrogenous decomposition product of leather substance), and the ash consisted chiefly of iron and tin compounds derived from the metal of the meter. Ammonia and cyanogen compounds were also present, as well as traces of chlorine, zinc, and graphite. Purified coal gas has a considerable action on meters, due to the hydrocarbons deposited by cooling and absorbed by the scrubbing action of the lubricating oil, to the condensation of moisture, and to the absorption by the condensed liquid of ammonia, cyanogen compounds, and hydrogen sulphide. The decay of the leather parts seems to be due to the presence of acid used in the manufacture of the leather. The agents causing the greatest damage appear to be acid introduced in the new leathers and as soldering flux, ammonia and cyanogen compounds not removed by the purifying apparatus, and the deposited hydrocarbons. The latter are in some cases derived from the spray of petroleum hydrocarbons introduced into the mains to overcome naphthalene troubles.—W. H. C.

Kerogen and kerogen shales. E. H. C. Craig. J. Inst. Petrol. Techn., 1916, **2**, 238—273.

The yellow substances, known as "kerogen," which yield petroleum and ammonium compounds on distillation, occur in shales, "boghead coals," etc., and are commonly regarded as the parent substance of petroleum. Microscopical examination of sections of shales, etc., shows that these yellow bodies are of irregular shape and size, have no definite vegetable structure, but have frequently a radiating appearance similar to that of certain concretions. They do not disturb the lamination as do vegetable fossils or large inorganic particles. The conclusions drawn from the microscopic appearance are that they are not fossil algæ or spores, and that they have probably been formed since the deposition of the shale. In the case of torbanite or boghead coal they may to a large extent have been developed *in situ*, but in the case of ordinary shales are probably of outside origin. Analyses by Mills of kerogen from average Scottish shale gave the following results, excluding sulphur and nitrogen :—Carbon, 73·05 ; hydrogen, 10·02 ; and oxygen, 16·33%. Hence kerogen is a highly oxidised product. The ratio of hydrogen to 100 of carbon is 14·5, as compared with 6·5 for an average bituminous coal, 12·9 for pure Trinidad bitumen, and 15·9 for torbanite. The evidenc suggests that kerogen is a product rather than a parent substance of petroleum.—C. A. M.

Petroleum refining. A. Campbell. J. Inst. Petrol Techn., 1916, **2**, 274—299.

Crude oil distillation : In most refineries som process of continuous distillation is now employed the tower still being a convenient form of apparatu for the process of "topping" or removing a smal proportion of the fractions of low b.pt. The fil still invented by Trumble gives maximum heatin and evaporation capacity with minimum erectio and working costs. The crude oil is heated in retort in a primary furnace, and then introduce into the vertical cylindrical still through perforate plates at the top. It falls on to a conical plat which diverts it in a continuous stream to th

sides, down which it flows in a thin film. Other conical plates maintain the flow in the desired direction until it reaches the outlet at the bottom. The vapours are conducted into a vertical column and thence to the condensers. The plant is suitable either for "topping" or for complete distillation. When 60 to 70% of the crude oil, comprising all the benzine, kerosene, and intermediate fractions, is to be removed, a series of connected continuous cylindrical stills is commonly used. These range from about 19 to 30 ft. in length by 7 to 10 ft. in diameter, and are fitted with internal flues to increase the heating surface, and have preheaters both for the distillates and residue. The benzine is redistilled in stills heated by means of superheated steam passed through coils, while the kerosene is redistilled in stills of the same kind as those used for the crude oil. The heavy oil is either distilled to yield lubricants or concentrated to yield residues. To prevent "cracking," the stills are connected with a vacuum pump. *Extraction of paraffin wax.*—The oil containing the wax is cooled first naturally and then by means of refrigerators using liquefied ammonia or carbon dioxide. Cooling is applied in one or two stages according to the amount of paraffin wax in the oil and the temperature at which a bright filtrate is obtained. Slow cooling, as in apparatus cooled by circulating brine, tends to effect better crystallisation of the wax than the more rapid cooling by direct action of a refrigerating agent. The crude wax is separated from the frozen mass by pumping it through filter-presses giving a pressure up to 150 lb. per sq. in., and which are worked in a room chilled by brine pipes suspended from the ceiling. In another process of separation, patented by the Triester Mineralöl Raffinerie, the fluid mixture of oil and wax is cooled down uniformly with only sufficient motion to prevent the formation of a non-conducting coating on the vessel. This motion is provided by the movement of a skeleton scraper round the interior of the vessel, which is meanwhile cooled outside by a current of water. The paraffin is precipitated on a false bottom of gauze, through which the sweated oil readily passes. *Refining of paraffin wax.*—In Henderson's sweating plant the wax is sweated in upright cylinders of sheet iron, 9 ft. high by 17 in. in diameter, within which other cylinders 7 in. in diameter are fixed. The latter are open at top and bottom, and the annular space between them and the outer cylinders is fitted with a false bottom of gauze a little above the outlet cock, while wire gauze is placed in layers round the inner cylinder. The wire gauze acts as a wick in drawing off the "sweats" and the process may be assisted by the suction of a steam injector. In Pyzel's plant the sweating vessels are placed on trucks which pass progressively through a passage heated by means of air blown over a hot coil. The finished wax is melted in the outlet air sluice. After sweating, the wax is freed from final traces of colouring matter by treatment with a decolorising medium, especially bauxite, which has also proved efficacious for decolorising and deodorising lamp oils and lubricants. The wax is best brought into contact with the bauxite by filtration, and all free moisture should be eliminated from both wax and bauxite. After the decolorisation, wax still adhering to the bauxite is extracted with petrol, the solvent expelled from the residue by steaming, and the bauxite incinerated and used again. The decolorised wax is passed through filter paper (*e.g.*, in Bryson's filter) on its way to the cooling racks. *Chemical treatment.*—A method of treating petrol is to pass it with a minimum of disturbance through vertical vessels containing the chemicals, the reactions taking place as well as when agitation is used and with but little loss of spirit. Kerosene is agitated with compressed air in large washers, while in the case of lubricants the same process is used in small vessels not exceeding 100 barrels in capacity. In Edeleanu's process (this J., 1914, 313), the liquid sulphurous acid dissolves the sulphur-containing constituents of the oil, and thus eliminates the objectionable odour of distillates which contain sulphur compounds. For example, a kerosene distillate containing 0·6% of sulphur showed only 0·08% after the treatment, while in another sample the sulphur was reduced from 0·46% to 0·04%. Deodorisation may also be effected by treating the distillates with an alkaline solution of litharge, prior to treatment with sulphuric acid. *Candle manufacture.*—The paraffin wax is melted by means of steam and mixed with a small proportion of stearine, and the mixture is clarified by means of oxalic acid, which precipitates any calcium salts present. The supernatant wax is run into a steam-jacketed pan, where impurities are readily detected. Thence it is transferred by means of a "swimmer" to a "jack" or bucket, which delivers a regular stream of melted material to the moulding machines.
—C. A. M.

Gasoline ; Cost of making —— by the Rittman process. Min. and Eng. World, 1916, 44, 1132.

The following U.S. Government estimates are based on the results of a 5-days run with an apparatus provided with five cracking tubes, each having a capacity of about 65 U.S. galls. per hour ; allowing for stoppages, the total working capacity is 5000 barrels (1 barrel = 42 U.S. galls.) per month. The yield of gasoline is about 17% and the loss 10%, whilst the residue consists of fuel oil equal in value to the fuel oil used as raw material. The cost of the plant is estimated as $15,000 and of the building as $5000. Using fuel oil at 50 cents. per barrel (42 U.S. galls.), the cost of production of gasoline is estimated as follows :—

5000 barrels fuel oil	$2500
Labour	560
Fuel	160
Electricity	100
Repairs	100
Interest and depreciation, 6% each	200
Refining cost, 20 cents per barrel	1000
Total cost	$4620
Residue, 3650 barrels at 50 cents per barrel	1825
Net cost of 850 barrels of gasoline	$2795

= 7·8 cents per gallon of gasoline.

In a similar way, the cost of gasoline is estimated as 9·74 cents per gallon with fuel oil at $1 per barrel, 11·5 cents per gall. with fuel oil at $1·47 per barrel, and 13·9 cents per gallon with fuel oil at $2·10 per barrel.—A. S.

Gasoline ; Extraction of —— from natural gas by absorption methods. G. A. Burrell, P. M. Biddison, and G. G. Oberfell. Natural Gas Assoc. of America, May 15, 1916. Met. and Chem. Eng., 1916, 14, 651—660.

Most of the so-called "dry" natural gases contain 1 to 2 pints of gasoline per 1000 cub. ft., and while this amount is too small to be recovered by compression and condensation methods (see this J., 1915, 1044), it may be profitably dealt with by an absorption method similar to the process of extracting benzene and toluene from coke-oven gases, except that the natural gas has to be treated at the pressure at which it is transported, viz., 200 to 300 lb. per sq. in. The removal of gasoline from "dry" gas is also important on account of the solvent action of condensed gasoline on the rubber rings used in the pipe couplings of the trunk lines, involving a large consumption of rubber and loss of gas through resulting leaks. It is considered that by absorption methods 75,000,000 gallons of gasoline, at present unrecovered, may be obtained annually. Tests were made with an experimental plant having a capacity of 15.000 to 30.000 cub.ft. per hour. The absorbing oil was a mineral seal oil from which the dissolved gasoline was recovered by steam distillation, the oil then being cooled and pumped back to the absorber. This oil had sp.gr. 0·850 (water = 1) and flash point (Pensky-Martens closed apparatus) 135° C. The best results were obtained by using a stone tower absorber in which the oil flowed down over a column of stones and the gas ascended. It was necessary with this tower to circulate 4 gallons of oil per 1000 cub.ft. of gas. In the case of the two gases dealt with in the experimental plant, the heating value was lowered 3·8% and 2·4% respectively by the extraction of the gasoline; the one gas contained 1·5 and the other 1 pint of gasoline per 1000 cub.ft. The sp.gr. of the gasoline obtained varied between 77 and 85° B. (sp.gr. 0·651 and 0·676). The boiling points ranged from 80° F. (26·7° C.) to 300° F. (149° C.). The evaporation loss was about 11% in 24 hours as compared with an evaporation loss of about 2·1% in 24 hours of a straight refinery gasoline of 60·4° B. (sp.gr. 0·735). The vapour pressure of the gasoline ranged from 1 lb. per sq. in. at 70° F. (21° C.) to about 5 lb. at 100° F. (38° C.). This latter value is of importance as enabling the gasoline, under U.S. regulations, to be transported in tank cars, the specified maximum being 10 lb. per sq. in. at 100° F. (38° C.). It is estimated that a plant capable of handling daily 60.000.000 cub. ft. of gas yielding 1 pint of gasoline per 1000 cub. ft., would cost $60,000. The gasoline obtained would realise $1500 daily, at 20 cents per gallon. Tests were also made in which the natural gas was simply passed into a naphtha of about 55° B. (sp.gr. 0·757), the product in this case being at once a commercial article requiring no further treatment. When the naphtha had absorbed all the gasoline that was desired, it was removed and fresh naphtha substituted. By this scheme there were obtained yields of gasoline varying between 300% and 500% greater than by the oil absorption and distillation method. An objection to the process lies in the fact that a large amount of naphtha has to be handled—at least seven times the volume of the gasoline recovered.—T. St.

Petroleum spirit; Discharge in earthed receptacles containing —— which has been electrically charged through flowing through narrow tubes. D. Holde. Z. Elektrochem., 1916, **22**, 195—199. (See also this J., 1915, 649; 1916, 411.)

The extreme mobility of the molecules of fluid insulators causes them almost instantaneously to give up to the containing vessel any charge which they may have acquired in flowing through narrow tubes or pipes. Although theoretically, therefore, petroleum spirit, having a conductivity of 10^{-14}—10^{-15} would take, if perfectly motionless, 39—390 seconds to discharge say from 3000 volts down to 300 volts, yet in practice any danger of a spark discharge is quite excluded owing to the motion of the liquid, provided the pipes and walls of the receptacles are well earthed. Even in the most unfavourable cases the addition of a small quantity of acetic acid (0·1%) or alcohol would increase the conductivity to above 3×10^{-13} when even by conductivity alone the discharge would take place in less than a second.—G. F. M.

Automobile cylinder oils; Data on the oxidation of ——. C. E. Waters. U.S. Bureau of Standards, Technol. Paper No. 73. J. Franklin. Inst., 1916, **181**, 850—851. (See this J., 1911, 608, 1367; 1913, 1000.)

On exposure to sunlight and air for 138 hours the rate of increase of weight due to oxidation gradually diminishes, and the formation of acid and the carbonisation value increase more rapidly. The Maumené number increases rapidly as the result of oxidation but the iodine number is lowered. The oxidised oils emulsify readily when agitated with water, but filtration through animal charcoal removes the emulsifying agents. When the oils are heated at 250° C. for one to seven hours or for three hours at 230°—280° C., carbonised matter forms at a rapidly increasing rate. The greater the rate of carbonisation at lower temperatures the more rapidly does it increase at higher temperatures or on prolonged heating. It is, therefore, unnecessary to prolong the heating in testing these oils. The carbonisation value is independent of the flash- and fire-points and of the loss from evaporation on heating.—A. B. S.

Petroleum products; Oxidation of ——. B. Schreyer and S. Kragen. Petroleum, 1916, **11**, 521—522. Z. angew. Chem., 1916, **29**, Ref., 294.

By the oxidation of different petroleum fractions by air in presence of finely powdered dry sodium hydroxide and mercury, yields of 1—1·5% of naphthenic acids were obtained in the form of viscous liquids of characteristic odour and red colour with green fluorescence. The residual petroleum had a high specific gravity owing to the presence of other oxidation products. These were removed by extraction with hot 75—80% alcohol whilst agitating with air, and were obtained in the form of a yellow, fairly viscous oil, having a pleasant ethereal odour. The oil is easily soluble in organic solvents, and consists of a tertiary unsaturated alcohol.—A. S.

Production of aromatic hydrocarbons from paraffin wax. Egloff and Twomey. *See* III.

Composition of carburetted water-gas tar. Brunkow. *See* III.

Heat treatment of steel in coal gas. Walter. *See* X.

Determination of iodine and bromine in saline waters from petroleum-bearing strata. Popa. *See* XIXb.

Patents.

Fuel [briquettes]. E. R. Sutcliffe, Leigh, and Pure Coal Briquettes Ltd., Cardiff. Eng. Pat. 5018, Mar. 31, 1915.

Carbonaceous substances such as coal, anthracite, coke, or charcoal, are reduced to a very finely divided state, and in those cases where it is requisite, a binding material is added to the dust before it is compressed into blocks or briquettes. The briquettes are then heated at such a temperature and for such a time as is required by the character and purpose to which the coke residue, or the by-products, are to be applied. A mixture of 75% anthracite, 15% steam coal, and 10% dry pitchish stated to yield an excellent fuel when briquetted in this way. It is necessary however to roast the anthracite in a retort in the absence of air at a temperature of 300° to 700° C. before admixture with the other components of the briquette.
—J. B. C. K.

Fuel; Manufacture of composition ——. C. T. Hopkins, Walthamstow, Essex. Eng Pat. 14,771, Oct. 19, 1915.

A mixture of fine coal, or coal and cinders in the proportion of 2 : 1, 16 lb., soot 8 lb., with or wthout wheat flour 0·25 lb., is mixed with water 3 pints, with or without sodium carbonate 1 oz. The mixture is moulded under pressure or worked by hand into spherical masses.—W. F. F.

Fuel from anthracite duff or small coal: Manufacture of ——. D. P. Lloyd and T. H. Jolley. Ammanford. Carmarthen. Eng. Pat. 100,547, Jan. 11, 1916. (Appl. No. 450 of 1916.)

A MIXTURE of anthracite duff or small coal 1—1·25 tons, lime or cement 1 cwt., and salt 2—4 lb., is moistened, and moulded in steam-heated moulds coated or lubricated with pitch.—W. F. F.

Briquetting with crude naphthalene: Plant for ——. J. Efrém. Woltersdorf. Ger. Pat. 292,454, Oct. 4, 1913.

THE crude naphthalene is melted in a closed chamber, and then led to nozzles which distribute it over the material to be briquetted; on its way it passes through a heating chamber, in which it is retained for such a period that about one-fifth of its weight sublimes; a cooled chamber is provided to collect the sublimed naphthalene. If the fraction of crude naphthalene which melts at about 70° C. is used, the residue which leaves the intermediate heating chamber remains liquid at about 40° C., at which temperature it can be mixed with the material to be briquetted, without any evolution of naphthalene vapour.—A. S.

Fuels: Method of drying moist —— *by addition of quicklime.* E. Schimansky, Berlin. Ger. Pat. 292,541, July 31, 1915.

THE fuel is partially dried, then mixed with quicklime, and pressed, the ratio of water to lime in the mixture being such that the lime is completely slaked and the heat generated is sufficient to vaporise the remaining water.—A. S.

Coal for coking; Process for compacting and dehydrating ——. E. Pohl, Rhöndorf. Ger. Pat. 292,336, May 19, 1915.

CONSOLIDATION and dehydration of the coal is effected by shaking or jolting in a shaking machine; during the operation a weighted plate is placed on the surface of the coal to consolidate the surface layer.—A. S.

Coke-ovens: Method of heating ——. C. Otto und Co. G.m.b.H., Dahlhausen. Ger. Pat. 292,142, July 2, 1915.

To attain uniform heating over the whole of the heating wall, mixtures containing excess of air and of gas respectively are burnt in alternate heating flues, and in the upper part of the flues the excess of gas from one set of flues is burnt by means of the excess of air from the other set.—A. S.

Coke-oven. A. E. Peters, Westmont Borough, Pa. U.S. Pat. 1,183,401, May 16, 1916. Date of appl., Sept. 10, 1913.

THE oven is provided in the side walls with a large number of double heating flues of inverted U-form, the mixing chamber for gas and air being connected with the lower ends of one of each pair of legs. A fuel-gas and hot-air supply is connected with the mixing chambers, and means are provided for reversing the direction of the flow of the gases through the heating flues and mixing chamber as desired.—J. B. C. K.

Coke; Method of improving —— *for use as domestic fuel.* A. Schollenbruch, Düsseldorf. Ger. Pat. 291,568, July 23, 1915.

THE coke is impregnated with a thin paste of water, coal dust, and loam or the like, then coated with a thick paste of the same materials, and dried; dry coal dust is sprinkled over it towards the end of the drying process.—A. S.

Sulphur-bearing fuel and other substances: Compound for treating ——. C Foxwell, Assignor to The Smoke-Coal Economizer Corporation, Baltimore, Md. U.S. Pat. 1,183,445, May 16, 1916 Date of appl., Feb. 19, 1916.

THE fuel is treated before burning with a solution of calcium chloride and borax, containing boron and chlorine in the proportions represented by BCl_3.—J. B. C. K.

Gas; Manufacture [and testing] of ——. L. H. Eady and H. W. Clarke, Southampton. Eng. Pat. 8830, June 15, 1915.

GAS is drawn from a point between the retorts and exhauster by a water-jet pump and passed through a cooler, filter, and governor to a jet photometer or the like. The retort-house governor bell carries a water tank, into which the short leg of a siphon dips. The long leg of the siphon has two branches with valves, one connected with a water supply and the other to waste. These valves are manipulated so as to add to or withdraw from the water in the tank on the governor bell while the photometer flame is kept steady, and thus the gas is maintained at uniform quality. —W. F. F.

[Gas] retorts; Revoluble ——. W. Thomas, Nanaimo, B.C., Canada. Eng. Pat. 9156, June 22, 1915.

A HORIZONTAL revolving gas-fired retort for coal distillation is provided with long combustion passages in the walls, into which open a number of Bunsen burners. The coal is fed in at one end by a helical conveyor in a projecting neck of the retort and the longitudinal gas-supply pipes for the Bunsen burners are connected to an annular groove in the projecting neck, which is surrounded by a fixed collar into which the gas is led.—W. F. F.

Gas; Method of making combustible ——. *Method of carbonising fuel [coal] in vertical-retort gas-benches for the production of gas and carbonised fuel [coke]. Method of conducting combustion.* H. L. Doherty, New York. U.S. Pats. (A) 1,187,048, (B) 1,187,049, (C) 1,187,050, and (D) 1,187,051, June 13, 1916. Dates of appl., Nov. 15, 1911; (A), (B), and (C) renewed Apr. 28, 1916.

(A) A BODY of fuel is conveyed, at a rate greater than that of complete combustion, past an oxidising current of such nature and in such volume that part of the fuel is converted into combustible gas. Part of this gas is circulated through the unburnt fuel and then through the partly burnt fuel to cool the latter, and is then withdrawn with the main current of combustible gas. The coarser part of the cooled fuel is separated and mixed with a regulated portion of fresh fuel for use as above. (B) Coal or a mixture of coal and coke is passed through a relatively long conduit heated externally at its middle zone, and the gas is withdrawn through the fuel at the charging end, where the heavier distillation products are condensed in the fuel. Part of the gas is treated to remove illuminants, cooled, and passed through the withdrawal end of the retort to cool the coke, and then returned to the gases leaving the charging end of the retort. (C) In a retort such as that described in (B), air is supplied to the heated zone in quantity sufficient to maintain the fuel at the desired temperature. Part of the discharged coke is mixed with the fresh coal charged into the retort to maintain its porosity. (D) In a retort such as that described in (C), a portion of the gas from the combustion zone is passed through the advancing fuel to preheat it and cool the gas, and the gas is then passed through the fuel at the discharge end to cool it and heat the gas, which is then passed through the combustion zone. The rate of feeding of the fuel by gravity may be such that sufficient fuel remains unburnt to maintain the porosity of the charge in the retort.—W. F. F.

Distillation : Process of and apparatus for ——. [*Recovery of pentane from gasoline.*] W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,186,855, June 13, 1916. Date of appl., Sept. 28, 1914.

To recover volatile components from petroleum oils, the oil is passed successively through a series of vaporisers and condensers at temperatures which progressively approach each other and approach the boiling point of the component to be recovered, the uncondensed vapour being removed at each stage. When applied to the recovery of normal pentane from gasoline, the vapour is passed through a condenser at 27° C., and the condensed liquid passed successively through vaporisers and condensers at 47° C. and 32° C., and finally at 42° C. and 35° C.—W. F. F.

Petroleum residues ; Process of treating ——. C. S. Palmer, Upper Montclair, N.J. U.S. Pat. 1,187,380, June 13, 1916. Date of appl., Mar. 2, 1907.

The yield of volatile compounds from petroleum residues is increased by digesting the residues under pressure of the evolved vapour between 60 and 400 lb. per sq. in. and at a temperature above 200° C. but below the point at which substantial carbonisation occurs, and without the addition of steam. The heating is continued till the greater part of the residue is converted into more volatile compounds, which are separated when the pressure is relieved.—W. F. F.

Hydrocarbons ; Process of producing low-boiling ——. E. C. R. Marks, London. From Iroline Co. of America, Wilmington, Del., U.S.A. Eng. Pat. 3327, Mar. 2, 1915.

Low-boiling hydrocarbons suitable as fuel for internal combustion engines are obtained by heating liquid or fusible hydrocarbons of higher boiling point in a closed vessel to a temperature sufficient to develop a pressure of 200—500 lb. per sq. in., the volume of hydrocarbon being from 0·125 to 0·5 that of the vessel. The liquid is withdrawn under sufficient pressure to retain the low-boiling hydrocarbons in solution at a lower temperature and these are recovered by distillation. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 18,119 of 1914, this J., 1915, 1045.)—W. F. F.

Combustion or power liquids ; Method for manufacturing ——. J. N. Wingett, Assignor to W. A. Haggott, Denver, Colo. U.S. Pat. 1,185,747, June 6, 1916. Date of appl., Mar. 1, 1915.

Liquid hydrocarbon, such as kerosene, is mixed with toluene and a nitrating solution, and the mixture distilled.—W. F. F.

Artificial fuel ; Furnace for the preparation of ——. V. Groom, London. U.S. Pat. 1,187,305, June 13, 1916. Date of appl., Apr. 24, 1916.

See Eng. Pat. 24,085 of 1914 ; this J., 1916, 103.

Coke-oven. N. Schuster, London. U.S. Pat. 1,186,687, June 13, 1916. Date of appl., Dec. 21, 1914.

See Eng. Pat. 29,494 of 1913 ; this J., 1914, 684.

Coke-oven ; Regenerative ——. C. Wilke, Assignor to C. Still, Recklinghausen, Germany. U.S. Pat. 1,185,961, June 6, 1916. Date of appl., June 11, 1914.

See Ger. Pat. 271,515 of 1913 ; this J., 1914, 471.

Gas retorts ; Settings of ——. H. A. Carpenter, Sewickley, Pa., and Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 100,628, June 8, 1915. (Appl. No. 4130 of 1916.)

See U.S. Pats. 1,174,390 and 1,177,171 of 1916 ; this J., 1916, 527, 592.

Oil-gas : Process for manufacturing ——. B. van Steenbergh, New York. Eng. Pat. 9155, June 22, 1915.

See U.S. Pat. 1,124,361 of 1915 ; this J., 1915, 216.

Volatile composition suitable [as fuel] for explosion-engines ; Process of making a stable ——. W. R. Gulick, Jersey City, N.J. U.S. Pat. 1,187,061, June 13, 1916. Date of appl., July 31, 1913.

See Eng. Pat. 18,681 of 1913 ; this J., 1914, 244.

Gas and liquid coolers and gas scrubbers. Eng. Pat. 8762. *See* I.

Industrial gas burners and furnaces. Eng. Pat. 100,603. *See* I.

Treatment of waste sulphuric acid from the refining of tar oils or petroleum. Ger. Pat. 291,775. *See* III.

Treatment of sulphuric acid residues from petroleum refining. U.S. Pat. 1,186,373. *See* VII.

Gas analysing apparatus. U.S. Pat. 1,186,014. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Patents.

[*Arc-lamp*] *projector-carbon.* W. G. Wilcox, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,186,253, June 6, 1916. Date of appl., July 2, 1913.

A mixture of 19—10 parts of potassium silicate and 1—10 parts of potassium silicofluoride, alone or mixed with carbon, is used to form a core for projector carbons for arc lamps.—W. F. F.

Ultraviolet radiation ; Apparatus for producing ——. F. G. Keyes, Boston, Mass., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,186,993, June 13, 1916. Date of appl., July 1, 1913.

Two chambers, containing hydrogen at different pressures, are separated by a mercury trap and a cock, so that a portion of the gas may be withdrawn from the chamber of lower pressure by suitable means, and successively replaced from the higher pressure supply chamber.—B. N.

Electron emitting cathodes and process of manufacturing the same. A. McL. Nicolson, New York, and E. C. Hull, Montclair, N.J. Eng. Pat. 17,580, Dec. 16, 1915. Under Int. Conv., Dec. 26, 1914.

Several successive coatings of strontium hydroxide are applied to the metallic filament, and afterwards similar coatings of barium resinate. The process is repeated, and the filament then heated to ignition temperature, thus producing alternate superposed films of barium and strontium oxides.—B. N.

Arc-lamp electrode. M. Doetsch, Assignor to C Condradty, Nuremberg, Germany. U.S. Pat 1,187,282, June 13, 1916. Date of appl., Dec. 17, 1913

See Eng. Pat. 22,223 of 1913 ; this J., 1914, 913

Treatment of sewage sludge and the like. Eng. Pats 3355 and 10,262. *See* XIXb.

III.—TAR AND TAR PRODUCTS.

Carburetted water-gas tar; Composition of ——. H. K. Brunkow. J. Gas Lighting, 1916, **135**, 67.

Tar from a carburetted water-gas plant generated at somewhat higher temperatures than ordinary, and using Californian crude oil of 18·8° B. (sp.gr. 0·941), after passing through a settling apparatus had a sp.gr. of 1·026 at 95° F. (35° C.). It consisted of about 60 % of water, 10 % of lampblack, 26 % of heavy oil, and 4½ % of naphthalene. It was nearly saturated with naphthalene and was useless as an absorbent of benzol or light oil.
—W. H. C.

Aromatic hydrocarbons from paraffin wax; Production of ——. G. Egloff and T. J. Twomey. J. Phys. Chem., 1916, **20**, 515—521.

Hitherto only aliphatic hydrocarbons have been obtained by the cracking of paraffin wax, and the production of aromatic hydrocarbons by the cracking of petroleum has been ascribed by Brooks (this J., 1915, 412) to the presence of compounds containing the phenyl radicle in the petroleum. The authors' experiments were made on a sample of commercial paraffin wax of m.pt. 47° C., containing 0.05 % oil, and the vapour cracking apparatus described previously (see this J., 1915, 1199) was used. No aromatic hydrocarbons were produced at atmospheric pressure and 500° C., but benzene, toluene, and xylene were formed at 600° C. at atmospheric pressure and at 500° and 600° C. at 150 lb. pressure. At 600° C. and 150 lb. pressure the oil produced by cracking contained 6·6 % benzene, 5·4 % toluene, and 2·3 % xylene, or 2·6, 2·2, and 0·9 % respectively on the quantity of paraffin wax.—A. S.

Nitro-compounds; Chemical processes in the reduction of aromatic —— to amino-compounds on the large scale. P. N. Raikow. Z. angew Chem., 1916, 29, 239—240. (See also this J., 1916, 627.)

The "activating" influence of salts of the heavy metals on the action of metals on water owing to their hydrolytic decomposition, is the underlying principle of the reduction of aromatic nitro-compounds by means of iron and water and a trace of hydrochloric acid. The ferrous chloride generated initially by the action of the iron on the acid is hydrolysed by the water and the hydrolytic equilibrium is disturbed by the removal of the free acid by reaction with a further quantity of iron, with the generation of hydrogen and reproduction of ferrous chloride, thereby completing the cycle, which is repeated so long as iron and water are present. The complete changes are expressed by the scheme: $3Fe + 6HCl + C_6H_5NO_2 = 3FeCl_2 + 2H_2O + C_6H_5NH_2$, and $3FeCl_2 + 3H_2O \rightarrow [3Fe(OH)_2 + 6HCl] + 3Fe + C_6H_5NO_2 \rightarrow 3Fe(OH)_2 + 3FeCl_2 + 2H_2O + C_6H_5NH_2$. The explanation of Muspratt previously given must accordingly be modified to the extent that the reaction depends primarily on the hydrolytic decomposition of ferrous chloride by water, whilst the formation of aniline hydrochloride and its reaction with iron is subsidiary and incidental.
—G. F. M.

Systems in which water, a phenol, and a base constitute the components; Equilibria in ——. G. J. van Meurs. Z. physik. Chem., 1916, 91, 313—346. J. Chem. Soc., 1916, **110**, ii., 304—305.

The heterogeneous equilibria between phenol, water, and each of the bases, sodium hydroxide, potassium hydroxide, lithium hydroxide, calcium hydroxide, barium hydroxide, and strontium hydroxide have been investigated at 25° C.; similar measurements have been made for the systems water, resorcinol, and each of the bases potassium hydroxide and barium hydroxide at 30° C. The three components in varying quantities were shaken in a thermostat until the required equilibrium had been set up; the solid and the liquid phases were then analysed. The experimental results are expressed in tabular form and also in curves. The first-named six systems exhibit a binodal curve. All the systems examined show isotherms made up of several curves, and these represent solutions which at the experimental temperature are saturated with the solid phase. The following substances occur as solid phases in one or other of the systems examined: $C_6H_5.OK.2H_2O$; $C_6H_5.ONa.3H_2O$; $C_6H_5.OLi.2H_2O$; $(C_6H_5O)_2Ca,3H_2O$; $(C_6H_5O)_2Ba,4H_2O$; $(C_6H_5O)_2Sr,4H_2O$; $C_6H_5.ONa.2C_6H_5.OH$; and $C_6H_5.OK,3C_6H_5.OH$ at 25° C., and $C_6H_4(OK)_2,4H_2O$. $C_6H_4O_2Ba.2H_2O$ (?), and $HO.C_6H_4.OK.2H_2O$ at 30° C. All the compounds mentioned above are soluble in water without decomposition. Tables of solubilities of these substances at the indicated temperatures are given. From the curves it is seen that by the addition of a base to an aqueous phenol solution, the phenol is eventually to a very large extent thrown out of the solution as phenoxide. On comparing the composition of the boundary solutions, that is, solutions which are saturated with phenol and base, with one another, and with a saturated solution of phenol in water, it is seen that the phenol content is much less in alkali solutions than in water, the values being: water, 93·78 %; potassium hydroxide, 0·12 %; sodium hydroxide, 0·32 %; lithium hydroxide, 2·03 %; calcium hydroxide, 12·05 %; barium hydroxide, 12·65 %; and strontium hydroxide, 22·52 %. In the solutions of the alkalis the phenol content increases as the content of alkali decreases, whereas with the alkaline earths both phenol and base increase together. The mono-acid bases expel more phenol from solutions than the di-acid bases. At the same time, the incorrectness of the text-book statement, "that phenol is easily soluble in alkali hydroxides," is demonstrated.

Hydrogen peroxide as a hydrolytic agent. J. V. Dubsky. J. prakt. Chem., 1916, **93**, 137—142.

Hydrogen peroxide behaves towards cyanides as a hydrolytic agent converting them into amides according to the equation: $R.CN + 2H_2O_2 = R.CONH_2 + O_2 + H_2O$ (compare Radziszewski. Ber., 1885, 18, 355). Although not proceeding with equal facility in all cases, the reaction can be brought about with cyanides, which had previously been found to resist the action of hydrogen peroxide, by using a large excess. Thus, 2·5 grms. of *o*-tolunitrile in 50 c.c. of methyl alcohol gave a yield of 2·1 grms. of *o*-toluamide on treatment at 40°—60° C. with 200 c.c. of 3 % peroxide and 10 c.c. of *N*/1 sodium hydroxide, the reaction product being subsequently neutralised, evaporated to dryness, and extracted with alcohol. Similar results were obtained with *a*-naphthonitrile, whilst with iminodipropionitrile, and iminodi-isobutyronitrile, small yields of amides were obtained. With diacetonitrile, on the other hand only a small quantity of a condensation product of this substance with aldehyde, produced from the alcoholic solvent, namely, 2.4.6-trimethyl-3.5-dicyanodihydropyridine, could be isolated. Potassium ferricyanide was converted by hydrogen peroxide into an isomeric modification which gives in water an intense brown red solution.—G. F. M.

Carbonisation of pitch. Smith. *See* IIa.

Patents.

Sulphuric acid from the refining of tar oils or petroleum; Treatment of waste ——. C. Still, Recklinghausen. Ger. Pat. 291,775, May 27, 1914.

The waste acid is warmed and fed to a steam jet blower worked by steam under pressure, which may be superheated. The intimate mixture of steam and waste acid thus produced is delivered to a vessel surmounted by a dome. The acid collects in this vessel, and the acid resins and other solid impurities settle out as a friable mass, which when freed from adhering liquid shows no sign of stickiness; the clear liquid acid is discharged through a tube. The steam and volatile substances after rising through the dome, which may be fitted with baffles to facilitate separation of liquid particles, pass to a condenser and then to a washer in which acid substances, such as sulphur dioxide, are absorbed; a steam jet injector is fitted in the pipe connecting the dome with the condenser in order to facilitate the flow of gases and vapours through the apparatus.—A. S.

2.9.10-Trichloroanthracene; Manufacture of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,356, June 20, 1914.

Anthracene or 9.10-dichloroanthracene is heated in a steam bath with sulphuryl chloride in presence of an indifferent solvent or diluent, *e.g.*, nitrobenzene. On cooling, 2.9.10-trichloroanthracene separates; it is purified by crystallising from benzene.—A. S.

Sulpho-chlorides of the naphthalene series; Manufacture of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,357, July 18, 1914.

Sulpho-chlorides of the naphthalene series are obtained by treating acyl-β-naphthylamines with chlorosulphonic acid. Acyl-α naphthylamines, when treated in a similar manner, yield sulphonic acids.—A. S.

Isatin; Manufacture of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,394, Aug. 11, 1914.

Isatin is obtained by heating 3-amino-2.4-dihydroxyquinoline hydrochloride with ferric chloride solution. The dihydroxyquinoline can be prepared from anthranilic acid (Ger. Pats. 102,894 and 117,167), and the latter from phthalic acid, so that the new method affords a means of obtaining isatin cheaply from naphthalene.—A S.

5-Nitro-1-alkylaminoanthraquinones; Manufacture of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,395, May 7, 1914.

5-Nitro-1-alkylaminoanthraquinones are prepared by nitrating α-N-acidylalkylaminoanthraquinones.—A. S.

Anthraquinone-α-mercaptans and disulphides; Manufacture of ——. Farbw. vorm. Meister, Lucius.u.Brüning. Ger.Pat.292.457,July 14,1914.

Anthraquinone-α-sulphochlorides or the corresponding sulphinic acids are reduced with hydrosulphites.—A. S.

Thioureas of the anthraquinone series; Manufacture of ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 291.984, Dec. 19. 1914.

Thioureas of the anthraquinone series are prepared by heating 2-aminoanthraquinone or its ring-substitution products with an alkali xanthate in an organic solvent of high boiling point.—A. S.

Diaminodiarylketones and N-alkyl substituted diaminodiarylthioketones; Manufacture of ——. J. Y. Johnson, London. From Badische Anilin und Soda Fabr., Ludwigshafen, Germany. Eng. Pat. 20,615, Oct. 6, 1914.

See Ger. Pats. 287,994 of 1913 and 289,108 of 1914; this J., 1916, 352, 353.

Plant for briquetting with crude naphthalene. Ger. Pat. 292,451. *See* IIa.

IV.—COLOURING MATTERS AND DYES.

Phenanthraquinone; Dyes derived from ——. K. C. Mukherjee and E. R. Watson. Chem. Soc. Trans., 1916, **109**, 617—628.

Attempts to introduce additional hydroxyl groups into 2.7-dihydroxyphenanthraquinone, or 2-hydroxyphenanthraquinone, by treatment with manganese dioxide and sulphuric acid, or fuming sulphuric acid followed by fusion with potash gave no results of value, as apparently the phenanthraquinone molecule cannot withstand such treatment. From bromonitrophenanthraquinones, however, anilino-derivatives were obtained by Ullmann's method (Ber., 1901, **34**, 2174), the nitro-groups being likewise replaced in some cases by the aniline residue. These products, which include 2.7-dianilino-, 2-, and 4-nitroanilino-, nitrodianilino- and dinitroanilino-phenanthraquinone, are all dyes giving dark green, blue, or black shades on wool (cp. Eng. Pat. 9311 of 1915; this J., 1915, 1136). Phenanthraquinone vat dyes were prepared by the action of acid chlorides on aminophenanthraquinones. They are dissolved by alkaline hydrosulphite and reprecipitated on oxidation. Examples are 2-benzoylaminophenanthraquinone which gives pale pink shades on cotton, 2-phthalylaminophenanthraquinone giving pale yellow shades, and 2-7-dibenzoyldiaminophenanthraquinone giving brownish-orange shades. Other derivatives prepared and examined as to their dyeing properties include 2.7-diaminophenanthraquinonemonosulphonic acid, giving dull green shades on alum-mordanted wool, phenanthraquinone-2.7-bisazophenol, and certain more complex vat dyes obtained from dibromophenanthraquinone and 2-aminophenanthraquinone, *p*-phenylenediamine, and β-naphthylamine respectively. In the latter cases however the products were impure, and the dyes apparently of no great value.—G. F. M.

Kermes; Dyestuff of ——. *III.* O Dimroth and R. Fick. Annalen, 1916, **411**, 315—338. (Compare this J., 1910, 749; 1914, 957.)

The similarity in properties between hydroxyanthrapurpurin (1.3.4.6-tetrahydroxyanthraquinone) and decarboxylated kermesic acid proves conclusively that the latter is a derivative of the former. The colours of the alkaline solutions of hydroxyanthrapurpurin, decarboxylated kermesic acid, kermesic acid, and carminic acid are identical; the spectra of these solutions and the absorption spectra of solutions in sulphuric acid are similar, and dye-trials on wool and on mordanted cotton also show their relationship. Bromination of kermesic acid gives tribromococcin, and similarly bromination of hydroxyanthrapurpurin yields the tribromo-derivative. Reduction of kermesic acid with zinc dust and glacial acetic acid gives the leuco-compound of 1-methyl-3.5.8-trihydroxyanthraquinone; apparently kermesic acid loses, in addition to the acetyl and carboxyl groups, the β-hydroxyl group in the same manner that purpuri is reduced to quinizarin by this method. Kermesi acid is considered to be 1-methyl-4-carboxy-7-acetyl-3.5.6.8-tetrahydroxyanthraquinone. Carminic acid is reduced in the same manner, and the statements of C. and H. Liebermann (this J., 191 544) that it is not an anthraquinone derivative i considered incorrect.—F. W. A.

Naphthoquinone derivatives; Degradation of hydr oxyanthraquinones to ——. O. Dimroth and E Schultze. Annalen, 1916, **411**, 339—345.

Autoxidation of anthragallol in alkaline solutio yields hydroxynaphthoquinonylacetic acid (Bamberger and Praetorius, Monatsh. Chem., 1902. **23**, 688), but purpurin is degraded still further, giving phthalic acid on air oxidation in alkaline solution. Careful oxidation of carminic acid in alkaline solution by means of hydrogen peroxide using cobalt oxide as catalyst yields 8-methyl-2.6-dihydroxy-1.4-naphthoquinone-3.5-dicarboxylic acid (this J., 1914, 956), and on similar treatment purpurin gives 3-aceto-2-hydroxy-1.4-naphthoquinone. These results are explained by assuming that the position of the quinone group in hydroxyanthraquinones is changed in alkaline solution. —F. W. A.

Anthradiquinones. O. Dimroth and E. Schultze. Annalen, 1916, **411**, 345—350.

THE highly labile products obtained by the careful oxidation of carminic acid, kermesic acid, and laccainic acid have not yet been isolated in a pure form, but are considered to be anthradiquinones. The parent bodies of this class of substances, the 1.4.9.10- and 1.2.9.10-anthradiquinones have been prepared by the oxidation of quinizarin and alizarin respectively by means of lead dioxide and acetic acid. 1.4.9.10-Anthradiquinone is obtained as stable yellow needles (m.pt. 211°—213° C.) by precipitation from benzene solution by means of petroleum spirit; it is readily soluble in chloroform and acetone, less soluble in benzene and alcohol; the solutions are yellow without the fluorescence characteristic of quinizarin. The diquinone oxidises quinol to quinhydrone, hydriodic acid to iodine, and is rapidly reduced to quinizarin by means of sulphurous acid; quinizarin is also formed from the diquinone in aqueous solution or suspension, without addition of a reducing agent, slowly on allowing to stand and immediately on boiling, phthalic acid also being produced. On treatment with hydrochloric acid in acetic acid solution, 3-chloroquinizarin (m.pt. 239°—240° C.) is obtained. The solution of the diquinone in sulphuric acid has the bluish colour of purpurin, and not the colour of quinizarin as stated by Lesser (this J., 1915, 543); this conversion of quinizarin-quinone into purpurin is similar to the conversion of benzoquinone into hydroxyquinol discovered by Thiele. 1.2.9.10-Anthradiquinone has similar properties, but is less stable.—F. W. A.

Quercetin from the bark of Pinus pinaster. R. Lepetit and C. C. Satta. Atti R. Accad. Lincei, 1916, [v], **35**, i, 322—325. J. Chem. Soc., 1916, **110**, i., 458—459.

THE yellow colouring matter obtained by treatment of the extract of the bark of the Tuscany pine with sodium bisulphite under pressure, and formerly regarded as fisetin (compare Lepetit, Atti VI. Congr. Chim. Appl., Rome, 1905, III., 156), is now shown, by means of its dyeing properties and the constants of several of its derivatives, to consist of quercetin.

Hydroxyazo compounds; Reactions of nitrates of ——. G. Charrier. Gaz. Chim. Ital., 1916, **46**, II., 1—17.

THE author has shown previously that, under suitable conditions, nitrates of hydroxy- (or amino-) azo compounds decompose, spontaneously or on heating, to yield a nitro-hydroxy (or amino) compound and an aryldiazonium nitrate:

$$Ar_1.N_2.Ar_2.OH(\text{or } NH_2).2HNO_3—H_2O\rightarrow$$
$$NO_2.Ar_2.OH(\text{or } NH_2)+Ar_1.N(NO_3):N.$$

When the nitrates of the ethers of hydroxyazo compounds are heated with concentrated hydrohalogen acids, the aryldiazonium nitrate first formed is decomposed by the acid, furnishing chiefly the corresponding arylhalogen derivative and free nitrogen. For example the nitrate of the ethyl ether of phenylazo-β-naphthol when heated with hydrochloric acid, yields, in addition to the ethyl ether of nitro-β-naphthol, chiefly chlorobenzene, but small quantities of other compounds are formed by secondary reactions. When dissolved in or heated with alcohols, the nitrates of the ethers of hydroxyazo compounds decompose in the following manner: $Ar_1.N_2.Ar_2OR,2HNO_3\rightarrow Ar_1.N_2.Ar_2OH+R.NO_3+HNO_3$.—A. S.

Anti-coagulating action of acid aniline dyestuffs on proteins. Hollande. *See* XIXA.

PATENTS.

[*Azo dyestuff*]*; Manufacture of a green chromium compound* [*of an*] ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,061, Oct. 25, 1915.

TWO different chromium compounds have been isolated from the blue solution obtained by boiling with a chromic salt the commercial *o*-hydroxyazo dyestuff (Eng. Pat. 26,460 of 1912; this J., 1913, 905) obtained by coupling in alkaline solution 4.2.1-nitrodiazophenol and 1.8-aminonaphthol-3.6-disulphonic acid (Chrome Fast Green G; Palatine Chrome Green G), viz., a sparingly soluble red compound, which gives loose reddish-violet shades destroyed by chroming, and a green compound which gives on animal fibres valuable green dyeings somewhat purer and bluer and of better fastness to light than the original dyestuff, the fastness to washing and alkali being very good and to fulling and potting satisfactory. *Example.* 47 grms. of chromium fluoride is dissolved in 1100 c.c. of hot water, 50 grms. of the commercial dyestuff (Chrome Fast Green G) added, and the liquid boiled for an hour until deep blue; 120 grms. of anhydrous sodium acetate is added, the mixture boiled for a quarter of an hour, filtered hot, and the filtrate evaporated to 500 c.c.; the red chromium compound separates and the filtrate is mixed with 150 grms. of common salt and allowed to stand until needles of the green chromium compound separate.—F. W. A.

Colouring matters of the anthraquinone series; Manufacture of ——. J. Y. Johnson, London. From Badische Anilin und Soda Fabr., Ludwigshafen, Germany. Eng. Pat. 17,764, July 27, 1914.

SEE Ger. Pat. 287,614 of 1914; this J., 1916, 171. 4-Aminoanthraquinoneacridones may be produced by splitting off the 3-sulpho group by means of acid, alkaline, or reducing agents during or after the condensation process, or, in some cases, in the dyeing bath, or after the sulphonated compound has been applied to the fibre.

Colouring matters of the anthraquinone series; Manufacture of —— *and intermediate products of such manufacture. New products of the anthraquinone series. Colouring matters of the anthraquinone series.* J. Y. Johnson, London. From Badische Anilin und Soda Fabr., Ludwigshafen, Germany. Eng. Pats. 3347, Mar. 2, 1915; 100,580, Mar. 2, 1915 (Appl No. 2873 of 1916); and 100,581, Mar. 2, 1915 (Appl. No. 2874 of 1916).

SEE Ger. Pat. 288,464 of 1914; this J., 1916, 355. A β-halogenanthraquinone may be used in place of anthraquinone-2-sulphonic acid, and the resulting β-arylaminoanthraquinones may be condensed further with an arylamino compound other than an aminoanthraquinone, in presence of caustic alkali or alkali alkyloxide, with or without an oxidising agent. Dyestuffs of the constitution, $A<^{NH}_{NAr}>Ar$, where A is an anthraquinone residue, and Ar is an aryl residue other than an anthraquinone residue, are obtained. They can be used directly for the manufacture of lakes and give acid wool dyes when sulphonated. The formation of the β-arylaminoanthraquinones and of the dyestuffs may be effected in one operation instead of in two stages.

Azo dyestuffs ; Manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 291,712, Nov. 28, 1914.

Azo dyestuffs are obtained from the hydrazide of 2.3-hydroxynaphthoic acid (Franzen, J. prakt. Chem., 1908, **78**, 164) or its derivatives in which a hydrogen atom of the amino group is replaced by an acidyl group, by coupling them, either in substance or on the fibre, with aromatic diazo-compounds. The dyes are faster and give deeper shades than the corresponding β-naphthol derivatives, and are suitable for printing and for the preparation of pigments.—A. S.

Sulphur dyestuffs ; Manufacture of yellow ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 292,148, Dec. 11, 1914.

Primary diamines of the diphenyl series, methylated in the nucleus, or their halogen substitution products are fused at a high temperature with more than one molecular proportion of sulphur, with or without addition of benzidine ; in the case of the tolidines the addition of benzidine is essential. The products dissolve readily in sodium sulphide solution and give fast, clear, greenish-yellow shades.—A. S.

Mono- and disazo dyestuffs ; Manufacture of ——. J. Hausmann, Frankfort. Ger. Pat. 291,906, Mar. 29, 1914.

Azo dyestuffs giving shades fast to washing and to light are obtained by coupling aromatic diazo or tetrazo compounds with oxindole-6-sulphonic acid.—A. S.

*N-Dihydro-*1.2.2.′1′*-anthraquinone-azine [Indanthrene] ; Manufacture of a chlorine derivative of* —— *fast to chlorine.* Chem. Fabr. Griesheim-Elektron. Ger. Pat. 292,127, Mar. 18, 1915.

Finely-divided Indanthrene is suspended or dissolved in a suitable medium and treated with chlorine at about 110° C., with or without addition of a chlorine-carrier. The product may be converted into trichloroindanthrene by treatment with alkaline hydrosulphite solution. It is similar in dyeing properties to the mixture of di- and trichloro-derivatives described in Eng. Pat. 17,242 of 1905 (this J., 1905, 1298).—A. S.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Animal wools and hairs ; Optical refraction of ——. A. Herzog. Chem.-Zeit., 1916, **40**, 528.

The optical properties of a series of animal fibres have been studied with the polarising microscope for purposes of comparison with results previously recorded for vegetable and artificial fibres. The mean refractive indices of the animal wool and hair fibres are fairly high, ranging from 1·519 to 1·553, as compared with 1·567 for natural silk, 1·562 for flax, 1·557 for cotton, 1·513 for cellulose artificial silks, and 1·477 for acetate silk. The differences shown by the various species of wool and hair fibres are inconsiderable, owing to the similarity of their chemical composition and microscopic structure. The differences between the refractive indices in the two main directions of the fibre, which is a measure of the specific double refraction, are only small (0·007—0·009) in the case of the wool and hair fibres, comparable in dimensions with, but opposite in sign to the value for acetate artificial silk. The differences in the case of the cellulose artificial silks are much larger. In the case of the wools, owing to their relatively small thickness, the interference colours between crossed nicols are only low grey or whitish colours of the first order but the higher colours were studied in the case of the coarser fibres of horse-hair and pigs' bristles.—J. F. B.

Sulphite lyes ; The ammonia test for ——. E. Oman. Teknisk Tidskrift, 1916, **46**, 4—6.

Sulphite lyes as used in the manufacture of wood pulp contain about 0·9% CaO and 4% SO_2. They are tested from time to time during the boiling by addition of ammonia which at the beginning produces a white precipitate of calcium sulphite ; towards the end of the boiling this precipitate diminishes, and if its volume falls below a certain limit, this is generally considered as proof that too little lime has been present and the boiling is then stopped even if not finished. The author has proved that this ammonia test—also called Mitscherlich's test—as applied at present gives no indication whatever of the quantity of lime present as sulphite and is, therefore, totally useless. If sufficient sulphurous acid is present all the lime will be precipitated, including that combined with organic compounds ; if not, only a very small precipitation occurs, so that the test is in reality a test for the sulphurous acid rather than for the lime. It is necessary, in using the test, to take out the samples of lye through a pipe or worm cooled by water circulation in order to prevent sulphur dioxide from escaping, but even so the test is quite illusory as a measure of the "exhaustion" of the lime. When a cooler is used, however, the Mitscherlich test may be used for estimating the amount of sulphurous acid present, provided some calcium chloride is added to the ammonia used in the test.—C. B.

Sugar-formation in the sulphite cellulose process. E. Oman. Teknisk Tidskrift, 1916, **46**, 6—8. (See also this J., 1916, 172.)

In most investigations of the formation of sugar during the sulphite boiling process, it has been taken for granted that the different sugars present in the lye are completely hydrolysed. The author finds that such is not always the case, and gives the results of his experiments as follows : 1. At the beginning of the boiling the lye contains a large proportion of non-hydrolysed sugar, often more of this than of hydrolysed sugar. 2. The non-hydrolysed sugar is split up by the acid liquor during the progress of the boiling, so that finally it is sometimes—but by no means always—completely hydrolysed. The hydrolysed (reducing) sugars were determined by Glassmann's method (this J., 1906, 236).—C. B.

Paper : Partial substitution of sodium bisulphate for aluminium sulphate in the sizing of ——. B. Haas. Chem.-Zeit., 1916, **40**, 571—572.

Sodium bisulphate has been proposed as a partial substitute for aluminium sulphate in the sizing of paper, but while the impure by-product forms of the bisulphate are suitable for the sizing of the lower grades of paper, it is considered that only purified salts should be used for the finer grades. The most economical and convenient method of employing pure bisulphate is to prepare a solution, as required, by the addition of sulphuric acid to a solution of pure normal sodium sulphate, which is less costly than the pure bisulphate and keeps better on storage. In sizing the pulp, sodium bisulphate or aluminium sulphate should be added before the rosin size, in order to acidify the pulp and to inhibit the action of the saline constituents of the water and fibre upon the dilute size-milk. An equally favourable result is obtained whether the whole or only a portion of the bisulphate or aluminium sulphate solution be added before the rosin size, but if the rosin size be added first, as is the custom in many cases, the economical effect is not realised.—J. F. B.

Cause and nature of soil acidity with special regard to colloids and adsorption. [Acidity of washed absorbent cotton.] Truog. *See* XVI.

Patents.

Silk and similar fibres ; Process for degumming ——. W. Buschhüter, Crefeld, and M. Voigt, Crefeld-Traar, Germany. Ger. Pat. 291,159, Nov. 29,1913.

Raw silk is impregnated with a solution of an alkali salt, other than a soap, of which the acid is weaker than the amino-acids of the sericin, and is then steamed, and the sericin thus separated from the silk fibres is dissolved by means of a soap bath or by the foam from a boiling soap solution. Suitable salts are the alkali salts of silicic, boric, or stannic acid or of the acids of acaroid resin, or alkali sulphides or aluminates. With certain of these salts a bleaching and weighting action is obtained in addition.—A. S.

Flax, hemp, and jute ; Preparation of fibres from Cyperus papyrus, L., as a substitute for ——. P. Hoering, Berlin. Ger. Pat. 291,302, June 30, 1914. Addition to Ger. Pat. 290,605.

Papyrus stems before being treated with hot water as described in the chief patent (see Eng. Pat. 6971 of 1914 ; this J., 1915, 867), are subjected to strong pressure, either in the fresh condition or after being moistened by immersion in water. —A. S.

Wood and other substances ; Process for obtaining fibre from ——. W. K. Freeman, Oscawana, N.Y., Assignor to Hydrolose Process Corporation, New York. U.S. Pat. 1,186,655, June 13, 1916. Date of appl., Nov. 25, 1913.

The material and chemicals are heated together in each of a series of digesters for periods insufficient to cause complete digestion in any one digester ; the mass is agitated in certain of the digesters and is transferred from one digester to the next throughout the series, without cooling or exposure to the atmosphere, until digestion is complete.—J. F. B.

Paper ; Process and apparatus for reducing —— *to pulp.* H. Wade, London From The General Waste-Paper Recovery Co., Baltimore, Md., U.S.A. Eng. Pat. 3702, Mar. 8, 1915.

Printed paper is steeped in hot water until softened, then charged into a pulping machine in the proportion of 1 part of dry paper to about 20 of water, heated to 160°—200° F. (71°—93° C.) and treated with a detergent mixture preferably containing soap, sodium silicate, and some free alkali. The pulping machine comprises a steep-walled feed hopper, a cylindrical tube closely surrounding a series of propeller blades of increasing pitch, and a delivery pipe back to the hopper. The propellers are rotated at such a high speed, *e.g.*, 1800—2500 revs. per min., that they form cavities in the liquid surrounding them, and circulation of the contents of the machine takes place at the rate of about 1200 ft. per min. The particles of paper approaching the cavities formed by the rapidly revolving propellers are unable to take up the speed of the blades and are there subjected to an opposition of forces, one of which is due to the inertia of the paper and suspending liquid, constituting a resistance against which the propellers draw apart the component fibres. The disintegrated stock is washed in a suitable engine with a drum washer until sufficiently clean for re-manufacture into paper.—J. F. B.

Paper and other materials ; Fireproofing of ——. T. J. I. Craig, and Whipp Bros. and Tod, Ltd., Manchester. Eng. Pat. 8687, June 12, 1915. (See also Eng. Pat. 16,153 of 1914; this J., 1915, 868.)

In the process of rendering materials non-inflammable by means of sodium aluminium carbonate, those materials in which the proofing agent cannot conveniently be precipitated *in situ*, may be treated by mixing or coating with a preparation of the double carbonate at any suitable stage in their manufacture. For instance, paper pulp may be mixed with a paste containing sodium aluminium carbonate precipitated by the action of excess of sodium bicarbonate on sodium aluminate. —J. F. B.

Paper ; Manufacture of transparent airtight and waterproof ——. H. Oeser, Berlin-Schöneberg, Germany. Ger. Pat. 291,198, Sept. 2, 1915. Addition to Ger. Pat. 285,978 (this J., 1915, 1139).

Fusel oil is added to the mixture of resin or wax, oil, and alcohol used for impregnating the paper, and a colouring matter or bronze powder is distributed over the surface of the impregnated paper. The fusel oil maintains the paper in a pliable condition whilst it is being manipulated and later escapes by volatilisation.—A. S.

Paper stock screening machines. A. R. Paull and A. E. G. Madley, Montreal, Canada. Eng. Pat. 10,808, July 26, 1915.

Paper ; Method used in the manufacture of —— *by machinery, together with apparatus for the purpose.* J. H. Wallin and K. Granqvist, Köpmanholmen, Sweden. U.S. Pat. 1,186,629, June 13, 1916. Date of appl., Nov. 14, 1913.

See Eng. Pat. 26,242 of 1913 ; this J., 1914, 478.

Degumming silk ; Process of ——. O. Röhm, Assignor to Röhm und Haas, Darmstadt, Germany. U.S. Pat. 1,186,140, June 6, 1916. Date of appl., Feb. 5, 1915.

See Eng. Pat. 2826 of 1915 ; this J., 1916, 418.

Waterproofing material [for paper] ; Method of heating ——. W. J. Mellersh-Jackson, London. From C. S. Bird, East Walpole, Mass., U.S.A. Eng. Pat. 18,093, Dec. 28, 1915.

See U.S. Pat. 1,165,367 of 1915 ; this J., 1916, 250.

Gypsum product [for coating paper]. U.S. Pat. 1,178,016. *See* VII.

Impregnation of leather or textile driving belts or the like. Ger. Pat. 291,461. *See* XV.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Wool and silk ; Effect of certain agencies upon the colour and dyeing properties of ——. M. Fort. J. Soc. Dyers and Col., 1916, **32**, 184—187.

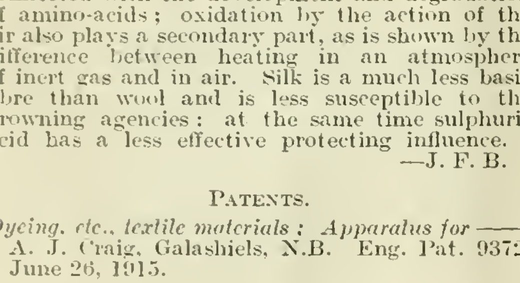
A brown colour has been observed on wool after it has undergone any of the following treatments : exposure, heating, steaming, boiling with water, action of alkaline solutions, action of strong acids, action of certain other chemical agents ; in the case of the first four agencies a prolonged treatment is required. Whenever browning occurs some modification in affinity to dyestuffs also takes place. Exposure to light for 1—2 months not only causes browning but makes the wool far more susceptible to subsequent browning under other agencies, *e.g.*, heating, steaming, boiling, &c. Boiling with 5% sulphuric acid before exposure acts in a large degree as a preservative : the effect

of this treatment is also preventive in the case of heating, steaming, and boiling. Stoving is no protection against the effect of exposure. Browning due to dry ironing sets in at 200° C. (after 1 minute), and definite scorching is observed at 250° C. Wool boiled with 5% sulphuric acid and stoved wool are more resistant than ordinary wool; these treatments also improve the colour of scorched wool. The affinity for basic dyestuffs of wool browned by heat is increased, just as in the case of faded wool (see this J., 1916, 534). The influence of steaming on the affinity for dyestuffs has already been noted (*loc. cit.*), also the reversibility of the effects when the treatment is prolonged. The browning of wool under the action of steaming is progressive with the duration of treatment. Previous treatment with sulphuric acid prevents the browning and a subsequent treatment is largely curative; stoving is still more effective in restoring the colour of steamed wool. Wool after being boiled with water readily turns brown on subsequent exposure; treatment with sulphuric acid acts favourably. Boiling with organic acids followed by repeated extraction with boiling water gives a product very liable to turn brown on keeping. Wool thus browned shows an increased affinity for basic, acid, and cotton dyestuffs. The action of dilute alkalis is well known; browning is progressive and fibre substance is dissolved. Previous acid treatment and stoving are protective only until the combination of fibre and acid has been decomposed by the alkali. Immersion in cold strong acids, even in a saturated solution of sulphurous acid, develops a brown coloration of wool, which however disappears on dilution. The browning of wool by exposure, heating, steaming, and boiling would appear to be connected with the development and degradation of amino-acids; oxidation by the action of the air also plays a secondary part, as is shown by the difference between heating in an atmosphere of inert gas and in air. Silk is a much less basic fibre than wool and is less susceptible to the browning agencies: at the same time sulphuric acid has a less effective protecting influence.
—J. F. B.

Patents.

Dyeing, etc., textile materials; Apparatus for ——. A. J. Craig, Galashiels, N.B. Eng. Pat. 9372, June 26, 1915.

The direction of circulation of the dye-liquor, etc., is reversed without violent agitation of the liquid, by use of steam passing through the perforated ring, E^2, or the nozzle, E^3, in which case the liquor ascends the telescopic pipe, C, and passes through the perforations in C^1, or alternatively by use of the steam coils, G, G^1, etc., in which case the liquor passes directly up into the cage, B, containing the material to be treated. In dyeing wool, uniform results are obtained and the wool is not felted.—F. W. A.



Dyeing yarn [with vat dyestuffs]; Process of ——. A. Schlegel, Mannheim, Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,185,943, June 6, 1916. Date of appl., Nov. 3, 1911.

See Addition of Mar. 7, 1911 to Fr. Pat. 359,466 of 1905; this J., 1911, 1052. The process is applicable to anthracene vat dyes in general.

Dyeing artificial leather; Process for ——. R. Weeber, Bärn, Austria-Hungary. U.S. Pat. 1,186,052, June 6, 1916. Date of appl., June 24, 1914.

The fabric is first impregnated with a mixture of cellulose esters and a suitable mordant, and afterwards dyed with basic dyestuffs.—F. C. T.

Aniline Black; Production of ——. A. Ehrenzweig, Charlottenburg. Ger. Pat. 291,955, Dec. 9, 1913.

Aniline Black is produced by the interaction, at a high temperature, of aniline, a diamine, and chloric acid, with or without another oxygen-containing mineral acid, but without a salt of copper, iron, manganese, vanadium, or chromium. The dye-bath is stable and can be centrifuged without alteration, so that it is applicable to the machine dyeing of tissues, yarn, cops, etc. of cotton and of union goods (half-wool and half-silk). The black is very fast and is not affected by sulphur dioxide, and the method is particularly suitable in cases where resist-discharges are to be produced by Prud'homme's method.—A. S.

Black shades on wool; Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 291,021, May 2, 1914.

Wool is dyed a deep black, fast to milling and to light, by treatment in a solution of a mono- or polysulphonic acid of a *p*-amino- or *p*-arylamino-aryl-β-naphthylamine or a substitution product, and then oxidising, either in the same or a separate bath, by means of a chromate, bichromate, or chromic acid, with or without addition of acids or salts.—A. S.

Fast [khaki] shades on wool; Production of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 291,456, Apr. 26, 1914.

Level khaki shades, fast to washing, milling, and rubbing, and very fast to light, are obtained by dyeing wool in baths containing dihydroxy- or aminohydroxynaphthalenesulphonic acids and copper salts, with or without addition of other salts or oxidising agents.—A. S.

Dyeing dead or living hairs, furs, feathers, or the like. F. Fresenius and A. Zimmer, Frankfort. Ger. Pat. 291,138, Dec. 22, 1914.

Fast shades are produced by dyeing with aromatic hydroxy or amino compounds, with addition of salts of nickel, cobalt, manganese, bismuth, iron, or the like.—A. S.

Laundrying and cleaning; Souring agent for —— *and process of using the same.* W. F. Elwood, Greensburg, Pa. U.S. Pat. 1,186,300, June 6, 1916. Date of appl., Dec. 7, 1915.

Fabrics showing stains are treated with a solution of an acid sulphate salt or other soluble oxygen compound of sulphur having an acid reaction, and a "stabiliser," *e.g.*, sodium silicate.—J. F. B.

Bleaching fabrics in open form : Process of ——. C. Taylor, North Adams, Mass., U.S.A. Eng. Pat. 15,733, Nov. 8, 1915. Under Int. Conv., Nov. 11, 1914.

See U.S. Pat. 1,146,461 of 1915 ; this J., 1915, 901.

Manufacture of azo dyestuffs. Ger. Pat. 291,712. *See* IV.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Sulphuric acid-water mixtures : The properties of mixed liquids. I. [Surface tension of] ——. J. L. R. Morgan and C. E. Davis. J. Amer. Chem. Soc., 1916, 38, 555—568.

The surface tensions of mixtures of sulphuric acid and water were determined at various temperatures, and formulæ are given for calculating the surface tension and specific cohesion at any concentration and at any temperature between 0 and 50° C. The surface tension was measured by determining the weight of a falling drop (Morgan, J. Amer. Chem. Soc., 1915, 37, 1461), and a mode of applying the method to liquids of high viscosity is described. Both the addition of sulphuric acid to water and of water to sulphuric acid causes an increase in the surface tension, so that different concentrations of sulphuric acid may have the same surface tension at the same temperature. The addition of sulphur trioxide to sulphuric acid also increases the surface tension. The results obtained and the variation of other physical properties with concentration are discussed in their bearing on the question of hydrate ormation in mixtures of sulphuric acid and water.
—F. Sodn.

Selenic acid : Reduction of ——. W. O. de Coninck and Chauvenet. Ann. Chim. Analyt., 1916, 21, 114.

When a mixture of formic acid with a slight excess f colourless selenic acid (sp.gr. 1·4) is heated radually to boiling, carbon dioxide is disengaged nd selenium is precipitated. Malonic and pyruvic cids also reduce selenic acid : acetic and succinic cids do not ; boiling with oxalic acid causes nly partial reduction. The selenium deposited as a dark reddish-brown colour, is amorphous, nd practically insoluble in carbon bisulphide ; it s apparently identical with that obtained by educing selenic acid with sulphur dioxide.
—E. H. T.

arbonic acid ; The time reaction in the neutralisation of —— and the true dissociation constant of carbonic acid. L. Pusch. Z. Elektrochem., 1916, 22, 206—212.

The reaction $OH' + CO_2 \rightarrow HCO_3'$ is the determining actor of the reaction velocity of the neutralisation f carbonic acid. Measurements with the pure cid showed that no alteration of conductivity ith the time occurred, hence the above reaction is pparently so accelerated by the hydrogen ions hat the time reaction is no longer measurable. similar catalytic action of hydrogen ions occurs the conversion of γ-hydroxy fatty acids into tones. In the neutralisation of carbonic acid he reaction velocity is proportional to the centration of the acid and base and inversely roportional to that of the bicarbonate. The mean alue at 0° C. is k = 0·043. By means of the residual current " the concentration of the ndissociated molecule H_2CO_3 was determined. hence the dissociation constant $k = \frac{[H] \times [HCO_3]}{[H_2CO_3]}$ as found to be $7{\cdot}42 \times 10^{-4}$, a value which is greater han that of acetic acid.—G. F. M.

Ammonia ; Synthesis of ——. C. Zenghelis. Comptes rend., 1916, 162, 914—916.

Varying small yields of ammonia were obtained by passing mixtures of nitrogen (1 vol.) and hydrogen (3 vols.) through water at 90° C., in the presence of a colloidal or finely divided metal as catalyst. The metals used were platinum, palladium, silver, copper, mercury, and gold, and in most cases the yields were considerably increased, although still small, by acidulating the water. Colloidal silver, prepared by Carey Lea's method, was most effective. Ammonia was also produced in small quantities by passing nitrogen through a mixture of zinc and dilute sulphuric acid, at 90° C., or into contact with nascent electrolytic hydrogen, also by passing hydrogen through a warm solution containing ammonium chloride and sodium nitrite ; but a much larger yield was obtained by the last method in presence of a metallic catalyst, and, in this way, using colloidal palladium, as much as 40 % of the nitrogen present was converted into ammonia.—F. Sodn.

Soda-lime : Properties of ——. *I, II, and III.* I. Guareschi. Atti. R. Accad. Sci. Torino, 1916, 51, 4—26, 59—82, and 263—278. J. Chem. Soc., 1916, 110, ii., 324—325.

Many reactions which do not take place with sodium or potassium hydroxide or lime, or take place only at high temperatures, occur at the ordinary temperature, and sometimes violently when soda-lime is employed. Further, soda-lime constitutes the most efficient agent to combat poisonous, irritating, or tear-producing gases, since it readily absorbs chlorine, bromine, halogen hydracids, carbon dioxide, sulphur dioxide, carbonyl chloride, cyanogen, hydrogen cyanide, cyanogen chloride, bromide and iodide, sulphur chloride, thionyl chloride, nitrosyl chloride, nitrogen peroxide, hydrogen arsenide, antimonide, sulphide, and selenide, mercaptans, thiocyanic acid, indole, scatole, aldehydes, chlorocarbonic esters, aromatic chloro- and bromo-derivatives with the halogen in the side-chain, ethyl bromoacetate and chloroacetoacetate, chloroacetone, bromoacetophenone, acetic anhydride, etc. The soda-lime acts far more energetically when recently prepared and stored in a hermetically sealed vessel. 100 grms. of soda-lime in fine granules will absorb 1500—2250 c.c. of carbonyl chloride. Hydrogen sulphide is readily absorbed by soda-lime, and the reaction is attended with the development of a very considerable amount of heat ; when the current of gas is mixed with air the soda-lime becomes incandescent, whilst replacement of the air by oxygen results in a violent explosion. This incandescence is observed only with freshly-prepared soda-lime, which should consist of granules 1—3 mm. in diameter. 100 grms. of soda-lime absorbs 35 litres of hydrogen sulphide. Soda-lime also absorbs hydrogen selenide, which produces rapid and intense irritation of the mucous membrane of the nose and is capable of paralysing the sense of smell for some hours or even days. Sulphur dioxide is absorbed by soda-lime, rapidly at first and subsequently more slowly, 26 litres being taken up by 100 grms. The mixture of hydrogen chloride, nitrosyl and nitroxyl chlorides, and chlorine obtained from *aqua regia* is also rapidly absorbed, and the same is the case at first with cyanogen, of which more than 6 litres is absorbed per 100 grms. ; the employment of soda-lime to retain the cyanogen emitted from blast-furnaces is suggested. Carbon monoxide at the ordinary temperature is absorbed but slightly or not at all. In presence of soda-lime, ammonia causes at the ordinary temperature reactions which otherwise occur only at high temperatures. Hydrogen phosphide, prepared by passing hydrogen into a flask containing 45

—50 %, potassium hydroxide solution, and a few pieces of phosphorus, is spontaneously inflammable, but loses this property when passed through soda-lime: the latter also absorbs phosphorus vapour. Soda-lime may be used to purify the hydrogen obtained by the action of acid on iron or zinc, but it will not remove hydrogen phosphide, which is detected by the green colour of the flame. Soda-lime absorbs many of the impurities of coal-gas and takes away its fœtid odour; similar purification and deodorisation occur with acetylene, which is not absorbed by soda-lime.

Alkaline earths with alkali hydroxides; Mixtures of the ——. I. I. Guareschi. Atti R. Accad. Sci. Torino. 1916. **51**, 372—377. J. Chem. Soc., 1916. **110**, ii., 325.

THE incandescence observed when a mixture of air and hydrogen sulphide is passed over soda-lime (preceding abstract) also occurs when the latter is replaced by a mixture of lime or, better, baryta with sodium or potassium hydroxide, even when the latter is present in relatively small proportion: potassium hydroxide is more effective than sodium hydroxide. A negative result is obtained when the lime or baryta is replaced by glucinum oxide.

Apatites: Composition of ——. F. Zambonini. Comptes rend., 1916. **162**, 919—921.

CRYSTALS having the formula, $CaCl_2.4{\cdot}34Ca_3(PO_4)_2$, were obtained by fusing tricalcium phosphate with sodium chloride and washing the product with water. The crystals were more highly birefractive than ordinary chlorapatite, $CaCl_2$, $3Ca_3(PO_4)_2$, and are regarded as a solid solution of this double salt with calcium phosphate.
—F. SODN.

Palladous salts: Catalytic action of —— in oxidation reactions. G. Scagliarini and G. B. Berti-Ceroni. Gaz. Chim. Ital., 1916, **46**, II., 51—56.

PALLADOUS salts accelerate the oxidation of oxalic acid and of ammonia by persulphates and, in a lesser degree, the oxidation of oxalic acid by nitric acid. The effect is due to the action of the palladous salt as an oxygen-carrier. It is oxidised by nitric acid and, more readily, by persulphates to a palladic compound, which in turn is decomposed by oxalic acid or by ammonia.—A. S.

Tetrathionates in alkaline solution; Decomposition of —— as a source of error in certain iodine titrations. R. M. Chapin. J. Amer. Chem. Soc., 1916. **38**, 625—626.

TETRATHIONATES are affected only slightly by sodium bicarbonate and still less by sodium bicarbonate in the presence of carbonic acid, but are sensitive to hydroxyl ions even in low concentration. The treatment of solutions containing tetrathionates with distinctly alkaline substances, before titrating with iodine (this J., 1914, 481), should therefore be avoided, and in the determination of arsenic by Williamson's method (this J., 1896, 171) or its modifications, it is preferred to use a dilute solution of sodium sulphite (containing about 0·5 % of the anhydrous salt), instead of thiosulphate, as a discharging agent for the liberated iodine.—F. SODN.

CaO-Al_2O_3-MgO; The ternary system ——. G. A. Rankin and H. E. Merwin. J. Amer. Chem. Soc., 1916. **38**, 568—588.

AN investigation of the system CaO-Al_2O_3-MgO by the method of thermal analysis involved equilibrium of the three components themselves and the binary compounds $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, $CaO.Al_2O_3$, $3CaO.5Al_2O_3$, and $MgO.Al_2O_3$ in ternary solutions, no ternary compounds being stable in contact with the melts. Equilibrium relations are exhibited in a series of tables and diagrams and in a representation of the concentration-temperature solid model: these show 8 fields of stability, 13 boundary curves, and 6 quintuple points, two of which are eutectic points. The same types of ternary crystallisation are found as in the system CaO-Al_2O_3-SiO_2 (this J., 1915, 139), and an equilibrium diagram is given which serves to indicate, when the original composition of a ternary melt is known, the composition of the solid phases which will crystallise from it on slow cooling, the order in which the phases will separate, and the final product of crystallisation. In addition to the properties of the components and binary compounds previously given (this J., 1909, 1124), further observations have been made on the optical characters of the compounds $5CaO.3Al_2O_3$ and $CaO.Al_2O_3$, and a new (β) form of alumina, which occurred occasionally in charges of pure alumina, after melting and slow cooling, and which appears to be monotropic with respect to the α form (corundum), is described. The compound $MgO.Al_2O_3$ (*loc. cit.*) melts at 2135° C. ± 20° and forms eutectics with magnesium oxide and also with both forms of alumina.—F. SODN.

Aluminium nitrate: Hydrates of ——. R. Seligman and P. Williams. Chem. Soc. Trans., 1916, **109** 612—617.

ALUMINIUM nitrate crystallises in at least thre forms each of which is stable in nitric acid o specific strengths. A hydrate $Al_2(NO_3)_6 18\ H_2$ is deposited in small needles from nitric aci solution of sp. gr. 1·42. It is the least solubl and most stable hydrate at 20° C. in nitric aci of this strength. In nitric acid of sp. gr. 1·5 th hydrate $Al_2(NO_3)_6.12H_2O$ is alone stable, and i moreover deposited initially from solutions o aluminium in the above mentioned weaker aci in large lozenge-shaped crystals which chang spontaneously into the octodecahydrate. In acid of intermediate strength a hydrate containing 1 or $16H_2O$ and crystallising in thin plates, is th stable form.—G. F. M.

Cupric thiocyanate; Action of water on —— J. C. Philip and A. Bramley. Chem. Soc. Trans 1916, **109**, 597—603.

CUPRIC thiocyanate, precipitated from cupri chloride solution by excess of potassium thi cyanate, is slowly acted on by the water presen reduction to cuprous thiocyanate being ultimatel complete. The other products formed con currently, namely, carbon dioxide, ammoni urea, hydrogen cyanide, and thiocyanic an sulphuric acids, were found to account quantit tively for the oxidised thiocyanogen radic When cupric thiocyanate was precipitated fro cupric acetate solution cyanogen was formed i addition to the substances already specified. Th following equations are suggested as representi the different ways in which the reaction betwe water and cupric thiocyanate occurs:—

$$8Cu(CNS)_2 + 6H_2O = 8CuCNS + 7HCNS + CO_2 + NH_4HSO_4;$$

$$6Cu(CNS)_2 + 4H_2O = 6CuCNS + 5HCNS + HCN + H_2SO_4;$$

$$14Cu(CNS)_2 + 8H_2O = 14CuCNS + 12HCNS + C_2N_2 + 2H_2SO_4;$$

$$16Cu(CNS)_2 + 11H_2O = 16CuCNS + 11HCNS + CO_2 + CO(NH_2)_2 + 2H_2SO_4.$$

—G. F. M.

Manganic compounds: Constitution of ——. Meyer. Z. Elektrochem., 1916. **22**, 201—202.

THE colour of manganic salts depends largely external circumstances, and in all cases absorption spectra are practically identical, hen the conclusion of Sem (this J., 1915, 1248) that there are two series of manganic salts is unwarranted. The existence of manganic nitrate is extremely doubtful, the solution obtained by Sem being in all probability a colloidal hydrated manganese dioxide. In pure manganic chloride solutions no manganous ions are present, hence Sem's views on the existence of di- and quadrivalent manganese in equilibrium with trivalent ions are incorrect.—G. F. M.

Radium : Experiments on the extraction of —— from carnotite ores with concentrated sulphuric acid. H. Schlundt. J. Phys. Chem., 1916, **20**, 485—494. (See also U.S. Pat. 1,181,411 of 1916 ; this J., 1916, 690.)

The carnotite ores of Colorado and Utah consist of a sandstone with a clay binder which carries the mineral carnotite, a hydrated potassium uranium vanadate containing some barium and calcium. The experiments were conducted on a low-grade ore containing 1·66 % of uranium (as U_3O_8), 4·03 % of vanadium (as V_2O_5), 1·36 % of moisture, and 4·88 parts per billion of radium ; also on a high-grade ore with 14·39 % of uranium, 9·67 % of vanadium, and 42·78 parts per billion of radium. Experiments with 100 grm. charges of the former showed that treatment with 78 % (60° B.), or stronger, sulphuric acid gave a radium extraction of fully 90 %, and that the vanadium and uranium were completely removed with 35 % acid. Temperature conditions were of less moment than concentration of acid. At the ordinary temperature 90 % acid gave an extraction of 84 % from the low-grade ore in 24 hours, but 15 minutes sufficed when the charge was added to boiling 78 % acid and was well stirred in. The high-grade ore was less easily extracted : one hour's treatment with 90 % acid up to 290° C. removed 89 % of the radium. Large-scale experiments were conducted with 10 kilo. charges of ore ground to pass through a 20-mesh sieve. The charge was introduced gradually into 18 litres of 78 % acid at 190° C. contained in a 50-litre cast iron vessel, and heated to 220° C. for at least 15 mins. Uranium, vanadium, and some iron and aluminium are thus converted into soluble compounds and the calcium, barium, and radium are dissolved as bisulphates. The liquid is cooled to 130° C., and the insoluble silicates and silica are filtered off on a stoneware filter packed with "Filtros" under a pressure of 5—10 cm. of mercury, the coarser particles being poured in first. The residue is dry within 30 mins. and is then washed with two successive portions of 5 litres of the hot concentrated acid. The acid filtrate is poured into eight times its bulk of hot water, whereby the radium and barium sulphates are precipitated, and by adding dilute barium chloride solution (5 grms. per 100 litres) a 2 % increased extraction of radium is obtained. After standing for at least 3 days the supernatant liquid is siphoned off, and the crude sulphates are washed on a filter with hot water containing a trace of barium chloride, and then dried. With low-grade ore, radioactivity measurements of these sulphates show that the radium concentration is 235 times greater than that of the original charge : with high-grade ore it is only 35 times greater. The residue on the suction filter contains soluble vanadium, uranium, and iron sulphates, together with acid retaining some radium. By washing it several times with hot water and stirring thoroughly on the filter), a deep blue filtrate is obtained which gradually deposits a white precipitate containing 3—9 % of the original radium content of the ore. The actual recovery of radium was slightly less than was expected from the estimate of the losses in tailings and solutions.—E. H. T.

Inorganic hydrogels : Effect of freezing on certain ——. [Hydrogels of alumina, silica, and ferric oxide.] H. W. Foote and B. Saxton. J. Amer. Chem. Soc., 1916, **38**, 588—609.

Hydrogels of alumina, silica, and ferric oxide, containing known proportions of total water, were subjected to progressive cooling in a dilatometer, as long as the influence of freezing was apparent on the volume-temperature curve. After removal of all water present in its usual free condition, the volume continued to increase somewhat down to a low temperature (below—20° C.), owing, it is thought, to the freezing of adsorbed or capillary water, of lower vapour pressure and therefore lower freezing point than "free" water. The proportions of free and capillary water were calculated from the expansion effect, whilst the difference between their sum and the total water is taken as combined water. The capillary and combined water correspond to that previously supposed to be in solid solution (Foote, J. Amer. Chem. Soc., 1908, **30**, 1388); but the free water, determined by the dilatometer method, includes part of the capillary water, on account of supercooling, so that the "apparent capillary water" given (that separating below —6° C.) is too low. With aluminium hydroxide, the amount of capillary water did not change when the free water was allowed to evaporate ; but repeated freezing, whilst having little effect on the combined water, converted most of the capillary water into free water ; after standing for 8 months, however, the total free and capillary water had increased at the expense of the apparently combined water, and with such material (considered as best representing equilibrium), 37·1 % of combined water was obtained, as against 34·6 % calculated for the formula $Al(OH)_3$. Silicic acid contained a much higher proportion of capillary water than aluminium hydroxide (over 0·7 grm. per grm. SiO_2), and the proportions of free and capillary water were but little altered by successive freezings ; the percentage of combined water corresponded approximately to the formula $SiO_2,1·3H_2O$.

With ferric hydroxide, freezing caused very little change in the capillary water, but from the form of the volume-temperature curves, this water is thought to be more firmly held or lodged in finer capillaries than in the other colloids examined ; the proportion of combined water corresponded to the empirical formula $Fe_2O_3,4·25H_2O$.—F. Sodn

Cobaltous oxide and other metallic oxides : Reactions between —— at high temperatures. J. A. Hedvall. Z. anorg. Chem., 1915, **93**, 313. Chem.-Zeit., 1916, **40**, Rep., 196. (See also this J., 1915, 1052.)

Rinman's green probably does not consist of zinc oxide and cobaltous oxide, but of cobaltozincate and zinc oxide. The crystals are not isodimorphous, but hexagonal structures of hexagonal white zinc oxide and hexagonal green cobaltozincate. The green colour could not be produced additively from brownish prismatic cobalt oxide and zinc oxide. Cobaltous oxide gives with glucinum (beryllium) oxide only a dark grey mass ; with chromic oxide a green octahedral spinel, $CoO.Cr_2O_3$; and with titanium oxide a metatitanate, $CoO.TiO_2$. No compounds are formed with zirconium oxide, thallium oxide, cerium oxide, or silica, but crystalline vanadates and tantalates are formed.—T. St.

Nitrogen ; An active modification of ——. VII. R. J. Strutt. Proc. Roy. Soc., 1916, A., **92**, 438—450. (See also this J., 1915, 422.)

The production of active nitrogen from a steady discharge obtained from a direct current dynamo, using a tube 18 mm. diameter, between aluminium disc electrodes 130 mm. apart, is greatest near the cathode, falls off to a minimum in the Faraday dark space, and increases again in the positive column to a value constant along that column but less than at the cathode. A much greater yield of active nitrogen is obtained from the positive column in a narrow tube of 6 mm. diameter than in a wide one of 15 mm. diameter. The potential gradients in the wide and narrow tubes were nearly the same in each case, so that the different yields of active nitrogen cannot be attributed to the potential gradient, but must rather be connected with current density. As the length of positive column traversed by the gas is increased, the yield of active nitrogen increases to a limit, owing to a destructive action of the discharge which beyond a certain concentration destroys the active nitrogen as fast as it is produced. It is known that a trace of oxygen, or other gas, increases the yield of active nitrogen, and the amount of oxygen required considerably increases the fall of potential at the cathode, but it does not measurably affect the fall of potential in the positive column. A smaller quantity of active nitrogen is produced at atmospheric pressure than at the usual pressure of 5 mm. of mercury or less, owing to the destructive action of the surrounding gas on the active nitrogen as it is produced. If a copper cathode be employed the metal disintegrated by the discharge emits its line spectrum excited by active nitrogen, as in those cases where active nitrogen is led over a heated metal.—W.G.C.

Oxygen: Solubility of —— in salt solutions, and the hydrates of these salts. C. G. MacArthur. J. Phys. Chem., 1916, 20, 495—502.

The solubility of oxygen in aqueous solutions of various concentrations of the following substances was determined by Winkler's manganous hydroxide method: the chlorides of lithium, sodium, potassium, rubidium, cæsium, ammonium, magnesium, calcium, barium; the bromides and sulphates of sodium and potassium; the iodide and nitrate of potassium; and sucrose. In every case the solubility diminished regularly with increasing salt concentration, and with ammonium chloride the diminution was particularly great. The values obtained for the solubility in sucrose solutions were low and somewhat unreliable owing to the sugar being slowly oxidised by the dissolved gas.—E. H. T.

Phosphorus; The system —— from the point of view of the theory of allotropy. A. Smits and S. C. Bokhorst. Z. physik. Chem., 1916, 91, 249—312. J. Chem. Soc., 1916, 110, ii., 317—319.

The vapour-pressure curves of molten white and violet phosphorus were found to belong to one and the same vapour-pressure curve, indicating that liquid white phosphorus may be termed supercooled liquid violet phosphorus. When violet phosphorus has not been completely freed from white phosphorus by extraction with carbon bisulphide, the vapour pressure is always too high. Above 450° C. the last traces of white phosphorus are transformed with measurable velocity into violet phosphorus, and the vapour pressure sinks to the value appropriate for the violet phosphorus. Red phosphorus is a metastable modification, which never exists in internal equilibrium and is not a homogeneous substance. The authors term it "red-coloured phosphorus," and characterise it as a mixture of mixed crystals of varying composition. The only stable solid modification of phosphorus is violet phosphorus (the metallic phosphorus of Hittorf), and the colour of this depends on the size of the particles, as is shown by the fact that, using the same method of preparation, red specimens and violet specimens are obtained which have the same vapour pressure and specific gravity. Graphically it has been shown that the triple point of violet phosphorus lies at 589·5° C. and 43·1 atms. An exact experimental determination gives 589·5° C. as the temperature of the triple point. The heat of sublimation, Q_{SG}, has the very high value of 25·839 Cal.; it is not a function of the temperature. The heat of fusion Q_{SL}, is 15·618 Cal. A particular confirmation of the theory of allotropy is furnished by the fact that when violet phosphorus is rapidly and partly vaporised in a vacuum at a temperature where the internal equilibrium is only slowly set up, a substance of abnormally low vapour pressure is obtained. This experiment proves that the more volatile component has been expelled at a temperature at which it can only slowly be re-formed. The vapour pressure of this substance increases continuously at constant temperature, and after the addition of 0·1% of iodine and heating at 410° C. the internal equilibrium is again set up and the vapour pressure becomes normal.

Phosphorus; Black ——. P. W. Bridgman. J. Amer. Chem. Soc., 1916, 38, 609—612.

Attempts to prepare black phosphorus (this J., 1914, 787), by heating the violet and bright red varieties of red phosphorus, alone and with iodine or metallic sodium as catalyst, at 200° C. under pressure, were unsuccessful, but, in the presence of iodine, bright red phosphorus was converted into violet phosphorus. Black phosphorus is stable, compared with white phosphorus, at 200° C. at pressures above 4000 kilos. per sq cm., and probably at lower pressures; violet is stable, compared with white phosphorus somewhat below 200° C. at 4000 kilos.; an violet phosphorus is stable, compared with re phosphorus, at 200° C. under 8000—12,00 kilos. pressure. Sodium acted as a very efficien catalyst in converting white phosphorus into th violet modification.—F. Sodn.

Graphite; Purification of ——, particularly fron sulphur and iron. E. Donath. Chem.-Zeit. 1916, 40, 579.

The graphite is either heated with zinc dust, ai being excluded, or treated with permanganate i presence of caustic soda. In either case the produc is treated with hot hydrochloric acid and washe with water.—G.F.M.

Hydrogen peroxide as hydrolytic agent. Dubsk *See* III.

Potassium chlorate and perchlorate as substitutes f nitre in the glass industry. Springer. *See* VII

Recovery of ammonium molybdate from filtrates the determination of phosphorus in iron and ste Friedrich. *See* X.

Pickling steel with sodium bisulphate. Le Chateli and Bogitch. *See* X.

Action of carbon dioxide on some metals and metali compounds. Von Bacho. *See* X.

Chemical and physical properties of artificial zeolit Von Sigmond. *See* XVI.

Ninhydrin reaction with amino-acids and ammoni salts. Harding and Warneford. *See* XX.

Separation of thorium from iron with the aid cupferron. Thornton. *See* XXIII.

Patents.

Nitre cake; Recovery of sulphuric acid from — J. Mackenzie, Middlesbrough. Eng. Pat. 13,9 Sept. 30, 1915.

Nitre cake is melted in the pot of an ordin salt-cake furnace. and when the moisture and weak acid have been eliminated. the charge is pushed on to the roaster. and the sulphuric acid expelled and led into a Glover tower or other suitable apparatus.—W. G. C.

Sulphuric acid residues [*from petroleum refining*]*; Process for the treatment of* ——. J. S. and A. A. Blowski. Oakland. Cal. U.S. Pat. 1.186.373. June 6. 1916. Date of appl., Jan. 30. 1915.

Waste acid from petroleum refining is separated from tarry matter by dilution with water. and the diluted acid is rapidly distilled in order to minimise the reduction of sulphuric acid by organic matter present. and to obtain a distillate with a maximum amount of hydrated sulphuric acid.—E. H. T.

Antimonates [*for clouding glass and enamels*]*; Manufacture of* ——. P. Eyer. Halberstadt. Germany. Eng. Pat. 11.083. July 30. 1915. Under Int. Conv.. Aug. 5. 1914.

Very pure antimonates. of white colour and voluminous structure, are prepared by heating oxides of antimony with one or more bases to a high temperature in presence of ammonium nitrate. The latter is volatilised during the reaction. Antimonates made in this way. particularly those of magnesium and zinc. are specially valuable for clouding glasses and enamels: for this purpose an excess of bases should be used. —E. H. T.

Electrolysis and treatment of [*cadmium or copper*] *sulphate liquors.* E. J. Hunt. Oldbury. and W. T. Gidden. Warley. Worcestershire. Eng. Pat. 14.273. Oct. 8, 1915. Addition to Eng. Pat. 11.634. May 19, 1913 (this J., 1914. 692).

The process claimed in the main patent. is applied to solutions of cadmium and copper sulphates. and the anode mud produced in the process. *e.g.*, lead or manganese peroxide. is used for separating impurities of iron from the solutions before electrolysis.—B. N.

Sodium perborate; Manufacture of ——. Deutsche Gold- u. Silber-Scheide-Anstalt vorm. Roessler. Frankfort. Germany. Eng. Pat. 14.292, Oct. 8. 1915. Under Int. Conv., Oct. 26, 1914.

Granulated borax is suspended in a solution of alkali carbonate which is electrolysed. the electrolysis being continued until all the borax is transformed into crystallised sodium perborate. Some impurities in the electrolyte known to be catalysers. such as iron compounds, retard the formation of sodium perborate; these can be removed or their harmful effect destroyed by the addition of negative catalysers exerting a protective action. such as stannic acid, sodium perborate. or sodium bicarbonate.—W. G. C.

Potassium chloride; Process for obtaining —— *from certain waters.* N. Wrinkle. Keeler. and W. W. Watterson. Bishop. Cal. U.S. Pat. 1.184.806.May 30.1916.Date of appl..Dec.15.1915.

Waters containing sodium chloride. sulphate. and carbonate in addition to potassium chloride are first treated with carbon dioxide gas in order to produce an amount of sodium bicarbonate sufficient to form " urao " ($Na_2CO_3.NaHCO_3.2H_2O$) with the unaltered carbonate. The solution is then concentrated by evaporation. and the urao which separates is removed; by concentrating the solution further. sodium chloride and sulphate separate. and finally the potassium chloride is obtained from the mother-liquor by cooling and crystallisation.—J. B. C. K.

Potassium chloride: Process for cooling and drying hot residues from the manufacture of ——. O. Bothner, Leipzig. Ger. Pat. 291,793. Mar. 25. 1914.

The residues left after the extraction of potassium chloride from potash minerals are cooled and dried by transporting them pneumatically through pipes. —A. S.

Titanic oxide concentrate and method of obtaining the same. A. J. Rossi and L. E. Barton. Niagara Falls, Assignors to Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1.171.512,Feb.15,1916. Date of appl.,May22,1914.

A titanic oxide concentrate readily soluble in concentrated sulphuric and other acids. is obtained by fusing the ore. *e.g.*. ilmenite, in an electric or reverberatory furnace. with a reducing agent. preferably petroleum coke, and an alkali sulphate or bisulphate, such as nitre-cake or salt-cake. The proportion of the latter must be such that the iron in the ore is converted into sulphide, the titanium into alkali titanate. and the silica and alumina into alkali silicates and aluminates: sufficient carbon must be used to ensure the reduction of the sulphate to sulphide. The solidified melt will disintegrate to a fine powder on exposure to the air for one or two days. or it may be crushed at once. It is then boiled with dilute sulphuric acid (in an amount slightly in excess of that required to combine with the bases present), whereby the iron. silicates. aluminates. etc., remain in solution. but not the titanium oxide which after separation and drying is left as a light or dark grey powder, containing from 65%—80% of the oxide. sodium. free sulphur. sulphate, and smaller amounts of silica, iron oxide. carbon and combined water. When calcined it turns yellow. and its titanic oxide content is raised about 2%.—E. H. T.

Gypsum product [*for coating paper*]. W. Hoskins. Chicago, Assignor to Best Brothers Keene's Cement-Co., Medicine Lodge. Kans. U.S. Pat. 1,178,016,Apr.4,1916. Date of appl..Nov.29.1915.

Natural gypsum is crushed and after mixing with water is ground in a ball mill to a degree of fineness considerably greater than that of the red corpuscles of the blood. The ground product is then separated and collected by flotation and is an exceedingly fine, velvety. uniform and amorphous powder, equal or superior to china-clay as a coating for paper.—W. G. C.

Ammonium sulphate; Manufacture of —— *from magnesium sulphate and ammonia.* H. Precht. Hanover. Ger. Pat. 292.218, May 4, 1915.

Magnesium sulphate solution is treated with excess of ammonia, preferably under pressure. and the resulting solution is concentrated. the excess of ammonia being recovered. Ammonium-magnesium sulphate crystallises out first. leaving nearly pure ammonium sulphate in solution. The ammonium-magnesium sulphate may be treated with a further quantity of ammonia to convert it into ammonium sulphate and magnesium hydroxide.—A. S.

Sulphur wells; Operating ——. W. D. Huff. La Fayette. La.. Assignor to L. G. Moss. New Iberia. La. U.S. Pat. 1.184.649, May 23, 1916. Date of appl., July 8. 1915.

A well-casing closed at the top is provided with perforations near the bottom. and also with one or more electric heaters mounted near the perforated portion of the casing. Water supplied to the casing is heated by the heaters and passes through the perforations into the sulphur-bearing strata. The molten sulphur is raised to the surface through an inner pipe which passes down and projects beyond the bottom of the casing.—J. B. C. K.

Basic ferric sulphate liquor ; Process of forming ——. S. S. Sadtler. Montgomery County. Assignor to The Westmoreland Chemical and Color Co., Philadelphia. Pa. U.S. Pat. 1.186,611, June 13, 1916. Date of appl.. Apr. 16. 1913.

Basic ferric sulphate is produced by adding barium hydroxide to a solution of ferric sulphate, dissolving the precipitated ferric hydroxide in excess of the sulphate solution. and filtering to remove barium sulphate.—A. B. S.

Cyanogen compounds : Synthetic production of ——. A. R. Lindblad. Ludvika. Sweden. U.S. Pat. 1.186.921, June 13. 1916. Date of appl.. Nov. 18. 1914.

See Eng. Pat. 22.852 of 1914; this J., 1915, 905.

Sodium sulphate and cement ; Process and apparatus for manufacture of ——. L. P. Basset. Paris. Eng. Pat 8128. June 1. 1915. Under Int. Conv.. June 11. 1914.

See Fr. Pat. 477.353 of 1914 ; this J., 1916, 601.

Salt : Process and apparatus for converting rock salt into a bulky table ——. L. W. Damman, Zwolle. Netherlands. Eng. Pat. 9082, June 21, 1915. Under Int. Conv., June 29, 1914. Addition to Eng. Pat. 10.304 of 1914, dated Sep. 17, 1913.

See Ger. Pat. 291,265 of 1914 ; this J., 1916. 690.

Zinc sulphate solution from zinc ores ; Process of preparing pure ——. S. Araki, Osaka, Japan. U.S. Pat. 1,185,757, June 6, 1916. Date of appl., Sept. 6. 1913.

See Fr. Pat. 464.038 of 1913 ; this J., 1914. 484.

Nitrogen ; Fixation of ——. E. A. Ashcroft, London. U.S. Pat. 1,186.367, June 6, 1916. Date of appl.. Dec. 21. 1914.

See Eng. Pat. 10,420 of 1914 ; this J., 1915, 716.

Furnaces and kilns for applying and utilising heat of combustion. Eng. Pat. 4226. *See* I.

Treatment of waste sulphuric acid from the refining of tar oils or petroleum. Ger. Pat. 291,775. *See* III.

Process for obtaining cement and soluble potassium compounds. U.S. Pat. 1,186,522. *See* IX.

Manufacture of caustic magnesia from crystalline magnesite. Ger. Pat. 291,686. *See* IX.

Manufacture of fertilisers containing ammonium chloride or pure ammonium chloride. Ger. Pat. 292.171. *See* XVI.

Manufacture of a fertiliser from the waste liquor from potash works. Ger. Pat. 292,209. *See* XVI.

VIII.—GLASS ; CERAMICS.

Potassium chlorate or perchlorate as substitute for nitre in the glass industry. L. Springer. Sprechsaal. 1916. 49, 96—97, 104—105. Z. angew. Chem.. 1916, 29, Ref., 304—305.

Experiments on a working scale have shown that nitre may be replaced by potassium chlorate or perchlorate. In consequence of the volatility of potassium chloride. it is necessary to add also sodium or potassium carbonate to maintain the desired viscosity and composition of the glass. In small-scale tests with lead glasses a slight opalescence was produced, probably owing to the action of volatilised potassium chloride.—A. S.

Silver on glass : Yellow coloration of burnished ——. L. Springer. Keram. Runds.. 1916. 24, 89—90, 95—96. Z. angew. Chem., 1916, 29, Ref., 306.

In continuation of earlier work (this J.. 1916, 539), it has been found that in using silver decoration in conjunction with enamel colours, it is immaterial whether the silver be applied first and fixed by burning and then the enamel applied and the ware fired a second time, or the silver and enamel applied and both fixed together by a single firing. Yellow coloration of the silver and discoloration of the enamel are not to be feared if pure silver is used, with lead borate as flux.—A. S.

Flint and quartz : Studies on ——. *I.* J. W. Mellor and A. J. Campbell. Trans. Eng. Ceram. Soc., 1915-16, 15, 77—85.

Crystallised silica occurs in nature as : α-Quartz, sp. gr. 2·65—2·66. α-tridymite, sp.gr. 2·32—2·33, and α-cristobalite sp.gr. 2·31—2·32. By heat these are changed into other forms, the equilibrium condition of all different forms between 1470° C. and the melting point, 1625° C., being β-cristobalite. The specific gravity of quartzose silica on calcination falls from 2·66 to 2·32. and that of potters' flint from 2·61 to 2·22. When calcined in a china biscuit oven at cone 10, the change from the high to the low specific gravity form is rapid in the case of flint, and slow in the case of quartz : the rates of change are about as 1 is to 3. The calcined products contain different proportions of two substances. which may be designated *A*- and *B*- quartz or flint. The reactions appear to be unimolecular. The relation between the specific gravity of flint and quartz and the number of times (n) they have been fired in a china biscuit oven is given by the equations :—

$$S(\text{flint}) = \frac{14{\cdot}87}{6.7 - e^{-1{\cdot}05n}} \text{ and } S(\text{quartz}) = \frac{18{\cdot}096}{7{\cdot}8 - e^{-0.314n}}$$

Calcining for 3 hours at cone 35 converts about 65% of *A*-quartz into *B*-quartz, but in the same time at cone 14 nearly all the *A*-flint is converted into the *B*-variety. At cone 3 about 35% of grey flint and about 30% of black flint is converted. The decrease in specific gravity is accompanied by a corresponding increase in volume of quartz and flint on calcination, and the latter is shattered much more than the former by the process. Calcined flint and quartz, containing different proportions of the *A*- and *B*-forms of silica, naturally do not behave quite the same in pottery bodies. —W. C. H.

Flint and quartz ; Studies on ——. *II.* J. W. Mellor. Trans. Eng. Ceram. Soc., 1915-16, 15, 86—102.

A brief outline of the geology of flint formation is given and the method of collection of potters' flints is described. These are divided into "chalky" flints—the outsides of which are coated with a white layer, which differs only from the main mass in composition in containing about 8% of calcium carbonate—and "boulder" flints. Geologically and chemically there is no essential difference between them. The colour of grey and black flints appears to be due to hydrocarbons. Partly for the sake of removing this colour, flints are calcined for pottery purposes, and if the process is complete the specific gravity of the material is reduced from about 2·61 to 2·22. Incomplete calcination yields a material having an intermediate value for the specific gravity and a table and method of calculation are given by which the percentages of high- and low-gravity flint in a sample can be determined from its specific gravity. Differences in calcination further affect the slop weight of flint ; the greater the specific gravity of a sample of calcined flint, the less will be the dry contents of the slip. The substitution of sand for flint is said to cause peeling or crazing. These faults may be due to sand being underground, owing to its toughness when uncalcined, or to the difference in the specific gravities of sand and calcined flint, which would affect the weight per unit volume of the slip and so cause a smaller quantity of sand to be introduced into the body. Several formulæ and diagrammatic representations for slop weights of slip are also given.—W. C. H.

Flint and quartz; Studies in ——. III. B. Moore and J. W. Mellor. Trans. Eng. Ceram. Soc., 1915-16, **15**, 103—116.

Owing to a possible shortage of flints, the authors have considered other available supplies of silica which might be suitable for bodies, the chief desideratum being a satisfactory colour when fired. Among fairly pure forms of silica are sand, geyserite (though this is obtained from Iceland, and consequently is not a British material), chert, samples of which, however, so far have not been found to fire a good colour, and quartz and quartzite rock. It is probable that the speed of reaction of flint with felspar and clay differs from that of quartz. Uncalcined sand is tougher and so requires more grinding to make it strictly comparable with calcined flint. When extra finely ground quartz is substituted for flint, the margin of safety from crazing is increased, but the percentage of cracked biscuit also increases very much. Similar results are obtained when Westwood stone is substituted for Cornish stone and flint, and no economy is effected; partial replacement of Cornish stone by more silicious rocks such as Washerwall or Westwood stone is hardly a case of a substitute for flint. Flint in body mixtures may also be dispensed with by partially replacing china and ball clay by some more silicious clay, such as silicious china and ball clays, pipe clays, etc. Many of these are white burning and comparatively highly plastic.
—W. C. H.

Fireclays; The effect of loads on the refractoriness of ——. J. W. Mellor and B. J. Moore. Trans. Eng. Ceram. Soc., 1915-16, **15**, 117—130.

The lowering of the fusing point of refractory materials by pressure may be due to pressure diminishing the apparent viscosity or to its hastening the reaction between different minerals in the clay. The authors used an electric resistance furnace in their tests. It consisted essentially of a graphite resistance packed round a refractory cylinder open at both ends; test-pieces were supported on blocks just inside the lower end and pressure could be exerted on the pieces by means of a thick graphite rod worked by a lever to give varying pressures. The test-pieces were cylinders 6 cm. long and 2 cm. diameter and were fired to cone 4. The rate of heating the furnace was about 50° C. in 5 mins., and the temperatures were measured by Seger cones. It was found that the softening or "squatting" temperature of fireclays is reduced by a compressive load, and the decrease, with unit increase of load, is directly proportional to the squatting temperature, and equal to k times the squatting temperature. The relation between the squatting temperature T (expressed either in degrees C. or in Seger cones) and the load W, expressed in pounds per square inch, is given by the equation: $T = Ce - kW$ where C represents the squatting temperature, without load. k is a constant dependent upon the particular clay, etc., and e is the regular exponential constant. The squatting temperature of china clay falls approximately one cone for every 5¼ lb. per square inch increase in the load. The more silicious the clay, the less is the difference between the squatting temperatures with and without load.—W. C. H.

Chrome-tin pink; A note on ——. J. W. Mellor. Trans. Eng. Ceram. Soc., 1915-16, **15**, 131—132.

The author considers that the tint of chrome-tin pink is the same whatever compound of chromium is used, and that differences observed by other workers arose from incomplete development of the colour through under-firing. To test this point, four portions of the same mixture were fired one at cone 06a, one at cone 4, and one at cone 10, whilst the fourth was fired at cone 10, ground, and refired at cone 10. The samples were ground, washed, mixed with 85% of slop glaze, and fired in the majolica kiln. The colours were analysed by Lovibond's tintometer with the following results:—

Pink matured at:	Red.	Yellow.	Blue.
Cone 06a	1·15	2·8	—
Cone 4	8·2	9·0	1·0
Cone 10	18·5	16·0	1·5
Cone 10 repeated ...	18·5	16·0	3·0

These figures show that at least for the particular chromium compound employed, the tint, during development, is sensitive to the temperature, and the reaction is virtually complete after once firing to the temperature of the china biscuit oven. If the calcination is stopped before the pink is fully developed, the tint is probably dependent on the source of chromium employed. The figures also show that purpling of the chrome-tin pink occurs when the colour is fired at too high a temperature.—W. C. H.

Brown [earthenware] colours; Studies on the ——. I. J. R. Adderley. Trans. Eng. Ceram. Soc., 1915—16, **15**, 133—134.

Experiments were made to show the effect of varying proportions of china clay and zinc oxide on a mixture of equal parts of ferric and chromic oxides. These mixtures were calcined, wet ground, sifted through a 200's lawn, dried, and painted on earthenware biscuit. The colours were hardened on, and dipped in (1) raw lead, (2) fritted lead, and (3) leadless glaze, and fired in the earthenware glost oven. The raw lead glaze gave the worst results, as it attacked the chromic and ferric oxides at different rates and so produced irregular variations in the colours. The fritted lead glaze gave the best results, and apparently did not attack the constituents at different rates. The tests showed the characteristic zinc-iron brown as the amount of zinc was increased, and much darker tints were developed as the amount of china clay was increased.—W. C. H.

Patents.

Glass; Method of marking ——. The British Thomson-Houston Co., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 12,617, Sept 2, 1915.

The surface of the glass is first covered with colloidal thorium or tungstic oxide and the coated surface is marked in the desired manner with a stylus of aluminium, magnesium, copper, brass, soft iron, nickel, platinum, gold, or other soft metal, depending on the colour desired. The article may subsequently be subjected to the action of colouring baths. The colloidal layer enables the stylus to "bite" the glass, which thereupon becomes deeply scratched, and particles of abraded metal adhere firmly to its surface and remain when the colloidal coating has been washed off; they are not removed by ordinary friction or washing but may be removed by solution in acid, leaving distinct markings on the glass.
—A. B. S.

Glass ; Manufacture of ——. J. A. Chambers, Pittsburgh, Pa. U.S. Pat. 1,186,076, June 6, 1916. Date of appl., Jan. 26, 1916.

The molten glass metal, at a flowing or dipping temperature, is transferred to a refractory receptacle and maintained at a temperature sufficiently high to eliminate bubbles in the glass.—A. B. S.

Glass furnace. W. Westbury, Assignor to L. S. Skelton, Okmulgee, Okla. U.S. Pat. 1,187,025, June 13, 1916. Date of appl., Nov. 12, 1915.

A glass furnace has a "dog-house" projecting internally and externally from the line of the front wall and terminating below the crown of the furnace. The top wall of the dog-house has a draw-hole extending equally on opposite sides of the line of the front wall, the latter having a breast curved to form a recess communicating with the inside of the draw-hole.—A. B. S.

Abrasive materials ; Manufacture of ——. T. B. Allen, Toronto, Canada, Assignor to General Abrasive Co., Niagara Falls, N.Y. U.S. Pat. 1,187,225, June 13, 1916. Date of appl., Apr. 19, 1915.

Bauxite containing iron oxide, silica, and titania, is fused in an electric furnace with a quantity of carbonaceous material sufficient to reduce the iron oxide and silica, and part of the titania. The abrasive material and ferro-silicon produced are tapped off at different levels, and the abrasive material is cast into ingots.—A. B. S.

Porcelain, earthenware, etc. ; Production of a coating of metallic appearance on ——. Lindner und Co., Jecha. Ger. Pat. 292,105, Oct. 9, 1915.

A black sharp-fire glaze is first produced on the article, which is then painted with a suitable stain, and again fired in a muffle-kiln.—A. S.

Clay and kaolin slips : Purification of ——. Richter und Richter, Frankfort. Ger. Pat. 291,834, Aug. 31, 1913. Addition to Ger. Pat. 258,152 (see Fr. Pat. 443,789 of 1912 ; this J., 1912, 1005).

The method of preparing clay for the purification of effluents, etc., as described in the chief patent (*loc. cit.*), is applied to the purification of clay and kaolin slips, for the purpose of removing sandy constituents and increasing the adsorptive power of the clay.—A. S.

Refractory materials applicable as electric resistances. W. R. Just, Freiberg, Assignee of M. Fraenken, Grunewald, Germany. Eng. Pat. 4080, Mar. 15, 1915. Under Int. Conv., Mar. 23, 1914.

A mixture of equal parts of commercial zirconia and coarse carborundum (silicon carbide) is fashioned by customary methods and burned at a high temperature. With such a mixture the tendency of zirconia to crack and lose mechanical coherence is not observed, and the carborundum is protected from oxidation. A chemical reaction appears to occur between the zirconia and carborundum ; the articles shrink considerably during burning and become covered with a glaze-like layer. The material is stated to be specially applicable to the manufacture of muffles, crucibles, and furnace linings and for electric resistances used at high temperatures.—A. B. S.

Grinding wheels ; Treatment of the material for use in the construction of ——. E. Gerbel-Strover, Westminster. Eng. Pat. 10,328, July 15, 1915.

Grit material, composed of alumina or fused bauxite (artificial corundum) is heated to 130° to 180° F. (51°—82° C.) and mixed with 20 to 25% of its weight of nitre-cake (sodium bisulphate) which has been heated to 250° F. (121° C.) so that the grains of grit may be uniformly coated. The product is spread in layers, roasted at a sufficiently high temperature to produce sulphuric anhydride, and then washed. This treatment removes iron oxide, titania, and free carbon. The purified grit is used for making grinding wheels.—A. B. S.

Bricks or tiles ; Regenerator ——. C. R. Payne, Leeds, and E. Linsley, Horsforth. Eng. Pat. 12,279, Aug. 26, 1915.

Fire bricks ; Manufacture of ——. M. Curry, Cornsay Colliery, and W. O. Wood, South Hetton, Durham. Eng. Pat. 12,756, Sept. 6, 1915.

Manufacture of antimonates for clouding glasses and enamels. Eng. Pat. 11,083. *See* VII.

IX.—BUILDING MATERIALS.

Portland cement. G. A. Rankin. J. Franklin Inst., 1916, **181**, 747—784. (See also this J., 1915, 139.)

The author attributes the superiority of Portland cement to the presence of 35% of tricalcium silicate. Study of the ternary system $CaO—Al_2O_3—SiO_2$ (this J., 1915, 139) indicates that the formation of the constituents of Portland cement is as follows:—The calcium carbonate is first converted into free lime which then unites with the clay forming $5CaO.3Al_2O_3$ and $2CaO,SiO_2$; these subsequently unite with more lime and form $3CaO,Al_2O_3$ and $3CaO,SiO_2$, the reaction being facilitated by the formation of a flux at 1335° C.—the eutectic temperature of $2CaO,SiO_2$, $5CaO,3Al_2O_3$, and $3CaO.Al_2O_3$. As the temperature rises above 1335° C. any free lime present reacts with the $2CaO,SiO_2$ forming $3CaO,SiO_2$. It is not necessary to continue the heating to complete fusion, a temperature of 1650° C. being usually sufficient for commercial materials. At this temperature the mass consists of 30% molten and 70% solid material, but on cooling the clinker is completely crystalline, and contains approximately $3CaO.SiO_2$ 45%, $2CaO,SiO_2$ 35%, and $3CaO,Al_2O_3$ 20%. The percentage of $3CaO,SiO_2$ is the chief factor in determining the value of a Portland cement. This is the last substance to be formed during the heating of the materials and under ordinary conditions 35% of it is the maximum obtained. The proportion is regulated by the temperature and duration of the heating, the amount of fluxing agents (FeO, MgO, Na_2O, etc.) present, and the size of the particles. A larger proportion of free lim than that normally used would produce a highe percentage of $3CaO,SiO_2$ if the temperature an duration of heating were sufficient, but free lim in the finished cement must be avoided as it cause loss of strength and facilitates disintegration. A an alternative to a higher burning temperatur (which is impracticable commercially), a materia richer in fluxes may be used, so as to bring abou the reaction $CaO+2CaO,SiO_2=3CaO.SiO_2$ belo 1650° C. instead of at the much higher temperatu required with the usual materials. It is propose to study other systems such as $CaO—Fe_2O_3—SiO$ to ascertain whether the replacement of Al_2 by other oxides will effect this reduction i temperature and increase the rate of formation $3CaO.SiO_2$.—A. B. S.

Nature of the sulphur in moorland soils injurious plant growth and subterranean structures. Thörn *See* XVI.

Patents.

Timber ; Treatment of ——. W. Powell, Londo Eng. Pat. 9014, June 19, 1915.

Timber is impregnated with a solution of sug (sp.gr. 1·080) to which has been added about 5 of another carbohydrate (such as starch dextrin) and 0·5% of gum tragacanth, with without 3 % of arsenic, at a temperature between 120° and 140° F. (49°—60° C.) and afterwards at boiling point. It is allowed to cool to 110° F. (43° C.) in the solution and is then taken out and dried. The sugar thickens the fibres of the wood, strengthening them and increasing their tenacity and lessening the pores; the other carbohydrate reduces the susceptibility of the wood to moisture and increases its strength and tenacity; the arsenic preserves it from the attacks of white ants and other insects.—A. B. S.

Plastic [paving] composition and process of making same. G. A. Henderson, St. Albans, W. Va. U.S. Pat. 1,187,311, June 13, 1916. Date of appl., Nov. 30, 1914.

Shredded wood, in particles of various shapes and sizes, is freed from all extractive matter; the particles are abnormally enlarged and partially dried. They are then graded so that the major portion consists of particles ranging from ¼ in. by ⅛ in. down to impalpable dust, the latter representing 2—3 % of the total; these are mixed with the larger sizes, so that the ultimate volume is equivalent to 70—90 % of the ungraded volume. The mixture is agitated with a preservative binder, previously heated to 300° F. (about 150° C.), until the particles have absorbed the binder into their expanded pores to a predetermined proportion (*e.g.*, 25—40 % by vol., measured cold). The mixture, when at 250° F. (about 120° C.), is exposed to a cooling effect to contract the ingredients, so that the binder is entrapped within the contracted pores, completely filling them, and the mass, while cooling, is gradually compressed to 50 % of its contracted volume. To determine the correct quantity of binder, the pores within and the spaces between the woody particles, when treated, expanded, and graded, are measured, and the result subtracted from 100, giving the percentage volume of solids; the latter figure is subtracted from 50 and 7—10 % added to the result.—J. F. B.

Building material; Cementitious ——. M. Rüdiger, Hamburg. Ger. Pat. 292,104, June 13, 1914.

A mixture of magnesia, magnesium sulphate, kieselguhr, and trass, with filling materials which do not putrefy or swell, can be used as a cement which sets to a stone-like material, resistant to water. The product, even with iron reinforcement, is lighter than water.—A. S.

Bricks of uniform deep red colour; Production of ——. J. Marz, Frankfort. Ger. Pat. 292,187, June 18, 1914.

The moist bricks, direct from the press, are arranged in pairs, and pressed tightly together, with a sheet of air-tight paper between the faces of the bricks. The double bricks are dried, burnt, and then separated. By excluding air and combustion gases from the face of the bricks in this way, a deep, uniform red colour is developed on the protected surfaces and extends to a sufficient depth for practical purposes.—A. S.

Plastic material and composite accelerating material therefor. Cementitious material. Composite strength-accelerating material. E. L. Conwell, Upland, Pa., Assignor to Aluminate Patents Co., Philadelphia, Pa. U.S. Pats. (A) 1,185,773, (B) 1,185,774, and (C) 1,185,775, June 6, 1916. Date of appl., Nov. 7, 1912.

(A) A hydrated high-calcium lime is mixed with 10 to 30 % of natural cement which has been ground with 5 to 15 % of "sodium supersulphate energising material." (B) A rich hydrated lime is mixed with 10 to 20 % of fused "calcium aluminate strength accelerating material comprising considerable silica," which has been ground with one-eighth as much sodium persulphate energising material. (C) A dry, finely divided composite material for accelerating the strength and improving the plasticity and cementitious properties of cement and plaster, consists of fused "calcium aluminate strength-accelerating material including silica" which has been ground with about one-eighth as much sodium persulphate energising material.—A. B. S.

Cement and soluble potassium compounds; Process for obtaining ——. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,186,522, June 6, 1916. Date of appl., Jan. 29, 1916.

Potassium-bearing silicious material is incorporated with calcareous material and calcium chloride and fused at about 1300° C. Potassium chloride is formed, volatilised, and collected. The molten non-volatile residue, after being sprayed with water and finely ground, is a hydraulic cement.—A. B. S.

Magnesia; Manufacture of caustic —— from crystalline magnesite. Austro-American Magnesite Co. (Oesterr.-amer. Magnesitges.), Radenthein, Austria. Ger. Pat. 291,686, Oct. 3, 1913. Under Int. Conv., Sept. 30, 1913.

The magnesite is burnt at as low a temperature as practicable, and the rate of dissociation of the magnesium carbonate is increased by adding steam to the atmosphere in the kiln. In this way caustic magnesia of high activity, suitable for the production of oxychloride cements from magnesium chloride liquors, can be obtained from crystalline magnesite.—A. S.

Sintered magnesite; Manufacture of ——. Harburger Chem. Werke Schön und Co., Harburg. Ger. Pat. 291,913, Oct. 6, 1915. Addition to Ger. Pat. 288,262 (this J., 1916, 180).

A mixture of lime, iron oxide, and alumina, to which suitable additions may be made to obtain a mixture containing 2—4 % SiO_2, is used to decompose the magnesium chloride liquor. The mixture should contain 1·5—5 % Fe_2O_3 and 0·5—1·5 % Al_2O_3, and such a quantity is used that the precipitate does not contain more than 5 % (calculated on the dry substance) of free lime.—A. S.

Wood; Method of increasing the density of ——. F. and H. Pfleumer, Dresden. Ger. Pat. 291,945, June 26, 1915.

The wood is subjected to pressure on all sides whilst surrounded by an elastic or viscous medium (pitch, asphalt, resins, thick glue solution, etc.) at 90°—150° C. The hardness and density of the wood are increased, and the treated wood will take a better polish.—A. S.

Wood; Process of treating ——. L. Petersen-Hviid, Kastrup, Denmark. U.S. Pat. 1,186,604, June 13, 1916. Date of appl., Dec. 30, 1913.

See Fr. Pat. 466,768 of 1913; this J., 1914, 965.

Coating composition for concrete and cement. U.S. Pat. 1,179,413. *See* XIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Semi-steel; The nature and uses of ——. I. I. Howell. Proc. Brit. Foundrymen's Assoc., 1914-15, 235—244.

Steel, when melted in a cupola, begins to take up carbon at a blood-red heat, and continues to do so until there is sufficient present to bring the melting point down to the temperature of the melting zone. The preparation of the coke bed is important for good cupola working, and, when using medium-weight coke, small pieces should be closely packed, the steel being then charged in first, in direct contact with the coke, following up with the iron. The steel should be charged into the middle of the cupola, to avoid oxidation and also action on the lining. These points affect considerably the quantity of slag, which is formed in greater quantity in melting semi-steel than with ordinary cast irons. The addition of steel to cast iron has a tendency to increase the hardness of the resulting metal, and in calculating mixtures for the production of semi-steel, the best results are obtained with :—phosphorus, 0·35 to 0·45 % or lower; sulphur, 0·025 to 0·035 %; and manganese, 1 % or higher. The silicon should be from 1·65 to 1·75 %, and ferro-manganese should be added to bring the manganese up to 2·0 to 2·5 %, as from 1 to 2 % is lost in the cupola. Increased tensile strength can only be obtained by addition of steel to low-grade irons; the addition of steel to strong irons, whilst increasing the hardness, decreases the tensile strength. Microscopic examination of a semi-steel, that has passed the point of hardness giving the greatest strength whilst the material is still machinable, showed the cementite in small and regular areas throughout, with almost entire absence of pearlite, and the phosphide eutectic in regular pools surrounding the cementite. When strength is a secondary consideration and wearing properties under high temperatures important, this structure is most desirable.—B. N.

Iron ; Thermo-electric measurement of the critical points of ——. G. K. Burgess and H. Scott. Comptes rend., 1916, **163**, 30—32.

The investigation was made with very pure iron (99·968 % Fe) by a modification of the thermo-electric method employed by Boudouard and Le Chatelier (this J., 1904, 20 ; Rev. Mét., 1, 134). The A_2 and A_3 points were clearly indicated on both heating and cooling curves, the former at 768° C. and the latter in the vicinity of 880° C. In the thermo-electric method employed by Benedicks (this J., 1916, 362) the A_3 point was clearly defined at 875° C. but no indication of the A_2 point was obtained.—W. E. F. P.

Iron-carbon diagram ; Position of martensite in the ——. W. Broniewski. Comptes rend., 1916, **162**, 917—919.

Comparative experiments on the E.M.F. of solution of annealed steels containing varying proportions of carbon, and of the same steels after quenching at 900° C., show that the dissolving of the carbon in the form of martensite reduces the free energy of the ferrite, and the order of magnitude of this diminution of free energy has been calculated. Martensite is regarded as a solid solution of carbon (or cementite) in α-iron, as maintained by Le Chatelier, and the experimental results are considered to indicate that the temperature region within which it is stable is below that of annealed steels. The limiting concentration of the solid solution (less than 0·05 % C at the ordinary temperature) increases as the temperature falls and becomes rapidly larger when the temperature of liquid air is approached ; this is shown in an equilibrium diagram. The appearance of martensite in a state of unstable equilibrium, as a result of quenching, is considered due to its being the form nearest to austenite (see Ostwald, Z. physik. Chem., 1897, 22, 283).—F. Sodn.

Steel ; Some properties of annealed ——. T. Matsuda. Sci. Rep. Tohoku Imp. Univ., 1916, **5**, 121—126.

To determine the effects of varying annealing temperatures on the properties of cold-drawn carbon steel (about 0·8 % C), wires 20 cm. long and 1·8 mm. thick (about one-third the diameter of the original rod) were heated for 1 hour at from 47° to 755° C. and tested when cold. The tensile strength was practically constant up to 100° C., increased gradually to a maximum (about 5 % above the value at ordinary temperature) at 200° C., and then decreased continuously, the decrease becoming much more rapid at 350° C. As regards torsion, the general features of the change were the reverse of those in the tensile tests, the minimum value occurring at 200° C. The solubility in 1 % sulphuric acid (24 and 48 hour tests) was practically constant up to 500° C., but decreased rapidly beyond this point. No appreciable change in microstructure occurred up to about 400° C. For electrical resistance tests, wires 80 cm. long and 0·47 mm. thick were used : no perceptible change in resistance was found up to 200° C., but above this point a gradual reduction occurred until, at 400° C., a decrease of about 2 % was observed. In the magnetic tests an external field of 267 gauss was applied : magnetisation began to increase from 100° C., attained a maximum (an increase of not more than 1 %) at 200° C., and then gradually decreased. Additional experiments to determine the nature of the magnetic change in the vicinity of 200° C., indicated that the increase in tensile and decrease in torsional strength at this temperature is due to the magnetic transformation of cementite.—W. E. F. P.

Steels ; Transformations of special [alloy] —— at high temperatures. K. Honda, K. Tawara, and H. Takagi. Sci. Rep. Tohoku Imp. Univ., 1916, **5**, 135—151.

Six carbon and six special steels were studied magnetically, thermally, and micrographically. The carbon steels contained from 0·1 to 1·22% C and were tested at temperatures up to 800° C. The special steels, the principal constituents of which are shown in the following table, were tested at various temperatures up to 1260° C. :—

Name of steel.	C %	Si %	Cr %	W %	Mo %	V %
A. D.S.W.	1·16	2·89	2·74	—	—	—
B. Ultra Capital Siebohm	0·66	0·08	3·43	16·81	—	0·11
C. New Capital Siebohm	0·64	0·05	3·73	14·06	—	0·11
D. Böhler super rapid	0·82	0·18	3·71	14·63	0·017	0·20
E. Novo	0·59	0·22	2·86	18·81	—	—
F. Becker Diamond ...	1·05	0·18	—	3·17	—	—

For all the carbon steels the magnetic transformation of plain cementite was observed at about 200° C. both on heating and cooling. By the eutectic transformation the magnetisation was changed abruptly, the amount increasing with the quantity of eutectic. The eutectic point for heating was 30° to 80° higher than for cooling, and considerable heat was evolved or absorbed by the transformation. In the heating curves for steels A, B, and C, only two peaks occurred in the whole range of temperature up to 900° C., the first being due to the magnetic or A_2 and the second to the A_3 transformation ; the positions of these peaks were independent of the maximum temperature to which the steels were previously heated. In the cooling curves for the same steels, the temperature of the beginning of the magnetic transformation was practically the same as that of its ending in the heating curves, but the A_3 transformation was displaced towards a lower temperature, coinciding with the magnetic transformation in steel B but occurring slightly above the critical point in steels A and C. In the heating curves of steels D and E there were only two peaks, corresponding to the A_2 and A_3 transformations, the positions of which were independent of the maximum temperatures previously attained. In the cooling curves, the critical point remained almost unaltered but the A_2 and A_3 transformations were coincident. When these steels were cooled from 1000° C. or above, the transformation was displaced to a much lower temperature (about 400° C.). Both on heating and cooling, steel F gave the magnetic transformation of plain cementite at about 200° C. in addition to a conspicuous heat phenomenon characteristic of the eutectic transformation. The existence of the latter was also shown by the magnetic experiments, the critical temperature being practically the same on heating and cooling. The conclusions drawn from the magnetic and thermal examinations were in all cases confirmed by the microstructures of the specimens.—W. E. F. P.

Coke as a reducing agent in the electric smelting furnace. R. C. Gosrow. Met. and Chem. Eng., 1916, **14**, 691—694.

The author describes attempts to smelt iron and manganese ores with coke in a three-phase furnace with four electrodes in a straight line. A large proportion of lime had to be used to eliminate a high content of sulphur in the coke. The furnace gave incessant trouble with crusts, hang-ups, broken electrodes, cold bottom, etc., although it had previously given good results when charcoal was used as the reducing agent. One important difference between coke and charcoal is that coke occupies only about one-third of the volume of the equivalent amount of charcoal. The volume of conducting material is thus reduced and the resistance of the charge increased. The controlling factor however in the action of coke is that the carbon is in the form of a dense hard structure in the mass forming the walls of the cell structure. This form of carbon is very resistant to oxidation, and also, at the temperature of the arc, gives rise to infusible carbides. This formation of carbides appears to be the principal objection to the use of coke in the electric smelting furnace. To it are due the "sowing" in the furnace, and the formation of accretions, with all their attendant evils. This trouble should be largely eliminated however where a nearly neutral or acid slag is used; bridging and "sowing" are much less marked in a low, stackless, type of furnace, than in the shaft and stack type.—T. St.

Electric arc furnace for melting and refining steel; Some faults of the small ——. W. M. McKnight. Min. and Eng. World, 1916, **44**, 955—956.

Losses may be caused by improper electrical conditions and by faulty design of the furnaces. The chemical conditions may be improved by employing a better refractory lining, producing an electrode that does not waste in heating the bath, and by utilising the waste gases. A basic lining of magnesite is recommended, either in the form of bricks conforming to the shape of the shell and embedded in a basic paste or coal-tar binder, or, preferably, the mass of magnesite is rammed into the shell. Graphite electrodes are preferable to carbon ones, as they have a greater carrying capacity, and may consequently be smaller in diameter, and offer less surface for radiation of heat and oxidation.—B. N.

Heat treatment of steel in coal gas. C. M. Walter. Midland Junior Gas Assoc., June 24, 1916. J. Gas Lighting 1916, **134**, 691.

Experiments on the case-hardening of steel showed that by using town's gas alone as a carburising agent very little carbon was absorbed by the steel, but if about 10% by vol. of ammonia was added to the gas very satisfactory results were obtained. One advantage of using gas was that the quenching and re-heating could be carried out in an atmosphere of gas and so surface decarburisation was avoided.—W. H. C.

Carbon in iron and iron alloys; Determination of total ——. F. Heinrich and K. Roger. Ferrum, 1916, **13**, 81—84. Z. angew. Chem., 1916, **29**, Ref., 287.

For the determination of carbon in iron by direct combustion in oxygen, an addition of aluminium, alumina, and lead peroxide is recommended. The aluminium facilitates the combustion owing to its high heat of oxidation, and the oxides accelerate the reaction, decompose carbides, and form a fusible slag. From 0·2 to 0·6 grm. of the sample is intimately mixed with about 2 grms. of a mixture of equal parts of aluminium powder, alumina, and lead peroxide, which has been dried at 300° C. From 0·7 to 0·9 grm. of lead peroxide is then added, according to the carbon content of the sample, and the mixture is placed in a boat, heated to 700°—800° C. in a Heraeus electric furnace, and then burnt in a current of purified oxygen. Combustion is complete in 5—6 minutes, and the carbon dioxide formed is absorbed by soda-lime.—A. S.

Iron; New method of determining the gases in ——. P. Goerens and J. Paquet. Ferrum, 1915, **12**, 57—73. Rev. Mét., 1915, **12**, Ext., 402—404.

The method consists in melting 3 grms. of the sample in an electric resistance furnace in a magnesia crucible with 3 grms. each of tin and antimony, and determining the gases evolved in an Orsat apparatus in which communication of the absorbent solutions with the outside air is prevented by mercury. Low-carbon steels produced in an electric furnace gave the smallest quantities of gas, a well deoxidised metal giving only 10 to 15 c.c. per 100 grms. Thomas and Martin steels gave from 22 to 78 c.c. per 100 grms. The limits found for the different gases were:—carbon dioxide 0·0020 to 0·0200, carbon monoxide 0·0015 to 0·1000, hydrogen 0·0002 to 0·0047, and nitrogen (by difference) 0 to 0·0141% by weight. Refined Thomas steel contains a smaller amount of gas than finished Martin steel. The authors also give the results of tests made at different stages in the manufacture of steels.—T. St.

Sodium bisulphate; Pickling [steel] with ——. H. Le Chatelier and B. Bogitch. Rev. Mét., 1915, **12**, 949—960.

The authors have worked out the following procedure for utilising nitre cake as a substitute for sulphuric acid in steel pickling baths. The first solution is made to contain 25 grms. of sodium bisulphate per 100 c.c. and is used at 80° C. until half the sulphuric acid has been consumed; 12·5 grms. of bisulphate is then added and again half the acid is consumed; 12·5 grms. of bisulphate is again added, and the bath used a third time. The acid liquid thus charged with ferrous sulphate and on the point of crystallising is then discarded. Alternatively the bath may be cooled to 25° C., after adding a third lot of bisulphate, when the double sodium and iron salt which crystallises is separated, the liquor reheated to 80° C., and the volume made up with added water. To ensure that none is wasted, it is best to add the bisulphate dissolved in half its weight of boiling water. It is necessary to control the acidity of the bath by actual tests to avoid loss of bisulphate, on the one hand, and undue impoverishment of the bath, on the other.—T. St.

Ammonium molybdate: Recovery of —— *from filtrates in the determination of phosphorus in steel and iron.* R. Friedrich. Chem.-Zeit., 1916, **40**, 560—561.

The filtrates from ammonium phosphomolybdate precipitates are treated with sodium phosphate solution. the yellow precipitate formed is collected. washed with water containing sodium sulphate. and then dried in air; 500 grms. of the dried precipitate is dissolved in ammonia, 30 grms. of ammonium chloride and 60 grms. of magnesium chloride added. the ammonium magnesium phosphate separated by filtration, and the filtrate treated with concentrated hydrochloric acid. a few drops of hydrogen peroxide having been added previously if the solution has a greenish colour. An excess of hydrochloric acid should be avoided. The precipitated molybdic acid is collected. washed with water, dissolved in hot ammonia, and the ammonium molybdate allowed to crystallise. The mother liquor from these crystals is added to the next batch of molybdic acid filtrates to be treated: the liquor from the hydrochloric acid precipitation of the molybdic acid may also be saved for subsequent treatment.—W. P. S.

Gold; Flotation of flour ——. R. W. Smith. Eng. and Min. J., 1916, **102**, 25—27.

AN ore containing Au 0·3 oz., Ag 2·5 oz. per ton, Pb 5, Zn 8·5, Fe 3·5, and Cu 0·5%, could not be treated with economic success by gravitation concentration, but was successfully dealt with by floating the slimes and treating the coarse portion by gravity and electrostatic separation. The froth concentrates, obtained without the use of acids or heat, were washed with water to a Wilfley table which effected a perfect separation of the relatively coarse lead and zinc. The gold, which was in an extremely fine state of division, appeared very largely in the first riffles of the table, the saving of gold amounting to about 85%.—T. ST.

Silver; Distribution of —— between metallic lead and litharge-containing slags. B. Dudley, jun. Met. and Chem. Eng., 1916, **14**, 636—641, 695—701.

IN the assay of gold and silver ores where the precious metals are concentrated in a button of lead, loss may arise due to the solvent action of the slag for the gold or silver. The ebullition caused by the escape of gases formed in the reaction, and the convection currents set up in the molten slag, tend to produce the conditions necessary for each of the two immiscible solvents, lead and slag, to exercise fully its solvent action, and for equilibrium to become established. Experiments made by the author showed that with slags consisting of PbO. Na_2O, SiO_2, and B_2O_3, such an equilibrium may be established between the slag and lead with respect to silver, the total amount of silver retained by the slag being proportional to the weight of the slag under a given set of conditions. The concentration of silver in the slag increases with increasing temperature, other conditions being constant. The rate of increase of the silver concentrate is somewhat greater than the rate of the temperature increase. At constant temperature the concentration of silver in the slag varies directly with its concentration in the alloy with which the slag is in contact. For small concentrations of silver in the metal, the concentration in the slag is proportional to the weight percentage of the silver in the alloy. With richer silver-lead alloys the silver concentration in the slag is proportional to the molecular percentage of silver in the metal. Litharge is the most active of the slag-forming constituents in dissolving and retaining silver, the amount retained by the slag being directly proportional, other conditions being constant, to the molecular concentration of litharge in the slag, and independent of the silicate degree, or oxygen ratio of the slag. From the results obtained with slags the author has calculated the equilibrium concentration-ratios of silver in silver-lead alloys and pure litharge at various temperatures. With regard to the retention of silver by litharge during cupellation, however it is pointed out that owing to oxidation of silver, the litharge produced may contain much more dissolved silver than corresponds to equilibrium conditions.—T. ST.

Zinc distillation process; The Roitzheim-Remy continuous ——. M. Liebig. Metall u. Erz, 1916, **13**, 143—156. Met. and Chem. Eng., 1916, **14**, 625—629.

CONTINUOUS reduction is obtained by feeding the preheated charge of ore into the top of a vertical retort, and discharging the cooled residue mechanically from the bottom of a cast iron cooling chamber. The retort is open, top and bottom, but is sealed from the atmosphere by the charge and ashes. The clay condenser is arranged perpendicularly to the retort in a niche suitably heated, the front end being connected to a tube leading to the "prolong" catching the zinc dust, and the escaping carbon monoxide is burnt to ascertain if uncondensed zinc is present, the gases being passed into the main chimney. The furnaces are heated by gaseous fuel on the regenerative principle, and require little attention beyond superintendence of the machinery, and tapping of the zinc once in 24 hours. Zinc, of 98·6 to 99% purity, is obtained and is fairly free from lead. Several advantages, over the Rhenish smelting system, are claimed for the process, including the reduction, by 40%, of the labour required, the lessened consumption of refractory materials in muffles and condensers, equal to about 45%, and a saving in tools, machine work, heating coal and general costs, but against these economies there must be set the greater use of power for driving the discharging machinery, pumping cooling water, etc. The net result is stated to be, in the production of 15,700 metric tons, a saving of M.407,000 (about £20,000). There are also the advantages of increased extraction, smaller mechanical losses of ore and metal, the furnaces have much less dead space, are easier to regulate and superintend, and the furnace room is free from fumes. The costs of installation of both systems, without the discharging machinery, are stated to be about the same, though the wear and tear on the parts of the machinery are so small that their ultimate cost is negligible.—B. N.

Sherardising process. O. W. Storey. Met. and Chem. Eng., 1916, **14**, 683—691.

THE finely divided zinc used for the sherardising process is usually "blue dust," a zinc dust of extreme fineness in which each metallic zinc particle is covered with a film of oxide; a granular zinc-iron alloy of the composition $FeZn_{10}$ is used to a limited extent. The coating formed consists of definite layers of iron-zinc compounds, and its structure depends on the time, temperature, and concentration of the zinc dust, employed in the operation. With a zinc dust low in metallic zinc a high temperature is necessary and alloys high in iron will be formed on the surface; with a rich zinc dust and a low temperature the alloy formed will be high in zinc and may have some free zinc on the exterior, though this layer of zinc will be thin. The author discusses the various theories which have been advanced to explain the sherardising process and concludes that it is principally a contact action made possible by the formation of intermetallic compounds. It is only at temperatures near the melting point of zinc that the vapour tension is high enough for the vapour to enter appreciably into the reaction. The action of $FeZn_{10}$ in sherardising is not fully known, but there are indications that the compound is deposited as such on the iron. Sherardised coatings

may contain from 9 to 30 % of iron ; those high in iron (over 15 %) are liable to become coated with red iron oxide on exposure. The best coatings turn deep grey, and finally black, due to the formation of magnetic iron oxide. Coatings may give poor results from being too porous, and should have a specific gravity of at least 6·75. A zinc dust having a high metallic content gives the best coating, and sherardising should be carried out at the lowest temperature economically possible, to secure a low iron content in the coating. The zinc dust should be frequently tested as to the metallic content and should be kept free from iron. The Preece test with copper sulphate gives excellent results for daily furnace-control tests.
—T. St.

Copper production of the United States. Board of Trade J., July 6, 1916.

The United States Geological Survey reports that the production of electrolytic, Lake, casting, and pig copper from primary sources, and the production of secondary copper by the regular refining plants in 1914 and 1915, was as follows :—

	1914.		1915.	
	Domestic.	Foreign.	Domestic.	Foreign.
Primary.	lb.	lb.	lb.	lb.
Electrolytic .	991.573.073	323,358,205	1,114,345,342	246,498,925
Lake	158,009,748	—	236,757,062	—
Casting	21,506,325	—	21,555,129	—
Pig	39,334,043	—	15,047,990	—
Total primary	1,210,423,189	323,358,205	1,387,705,523	246,498,925
	1,533,781,394		1,634,204.448	
Secondary.				
Electrolytic .	27,702.928		38.156,789	
Casting	4,224,052		21,417,901	
Total secondary	31,926,980		59,574,690	
Total output .	1,565,708,374		1,693,779,138	

The apparent consumption of refined new copper in the United States in 1915 was about 1,013,000,000 lb. In 1914 it was about 620,445.373 lb.

Copper : Brittleness of annealed ——. W. E. Ruder. J. Franklin Inst., 1916, **181**, 859.

The brittleness which occurs on heating copper and frequently ascribed to "burning" is due to deoxidation. With commercial copper brittleness first appears at 400° C. in dry hydrogen, at 600° C. in wet hydrogen, at 800°—850° C. in carbon monoxide, and at 700° C. in steam. Copper previously deoxidised by boron remains unaffected at all temperatures in a reducing atmosphere. The brittleness is attributed to the formation of a weak, spongy mass by the reduction of cuprous oxide around the copper grains.—A. B. S.

Copper-zinc and copper-tin alloys ; Structure of ——. W. Broniewski. Rev. Mét., 1915, **12**, 961—989.

The author has made a résumé of the results obtained by various investigators in studying the different properties of the copper-zinc and copper-tin series of alloys, and concludes that the evidence indicates the existence of the compounds CuZn, $CuZn_2$, $CuZn_6$, and Cu_4Sn, Cu_3Sn, CuSn. The solid solutions obtained in the copper-zinc series are classified as follows :—α, solid solution of CuZn in copper ; β, solid solutions round about CuZn ; γ, solid solutions round about $CuZn_2$; δ, solid solution of $CuZn_2$ in the modification of $CuZn_6$ stable at high temperatures ; ε, solid solutions round about the modification of $CuZn_6$ stable at low temperatures ; η, solid solution of $CuZn_6$ in zinc. Those contained in the copper-tin series are classified as follows :—α, solid solution of Cu_4Sn in copper ; β, solid solution of copper in the modification of Cu_4Sn stable at high temperatures ; γ, solid solution of Cu_3Sn in the modification of Cu_4Sn stable at high temperatures ; δ, solid solutions (very restricted) round about the modification of Cu_4Sn stable at low temperatures ; η, solid solutions of CuSn in Cu_3Sn ; H, solid solutions of Cu_3Sn in CuSn.—T. St.

Copper and tin ; Transformations in alloys of —— in the solid state. M. P. Slavinsky. Rev. Soc. russe de Métal., 1913, **1**, 548—563. Rev. Mét., 1915, **12**, Ext., 405—409.

Copper-tin alloys with 57 to 77 % Cu were cast in sand and cooled slowly. Observations on the transformations taking place in the solid state during heating and cooling were then made by the differential method. A diagram showing the results obtained is given. There is a marked discontinuity in the series at the composition Cu_4Sn. The alloy of this composition is considered to be a true compound, and to undergo an allotropic transformation at 601° C. The alloys richer in copper give a variable arrest and also a constant arrest (497° C.). The first is considered to be due to the decomposition of the solid solutions, induced by the Cu_4Sn transformation ; as regards the second point, after the separation of excess of Cu_4Sn, the final crystallisation consists of the simultaneous deposition of the saturated α solid solution and of Cu_4Sn. In the alloys poorer in copper than Cu_4Sn there is a separation first of Cu_3Sn and afterwards of Cu_4Sn. The alloy corresponding to Cu_3Sn has a single arrest at 680° C., considered to indicate the complete transformation of Cu_3Sn to Cu_4Sn and Sn.—T. St.

Tin ores : Chemical assay of ——. A. M. Matheson. Proc. Austral. Instit. Min. Eng., 1916, No. 21, 1—7.

The percentage of tin in the battery pulp and primary and secondary tailings from a highly pyritic tin-stone was determined by vanning (after digestion with acid) and fusion with cyanide, and also by the Pearce-Low wet method (treatment with *aqua regia*, fusion with sodium hydroxide, reduction with nickel and hydrochloric acid, and titration with iodine solution). With the battery pulp, the average results by vanning were about 50 % below those found by the chemical assay. Vanning the primary tailings gave a recovery of about 14·5 %, but when 10 grm. (instead of 100 grm.) samples were taken, 50 % of the tin content was recovered. With the secondary tailings, vanning gave 33 % of the tin value as shown by the wet assay, but 50 % when 10 grm. portions were used. In addition to being quick, the vanning method is valuable because it gives results which correspond roughly to those obtained in actual milling practice. Vanning for 15 mins. without acid treatment and in dirty water, showed that a slime table might be expected to save about 40 % of the tin content of the primary tailings and about 48 % of that of the secondary tailings. A Cornish round table actually operating on the latter made an average saving of 50 %. The wet assay method has not been found to give too high results. The substitution of iron (horseshoe) nails for nickel in the reduction works well provided that two nails only are used.—E. H. T.

Lead [sulphide] ; Reactions during roasting of ——. W. Reinders. Z. anorg. Chem., 1915, 93, 213—231. Chem.-Zeit., 1916, 40, Rep., 196.

The roasting process consists of first incompletely roasting lead sulphide, and then heating the product with further amounts of sulphide without admission of air, but with removal of the sulphur dioxide formed, until all the sulphur has been removed and the lead has separated. In this process, the lead sulphate first formed does not react with sulphide to produce lead and sulphur dioxide directly, nor are these products obtained by the interaction of lead sulphide and lead monoxide, but there are formed in succession the basic sulphates, $(PbO)PbSO_4$, $(PbO)_2PbSO_4$, $(PbO)_3PbSO_4$, and finally, PbO. Lead sulphide and lead monoxide are not stable together, but give lead and basic sulphate. Lead reacts with normal lead sulphate with the formation of sulphide, but this reaction does not take place with basic sulphates. The pairs of phases $PbS+PbSO_4$, $PbS+(PbO)PbSO_4$, and $Pb+(PbO)PbSO_4$, are stable, and give monovariant equilibria, when heated in closed tubes; only when the sulphur dioxide is withdrawn does the separation of the lead proceed. Pressure and temperature measurements have given, for the complete reaction, the equation $PbS+PbSO_4=2Pb+2SO_2$—99,543 cals. The value calculated from the heats of formation is 95.230 cals. The separated lead retains a certain amount of lead sulphide in solid solution.—T. St.

[*Ore*] *flotation oils; Froths formed by* ——. W. A. Mueller. Eng. and Min. J., 1916, **102**, 31—35.

The froth produced by any given oil differs with the machine in which it is made. It is extremely important that the oil shall be well mixed with the pulp before flotation is attempted, the best way being to add the oils in the mills during grinding. When not thoroughly mixed, the oils prevent rather than produce froth, and for this reason extraneous oils such as cup greases and lubricating oils cause trouble in the flotation machines. *Pine oil*, as a general rule, is a rather poor mineral collector but a good frothing agent; it is, however, a good mineral collector on ores carrying chalcocite and on some zinc ores; its action as a mineral collector can often be increased by the addition of acid, and sometimes by the addition of caustic alkali; the froth is brittle, and the bubbles produced are small. *Coal tar* is a poor frothing agent but a good mineral collector, and is seldom used without mixing with pine oil or other frothing agent; it works well with many different minerals; it is difficult to mix with the pulp, and, in general, requires grinding; the bubbles are brittle. *Coal-tar creosote* is used chiefly to dilute the cheaper coal-tar oil, and for this purpose is very good; it is easy to mix; and works best on copper-bearing ores. The bubbles are very tough and tend to be rather large. *Wood creosote* resembles coal-tar creosote in some characteristics; it works best on zinc ores, and is often used to dilute coal tar in the treatment of these ores. The bubbles are even tougher than those yielded by coal-tar creosote. *Cresol* is used in small proportions in mixtures with coal tar. *Fuel-oil, pine-tar oil, oleic acid, and eucalyptus oil* are often used in mixtures. The best mixture can only be determined by trial, preferably on the large scale. In general, the best froth is one in which the bubbles are of medium size and rather tough.
—T. St.

[*Ore*] *flotation; Use of oils in* ——. H. A. Megraw. Eng. and Min. J., 1916, **102**, 50—56.

The functions of a flotation oil are to reduce the surface tension of the liquid so that a more permanent gas bubble may be formed, and to oil the mineral particles preferentially. The oils used may be divided into two groups:—(1) those which serve to make frothing possible by reducing the surface tension of water, and (2) those which provide a non-wet film on the surface of the mineral particle. The best mixtures of oils to accomplish these results can only be determined by trial in each special case. The author describes investigations made to ascertain the best mixtures of oils for certain ores, and gives examples of actual practice.—T. St.

Mercury ores in California: Concentration of ——. F. Hamilton. Min. and Eng. World, 1916, **44**, 997.

Friable ores, in which the cinnabar is distinctly crystalline, have given a high extraction (above 90%) by water concentration on tables. Crushing by rolls produces a minimum of slimes, but if the pulp contains a cinnabar slime, either from "paint" ores or through fine crushing to release the sulphide, the extraction by tables is low. In such cases it may be improved by classification, and treating the different sizes on separate tables. The slimed cinnabar may be recovered by flotation, and a high extraction has been obtained with finely ground (80-mesh) ores, using either pine oil derivatives or eucalyptus oils, but the cinnabar should be "fresh," as on exposure it is oxidised sufficiently to affect results obtained by flotation.
—B. N.

Manganese nitride: Magnetic susceptibility of ——. T. Ishiwara. Sci. Reports, Tohoku Imp. Univ., 1916, **5**, 53—61.

Manganese and nitrogen give rise to three ferromagnetic substances between 600° and 1600° C., two being nitrides, and the third probably a solid solution. One of these is Mn_5N_2, but the composition of the others has not been determined, though they may be differentiated by their characteristic thermo-magnetic curves and their critical points. Ammonia affects manganese in a manner similar to nitrogen at high temperatures, an exception being the formation of the paramagnetic nitride, Mn_3N_2. The existence of the ferromagnetic Mn_7N_2, described by Wedekind and Veit (Ber., 1911, **44**, 263), has not been confirmed. The various values of susceptibilities for manganese, obtained by different physicists, may be explained as being due to the effects of nitrogen present in air or from other sources. The correct value of the susceptibility for pure manganese is given as $\chi=9{\cdot}66\times10^{-6}$.—B. N.

Carbon dioxide: Action of —— *on some metals and metallic compounds at a high temperature.* F. von Bacho. Monatsh. Chem., 1916, **37**, 119—123. Z. angew. Chem., 1916, **29**, Ref., 279.

If zinc sulphide be heated in a current of carbon dioxide, decomposition begins at 750° C., and increases with the temperature, the products being zinc oxide, sulphur dioxide, and carbon monoxide. Metallic copper when heated in carbon dioxide is attacked only when the metal begins t melt; cuprous oxide and carbon monoxide ar formed. Metallic antimony is attacked at 830° C. At 1100° C. the following reaction occurs $2Sb+3CO_2\rightarrow Sb_2O_3+3CO$.—A. S.

Cetraria islandica [*Iceland moss*] *as a protectiv colloid. II. Colloidal gold. III. Colloida palladium.* A. Gutbier, J. Huber, E. Kuhn, an J. Kräuter. Kolloid-Zeits., 1916, **18**, 57—71 Z. angew. Chem., 1916, **29**, Ref., 270.

By using an extract of Iceland moss as protectiv colloid (this J., 1916, 657), solid colloids containing high percentages of gold can be prepared and so long as the gold content does not exce 82%, these can be converted completely into th sol condition by means of water. Paal (this J., 1902, 994) obtained reversible gold colloids containing up to 93·41% Au, by using sodium lysalbinate as protective colloid, but in this case it i necessary to use an alkali solution to convert th solid colloid into the sol condition. Wate sterilised by addition of chloroform was used i preparing the extract of Iceland moss, and it wa observed incidentally that water saturated with chloroform had a stabilising effect on some unprotected inorganic colloids. A protected colloidal gold preparation containing 42 % Au showed no indications of ageing even after keeping for 1 month at 25 C. Colloidal palladium was prepared by reduction of palladous chloride by hydrazine hydrate in presence of an extract of Iceland moss; the limit of complete reversibility was attained at 70 % Pd.—A. S.

PATENTS.

Iron and steel ingots ; Moulds for casting ——. B. Talbot. Middlesbrough. and J. E. James, Marton-in-Cleveland. Eng. Pat. 100,549. Jan 19, 1916. (Appl. No. 888 of 1916.)

THE invention relates to composite moulds in which an annular channel is formed at the top for the reception of non-conducting material, with the object of keeping the upper part of the ingot fluid so long that it will flow down and fill the main portion of the cavity formed as the ingot solidifies. —T. ST.

Armour-plate ; Process of forming ——. F. Conlin, Plainfield, N.J. U.S. Pat. 1,186,172, June 6, 1916. Date of appl., June 25, 1913.

THE face of a chill is covered with a plate of metal, and metal of relatively higher carbon content is poured on. The latter metal is harder and has a lower melting point than the plate-metal.—T. ST.

Removing oxide from the surfaces of articles of iron or steel ; Electrolytic process for ——. P. Marino, London. Eng. Pat. 14,230. Oct. 7. 1915.

THE layer of iron oxide is removed by employing the articles as cathodes in an aqueous solution of phosphoric acid, or a compound of the acid to which free phosphoric acid has been added.—B. N

Iron or steel article ; Metal-coated ——. C. Mark and C. Mark, jun.. Evanston. Ill.. Assignors to C. Mark. Chicago. Ill. U.S. Pat. 1,186,217, June 6, 1916. Date of appl.. Aug. 4. 1915.

AN iron or steel article is coated with an alloy containing approximately Pb 94·45, Sn 3·74, and Zn 1·81 %. The tin should be between 2 and 16 %, the zinc between 0·80 and 5 %, and the remainder lead, but the percentage of zinc should be less than that of tin. The coating, which is slightly electro-positive to iron, is applied in direct contact with the article.—T. ST.

Iron : Puddling ——. J. E. Fletcher. Dudley, and J. Harrison, Tipton. Eng. Pat. 7691, May 22, 1915.

CRUDE molten iron from a cupola or smelting furnace is treated in an intermediate refining furnace, at a medium temperature, until the carbon content is reduced preferably to 2·5—3 % and the silicon, manganese. and phosphorus to below 0·5, 0·3. and 0·3 %, respectively. After separation from slag, the semi-refined. molten metal is delivered, in separate portions, to a series of puddling or balling furnaces, in which a carburising atmosphere may be maintained if necessary, and finished as usual.—W. E. F. P.

[Iron.] Puddling and basic open-hearth furnaces ; Fix material for use in ——. J. F. Dery. New York. U.S. Pat. 1,175,933, Mar. 21, 1916. Date of appl., July 2, 1915.

A MIXTURE of finely divided iron ore or flue-dust, 9, lime, 1, and Portland cement. 2 parts by weight, is made fluid with water, poured into moulds, and allowed to set. the resulting blocks being afterwards allowed to dry slowly. The composition and exact proportions of the ingredients should be such that the silica content of the finished material does not exceed 7 %.— W. E. F. P.

[Iron.] (A). *Electric welding ; Method of* ——. (B) and (C). *Alloy for arc-welding.* D. H. Wilson, Paterson, N.J., and S. M. Rodgers. Pittsburgh. Pa. U.S. Pats. 1,187,410, 1,187,411, and 1,187,412, June 13, 1916. Dates of appl., (A) July 9, 1915, (B) and (C) June 16, 1915; all renewed May 10, 1916.

(A) THE welding metal is transferred continuously from the welding electrode to the work, across an arc produced by a current having a maximum potential sufficiently low to prevent pitting, formation of slag, and boiling or spattering of the material. (B) and (C). The welding metal consists of an alloy of iron (B) with about 1 % Mn and a substantial proportion of copper, or (C) with more than 0·5 % Mn.—W. E. F. P.

Metal-coating baths ; Protecting layer of refractory material for ——. O. van Raay, Ges.m.b.H., Kettwig. Ger. Pat. 292,031, May 9, 1915.

A LAYER of small balls of refractory material, *e.g.*, glass, is used, which protects the bath from oxidation and prevents the coated metal cooling too quickly as it emerges from the bath, and thus facilitates the return to the bath of the excess of coating metal.—A. S.

Cupolas and other furnaces ; Safety device for ——. Akt.-Ges. R. P. Waagner, L. and J. Biro, and A. Kurz. Vienna. Eng. Pat. 6180, Mar. 14, 1914. Under Int. Conv., July 29, 1913.

A CAST-IRON cylinder provided at each end with a perforated dome is attached to the air-duct of the cupola. The upper dome is fitted with a safety valve which is kept closed by a spring until the pressure in the air-duct rises to an undesirable value by reason of stoppages in the blast tuyères and the like. When the valve is thus raised, the spindle actuates a lever which closes an electric circuit, and so rings an alarm. The lower dome is fitted with a valve which is kept open by a spring until the pressure inside the air-duct rises to a certain value. By this means a natural draught is provided in the cupola when the blast, for any reason is stopped, and prevents carbon monoxide from collecting in the air-duct. When the blast is again turned on, it blows first through the open valve into the atmosphere, and so clears the air-duct of any inflammable gases, then, when the pressure has risen sufficiently, the valve automatically closes and the blast passes into the cupola.—T. ST.

Gas furnaces [for melting metals]. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 100,599. Jan. 3, 1916 (Appl. No. 10 of 1916.)

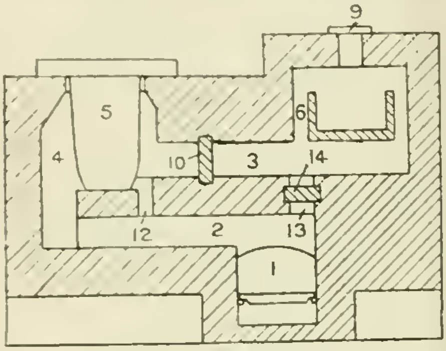
AN annular crucible, suitable for melting metals of high melting point, is heated by an atmospheric gas burner, the products of combustion passing up through the central aperture and then down over the outside to two superheaters for the combustible mixture, attached to the opposite sides of the furnace. Each superheater comprises an inner heating chamber provided with baffles, through which the mixed gas and air pass to the burner, surrounded by a casing provided with internal baffles through which the hot combustion products circulate to the flue.—W. F. F.

Furnace. W. M. Kelly. Anaconda, Mont. U.S. Pat. 1,186,104, June 6, 1916. Date of appl., Dec. 18, 1915.

TWO reverberatory furnaces are disposed in longitudinal axial alinement. thus forming a single treatment chamber, with means for firing at both the opposite ends of the double furnace. A central transverse exit flue, in free communication with the furnace, surmounts and spans the roof of the latter, means being provided to control the discharge of waste gases from each end of the flue.—T. St.

Salt-bath and preheating furnace; Combined ——. Gebr. Pierburg, Berlin. Ger. Pat. 291,836, Aug. 3, 1915.

The furnace (see fig.) is heated by coke, and the fire-gases pass from the combustion chamber, 1, through the flue, 2, to the chamber, 4, containing the salt-bath, 5, and then return through the flue, 3, to the preheating chamber, 6; a portion of the fire-gases passes directly from the flue, 2, to the flue, 3, through the passage, 12, without passing through the chamber, 4. If desired, fire-gases may also pass directly to the preheating chamber through the passage, 13. Dampers are provided at 9, 10, and 14.—A. S.



Roasting furnace; Mechanical ——. S. Barth, Düsseldorf-Oberkassel. Ger. Pat. 291,886, May 21, 1914.

The furnace is provided with a series of superposed rotating hearths, mounted on a central vertical shaft, and alternating with fixed hearths. The hearths are constructed of firebrick carried on a hollow iron framework, and air for cooling is circulated through the hollow shaft and frames. The charge is moved over the hearths by scrapers or the like to the openings leading from one hearth to the next, these openings being at the periphery in the case of the rotating hearths and at the centre in the case of the fixed hearths.—A. S.

Shaft furnace for metallurgical purposes. H. Rehmann and A. Mirbach, Düsseldorf. Ger. Pat. 292,004, May 10, 1914.

Just below the arched crown of the shaft an annular dust separating and collecting chamber is formed by means of a low wall projecting from the inner wall of the shaft. This chamber communicates by passages in the crown with a second annular chamber above the latter. The furnace gases strike against the crown of the shaft and pass first into the lower and then into the upper dust-collecting chamber before being discharged. The dust chambers are provided with doors for cleaning purposes and with explosion doors. Passages lead from the bottom of the dust-collecting chambers through the wall of the shaft and open into the shaft lower down.—A. S.

Refractory metal tubes. The British Thomson-Houston Co., Ltd. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 8702, June 12, 1915.

Tubular bodies of refractory metal, such as tungsten or molybdenum, are prepared by placing loose metallic powder in the annular space of a tubular mould between an inner flexible or elastic tubular wall, and an outer refractory rigid one, with open ends, a perforated tube supporting the flexible wall. The mould is placed in a container filled with liquid, so that pressure, applied to the liquid, is exerted uniformly in a radial direction upon the inner surface of the inner wall and against the outer wall. After removing the mould from the liquid, the flexible inner wall is detached, and the powder is baked in a furnace, whilst supported on the outer wall, to make it coherent, and then sintered by subjecting it to a high temperature before detaching it from the outer wall of the mould.—B. N.

"*Dental amalgam.*" T. J. Davis, New York. Eng. Pat. 12,806, Sept. 7, 1915.

An alloy of gold and other metals is subdivided into granules, and a coating of gold is applied to each granule. The resulting product is used for preparing the amalgam.—B. N.

[*Metal*] *leaf or foil; Decorative* —— *and process of making the same.* W. J. Mellersh-Jackson, London. From Diamond Decorative Leaf Co., New York. Eng. Pat. 15,706, Nov. 6, 1915.

This pliable decorative leaf is produced by spraying on to a removable sized backing a thin layer of liquid material, comprising powdered aluminium, a colloidal protective substance, and a volatile solvent; in making artificial gold leaf, a tinting material of a yellowish or orange colouring matter is dissolved in the solvent. When dried slowly and uniformly, stratification takes place, the duplex leaf presenting a gold-coloured lustrous, metallic appearance on one face, and a silver-coloured appearance on the other.—B. N.

Zinc; Recovery of ——. F. W. Highfield, Whitchurch-on-Thames, Oxford. Eng. Pat. 9009, June 18, 1915.

In an apparatus, other than that claimed in Eng. Pat. 6885 of 1914 (this J., 1915, 838), for condensing zinc vapour to liquid metal, the condensing chamber is divided into two compartments by a partition of fireclay, unglazed porcelain, carbon, or similar material impervious to molten zinc but pervious to carbon monoxide at the ordinary working temperature. The molten zinc is retained in the first compartment and removed periodically, while the carbon monoxide passes through the partition into the second compartment and is burnt therein, alone or with other gas, to maintain the necessary temperature. According to one method of carrying out the invention, eight zinc retorts are connected by radial pipes to a vertical, cylindrical condensing chamber having a concentric, vertical, porous partition by which the interior is divided into a closed, outer or annular compartment for retaining molten zinc, and a central compartment surmounted by a flue and provided with openings for the admission of air and combustible gas.—W. E. F. P.

Zinc; Production of ——. F. Tharaldsen, Drontheim, Norway. Ger. Pat. 292,471, Apr. 23, 1915. Addition to Ger. Pat. 286,229.

The gases produced on treating the slag as described in the chief patent (this J., 1916, 185) are led into the condensing chamber connected with the furnace instead of into a separate chamber. —A. S.

Aluminium; New metallic body consisting principally of ——, *and process of manufacturing the same.* A. J. de Montby, Paris. Eng. Pat. 16,359, Nov. 19, 1915.

See Fr. Pat. 473,412 of 1914; this J., 1915, 558. The alloy to be added to the aluminium is prepared by melting together 1·5 parts of cobalt, 12 of nickel, 0·25 of tungsten, 20 of silver, 2·25 of magnesium, and 70 of aluminium.

Soldering pastes. H. Hess, Philadelphia, Assignee of C. E. Bonine, Melrose Park, Pa., U.S.A. Eng. Pat. 17,931, Dec. 23, 1915. Under Int. Conv., Oct. 15, 1915.

Glue is added to a soldering paste containing solder powder, glycerin, and ammonium chloride, to prevent segregation of the ingredients on standing. When the paste is contained in collapsible tubes vaseline also is added to make the material flow easily under pressure. The most satisfactory results are obtained when a somewhat thick paste of the ingredients is baked for three hours at 50° C. before the full amount of glycerin necessary to bring the paste to its proper consistency is added. The paste contains solder powder 85·65 to 90·97, ammonium chloride 2·53 to 2·59, glycerin 5·43 to 5·85, and glue mixture 0·59 %.—T. St.

Metal and mineral bearing materials: Treating ——. J. L. Malm, Denver, Colo. U.S. Pat. 1,185,817, June 6, 1916. Date of appl., Feb. 21, 1911.

Ores, containing metallic sulphides, such as iron sulphide, are partially chlorinated to the extent of forming sufficient metallic chlorides, such as iron chloride, decomposable at low temperatures, so that, when heated, chlorine is liberated in amount sufficient to chlorinate substantially the entire remaining metallic contents of the ore. The metal from the decomposed chlorides is left in an inert condition.—B. N.

Ores; Process of treating ——. R. S. Handy, Kellogg, Idaho. U.S. Pat. 1,185,902, June 6, 1916. Date of appl., Oct. 28, 1914.

Sulphide ores containing lead, silver, and zinc, are roasted, and then treated, whilst subjected to agitation and aeration, first with a hot aqueous solution of sodium chloride to extract the lead sulphate, and then with a hot aqueous solution of ferric chloride to extract the silver and zinc. The metal values are recovered from the resulting solutions.—T. St.

Nickel anode and process of manufacture. J. J. Walsh, Assignor to The Prest-O-Lite Co., Inc., Indianapolis, Ind. U.S. Pat. 1,185,959, June 6, 1916. Date of appl., June 24, 1915.

Plating nickel anodes are built up from scrap anodes, by permanently uniting a number of them to a support or base by autogenous welding, so as to form a single anode.—B. N.

Metals [copper]; Process of extracting —— from ores. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,186,306, June 6, 1916. Date of appl., May 7, 1912.

Copper ores are treated with an acid chloride solution which is then run off and the copper precipitated by hydrogen sulphide. The copper sulphide is separated from the regenerated acid solution and electrolysed in a sulphate electrolyte for the recovery of copper and sulphur, the latter being converted to hydrogen sulphide. Chlorine is passed through the regenerated acid solution which is then returned to the ore to extract precious metals and more copper.—T. St.

Electrochemical amalgamator. S. S. Rose, San Jose, Cal. U.S. Pat. 1,186,335, June 6, 1916. Date of appl., Mar. 25, 1915.

An annular receptacle containing mercury is provided with "runways" projecting inwards from its inner and outer circumference, and rollers, carrying insulated frames, are mounted on the runways. Sweeper bars are mounted on the frames, which are driven by gearing, and drag bars are spaced behind and connected with the sweepers. The forward edges of the drag bars are curved, and both the sweepers and drag bars move in close proximity to the surface of the mercury. Another insulated frame secured to the receptacle, and arched over the gearing, carries a roller which bears on the gearing. Wire connections from the latter frame, and from the receptacle are connected to a source of electricity.—B. N.

Crucible furnaces and the like; Tilting ——. Alldays and Onions Pneumatic Engineering Co., Ltd., and E. W. Nicholson, Birmingham. Eng. Pat. 16,391, Nov. 20, 1915.

Electrolytic apparatus [for production of alkali metals]. J. Pfleger and F. Ott, Frankfort, Germany, Assignors to The Roessler and Hasslacher Chemical Co., New York. U.S. Pats. 1,186,936 and 1,186,937, June 13, 1916. Dates of appl., June 16 and Oct. 2, 1913.

See Eng. Pats. 1933 of 1913 and 10,193 of 1914; this J., 1913, 918; 1915, 909.

Metals from tinning, galvanising, and like waste: Recovery of ——. M. E. Rothberg, Crafton, Pa., U.S.A. Eng. Pat. 100,657, Feb. 8, 1916. (Appl. No. 1863 of 1916.)

See U.S. Pat. 1,170,342 of 1916; this J., 1916, 364.

Manufacture of abrasive materials. U.S. Pat. 1,187,225. *See* VIII.

XI.—ELECTRO-CHEMISTRY.

Patents.

Electrolytic apparatus. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,186,898, June 13, 1916. Date of appl., Aug. 28, 1913.

Vertical cathodes and anodes are suspended alternately in the electrolyte, the anodes being completely surrounded by diaphragms, forming anode cells suspended on pivots so that they may be oscillated. Means are provided for withdrawing the electrolyte from the anode chamber without allowing it to mingle with the cathode liquor.—B. N.

Secondary battery plates. Electrical Power Storage Co., Ltd., London, and W. Schofield, Southend-on-Sea. Eng. Pat. 9012, June 18, 1915.

A thick paste is formed by adding 25 parts by weight of lead oxides to a mixture of one part each of glycerin and water, or one part of glycerin, 2 parts water, and 0·5 part sulphuric acid. The paste is heated to dryness in a suitable vessel between 120° and 140° C., cooled, and finally made into a paste with a mixture of sulphuric acid and water.—B. N.

Electrolysis. H. R. Nelson, Elizabeth, N.J., U.S.A. Eng. Pat. 10,605, July 21, 1915. Under Int. Conv., Aug. 17, 1914.

See U.S. Pats. 1,149,210 and 1,149,211 of 1915; this J., 1915, 969.

Electron-emitting cathodes. Eng. Pat. 17,580 of 1915. *See* IIb.

Apparatus for producing ultra-violet radiation. U.S. Pat. 1,186,993. *See* IIb.

Electrolysis and treatment of [cadmium or copper] sulphate liquors. Eng. Pat. 11,273. *See* VII.

Refractory materials applicable as electric resistances. Eng. Pat. 1080. *See* VIII.

XII. FATS; OILS; WAXES.

Palm-kernel industry: Protection of the ——.

The following recommendations are made in the Report of the Committee on Edible and Oil-producing Nuts and Seeds (West Africa):—

(1) To impose an export-duty of 2*l.* per ton, or more if necessary, on palm-kernels shipped to ports outside the Empire;

(2) Continuation of the campaign for the popularisation of palm-kernel cake as a feeding-stuff;

(3) New legislation to allow the addition of the words "British-made" to the word "margarine" on the statutory wrapper for margarine;

(4) The continuation and extension of the joint researches on the oil palm, carried on by the West African Agricultural and Forestry Departments and the Imperial Institute.

The British West African Government has been instructed to put the first and fourth recommendations into action.

Stearolic acid; Isomerides $T_{7\cdot8}$ and $T_{5\cdot6}$ of ——. S. Posternak. Comptes rend., 1916, **162**, 944—946.

Melted tariric acid (1 mol.) was treated with dry hydriodic acid until the increase in weight corresponded to two mols. of HI. The resulting brown oil was dissolved in 30% alcoholic potassium hydroxide solution, heated for 3 hours on the water-bath, the soap solution filtered from the crystals of potassium iodide and decomposed with dilute sulphuric acid. Crystals consisting of a mixture of the three isomeric stearolic acids (T_{7-8}, T_{6-7}, and T_{5-6}), contaminated with oily monoiodo-oleic acid, were obtained. The mass was dissolved in alcohol and treated with N/1 alcoholic sodium hydroxide solution to obtain crystals of the sodium salts of the three acids. By decomposing these with sulphuric acid, and crystallising the product from alcohol, nearly pure tariric acid (T_{6-7}) separated first. The residual acids were converted into di-iodo derivatives and dissolved in alcohol. On cooling the solution di-iodo-7.8-elaidic acid (m.pt. 68° C.) separated, and from this by treatment in alcoholic solution with metallic sodium the $T_{7\cdot8}$ isomeride (m.pt. 49·25° C.) was obtained. The $T_{5\cdot6}$ isomeride was separated by eliminating the iodine from the mother liquors, dissolving the recovered acids in alcohol, and adding successive portions of N/1 alcoholic sodium hydroxide solution. Repeated recrystallisation of the fractions melting above 44° C. yielded the $T_{5\cdot6}$ isomeride (m.pt. 52·5° C.).—C.A.M.

Use of castor oil for removing resin from rubber and guttapercha. Schopper. *See* XIV.

Cause and prevention of rancidity in palm nut kernel cake. Calder. *See* XIXa.

Croton-resin. Boehm. *See* XX.

Patents.

Unsaturated materials [*oils*]; *Process and apparatus for reducing* ——. A. H. Ney, Hasbrouck Heights, N.J., Assignor to Hydrogenated Oil Co., New York. U.S. Pat. 1,185,704, June 6, 1916. Date of appl., June 7, 1912.

The oil, etc., in a state of fine division ("oil-fog") is brought into contact with hydrogen or a gas containing hydrogen in presence of a movable permeable catalyst, which is constantly freed from the hydrogenated oil.—C. A. M.

Detersive and emulsive agents: Manufacture of ——. R. Macpherson, Brondesbury, and W. E. Heys, Bushey. Eng. Pat. 8178, June 8, 1915.

Proteins or farinaceous substances or substances containing them are treated in the cold with solid caustic soda or potash, with or without added fats or fatty acids, and in presence of only sufficient water to effect the reaction, whereby a practically dry detergent is obtained.—C. A. M.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Linseed oil: Effect of certain pigments on ——. E. W. Boughton. U.S. Bureau of Standards, Techn. Paper. No. 71, Apr. 13, 1916, 1—16.

In a former communication (this J., 1913, 371) it was shown that the constants of linseed oil mixed with various pigments and kept in closed cans for 2 years showed only slight changes. The remainders of the paints used in these experiments were placed in glass jars, which they partially filled, and these jars were closed and exposed to diffused light for 1 year. The oil was then extracted with ether and examined. Considerable changes had taken place in the constants of the oil except in the case of the zinc yellow, chrome yellow, and artificial graphite paints. White lead and zinc white were the only pigments which had caused a large increase in the ash yielded by the oil (1·02 and 0·99% respectively, as compared with 0·13% from the original oil). The oil from the white lead paint was orange-red, viscous, and had a skin on the surface. Its iodine value had fallen to 145. In other experiments white lead and zinc white were mixed with raw or boiled linseed oil, and thin films of the paints brushed over glass. After intervals of 6 hours to 8 days the films were removed and treated with a mixture of benzene (60 vols.) and 95% methyl alcohol (10 vols.), and the extract centrifuged and filtered through paper pulp. The extracted oils were red and viscous and had an acrid odour. In the case of the mixture of raw oil and white lead, the iodine value of the fatty acids had fallen from 194 to 103, while the ash of the oil had increased from 0·11 to 0·85 after 6 days. The corresponding figures for the oil extracted from the film of zinc white paint were 101 and 2·17% after 8 days. The oil from the mixture of boiled oil and white lead showed:—iodine value of fatty acids 148 (original value, 182) and ash 0·82% (original oil, 0·56%) after 6 hours, while the oil from the mixture of zinc white and boiled oil showed:—iodine value 141 and ash 1·60% after 6 hours. These results indicated that there was an appreciable combination of oil and pigment on exposure of the paints to the air. On mixing white lead and zinc white respectively with linseed oil fatty acids, considerable combination occurred, the amount of zinc soap produced being about four times as much as the amount of lead soap. In experiments in which films of raw linseed oil mixed with the pigments were exposed to oxidation, white lead had a greater accelerating influence than zinc white, and the latter a greater effect than China clay on the oxidation.—C. A. M.

Self-luminous paint. F. H. Glew. Optical Soc., June 8, 1916. Chem. and Drug., 1916, **88**, 653.

When radium is mixed with a zinc sulphide it exerts a continuous excitation on the sulphide and eventually exhausts it. The Admiralty specification for radium luminous paint is 0·1 mgrm. of radium bromide per gram of zinc sulphide: the paint is also made with half this proportion of radium. At the end of a year it is probable that paint made to the Admiralty specification will have only half its original luminosity. The more radium the paint contains the shorter will be the life of the zinc sulphide. The act of mixing the paint exhausts the zinc sulphide somewhat, and it requires time for the radium to excite it to further action. A palette-knife must not be used for mixing the paint or the crystalline structure of the zinc sulphide will be destroyed, with a corresponding loss of illuminating-power. Other substances than radium are used in paint, mesothorium more frequently. Ionium would be an ideal substance, but it is not obtainable in a pure state.

Oleo-resinous exudation of coniferæ; Improved method of collecting the ——. H. Wislicenus. Chem.-Zeit., 1916, 40, 559—560.

The ordinary method of obtaining the resinous exudation from pines (by excision and collection in open vessels) is very wasteful, since upwards of 50% of the oil of turpentine present may evaporate from the resin during its exposure to the atmosphere. An improved method consists in boring a hole into the tree and inserting the neck of a bottle into this hole; other smaller holes are bored through the outer portion of the tree and connect with the first hole, the outer ends of the smaller holes being plugged. The fluid resin, rich in turpentine (about 38%), collects in the bottle. —W. P. S.

Patents.

Coating composition [for concrete and cement]. C. Ellis and A. A. Wells, Montclair, N.J. U.S. Pat. 1,179,413, Apr. 18, 1916. Date of appl., Aug. 13, 1912.

A composition for painting concrete and cement structures is made by heating Poutianak (Borneo) rubber resin (jelutong) for about four hours at 675°—700° F. (357°—371° C.) or higher, in a retort fitted with a reflux condenser, so as to decompose it with formation of acetic and similar acids (which are removed by distillation) and a neutral oily unsaponifiable resin which is readily soluble in benzene and has siccative properties. The product is dissolved in benzene or other suitable solvent, passed through a tower filled with quicklime to remove any acids, and may then be used alone or incorporated with drying oils, dryers, or with suitable thickeners.—A. B. S.

Finish-removing process. C. Ellis, Montclair, N.J., Assignor to Chadeloid Chemical Co., New York. U.S. Pat. 1,185,641, June 6, 1916. Date of appl., Oct. 10, 1911.

To remove a coating of paint, varnish or other finish, the article is immersed in or treated with an organic solvent of high boiling-point (over 200° C.) previously heated to over 90°—100° C. When the temperature of the article has reached substantially that of the solvent, the article is taken out, and when the finish has been dissolved, softened or loosened, the surface is cleaned with volatile liquid.—E. W. L.

Drying or hardening [siccative] coatings; Process for ——. W. M. Grosvenor, Grantwood, N.J., Assignor to Wenborne-Karpen Dryer Co., Chicago, Ill. U.S. Pat. 1,186,477, June 6, 1916. Date of appl., Nov. 20, 1908.

The coatings are subjected simultaneously to heat and to the action of a more powerful oxidising agent than air, in the presence of moisture in excess of the natural humidity.—W. F. F.

Condensation products of phenols and formaldehyde; Process of making ——. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., New York. U.S. Pat. 1,187,229, June 13, 1916. Date of appl., Oct. 2, 1909.

Compact, coherent bodies containing insoluble, infusible condensation products of phenols and formaldehyde and a basic substance, are formed by adding to a mixture of phenols and a substance containing a mobile methylene group (formaldehyde) a basic condensing agent in excess of the proportion desired in the final product, then eliminating the undesired excess of condensing agent by adding a reagent which yields with it an insoluble compound, and hardening the mass by heat and pressure.—E. W. L.

Reaction product of hexamethylenetetramine and phenolic bodies, and method of making same. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., N.Y. U.S. Pat. 1,187,230, June 13, 1916. Date of appl., Dec. 13, 1910.

Phenols are heated with hexamethylenetetramine, with or without the addition of water, until the water and a portion only, or the whole, of the ammonia have been expelled, and the product is hardened by the application of heat and pressure. The final product is a yellow mass somewhat resembling amber, and containing, in the one case, uncombined ammonia.—E. W. L.

Phenolic condensation product and method of making the same. L. H. Baekeland, Yonkers, and N. Thurlow, New York, Assignors to General Bakelite Co., N.Y. U.S. Pat. 1,187,231, June 13, 1916. Date of appl., Dec. 11, 1912.

The condensation product is formed by the action of a phenol upon a salt (the hydrochloride) of hexamethylenetetramine, and is rendered infusible and insoluble by the application of heat.—E.W.L.

Insoluble bodies derived from phenol alcohols; Process for making ——. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., N.Y. U.S. Pat. 1,187,232, June 13, 1916. Date of appl., May 15, 1915.

Hard, compact, infusible bodies or moulded articles are produced by eliminating water from phenol-alcohols and hardening the anhydrides, by the action of heat and pressure, in presence of a basic condensing agent, and in presence also, if desired, of suitable filling materials.—E. W. L.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Plantation rubber of uniform quality; Preparation of ——. Arens. Gummi-Zeit., 1915, 29, 1248—1249. Chem.-Zeit., 1916, 40, Rep., 218.

The quality of the rubber is not appreciably affected by the method of tapping the trees, but addition of water to the latex produces variations in quality and should be avoided on the plantation unless the quantity added is under strict control; in the factory, dilution of the latex with an equal volume of water is recommended, especially in the preparation of thin sheet rubber. The nature of the acid used as coagulant is of no importance so long as only the minimum quantity necessary to produce coagulation is added, but dilute acid can be distributed more uniformly in the latex than concentrated acid. The duration of the period between coagulation and working-up of the coagulum has considerable influence on the quality of the rubber. Artificial drying in vacuum dryers or similar apparatus always causes deterioration in the quality of rubber. Drying in smoke chambers, at a temperature not exceeding 55° C., gives better results than air-drying, and within certain limits, the quality is better the longer the rubber remains in the smoke chamber.—A. S.

Rubber and guttapercha; Use of castor oil for removing resin from ——. T. Schopper. Gummi-Zeit., 1916, 30, 601. Z. angew. Chem., 1916, 29, Ref., 295.

The purification of raw rubber by extraction with castor oil possesses the following advantages. All resinous constituents are removed and the water present in the rubber is evaporated, and hence the further purification of the rubber is facilitated and less alcohol is required. Only a short extraction with castor oil is required. The solution of rubber resins in castor oil can be used in the manufacture of soaps.—A.S.

Rubber; The effect of vacuum drying crêpe ——. B. J. Eaton. Agr. Bull. Fed. Malay States, 1916, 4, 219—221.

From the results of a long series of vulcanisation tests with thin crêpe dried at ordinary temperature in a drying room, another portion of the above dried in a Passburg vacuum drier, and a portion of the latter re-machined after removal from the drier, as is usual on the estates, the author concludes that neither the rate of cure nor the physical properties are affected by the vacuum drying process. —E. W. L.

Rubber; Action of alkalis and acids on ——. B. J. Eaton. Agr. Bull. Fed. Malay States, 1916, 4, 162—167. (Cf. Martin, this J., 1915, 725.)

Samples of fast- and slow-curing crêpe rubber were soaked in dilute solutions of sodium and potassium hydroxides, and the re-crêped samples were vulcanised. The acceleration of the rate of cure was about the same for soda as for potash, and for slow-curing as for fast-curing rubbers. Slow-curing rubber which had been soaked in alkali, and neutralised on the following day with acetic acid, was found still to be slow-curing, but when neutralisation was not carried out until 10 days after soaking, the rubber cured more rapidly than the control. Rubber soaked in alkali and re-crêped became very tacky and soft on keeping. The use of mineral acids and of potash alum in coagulation tends to retard the cure, more especially when even slight excess over the minimum quantity necessary is used. The greatest care should therefore be taken to keep conditions constant when coagulating with sulphuric instead of acetic acid.—E. W. L.

Patents.

Rubber latex; Apparatus for coagulating and drying ——. S. Milne, Edinburgh. Eng. Pat. 9039, June 19, 1915.

A cylinder, about 10 ft. diameter and 12 ft. long, is provided on its surface with blade- or plate-like flanges, 1 ft. 6 in. deep or more, arranged either parallel to one another, and at right angles to the axis of the cylinder, 2 inches apart; or spirally round the cylinder; or inclined to the axis; or in zig-zag fashion. As the cylinder revolves the blades dip into an open steam-jacketed pan containing heated latex, a thin film of latex is carried round on the blades, and the drying of this is further facilitated by passing hot air through the cylinder housing. A large surface of evaporation is thus provided in a small space.—E. W. L.

Rubber; Manufacture of —— and apparatus therefor. C. A. Heken and St. V. B. Down, Singapore. Eng. Pat. 8187, June 8, 1915.

Latex is coagulated by adding to it, in the form of liquid, liquid spray, or vapour, a mixture of alcohol—either absolute alcohol, or methylated spirit, or normal or iso-propyl alcohol—and a hydrocarbon solvent, such as petroleum spirit (b.pt. 40°—150° C.) or coal-tar naphtha (b.pt. 80°—140° C.) or motor spirit. In the case of *Hevea Braziliensis* latex the proportions recommended are:—methylated spirit, 5 % of the weight of latex; petroleum spirit, 10 % of the weight of rubber in the latex. Coagulation occurs rapidly, and the rubber is then removed, pressed, and dried. The methylated spirit can be recovered, but the petroleum spirit is allowed to remain and evaporate slowly from the rubber. In crêping the bulk of the resins dissolved in the petroleum spirit, and proteins will be eliminated by pressure. The temperature should not be allowed to rise above 90° F. (32° C.).—E. W. L.

Caoutchouc; Method of producing synthetic ——. E. Gottschalk, Newark, N.J. U.S. Pat. 1,185,651, June 6, 1916. Date of appl., May 17, 1911.

Pinene is "cracked" by passage in the form of vapour, through a tube heated to 300°—350° C. (572°—662° F.), and the emergent vapour is cooled quickly. The hydrocarbons thus formed are distilled, and the distillate, either alone or in presence of an acid reagent, is heated in a closed vessel, thereby creating pressure. The temperature is then kept constant, while the pressure falls until it reaches a point where it remains substantially constant. At this point any volatile matter is distilled off, and the residue oxidised.—E. W. L.

Coating composition for concrete and cement. U.S. Pat. 1,179,413. *See* XIII.

XV.—LEATHER; BONE; HORN; GLUE.

Adsorption [of organic acids by hide powder]. V. Kubelka. Collegium, 1915, 389—408. J. Chem. Soc., 1916, 110, ii., 297.

Aqueous solutions of formic, acetic, propionic, and butyric acids were shaken at a temperature of 19°—21° C. with a weighed quantity of standardised non-chromed hide powder, and the changes in concentration of the acid solution determined. The results obtained show that the removal of the acids from aqueous solution takes place very rapidly and that a condition of reversible equilibrium is attained in each case. The relation between the quantity of acid removed by a given weight of hide substance and the concentration of the aqueous solution in equilibrium may be represented by the well-known adsorption formula. For the three higher aliphatic acids the adsorption constant β is proportional to the ionisation constant of the acid.

Influence of pine resin and tannin on the nitrogen economy and on the physical properties of the soil. Koch and Oelsner. *See* XVI.

Patents.

Tanning; Process of ——. H. Morin, St. Denis, France. Eng. Pat. 100,163, Mar. 14, 1916. Under Int. Conv., Oct. 22, 1914. (Appl. No. 3802 of 1916.)

Skins, after thorough rinsing, are soaked in a solution containing from 2½ % to 10 % of sodium or potassium silicate, and afterwards treated with acetic or some other acid to precipitate silica on the hide fibre. The leather produced is white, supple, and unaffected by boiling water.—F. C. T.

Impregnation of leather or textile driving belts or the like. O. Heublein, Frankfort. Ger. Pat. 291,461, Jan. 10, 1915.

The belts are impregnated with a solution, liquid at the ordinary temperature, of wool fat, pitch, or the like, in a volatile solvent. Suitable solvents are chloro-derivatives of aliphatic hydrocarbons, petroleum, ketones, aromatic hydrocarbons, oil of turpentine, chlorohydrins, or mixtures of these substances.—A. S.

[*Glue*] *adhesive, and process of making same.* C. H. Campbell, Chicago, Ill., Assignor to American Glue Co., Boston, Mass. U.S. Pat. 1,181,071, May 23, 1916. Date of appl., Oct. 12, 1912.

A small quantity of a soluble nitrate is added to a solution of glue, which is then heated for a short time to about 120° C. After drying, the glue is soluble in water at the ordinary temperature. —F. C. T.

Leather substitute: Process for the manufacture of a material suitable for use as a ——. J. Chylik, Krizenau, Austria. Eng. Pat. 8821, June 15, 1915.

Rosin (0·2 kilo.) is heated with linseed oil varnish (0·28 kilo.) until a viscous solution is formed. This is cooled, and milk curd (1 kilo.) is added, the whole being worked up to a stiff paste; slaked lime (0·50 kilo.) is then added so as to produce a paste suitable for spreading. Canvas or other fabric may now be coated or impregnated with this paste, and built up to the required thickness. The product is dried, and then softened in water, when it can be pressed into sheets or plates. The paste may also be mixed with finely divided leather waste, and rolled or pressed into sheets.—E. W. L.

Gelatinising substances; Treatment of ——. Aktienges. für Chemische Produkte vorm. H. Scheidemandel, Berlin, Assignees of P. Askenasy, Karlsruhe, Germany. Eng. Pat. 100,392, Mar. 30, 1916. Under Int. Conv., May 3, 1915. Addition to Eng. Pat. 15,365 of 1915.

Gelatin globules, formed by the cooling of drops of a hot solution of gelatin, may be thoroughly cooled and prevented from adhering together by using a cooling liquid of such specific gravity that the globules do not sink in it until they are nearly solid, and too hard on the surface to permit adhesion.—F. C. T.

Tanning substances and method of preparing the same. A. Römer, Stuttgart, Assignor to Deutsch-Koloniale Gerb- u. Farbstoff-Ges.m.b.H., Karlsruhe, Germany. U.S. Pat. 1,186,500, June 6, 1916. Date of appl., Jan. 24, 1916.

See Fr. Pat. 471,924 of 1914; this J., 1915, 438.

Process for dyeing artificial leather. U.S. Pat. 1,186,052. *See* VI.

XVI.—SOILS; FERTILISERS.

Sulphur in moorland soils injurious to plant growth and subterranean structures; Nature of the ——. W. Thörner. Z. angew. Chem., 1916, **29**, 233—236.

The so-called reactive sulphur which is deleterious to both plant growth and the mortar or cement of underground foundations, etc., occurs not only as pyrites, but also in the free state and in organic combination. Its destructive action is ascribed to the production of sulphuric acid by atmospheric oxidation in presence of moisture. Finely divided sulphur mixed with moist sand or peat on a filter underwent slow oxidation as the water evaporated, and similar conditions may be assumed to exist in peaty land containing sulphur, on exposure to the atmosphere. An energetic oxidation of finely divided sulphur in aqueous suspension was observed during electrolysis of the water.—G. F. M.

Molasses: Utilisation of (cane) —— as a manure. L. de Wall. Intern. Sugar J., 1916, **18**, 267—272.

A series of plots in Java was treated with sulphate of ammonia. Some of these in addition received: (1) a solution of cane molasses; (2) a solution of sugar of the same sucrose content as the molasses; and (3) the nitrogen, and (4) the nitrogen and potash equivalent to the amounts present in the molasses added. In the case of the molasses and the sugar plots the increased tonnage of cane per acre over that found when using sulphate of ammonia alone was 10—11 and 6·5 respectively: whereas in the extra nitrogen and extra nitrogen and potash plots it was 2½—3½ and 3—4 tons. Notwithstanding, however, these increased yields of cane caused by the presence of sugar, the available sugar of the cane was markedly decreased. Application of the molasses was made in these experiments in the form of a solution, which would immediately drain to the lower strata of the soil. Probably a more advantageous procedure would have been to use "solidified molasses."—J. P. O.

Zeolites: Chemical and physical properties of artificial ——. A. von Sigmond. Kir. Magyar Termés. társulat, Budapest, Feb. 29, 1916. Chem.-Zeit., 1916, **40**, 519—520.

Experiments were made with artificial sodium-zeolites containing widely varying molecular proportions of silica, alumina, and soda, which were converted into calcium-zeolites by treatment with 20% calcium chloride solution. The calcium zeolites obtained were of four kinds and possessed the following molecular compositions:—

(1) $3SiO_2.Al_2O_3.CaO + 3H_2O$;
(2) $7SiO_2.2Al_2O_3.2CaO + 6H_2O$;
(3) $9SiO_2,2Al_2O_3.2CaO + 8H_2O$;
(4) $23SiO_2.4Al_2O_3.4CaO + 20H_2O + CaSiO_3$.

The reaction is a true chemical reaction and does not result in the formation of gel complexes; there is evidence of crystalline structure in the products. The sodium-zeolites are slimy products whilst the calcium-zeolites are granular. This corresponds with the fact that soils containing natural sodium-zeolites in quantity have poor physical properties which can be improved by treatment with calcium salts. There is thus a close connection between the physical properties of a soil and the chemical properties of the zeolites which are present.—J. H. J.

Soil acidity; Cause and nature of —— with special regard to colloids and adsorption. E. Truog. J. Phys. Chem., 1916, **20**, 457—484.

The production of acidity or alkalinity when certain neutral solutions come in contact with certain solids is probably due to chemical action and not to selective adsorption of ions. Cameron's contention that the acid reaction towards litmus of washed absorbent cotton (and inferentially of certain soils) is due to adsorption of cations, is untenable, since such cotton has been found to contain an insoluble fatty acid (perhaps margaric acid), which would not be removed completely by the preliminary washings with alkali and acid. When the cotton is brought into a neutral salt solution, the salt reacts with the fatty acid, some cations are removed, and an equivalent amount of soluble acid is liberated. Similarly, the reputed selective adsorption of ions by charcoal is accounted for by chemical actions between impurities contained in it and the dissolved salt. Assuming selective adsorption, the vastly greater adsorptive power of soils would still need explanation. Arguments are also adduced to prove that soil acidity is not the result of selective ion-adsorption by colloids or by finely divided solids; and it is shown experimentally that under suitable conditions, the reactions causing soil acidity proceed according to chemical laws. The acidity in well aerated soils, in particular in cultivated upland soils, is due to hydrolysis of silicates, of which the bases are removed by plants and by soil water, and the silica and acid silicates left behind. The weathering process in soils can be reproduced by treating powdered basalt, granite, felspar, etc., with carbonated water and filtering: the residues are acid to litmus. In dry regions, the soluble salts accumulate and cause alkalinity. In these soils, organic acids derived from plant residues are of little importance: they may be formed, but are quickly transformed. In badly aerated soils, *e.g.*, in peat soils, the plant remains are decomposed much more slowly; instead of being oxidised to carbon dioxide, much of the carbon remains in the soil in organic combination as the so-called humic acids, and eventually is transformed into coal. The latent acidity of a soil (see this J., 1916, 699) may be largely due to kaolinite and similar compounds, or to free quartz; and the results of the determinations of active and latent acidity show that the amounts of different hydroxides that react with the insoluble acids, are approximately chemically equivalent. The fact that acid soils do not take up equivalent amounts of different bases from salt solutions possessing a common ion, is not opposed to the hypothesis that soil acidity is due to the presence of free acids, for the reactions involved would be much influenced by secondary reactions. By using small quantities of finely powdered soil and large volumes of salt solutions, and minimising the time of contact, the effect of such side reactions can be practically annulled; and determinations of soil acidity, under these conditions, give results which are best explained on the assumption of the existence of free acids. Further, the adsorption hypothesis would lead to the conclusion that the acidity of a soil would increase if the particles were ground to an impalpable powder: experiments showed a slight decrease.—E. H. T.

Bacterium; A hydrogen-oxidising —— from Indian swamp rice soils. W. H. Harrison and P. A. Subramania Aiyer. Mem. Dept. Agric. India, Chem. Series, 1916, 4, 135—148.

Crude cultures of the bacterium found in the soil-film of swamp rice land (this J., 1913, 1165, and 1915, 190) developed very poorly in Kaserer's solution (K_2HPO_4 0·05%, $MgSO_4$ 0·02%, NH_4Cl 0·1%, $NaHCO_3$ 0·05%, $FeCl_3$ trace), and when plated out on silica jelly, or on washed agar media containing the salts forming Kaserer's solution, and incubated in an atmosphere of mixed carbon dioxide, methane, oxygen, and hydrogen, did not oxidise the hydrogen except in one instance. In this case the microscope revealed two species of bacteria, a non-motile organism and a pseudomonas. Inoculation of this mixed culture into Kaserer's solution containing 0·1% of sodium asparaginate, caused a greatly increased oxidation of hydrogen. By repeated plating and re-plating on mineral agar containing the asparaginate, a pure culture of the oxidising non-motile bacterium was isolated, which was not identical with Kaserer's organism, *B. pantotrophus*. It is about 1—4 μ long and 0·5 μ broad, stains readily with aqueous stains, has no flagellæ and is non-spore-forming. It gives a white gelatin stab culture, and does not reduce nitrates or ferment sugars. Practically inactive under autotropic conditions, it oxidises hydrogen in symbiosis with the motile bacterium mentioned above. In presence of sodium asparaginate, peptone, or nutrose (optimum amounts, 0·01—0·03%) oxidation takes place readily, but excess of such organic matter inhibits the action. The presence of the motile organism promotes oxidation when the organic substances are also present, and only in this case was complete oxidation observed. The organism utilises ammonia and nitrates in presence of dextrose, but under these circumstances no oxidation of hydrogen takes place.—E. H. T.

Carbon and nitrogen changes in soil variously treated: soil treated with calcium carbonate, ammonium sulphate, and sodium nitrate. R. S. Potter and R. S. Snyder. Soil Science, 1916, 1, 76—91. J. Chem. Soc., 1916, **110**, i., 459—460.

The soil employed was a silt loam containing 1·35% of carbon and 0·1137% of nitrogen; its lime requirement was 600 lb. per acre according to the Veitch method (this J., 1904, 762). The amounts of ammonia and carbon dioxide given off by the soils, both alone and with addition of ammonium sulphate and sodium nitrate respectively, without and with calcium carbonate, were estimated by passing air over the soil contained in pots under bell-jars, and then successively through standard acid and 5% potassium hydroxide. Considerable amounts of carbon dioxide were given off during the first two days from the soil alone and from the soil with sodium nitrate; with ammonium sulphate the amount was much higher; and with calcium carbonate very much higher, whether employed alone or in conjunction with the nitrogenous manures. The production of carbon dioxide rapidly fell, but remained highest in the pots which received calcium carbonate. As regards the origin of the carbon dioxide, it is shown that in this experiment addition of calcium carbonate diminished its production from the organic matter; in another experiment the organic matter yielded more carbon dioxide when calcium carbonate was added than without. The loss of ammonia amounted to about 0·3 lb. per acre in twelve weeks, and was only higher (about ten times in the pots which received both calcium carbonate and ammonium sulphate. The losses of total nitrogen were generally less and the gains greater when calcium carbonate was added than without it.

Pine resin and tannin; Influence of —— on the nitrogen economy and on the physical propertie of the soil. A. Koch and A. Oelsner. Centr. Bakt Par., 1916, ii., **45**, 107—118. J. Chem. Soc., 1916 **110**, i., 454.

In soil to which 5% of colophony and 0·025% of nitrogen as nitrate were added, the whole of the nitrate was denitrified by bacteria, which utilised the colophony as source of energy, in four weeks The total nitrogen of the soil was only slightly diminished, so that the nitrate was utilised as source of nitrogen without liberation of free nitrogen. In an experiment in which colophony was substituted for citric acid in a Giltay solution there was a slight reduction of nitrate to nitrite in a few days. The reduction was more vigorous in a Raulin solution, with colophony instead o sugar, owing probably to the solvent action of the potassium carbonate on the resin. It is possible that nitrification is hindered by the presence of resin constituents dissolved by alkal salts. Tannin is readily assimilated by mould fungi, and the increased growth of the fungi give rise to a temporary loss of nitrogen present in the forms of ammonium salts and nitrates, which explains the low amounts of nitrates found in soils containing tannin. No oxalic acid is produced by *Aspergillus niger* from tannin. Addition of tannin to soils results in the production of a dark colou not due to iron. The power of retaining water is increased by addition of tannin to soils. Larg additions of tannin render soils hard like stone owing perhaps to the precipitation of colloids.

Calcium cyanamide; Effect of varying amounts o admixed water upon the decomposition of crud ——, and the formation of dicyandiamide. G Hager and J. Kern. Z. angew. Chem., 1916 **29**, 221—223.

Quantities of crude calcium cyanamide of 10 grms. each were treated separately with 5, 10, 15, 25, and 50 grms. of water, and enclosed in air-tight glass vessels. After 5 and 7 months the material was analysed. The fertiliser used contained: total nitrogen 18·62 %, of which 17·73 was water-soluble, cyanamide-nitrogen 16·75 %, nitrogen as dicyandiamide 0·50 %, as ammonia 0·24 %, and as "urea" nitrogen (*i.e.*, the element left in the filtrate after precipitation of the dicyandiamide) 0·48 %. Seven months' storage without added water caused no perceptible change: with 5 and 10 grms. of water, the changes were very small, the dicyandiamide nitrogen rising to 0·61 and 0·87 % respectively. The presence of 15 grms. of water produced more change; the dicyandiamide nitrogen rose to 1·13 %, the urea-nitrogen to 0·71 %, the cyanamide nitrogen fell to 13·61 %, and the ammonia nitrogen to 0·14 %. Very little change took place in the first ten days when 25 grms. of water was added, but after 7 months, 2·58 % of dicyandiamide was found. With 50 grms. of water, profound changes took place and the material set to a hard stone-like mass; after 2½ months and 7 months, the dicyandiamide nitrogen rose to 7·51 and 9·17 % respectively, the cyanamide nitrogen falling to 2·81 and 0·28 % respectively in the same periods. The analyses were performed by Caro's method (compare this J., 1916, 647). Calcium cyanamide should not be stored after it has become wet, but may be used immediately; the use of water to produce it in a granulated form is not likely to succeed.—E. H. T.

Phosphoric acid; Determination of —— by the citro-uranium method. D. Crispo and R. W. Tuinzing. Landw. Versuchs-Stat., 1916, **88**, 131—141. J. Chem. Soc., 1916, **110**, ii., 342.

The citrate-soluble phosphoric acid in phosphatic ertilisers may be estimated by precipitating the hosphoric acid as ammonium magnesium phos-hate under the conditions described by Popp this J., 1912, 831), dissolving this precipitate in ot acetic acid, and titrating the solution with tandardised uranium acetate solution, using otassium ferrocyanide as the indicator. For the stimation of total phosphoric acid in fertilisers ontaining much silica, the interfering action of he latter may be eliminated by boiling 10 grms. f the sample with 5 grms. of ferrous sulphate nd filtering the mixture. Results of numerous stimations of phosphoric acid in a variety of ertilisers are recorded, showing that the results btained by the method are trustworthy.

Arsenic; Stimulating influence of —— upon the nitrogen-fixing organisms of the soil. J. E. Greaves. J. Agric. Res., 1916, **6**, 389—416. (See this J., 1915, 808.)

The influence of arsenic compounds upon soil ertility is complicated by the fact that the anion nd cation of the salt may act in co-operation or ntagonistically. Thus the good effect of lead rsenate is due to both lead and arsenate ions, nd the injurious nature of Paris green is the result f the toxic action of the copper preponderating ver the beneficial action of the arsenic. Arsenic annot take the place of phosphorus as a source f energy for nitrogen-fixing organisms, but n some unknown manner it renders available he phosphorus that is present in insoluble forms; also stimulates the cellulose ferments which their turn promote the activity of these rganisms. The nitrogen-fixing powers of soil xtract, unfiltered or filtered, and of soil which as been dried for some time, are but little affected arsenic, indicating that this stimulant acts ainly by removing a thermolabile constituent f the soil.—E. H. T.

Fungicidal properties of certain spray fluids. Eyre and Salmon. *See* XIXb.

Patents.

Phosphoric acid; Enrichment of minerals containing ——. A. Frank, Charlottenburg. Ger. Pat. 292,090, Nov. 1, 1914.

Phosphatic minerals containing calcium carbonate are calcined to convert the latter into quicklime, and this is removed in the form of oxychloride by treatment with calcium chloride solution. Basic slag may be treated directly with calcium chloride solution to remove the free lime. By treating the calcium oxychloride solution with carbon dioxide or gases containing it, calcium carbonate is precipitated and calcium chloride regenerated.—A. S.

Superphosphate; Production of dry disintegrated ——. H. Hilbert, Neuss. Ger. Pat. 292,173, June 12, 1915.

The fluid mixture of raw phosphate and sulphuric acid is heated by direct contact with fire-gases flowing in the same or in the opposite direction, and is at the same time continuously agitated. For example it may be passed through a series of superposed chambers, each provided with a stirrer, and traversed by fire gases. Provided the mass is kept well stirred and the duration of heating is not prolonged, a temperature of 300° C. may be used without risk of formation of metaphosphate or reversion of the superphosphate, and under these conditions the mass sets very quickly to a finely-divided product.—A. S.

Fertiliser and method of preparing same. W. S. Allan, Freeport, and H. H. and J. W. Sturgis, Standish, Maine. U.S. Pat. 1,178,119, Apr. 4, 1916. Date of appl., Nov. 13, 1914.

"Muscle mud," a shell-fish formation found in deposits on the sea coast and containing any or all of the elements, nitrogen, phosphorus, calcium, is drained, dried in heated ovens or drying cylinders, ground, and then mixed with a fertilising material, *e.g.*, a potassium mineral.—E. H. T.

Fertilisers containing ammonium chloride, or pure ammonium chloride; Manufacture of ——. H. Precht, Hanover. Ger. Pat. 292,174, Mar. 23, 1915.

Ammonium-magnesium chloride, obtained by the action of ammonia on magnesium chloride solution, is dissolved in a small quantity of hot water, so that on cooling, decomposition occurs and ammonium chloride crystallises out, the magnesium chloride remaining in the mother liquor together with undecomposed double salt. The solution is evaporated and the residue again treated with hot water to decompose the double salt. Dilute aqueous alcohol may be used in place of water, and instead of dissolving the double salt it may be decomposed by stirring it with a quantity of cold water or aqueous alcohol insufficient to dissolve it completely.—A. S.

Fertiliser from the waste liquor from potash works; Manufacture of a ——. Kaliwerke Grossherzog von Sachsen A.-G., Dietlas, and K. Hepke, Dorndorf. Ger. Pat. 292,209, Jan. 29, 1915.

The liquor is treated with gaseous ammonia or gases containing it, for example in absorption towers, in order to convert the dissolved magnesium chloride into ammonium chloride, suitable for use as a fertiliser, and magnesia.—A. S.

Lime-nitrogen [crude calcium cyanamide]; Improving the fertilising action of ——. A. Stutzer, Königsberg. Assignor to Bayerische Stickstoff-Werke A.-G., Berlin, Germany. U.S. Pat. 1,185,731, June 6, 1916. Date of appl., Sept. 12, 1911.

See Ger. Pat. 242,522 of 1910; this J., 1912, 293.

XVII.—SUGARS ; STARCHES ; GUMS.

Sucrose ; Determination of —— in cane products by direct polarisation after the destruction of the reducing sugars. C. Muller. Intern. Sugar J., 1916, **18**, 274—275.

In place of the use of alkali hydroxides and hydrogen peroxide, recommended by Lemeland (this J., 1910, 1220) and Vollant (this J., 1911, 1329) for the destruction of the reducing sugars previous to the determination of sucrose in cane molasses and similar products by direct polarisation, the author uses a solution containing 25 grms. of Rochelle salt and 32 grms. of sodium hydroxide in 400 c.c. of water, in which is dissolved 11 grms. of bismuth subnitrate, the mixture being made up to 500 c.c. 50 c.c. of a 40% solution of the sample contained in a 300 c.c. flask is heated with 15 c.c. of the reagent (sufficient for the destruction of 3 grms. of reducing sugars) in a boiling water-bath for 15 minutes. The liquid is then cooled, 150 c.c. of water and 60 c.c. of basic lead acetate (36° B., sp. gr. 1·33) added, the volume made up to 300 c.c., and the liquid mixed and filtered. 100 c.c. of the filtrate is treated with 5 c.c. of acetic acid, made up to 110 c.c., treated with 2 grms. of decolorising carbon, mixed, filtered, and polarised in a 400 mm. tube. Rapid and certain results, corroborating those found by double polarisation using sulphurous acid, are claimed to be obtained, and the procedure is stated to be particularly applicable to routine work in cane sugar factories.—J. P. O.

Lead [in sugar solutions] ; Determination of —— as sulphite. H. Pellet. Ann. Chim. Analyt., 1916, **21**, 114—116.

The determination of lead as sulphite (see this J., 1915, 925) was recommended by the author in 1913 (Sucrerie Belge, and Bull. l'Assoc. Chim. Sucr., **19**, 362). The method gives very accurate results with the lead left in solutions of beet and cane sugar molasses after treatment with basic lead acetate. Lead sulphite is less soluble than the carbonate, particularly in presence of sugar and of the organic substances in molasses. The complete removal of lead from sugar solutions destined to be inverted with invertase, is most satisfactorily accomplished by precipitating it with an excess of sulphurous acid.—E. H. T.

Starch ; Influence of various salts on the liquefaction of ——. B. Viswanath, T. L. Row, and P. A. R. Ayyangar. Mem. Dept. Agric. India, Chem. Series, Vol. IV., No. 5, 160—163.

Teh authors studied the relative influence of various compounds at $N/10$ concentration on the rate of liquefaction of rice starch at 70° C. One grm. of starch in 50 c.c. of the liquid under investigation, was shaken continuously for 1 hour at 70° C., then cooled, treated with 15 c.c. of malt extract and kept for 2 hours at 30° C., Warth and Darabsett (this J., 1914, 133) having previously shown that at this temperature malt extract attacks only liquefied starch. The liquid was then made up to 100 c.c. and filtered with kaolin, and 50 c.c. of the filtrate was hydrolysed with hydrochloric acid and the dextrose formed was determined and calculated back to starch. The results showed that 44·91% of the starch was liquefied by distilled water alone, and the following percentages in presence of the substances indicated, at $N/10$ concentration :—KOH, 67·51% ; Na_2CO_3, 26·62% ; $CaCO_3$ ($N/10$ suspension), 25·04% ; HCl, 23·00% ; Na_2SO_4, 22·06% ; $MgSO_4$, 20·40% ; NaCl, 19·00% ; $MgCl_2$, 17·14% ; $CaCl_2$, 13·50%.—J. H. L.

Sugar formation in the sulphite-cellulose process. Oman. *See* V.

Utilisation of cane molasses as manure. De Wall. *See* XVI.

Use of cane sugar as adjunct and its inversion during the production of beer. Schönfeld. *See* XVIII.

Determination of gum in officinal syrups. Luce. *See* XX.

Biochemical synthesis of a galactobiose. Bourquelot and Aubry. *See* XX.

Patents.

Starch from corn [maize] ; Process for utilising wast products from the manufacture of ——. W. N. Sage, Keokuk, Iowa. U.S. Pat. 1,187,392 June 13, 1916. Date of appl., Apr. 30, 1915.

The soluble products in the waste liquors fror the manufacture of maize starch are precipitatec by agitating the liquors with lime, transferrin to a settling tank, drawing off the supernatan liquor, forcing the sediment into a press, anc drying the pressed product.—J. F. B.

Starch ; Apparatus for drying ——. J. J. Merrill Chicago, Ill., Assignor to Corn Products Refinin Co. U.S. Pat. 1,183,097, May 16, 1916. Dat of appl., Oct. 12, 1914.

The starch is passed through a drying tunnel upor a truck, which runs on rails. The upper part o the truck is divided into narrow, vertical, longitudinal compartments, having sides and botton of foraminous material and open at the top The compartments are spaced apart to allow th air to circulate between them. When the starc is dry, the truck is withdrawn from the tunnel an inverted to discharge its contents.—W. H. C.

Process and apparatus for revivifying or decarbonising bone-black or other filtering media. U.S. Pats 1,184,397 and 1,184,398. *See* I.

Filter for liquids, especially for sugar juices. Ger Pat. 291,519. *See* I.

Centrifugal machine [for drying sugar] ; Automati ——. F. Villarreal, Cruces, Cuba. U.S. Pat 1,187,205, June 13, 1916. Date of appl., Oct. 1, 1914

"Depulverisation" of starch and the like. Materia for use in brewing. U.S. Pats. 1,186,893 an 1,186,894. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Beer ; Use of cane sugar as adjunct, and its inversio during the production of ——. F. Schönfel Woch. Brau., 1916, **33**, 9—11.

A reduction of 40% in the amount of ma available for brewing in Germany has led to th use of cane sugar as adjunct, this being permitte on condition that the primary fermentation i carried out with top-fermentation yeast. Ca sugar added to wort is not inverted by one hour boiling of the wort, but if added just before after the primary fermentation it is complete inverted in 1 or 2 days at 20° C. and more slow at cellar temperature (cp. Baker and Hulto this J., 1911, 562). If added to beer short before pasteurisation it is sometimes complete hydrolysed before the operation is conclude especially when the rise of temperature is slow but if any sucrose remains after pasteurisation rate of inversion is much slower than in u pasteurised beer. The author considers that using cane sugar for German beers the additi of the sugar without prior inversion is not lik to weaken the yeast, since the invertase acts outside the cell.—J. H. L.

Hops; Influence of —— on the protein-content, foam-retaining power, and stability of beer. R. Heusz. Z. ges. Brauw., 1916, 39, 49—52.

In experiments in which 5·5 grms. of hops was boiled for 1 hour in about 1 litre of water, the amount of nitrogen (calculated as protein) extracted was only 0·369 % of the dry substance of the hops, and only about $\frac{1}{10}$ of this was precipitable by phosphotungstic acid. Further experiments indicated that the precipitation of nitrogenous matters from wort during boiling is not increased by addition of a hop-extract. The foam-holding power of a mixture of hop-extract and malt-extract was found to be far greater than that of either extract alone.—J. H. L.

Fermentation; Mechanism of alcoholic ——. A. Fernbach. J. Inst. Brew., 1916, 22, 351—367.

The author has previously shown that when fermentation is conducted in presence of calcium carbonate, relatively large quantities of calcium pyruvate accumulate in solution, thus confirming the view that pyruvic acid is an intermediate product of fermentation (this J., 1914, 97, 707). The quantity of acids formed, as estimated from the amount of lime dissolved at various stages of fermentation, increases approximately in proportion to the amount of sugar decomposed, and far exceeds the limit possible in absence of calcium carbonate. The total weight of salts precipitable by alcohol, obtained by the author in fermentation with yeasts, varied between 7 and 25 % of the sugar, and consisted mainly of calcium pyruvate. The amount of free pyruvic acid actually isolated did not in any case exceed 5 % of the sugar, owing to the tendency of the free acid to condense forming a lactone from which pyrotartaric acid is produced by elimination of carbon dioxide. This lactone may possibly play a part in the formation of succinic acid during fermentation. In fermentations conducted in presence of calcium carbonate the amount of pyruvic acid present (estimated by absorption of iodine in presence of alkali) increases until practically all the sugar is decomposed, and afterwards diminishes, for even in the form of calcium salt it is slowly decomposed by the yeast. The products of the decomposition of pyruvic acid by yeast are carbon dioxide and acetaldehyde, and the author considers that the latter is converted into alcohol by the reducing action of the yeast. The salts formed during fermentation in presence of calcium carbonate include calcium lactate, the lactic acid being formed doubtless by reduction of pyruvic acid.—J. H. L.

Wine; Rapid method for the determination of the sulphate-content of ——. J. Pritzker. Chem.-Zeit., 1916, 40, 499—501.

For approximate determinations, 8 c.c. of wine, or a smaller quantity diluted to 8 c.c. with water, is mixed with 1 c.c. of a 10 % solution of barium chloride containing hydrochloric acid, and centrifuged for 3 mins. at about 1400 revs. per min. in a tube of which the closed end is drawn out to form a narrow, graduated extension. The amount of sulphate is estimated from the volume occupied by the precipitate. When greater accuracy is required, 10 c.c. of wine may be titrated with standard barium chloride solution (14 grms. $BaCl_2.2H_2O$ and 50 c.c. concentrated HCl per litre; 1 c.c. corresponds to 1 grm. of K_2SO_4 per litre of wine) in a centrifuge tube such as a Schmid's albuminometer. The tube is spun for 1 min. after addition of slightly less than the required amount of barium chloride (as found by the foregoing test), and again after addition of successive portions of 0·1 c.c., so long as a drop of the barium chloride solution produces a precipitate in the supernatant liquid. The second method was found to give results in close agreement with the conductivity method of Dutoit and Duboux (this J., 1908, 871, 912), which the author considers accurate but troublesome to operate without considerable experience (cp. Bruno and D'Auzay, this J., 1912, 506, 742).—J. H. L.

Liqueurs; Determination of essential oils [essences] in ——. X. Rocques. Ann. Falsif., 1916, 9, 127—134.

A Commission appointed to investigate the methods for determining the total quantity of essential oils in various liqueurs reports that the iodine method (see Bonnet, this J., 1916, 613) yielded accurate results only in the case of liqueurs flavoured with aniseed or carraway (kummel) oils, the iodine values of these two oils being 1·45 and 2·40, respectively. In the case of all other liqueurs (Benedictine, Chartreuse, Curaçao, mint, orange bitters, etc.) the gravimetric method described by Muttelet (this J., 1916, 432, 613) should be employed. It was found that well-known brands of liqueurs frequently contained more than 0·5 grm. of essential oil per litre, the maximum limit fixed by a recent French law; in Curaçao liqueur the quantity exceeded 2 grms. per litre. Vermouth did not contain any appreciable quantity of essential oil.—W. P. S.

Methane fermentation of ethyl alcohol. V. L. Omeliansky. Ann. Inst. Pasteur, 1916, 30, 56—60. J. Chem. Soc., 1916, 110, i., 453—454.

Aqueous solutions of ethyl alcohol (1 %) containing, in addition, only mineral matter in amounts necessary as bacterial food, have been submitted to anærobic fermentation by inoculation with fæcal matter from a rabbit which had previously received alcohol for a fortnight. The gas collected consisted of carbon dioxide, 11·5 %; methane, 87·4 %; and hydrogen, 1·1 %. The solid matter collected at the bottom of the liquid was used to inoculate another solution, the gas this time consisting of carbon dioxide, 12 %, and methane, 88 %. Fermentation in each case continued until the whole of the alcohol was decomposed, and the bacteria persisted through a series of generations for more than a year. The bacteria were examined microscopically, and presented the forms of very slender, moderately long rods, slightly bent and without spores.

Urease content of certain beans, with special reference to the jack bean. J. C. Mateer and E. K. Marshall, jun. J. Biol. Chem., 1915, 35, 297—305.

The jack bean (*Canavalia ensiformis*), growing in the West Indies, was found to contain more than fifteen times, and the sword bean (*C. gladiata*) about five times as much urease as the soya bean (*Glycine hispida*); whilst the horse gram (*Dolichos biflorus*) contained about one-fifth, the white lupin (*Lupinus albus*) about one-fiftieth, and the urd bean (*Phaseolus aureus*) about one-three-hundred and fiftieth as much urease as the soya bean. The extract from the jack bean contained much less solid residue than did that from the soya bean, and the urease appeared to be specific for urea; the extract was found to be useful for the removal of urea previous to the determination of amino-acids in urine by the Van Slyke method.
—W. P. S.

A hydrogen-oxidising bacterium from Indian swamp rice soils. Harrison and Subramania Aiyer. *See* XVI.

Influence of various salts on the liquefaction of starch. Viswanath and others. *See* XVII.

Patents.

Potato peelings ; Preparation of —— for industrial utilisation. E. Borràs, and Anón. Borràs, Barcelona, Spain. Eng. Pat. 100,675. Jan. 3, 1916. (Appl. No. 50 of 1916.)

Potato peelings are boiled with water or steamed, then dried in a stove at a temperature gradually rising from 60° to 130° C. to obtain a product having a certain hardness or rigidity, which may be crushed or ground and subsequently used for the manufacture of glucose, alcohol, etc.—J. F. B.

Starch and the like : "Deputverisation" of ——. Material for use in brewing. P. Dreesbach, Assignor to Corn Products Refining Co., New York. U.S. Pats. (A) 1,186,893 and (B) 1,186,894, June 13, 1916. Dates of appl. Mar. 30 and Apr. 30, 1915.

A starch powder is mixed with a solution of a binder which will form with it a solid mass and is non-injurious for human consumption, *e.g.*, glucose or other sugar, in the proportion of about 1 part of dry binder to 9 of starch ; the resulting paste is moulded, dried by heat, and broken up. (2) The material for use in brewing consists of starch substantially ungelatinised, the granules of which are held together in the form of fragments by a binder.—J. F. B.

Treatment of earthenware filters for the preparation of non-alcoholic beverages from wines and fruit juices. Ger. Pat. 291,848. *See* XIXa.

XIXa.—FOODS.

Gluten considered from the stand-point of colloid chemistry. Influence of fat and acids on the baking strength [*of flour*]. K. Mohs. Z. ges. Getreidew., 1915—1916, **7**, 218—225, 239—242, 250—260. Z. angew. Chem., 1916, **29**, Ref., 274.

In the preparation of dough the excess of water acts as dispersing medium, the starch and proteins forming the dispersed phase. Gliadin and glutenin have a microscopic honeycomb structure ; they are hydrophil colloids and form inelastic gels. When swollen they produce gluten as a result of mutual irreversible coagulation ; the glutenin is enclosed by the gliadin, which is present in larger proportion, and hence the gluten tends to resemble gliadin in its properties. If the gliadin content be diminished the formation of gluten decreases rapidly until, ultimately, the gluten can no longer be separated by washing. The extensibility of the gluten depends upon the degree of hydration of the gluten proteins. The destruction of the swollen condition of the inelastic gluten gel in baking is irreversible, that is, the protein-structure of the finished loaf cannot be again swollen. Fats, up to 15%, have a favourable influence on the yield of dough from flour, and on the volume and development of the crumb of the loaf. The effect is due to reversible adsorption of the fat by the gluten proteins. Organic acids produce increased swelling of gliadin and glutenin and increased hydration of the gluten proteins.—A. S.

Pectin in spices ; Determination of ——. T. von Fellenberg. Mitt. Lebensmittelunters. Hyg., **7**, 42—61. J. Chem. Soc., 1916, **110**, ii., 351—352.

The method depends on the estimation of the methyl alcohol yielded by the pectin (compare this J., 1915, 574). From 1 to 2 grms. of the sample is placed on a filter and treated with small quantities of boiling 95% alcohol until the filtrate measures about 40 c.c. ; after a similar treatment with light petroleum, the contents of the filter are dried, transferred to a flask, and distilled with 40 c.c. of water, 20 c.c. of distillate being collected. The mixture in the flask is now treated, while hot, with 5 c.c. of 10% sodium hydroxide solution, and, after five minutes, 2·5 c.c. of dilute sulphuric acid (1 : 4) is added, and 16·2 c.c. is distilled over ; this distillate is mixed with 5 drops of sodium hydroxide solution and 5 drops of 10% silver nitrate solution and again distilled, 10 c.c. of distillate being collected and once more distilled. The final distillate, measuring exactly 6 c.c., is weighed. Three c.c. of it is then treated with 1 c.c. of an alcohol-sulphuric acid solution (21 c.c. of 95% alcohol and 40 c.c. of concentrated sulphuric acid diluted with water to 200 c.c.) and 1 c.c. of 5% potassium permanganate solution. Comparison solutions containing 5 mgrms., 1 mgrm., and 0·3 mgrm. of methyl alcohol, respectively, are similarly treated at the same time. After two minutes, the mixtures are each treated with 1 c.c. of 8% oxalic acid solution, 1 c.c. of concentrated sulphuric acid, and 5 c.c. of magenta-sulphurous acid solution, and the colorations obtained are compared after the lapse of one hour. The pectin content of the sample is ten times that of the methyl alcohol.

Cottonseed meal ; Nutrition investigations upon ——. A. E. Richardson and H. S. Green. J. Biol. Chem., 1916, **25**, 307—318.

Cottonseed meal contains sufficient protein and fat-soluble growth-promoting substance but the quantity of mineral substances present is inadequate for growth of animals. When mixed with other substances the meal forms an efficient food material. For instance, rats grew and developed normally when fed on a mixture containing cottonseed meal, 45, whole milk powder, 17, starch, 10, and lard, 28%.—W. P. S.

Palm nut kernel cake ; Cause and prevention of rancidity in ——. R. B. Calder. J. Agric. Sci., 1916, **7**, 470—472.

After heating for a short time at 70° C., or for a long time at 60° C., palm nut kernel cake can be kept sweet for at least ten weeks. The rancidity is due to a zymogen which, under the influence of warmth and moisture, gives rise to a lipase ; the latter is usually destroyed on heating the dry cake, but heating when moist is more certain.—E. H. T.

Aniline dyestuffs ; Anti-coagulating action of acid —— on proteins. A. C. Hollande. Comptes rend., 1916, **162**, 959—961.

On adding an aqueous solution of a basic aniline dyestuff to blood serum, a copious precipitate is obtained, whereas an acid dyestuff produces at most a slight turbidity. If the serum be heated with the acid dyestuff (*e.g.*, Congo Red) no coagulation of protein occurs even at 120° C. By reducing the amount of dyestuff to the point where it is only just sufficient to prevent coagulation on boiling, the serum becomes a transparent jelly when cold. Similar results are obtained with other sera such as white-of-egg, etc. Among acid dyestuffs the following are mentioned in the order of anti-coagulating activity :—Water-soluble Eosin, Orange G, Uranin, Congo Red. The specific character of a protein is modified on boiling the liquid in presence of an acid dyestuff. For example, repeated injection of white-of-egg, which has been boiled with Congo Red for 10 mins., into a rabbit, does not produce precipitins specific for egg albumin in the rabbit serum. Agglutinins, hæmolysins and alexins are not destroyed by the addition of acid dyestuffs in the cold. Compounds of acid dyestuffs with proteins are not precipitated by cold 90% alcohol, by nitric acid, or 40% formaldehyde ; 10% acetic acid gives a precipitate which is rapidly soluble in excess of the reagent.

Saturation with sodium chloride gives only a slight turbidity, but saturation with ammonium sulphate yields an abundant precipitate. Sera mixed with Congo Red may be sterilised in an autoclave at 120° C. and used as culture media for bacteria. By adding 1 vol. of 2% Congo Red solution to 2 vols. of a serum a mixture is obtained which gelatinises in a few minutes at 100° C. and may be sterilised for 20 minutes at 120° C. without losing its transparency. It is considered that the acid dyestuffs combine with the proteins to form coloured acid-albumins. —C. A. M.

Urease content of certain beans, with special reference to the jack bean. Mateer and Marshall, jun. *See* XVIII.

Ninhydrin reaction with amino-acids and ammonium salts. Harding and Warneford. *See* XX.

Ninhydrin reaction with amines and umides. Harding and MacLean. *See* XX.

Patents.

Condensed milk ; Manufacture of —— and apparatus therefor. S. S. Cohen, Rotterdam, Holland. Eng. Pat. 7105, May 12, 1915.

An apparatus for preparing sterilised condensed milk (sweetened or unsweetened) consists of three superposed vessels. The milk is concentrated under reduced pressure in the upper vessel ; the connection with the pump is then closed and the milk is allowed to flow into the middle vessel where it is cooled, means being provided for equalising the pressure in these two vessels. When cold, the milk is discharged into the lowest vessel and thence into sterilised receptacles. Filtered compressed air or other gas may be admitted to the top of the lowest vessel to expedite the discharge of the condensed milk. By means of suitable tapped valves provided with filters, air may be admitted to the different vessels after the milk has been concentrated to the desired consistence.—W. P. S.

Cheese ; Process of sterilising —— and an improved product produced by such process. J. L. Kraft, Chicago, Ill. U.S. Pat. 1,186,524, June 6, 1916. Date of appl., Mar. 25, 1916.

Cheese of the Cheddar type is heated at 175 F°. (80° C.) for some time and stirred during this treatment ; it is then filled into sterilised receptacles which are hermetically sealed.—W. P. S.

Earthenware filters for the preparation of non-alcoholic effervescent beverages from wines and fruit juices ; Treatment of ——. Gebr. Seyboth Chem. Fabr., Munich. Ger. Pat. 291,848, Aug. 24, 1915.

In the preparation of aerated beverages from fruit juices and from wine from which the alcohol has been removed by distillation, the liquid is filtered through an earthenware filter which has been impregnated with a fluorine salt capable of combining with the silica of the earthenware and with sodium chloride. By this treatment the microscopic cracks in the filter are partially closed without unduly diminishing the porosity of the filter, and a filtrate quite free from germs is obtained.—A. S.

Comestibles and their method of manufacture ; Powders mainly applicable as ——. S. A. Vasey and U. A. Cleeve, London. Eng. Pat. 9343, June 25, 1915.

The powder, *e.g.*, oatmeal, pea flour, coffee, is projected by an air-blast into an atomised hydrocarbon, such as petroleum, which is odourless, liquid, and non-volatile at ordinary temperatures. From 1—3% of hydrocarbon is used.—J. H. J.

Eggs ; Art of preserving ——. S. F. Henderson, Assignor to Yester-laid Egg Co., Woodwardville, Md. U.S. Pat. 1,174,008, Feb. 29, 1916. Date of appl., Aug. 28, 1915.

The eggs are placed in a wire basket and immersed in a bath of "liquid petrolatum." This substance is a mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the more volatile portions of petroleum and purifying the residue so as to produce a colourless, odourless, tasteless, and non-poisonous oil, which remains liquid on exposure and is non-volatile at ordinary temperatures. After immersion for 15 secs., the eggs are removed and drained.—J. H. J.

Preparation of potato peelings for industrial utilisation. Eng. Pat. 100,675. *See* XVIII.

XIXb.—WATER PURIFICATION; SANITATION.

Waters carrying colloids ; "Relative stabilities" in polluted ——. A. Lederer. Chem. News, 1916, **113**, 308—309.

In applying the methylene-blue test for putrescibility to waters carrying colloidal suspensions of clay, sewage matter, etc., the dye is adsorbed by the clay, leaving the liquid colourless and the sediment coloured. This decolorisation of the liquid may be partial or complete, depending upon the amount of colloid present, and prevents any accurate determination of the relative stability of the water. Experiments showed that the methylene-blue adsorbed by the colloid is rendered largely inert as an indicator, the sediment remaining blue long after all available oxygen in the water has been used up. If more than the standard amount of methylene-blue is added and remains in solution, the antiseptic action of the dye affects the result and causes an apparent higher relative stability. Attempts to cause the colloids to settle by means of freshly precipitated coagulants before adding the dye, gave unsatisfactory results. In the presence of colloids, therefore, the methylene-blue test is inapplicable, and resort must be had to the determination of the available oxygen used up by the water. For this the author recommends determining the dissolved oxygen on the spot, bottling other portions of the water with and without the addition of potassium nitrate (this J., 1915, 731) and incubating at 20° C.for 10 days. Then the samples are analysed for dissolved oxygen and nitrites and nitrates. The nitrous and nitric nitrogen is calculated into its equivalent of oxygen, and the total loss of available oxygen during incubation gives the oxygen demand of the water.—J. H. J.

Water ; Field-sterilisation of —— by treatment with hypochlorite. Composition and stability of sodium hypochlorite solution. H. Penau. J. Pharm. Chim., 1916, **13**, 377—385.

A method proposed for the sterilisation of water for the use of armies in the field consists in adding a large excess of active chlorine and subsequently destroying this excess by the addition of sodium thiosulphate. The sodium hypochlorite solution employed is prepared by dissolving 5 kilos. of Solvay sodium carbonate (75% Na_2CO_3) in 40 kilos. of water and adding a mixture of 5 kilos. of calcium hypochlorite and 50 litres of water. After settling, the supernatant liquid is filtered through cloth, and potassium permanganate is added in the proportion of 0·2 grm. per litre of the liquid. The latter contains sodium chloride, 8·7—11·3 ; sodium hypochlorite, 11·0—11·7 ; sodium chlorate, 0·7—2·6 ; sodium carbonate, 3·7—5·8 ; sodium sulphate, 0·5—2·8 : sodium hydroxide, 2·4—2·7 grms. per litre ; it yields about 10·5 grms. of active chlorine per litre, and maintains its strength for at least 2 months. Five hundred litres of the water to be sterilised is mixed with 250 c.c. of this hypochlorite solution and, after 45 mins., the excess of chlorine is destroyed by the addition of 30 c.c. of sodium thiosulphate solution (10 kilos. of the salt per 100 litres of water): the water is ready for drinking after the lapse of a further 5 mins. Wooden tubs or barrels, coated inside with a layer of paraffin wax, are used in the preparation of the hypochlorite solution and in the treatment of the water.

—W. P. S.

Waters: Control of the purification of —— with hypochlorite, after elimination of active chlorine by sodium thiosulphate. J. Golse. J. Pharm. Chim., 1916, **14**, 8—13.

TWO methods are described for the detection or determination of traces of thiosulphate in waters. In the first, 20 c.c. of water is treated with 1 c.c. of silver nitrate solution (1 in 20) and just sufficient ammonia to dissolve all silver chloride. The presence of even 1 mgrm. of sodium thiosulphate per litre will be indicated by a faint brown tint due to silver sulphide, and the test can be made quantitative by the use of standard tints. A more sensitive test is based on the action of thiosulphate in reducing iodine liberated by the reaction:

$$KIO_3 + 5KI + 6HCl = 3H_2O + 6KCl + 6I.$$

In a separating funnel of 150 c.c. capacity, 100 c.c. of the water, containing 1 c.c. of 5 % potassium iodide solution and 1 c.c. of hydrochloric acid (1 : 10), is treated with sufficient benzene (1 or 2 c.c.) to form a thin layer on the surface. A solution of potassium iodate, containing 0·0144 grm. per litre, is added until, after shaking, the benzene film, viewed at grazing incidence, shows a slight reddish tint. One c.c. of iodate solution corresponds to 1 mgrm. of crystallised sodium thiosulphate per litre of the water. The test is rendered more trustworthy if accompanied by a blank with distilled water. The difference in the volumes of iodate solution required to produce equal tints in the two cases, is a measure of the thiosulphate present.—J. H. L.

Iodine and bromine in saline waters from petroleum-bearing strata; Determination of ——. D. E. Popa. Bull. Sci. Acad. Roumaine, 1915—16, 4, 308—317. J. Chem. Soc., 1916, **110**, ii., 339.

A MODIFICATION of a method proposed by Weszelszky is recommended; the method depends on the oxidation of the iodine to iodic acid by means of chlorine in acid solution, the bromine at the same time being liberated and removed by distillation. A small quantity of bromine is, however, converted into bromic acid, and the modification described consists in a double treatment with chlorine, with intervening reduction, in order to recover all the bromine. 100 c.c. of the water is rendered alkaline with sodium hydroxide, evaporated, the residue is ignited at a low temperature in order to destroy organic substances, then dissolved in water, the solution filtered, and the insoluble portion washed. The filtrate and washings are evaporated to about 70 c.c., transferred to a distillation flask, and acidified with sulphuric acid or hydrochloric acid. 75 c.c. of 1 % chlorine water is now added, the flask is connected with a receiver containing 1 % potassium hydroxide solution, and the contents of the flask are heated, a current of carbon dioxide being passed through the apparatus when steam begins to enter the receiver. After continuing the distillation for about thirty minutes, the contents of the flask are cooled, 20 c.c. of saturated sulphur dioxide solution (at 0° C.) is added, and the mixture is boiled until practically all the sulphur dioxide has been expelled; the receiver is meanwhile detached, the alkaline solution transferred to a porcelain dish, and a fresh portion of potassium hydroxide solution introduced. The solution in the flask is then treated with chlorine and the distillation repeated. The united distillates are evaporated, the residue is heated on a boiling water-bath for 45 mins., then dissolved in 130 c.c. of water, the solution treated with potassium iodide and sulphuric acid, and the liberated iodine titrated; its quantity is a measure of the amount of bromine present. The solution remaining in the distillation flask is boiled for about fifteen minutes to remove a small trace of bromine which remains (this amount of bromine is too small to affect the result for bromine, but interferes with the iodine estimation), then cooled, potassium iodide is added, and the liberated iodine titrated.

Spray-fluids; Fungicidal properties of certain ——. J. V. Eyre and E. S. Salmon. J. Agric. Sci., 1916, 7, 470—507.

THE fungicidal efficiency of a variety of preparations was investigated on 1—2 year old seedlings of the Hop (*Humulus Lupulus* Linn.) bearing the "powdery mildew" (*Sphærotheca Humuli* (D.C.) Burr.) grown in an unheated greenhouse, and in a few cases on gooseberry bushes infested with American gooseberry-mildew (*Sphærotheca mors-uvae*) grown in the open. The spraying was done in May, June, and July, by means of a hand "atomiser," and sufficient spray was used to wet thoroughly the infested leaves, untreated leaves being observed on the same plant. None of the following had any fungicidal value: soft soap (1 % solution), saponin (0·25 %), sodium carbonate (0·3 %) and soft soap (1 %), sodium thiosulphate (1 %) and soft soap (1 %). Trials with solutions of sodium hydroxide and soft soap (1 %), showed that with concentrations of alkali up to 0·5 % the mildew was not killed, although the epidermal cells of the leaves were affected; a 1 % solution killed the fungus but "scorched" the leaves badly, and a 1·5 % solution killed the leaves after 3 days. A 2 % solution of ammonia was practically useless, a 4 % solution checked the mildew but seriously affected the leaf-tissue. Preparations of "liver of sulphur" and of ammonium sulphide required the addition of soft soap or similar substance (see also this J., 1916, 378). The fungicidal value of alkaline sulphide solutions is determined neither by the presence of free alkali, nor by the proportion of sulphide-sulphur present, but by the polysulphides present as such, irrespective of the sulphur they deposit on decomposition. Colourless solutions of ammonium hydrosulphide and of ammonium sulphide, containing up to 3·3 % of sulphide-sulphur, merely checked the mildew temporarily, and a solution of hydrogen sulphide (0·056 % sulphide-sulphur and 1 % soap) was useless. A solution containing 0·6 % of iron sulphide + 0·5—1·0 % of soft soap has a remarkably rapid fungicidal effect; it leaves a rusty-brown deposit, and when made by a method which leaves a trace of yellow ammonium sulphide in it, is quite harmless to foliage and can be applied as a fine spray.

—E. H. T.

Chemical and physical properties of artificia zeolites. Von Sigmond. *See* XVI.

PATENTS.

Water-softening and purifying apparatus. W Paterson, London. Eng. Pat. 4275, Mar. 18 1915. (See Eng. Pat. 10,293 of 1909.)

A TIPPING vessel for the by-passed, measure quantity of water is mounted on a movable shaft and is provided with levers to operate a double ended ram, the ends of which are connected by a pipe having controllable outlets, so that as the tipping vessel falls, one of the rams is operated and the water in its cylinder is forced through the connecting pipe; by this means the energy of the falling water within the tipping vessel is absorbed. In connection with this apparatus, there is a tank for the chemical reagent, the contents of which are kept constantly stirred by revolving paddles mounted on the shaft of a water wheel which is actuated by the main flow of water. Numerous cups are mounted on the paddles which are filled with the reagent during rotation and discharge into a hopper connected to a double-compartment, oscillating, measuring vessel. The compartment which is in action is kept full until such time as it is required to be discharged into the water to be treated, the surplus reagent entering the compartment meanwhile, being allowed to overflow back to the reagent tank. In order that the whole contents of the reagent-measuring vessel may be discharged instantaneously, it is connected with the water-measuring vessel by linked levers which operate a loosely-mounted weighted lever. When this is raised to a vertical position, it falls over by its own weight and strikes a pin on the reagent-measuring vessel, thus instantly tipping it. For adding dry reagents to water, a modified apparatus on the same principle is employed.—J. H. J.

Filter for water. W. J. Rankin, Tulsa, Okla. U.S. Pat. 1,186,608, June 13, 1916. Date of appl., Dec. 3, 1915.

A casing is divided by horizontal partitions into an upper, an intermediate, and a lower chamber, all filled with granular filtering material. The water to be filtered is supplied to the upper chamber and passes successively into the other chambers through openings in the partitions, and the flow of water is directed by transverse baffle-plates in the upper chamber and longitudinal guide-plates in the intermediate and lower chambers. Spaced above the floor of the lower chamber is a grating so as to form a drain, and immediately above the drain is an outlet opening in the side of the casing. Guards are provided to prevent the granular filtering material passing into the openings in the partitions and the outlet opening.—A. S.

Lime-sulphur compounds and solutions; Process for making ——. A. D. Fest, Chicago, Ill. U.S. Pat. 1,186,564, June 13, 1916. Date of appl., Aug. 8, 1914.

Suitable proportions of lime and sulphur are mixed with water to a paste and treated with steam in an autoclave. The product is a concentrated solution of 40° B. (sp. gr. 1·38) or over, which is diluted to form an insecticidal spray. —J. H. J.

Sewage sludge and the like; Treatment of ——. E. A. Paterson, Thorold, Ontario, Canada. Eng. Pats. 3355, Mar. 2, and 10,262, July 14, 1915.

Pressed sewage sludge is neutralised, if necessary, by the addition of calcium carbonate, then mixed with from 1 to 5% of its weight of sodium silicate, dried at a temperature not exceeding 250° F. (about 120° C.), and submitted to destructive distillation. The treatment with sodium silicate renders the sludge more porous and the hot gases readily penetrate the mass during the distillation. —W. P. S.

Liquid-treating apparatus. K. W. Bartlett, Hammond, Ind. U.S. Pat. 1,186,161, June 6, 1916. Date of appl., Mar. 15, 1916.

The liquid is discharged over a bucket-wheel into a settling tank, the movement of the wheel controlling means for supplying definite quantities of chemical reagent from a separate tank to the settling tank.—W. P. S.

Electrochemical apparatus [for purifying liquids]. C. P. Landreth, Philadelphia, Pa. U.S. Pat. 1,186,106, June 6, 1916. Date of appl., Oct. 14, 1914.

See Eng. Pat. 18,564 of 1914; this J., 1915, 978.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids; Determination of small quantities of ——. E. Carlinfanti. Boll. Chim. Farm., 1915, **54**, 321—323. J. Chem. Soc., 1915, **108**, ii., 709—710.

The estimation of small amounts of morphine or codeine, either in pharmaceutical preparations or for toxicological purposes, may be effected by the following colorimetric methods, a Wolff colorimeter being employed. In the case of morphine, the solution to be examined and a known volume, say 1 c.c., of a 0·5% morphine hydrochloride solution are evaporated separately in basins on a water-bath, and allowed to cool in a desiccator. Each of the residues is dissolved in 5 c.c. of concentrated sulphuric acid, and the liquid introduced into a tube holding about 50 c.c. and fitted with a ground stopper; each dish is washed twice with 3 c.c. of concentrated sulphuric acid, and the washings added to the tube, which is then closed and immersed for fifteen minutes in a boiling water-bath. To the cooled tubes are added 10 c.c. of a mixture of 100 c.c. of concentrated sulphuric acid with two drops of nitric acid (sp.gr. 1·4); on shaking the tubes, the characteristic, blood-red coloration appears. The solutions are then introduced into the cylinders of the colorimeter, in which they are made up to the same height by addition of the small quantities of concentrated sulphuric acid used for washing the tubes.

In the case of codeine, to each of the two aqueous residues, reduced to about 1 c.c. by evaporation on a water-bath at 70°—75° C., 15—20 c.c. of monohydrated sulphuric acid is added cautiously so that the mixture is not heated. The liquid is then introduced into a 50 c.c. flask, together with three quantities of 5 c.c. of the acid used to wash out the dish and 10 c.c. of monohydrated sulphuric acid containing 2 c.c. of 10% ferric chloride solution per 100 c.c. of the acid. After being shaken, the flasks are immersed for fifteen minutes in a water-bath at 80° C., the cooled solutions, which have assumed blue colorations, being introduced into the cylinders of the colorimeter as before.

These methods admit of the estimation of 0·001—0·003 grm. of morphine or codeine hydrochloride to within about 0·0001 grm.

Alkaloids; Determination of small quantities of ——. C. Carlinfanti and M. Scelba. Boll. Chim. Farm., 1916, **55**, 225—232. J. Chem. Soc., 1916, **110**, ii., 356—357.

Under the conditions given for the estimation of morphine (see preceding abstract), acetoxymorphine (heroine) may be estimated with considerable accuracy; it may be distinguished from morphine, since it colours concentrated sulphuric acid containing nitric acid orange-yellow in the cold and blood-red on heating, and does not reduce iodic acid. Codeine may also be estimated similarly, but for very small quantities of this alkaloid the method previously given (*loc. cit.*) is recommended.

Apomorphine may be estimated as follows: 1—5 c.c. of a 0·1% solution of the hydrochloride is evaporated to dryness in a basin on a water-bath. The residue is allowed to cool in a desiccator, and 10 c.c. of 95% alcohol and 0·1 grm. of sodium bicarbonate immediately added. The whole is then covered with a watch glass and mixed repeatedly during four to five hours, after which the liquid is poured into a tared flask and made up to volume with the washings of the residue with 95% alcohol. When the suspended sodium bicarbonate has settled, a portion of the clear liquid is decanted into a colorimeter, and the emerald-green coloration which develops compared with that obtained from a known quantity of the alkaloid treated similarly. This method gives good results with quantities of apomorphine of the order 0·001—0·002 grm. For smaller amounts, the authors recommend the following modification of Grimbert and Leclère's method (this J., 1915, 150): To the solution of the alkaloid, made up with water to 3 c.c., are added 5 drops of saturated mercuric chloride solution and then 5 drops of 10% sodium acetate solution. The liquid is boiled for half a minute, cooled, mixed with 1 c.c. of amyl alcohol, and introduced into a 50 or 100 c.c. flask, the vessel being washed out several times with small quantities of 95% ethyl alcohol, and the volume made up with concentrated alcohol. After being shaken, the liquid is left until the mercurous salt settles, the clear solution being compared in the colorimeter with one prepared similarly from a known weight of apomorphine.

In the case of strychnine, a definite volume of the solution containing at least 0·004—0·005 grm. of the alkaloid is heated to boiling with 20—25 c.c. of 15% sulphuric acid solution, recently prepared bromine water being added, drop by drop, until the liquid assumes a pale yellow colour, and the boiling then continued for a few minutes; the presence of strychnine is revealed by a more or less intense reddish-violet coloration. Further addition of a few drops of bromine water turns the hot acid liquid pale yellow, and subsequent boiling renders it reddish-violet again. The cold solution is made up to 50 to 100 c.c., and its depth of colour matched with that of a solution prepared similarly from a known weight of the alkaloid. With a pharmaceutical preparation containing a strychnine salt, a quantity presumably containing at least 0·005 grm. of the base is mixed with an alkali, and the mixture extracted with chloroform, the residue from the latter then being dissolved in 15% sulphuric acid solution and treated as above.

Under the conditions employed in the case of strychnine, brucine gives a salmon-red coloration with bromine water, but, when the alkaloid is present in small proportion, the second addition of bromine water renders the solution colourless. With strychnine, on the other hand, the violet-red coloration persists almost unaltered after a second and even a third treatment with bromine water. In conformity with this behaviour, the proportion of strychnine in *Nux vomica* preparations and other solutions containing strychnine and brucine in approximately equal proportions may be estimated by means of bromine water in the manner described above.

Cocaine and opium; Importation of —— prohibited.

A Royal Proclamation, dated July 28th, 1916, prohibits the importation of "all cocaine and all opium" into the United Kingdom, except that imported under the licence of a Secretary of State. The word "cocaine" includes "all preparations, salts, derivatives, or admixtures prepared therefrom or therewith and containing 0·1% or more of the drug." The word "opium" means "raw opium, powdered or granulated opium, or opium prepared for smoking, and includes any solid or semi-solid mixture containing opium." Regulations under Order in Council, dated July 28th, have been framed to carry out the provisions of the above proclamation.

Picrotoxin. P. Horrmann. Annalen, 1916, **411**, 273—314.

The work of Sielisch (Annalen, 1912, **391**, 1), showing that picrotoxin is a compound, $C_{30}H_{34}O_{13}$, which readily decomposes into picrotoxinin, $C_{15}H_{16}O_6$, and picrotin, $C_{15}H_{18}O_7$, is accepted, and these two substances are shown to be dilactones. Hydrolysis with aqueous alkali first gives α-picrotoxininic acid, $C_{15}H_{18}O_7$, and β-picrotinic acid, $C_{15}H_{20}O_8$, respectively, and these yield with excess alkali the dicarboxylic acids of picrotoxinin and picrotin, $C_{15}H_{20}O_8$ and $C_{15}H_{22}O_9$, respectively. On account of the readiness with which they are hydrolysed by dilute alkalis and of the stability of the free hydroxy acids, picrotoxinin and picrotin are not considered to be γ-lactones. The powerful reducing properties towards ammoniacal silver and Fehling's solutions characteristic of picrotoxin, etc., are absent in the derivatives with the exception of α-picrotoxininic acid; hence the production of these acids is not due solely to the splitting of the lactone ring, and further transformation must occur in the alkaline solution. The behaviour of β-picrotoxininic acid, α-picrotinic acid, and picrotoxinic acid is very different to that of the isomeric α-picrotoxininic acid and β-picrotinic acid; they are stable to weak oxidising agents and contain a lactone ring which is not attacked even by stronger alkalis α-Picrotoxininic acid is converted into the β-isomer by boiling with 2*N* sulphuric acid Of the 6 oxygen atoms in picrotoxinin, 4 are present as lactone and 1 as hydroxyl; in α-picrotoxininic acid, 2 are present as lactone, 2 as hydroxyl, and 2 as carboxyl; in picrotoxinindicarboxylic acid, 3 are present as hydroxyl, 4 as carboxyl; the corresponding derviatives of picrotin contain one more oxygen atom as hydroxyl. Picrotoxinic acid, $C_{15}H_{18}O_7$, and α-picrotinic acid, $C_{15}H_{20}O_8$, are closely related, the latter containing an additional hydroxyl group. There is not yet sufficient evidence to warrant any constitutional formulæ for picrotoxinin and picrotin being advanced.—F. W. A.

Gum in officinal syrups; Determination of ——. E. Luce. J. Pharm. Chim., 1916, **14**, 13—19.

The author obtained very accurate results by the method of Rocques and Sellier (see this J., 1911, 823), diluting the French officinal syrup five-fold, and precipitating 25 c.c. of the diluted syrup with 50 c.c. of 95% alcohol and 2 c.c. of saturated alcoholic lead acetate solution. Bellier's method (Ann. Falsif., 1910, **3**, 528), though not so accurate, was found sufficiently exact for many purposes. Twenty c.c. of the five-fold diluted syrup is precipitated with 40 c.c. of 95% alcohol and 1 c.c. of a 10% aqueous calcium chloride solution. After 24 hours the precipitate is washed by decantation with 60 c.c. of 65% alcohol in 3 portions, transferred to a tared filter, washed again with 20 c.c. of 65% alcohol, dried for 6 hours in an oven, and weighed. The weight represents dried gum, and is therefore multiplied by 100/88, since the natural moisture-content of gum is about 12%. The ash-content of the dried precipitate is practically the same as that of gum, and may be neglected. These methods, of course, are not applicable to gums containing dextrins.—J. H. L.

Cinnamaldehyde in cinnamon; Colorimetric determination of ——. T. von Fellenberg. Mitt. Lebensmittelunters. Hyg., 1915, **6**, 254—266. J. Chem. Soc., 1916, **110**, ii., 354—355.

The value of cinnamon lies in its cinnamaldehyde content rather than in the quantity of total essential oil it contains. A method for the estimation of cinnamaldehyde depends on the coloration which develops when the aldehyde is treated with sulphuric acid and isobutyl alcohol. 1 grm. of the cinnamon is heated just to boiling for ten minutes with 40 c.c. of 95% alcohol in a flask attached to a condenser, and any distillate collected in a 100 c.c. flask. From 30 to 35 c.c. of the alcohol is then distilled, 100 c.c. of boiled water is added to the residue, and the distillation is continued until the total distillate measures 100 c.c. 5 c.c. of the distillate is then mixed with 2 c.c. of 5% isobutyl alcohol solution (in 95% alcohol) and 3 c.c. of 38% alcohol, 20 c.c. of concentrated sulphuric acid is added, and, after 45 mins., the coloration obtained is compared with that yielded by a known amount of cinnamaldehyde under similar conditions. The standard cinnamaldehyde solution used for comparison contains 2% of the aldehyde in 38% alcohol solution; it may be prepared from the aldehyde-sulphite compound and standardised by a bromine-iodine titration. Nine samples of Ceylon cinnamon were found to contain from 1·31 to 1·84% of cinnamaldehyde; seven samples of cassia-cinnamon contained from 1·23 to 2·77%, and a sample of cinnamon flowers 3·73%.

Vanillin in vanilla; Colorimetric determination of ——. T. von Fellenberg. Mitt. Lebensmittelunters. Hyg., 1915, **6**, 267—274. J. Chem. Soc., 1916, **110**, ii., 355.

One gram of the finely-divided sample is boiled under a reflux apparatus with four successive quantities of about 20 c.c. of water, the extracts are diluted to 100 c.c., 0·5 grm. of kieselguhr is added, and the mixture filtered. Fifty c.c. of the filtrate is extracted five times with alcohol-free ether, using 150 c.c. of the solvent altogether, the ethereal solution is treated with solid calcium chloride, filtered, evaporated to a small volume, and the remainder of the ether removed by a current of air. The residue is warmed to 60° C. with 30 c.c. of water, the solution filtered, and the filtrate diluted to 100 c.c. 5 c.c. of this solution is then treated with 5 c.c. of 1% isobutyl alcohol solution (in 95% alcohol) and 20 c.c. of concentrated sulphuric acid, and the coloration produced is compared, after 45 mins., with that given by a known quantity of vanillin. It is recommended that the vanillin should be estimated separately in the outer and inner portions of the vanilla pod; in the case of normal vanilla, these two portions contain approximately the same quantity of vanillin, and a difference would indicate that some of the vanillin had been extracted from the outer portion.

Lemongrass oil from Formosa. K. Kafuku. J. Chem. Ind., Tokyo, 1916, **19**, 403—411.

Lemongrass oil from Formosa (Hyang-Bow oil) has the following characters: sp. gr., 0·8829 at 22° C., 0·8696 at 40° C.; $n_D^{22\cdot5^\circ}$ = 1·4850; opt. rot., +0·1° to —0·1°; acid value, 3·1; citral, 64%; total aldehyde, 66·8%. The oil is insoluble in 70%, 80%, and 90% alcohol but is soluble in 1 vol. of absolute alcohol. The terpene fraction after rectification distils at 39°—39·5° C. and consists of myrcene.—T. C.

Citronella oil from Formosa. K. Kafuku. J. Chem. Ind., Tokyo, 1916, **19**, 411—417.

An oil distilled in Formosa from a grass supposed to be "Indian geranium" (Formosa citronella oil) possessed the following characters, which are similar in all respects to those of the so-called Java citronella oil distilled from *Cymbopogon Winterianus*, Jowitt (Mahapangiri grass): sp.gr., 0·8868 at 17° C.; $n_D^{17^\circ}$ = 1·4700; α_D = 24°24′ in 10 cm. tube; total geraniol, 84·97%: citronellol, 38·98%; geraniol, 37·23% by phthalic anhydride method; soluble in all proportions in 90% alcohol, and in 0·9 vol. of 80% and 4·6 vols. of 70% alcohol.—T. C.

Japanese oil of pepper. Xanthoxylin. H. Thoms Arbeit. Pharm. Inst. Univ. Berlin. 1914, **11**, 58—59. J. Chem. Soc., 1916, **110**, i., 412.

Xanthoxylin (phloracetophenone dimethyl ether) is present in the oils derived from *Xanthoxylum alatum* and *X. aubertia*, but not in the true Japanese oil of pepper obtained from *X. piperitum*. The yield of the last-named oil was 4·33%, calculated on the weight of the fruits taken (see next abstract).

Japanese oil of pepper (from Xanthoxylum piperitum, D.C.). M. Duruttis. Arbeit. Pharm. Inst. Univ. Berlin. 1914, **11**, 60—63. J. Chem. Soc., 1916, **110**, i., 412. (Compare preceding abstract.)

The oil had sp.gr. 0·890 at 20° C., n_D = 1·47320, α_D = +26·5. By fractional distillation the liquid was separated into several portions; the most volatile part, b.pt. 175°—178° C., appeared to consist chiefly of dipentene and α-limonene. In the less volatile portions, palmitic acid and combined acetic acid were present, indications of cuminaldehyde and esterified geraniol also being observed. Methyl cinnamate was not present.

Croton-resin. R. Boehm. Arch. Pharm., 1915, **253**, 574—585. J. Chem. Soc., 1916, **110**, i., 412. (Compare Dunstan and Boole, this J., 1895, 768, 985).

In order to obtain pure croton-resin from crude croton oil, the latter is treated repeatedly in the cold with methyl alcohol, which dissolves the resin, the fatty acids, and the neutral fatty matter. The acids are removed by treatment with either barium hydroxide or potassium carbonate, which is also employed again after decomposition of the fats by the lipase of powdered *Ricinus* or *Chelidonium* seeds, previously freed from fat. Croton-resin is an almost colourless or pale reddish-yellow, dusty, odourless powder, softening at 80°—90° C., and exhibiting a bitter and, subsequently, an intense and persistent burning flavour. It dissolves sparingly in water and in almost all proportions in organic solvents with the exception of light petroleum, and is highly poisonous, besides exerting a vesicating action. With boiling concentrated hydrochloric acid its alcoholic solution gives a rose-red and then a dark red coloration, a peculiar odour of mould being emitted; with concentrated alcoholic sulphuric acid it gives a grass-green coloration on heating. The iodine value is 76·98, and $[\alpha]_D$ in chloroform varies for different preparations from +49·96° to 63·23°. Analysis and determination of the molecular weight in naphthalene solution lead to the formula $C_{36}H_{54}O_9$. (Compare Paal and Roth, this J., 1909, 611.)

Evodia rutae carpa; Essential oil of fruit of ——. Asahina and Kashiwuki. Apoth.-Zeit., 1916, **31**, 115. Z. angew. Chem., 1916, **29**, Ref., 282.

A terpene, evodene, was isolated from the oil by fractional distillation in the form of a colourless liquid, sp.gr. 0·799, b.pt. 67° C. at 20 mm., n_D = 1·4843. A solid crystalline substance, evodiamine, m.pt. 278° C., was also isolated; it yields methylanthranilic acid and a base, $C_{11}H_{10}N_2$, when decomposed by heating with alcoholic potassium hydroxide.—A. S.

Ninhydrin reaction with amino-acids and ammonium salts. V. J. Harding and F. H. S. Warneford. J. Biol. Chem., 1916, **25**, 319—335.

The ninhydrin (triketohydrindene hydrate) reaction with ammonium salts, first pointed out as a general one by Neuberg (Biochem. Zeits., 1913, **56**, 500), takes place only in the presence of hydroxyl ions and these hydrolyse triketohydrindene hydrate to phenylglyoxal-*o*-carboxylic acid. In the ninhydrin reaction with amino-acids (Ruhemann, Chem. Soc. Trans., 1910, **107**, 2030; 1911, **109**, 798), it is probable that the amino-acid is decomposed into ammonia and the corresponding glyoxal, the latter acting as the reducing agent. Whilst the ninhydrin reaction is given by 1% solutions of the ammonium salts of weak acids, the reaction is obtained in the case of ammonium chloride and nitrate only when the solutions of the latter are nearly saturated. The blue coloration produced in the reaction is due to the formation of the ammonium salt of diketohydrindylidene-diketohydrindamine. This colouring matter shows a broad absorption band when examined in dilute solution, the band extending from the red to the green part of the spectrum and blocking out almost the whole of the yellow; the blue colour has a purple appearance when viewed in artificial light, and it is not oxidised by exposure to air.—W. P. S.

Ninhydrin reaction with amines and amides. V. J. Harding and R. M. MacLean. J. Biol. Chem., 1916, **25**, 337—350.

Organic bases of the type $R.CH_2.NH_2$ and $R_2CH.NH_2$, where one radicle is negative in character, give the ninhydrin (triketohydrindene hydrate) reaction; other bases which readily yield ammonia or which are readily oxidised also give the reaction. In the case of fatty amines and in the presence of pyridine, the strongest reaction is given by the simplest members. Amides and guanidine and its derivatives do not give the reaction. It is evident that the reaction does not positively indicate the presence of amino-acids (see preceding abstract), and its application to saliva, urine, serum, etc., may lead to erroneous conclusions unless precautions are taken to remove ammonium salts and certain amines. —W. P. S.

Uric acid; New salt of —— and its application to the analysis [determination] of uric acid and phenol. J. L. Morris. J. Biol Chem., 1916, **25**, 205—210.

Attempts to obtain a compound of zinc and uric acid in a pure state were unsuccessful, but there is strong evidence that zinc urate is formed when uric acid and a zinc salt are brought together under certain conditions. Uric acid may be precipitated completely from its solution by means of zinc as follows:—The uric acid solution is acidified with acetic acid, an excess of 10% zinc acetate solution is added, and the mixture is then rendered alkaline to litmus by the addition of saturated sodium carbonate solution. If it is desired to determine the amount of uric acid present, the precipitate formed is collected on a filter, dissolved in acetic acid, the solution treated with a small amount of bismuth carbonate, boiled, and saturated with hydrogen sulphide. The mixed bismuth and zinc sulphides are separated by filtration, the filtrate is boiled to expel hydrogen sulphide, then concentrated to about 10 c.c., and the uric acid estimated colorimetrically by means of phosphotungstic acid. The method is useful for the removal of uric acid from urine previous to the determination of phenol. Four c.c. of the urine is treated with 1 c.c. of 10% zinc acetate solution and a quantity of acetic acid sufficient to dissolve the zinc phosphate formed, the mixture is then rendered just alkaline with saturated sodium carbonate solution, filtered, and the precipitate washed with about 10 c.c. of dilute sodium carbonate solution. The filtrate is boiled with the addition of about 0·5 grm. of calcium carbonate and 1 c.c. of 10% sodium oxalate solution, filtered, the filtrate acidified with oxalic acid, and the phenol determined colorimetrically.—W. P. S.

Formaldehyde and hexamethylenetetramine; Colorimetric method for the determination of free ——. R. J. Collins and P. J. Hanzlik. J. Biol. Chem., 1916, **25**, 231—237.

Aliquot portions of the formaldehyde solution are measured into Nessler tubes, 2 c.c. of phloroglucinol reagent (0·1 grm. of phloroglucinol dissolved in 10 c.c. of 10% sodium hydroxide solution) is added to each, and the mixtures are diluted to 50 c.c. After 3 mins., the colorations obtained are compared with standard colours. The latter are prepared from definite quantities of Congo red solution (0·025% in water containing 5% of alcohol) and methyl orange solution (0·01% in water); 2·5 c.c. of the Congo red solution diluted to 50 c.c. gives the same coloration as 50 c.c. of 0·001% formaldehyde solution when both are viewed in a column 12 cm. in depth. Different samples of Congo red do not always give the same depth of colour and the solution should be standardised against potassium bichromate; 2·5 c.c. of the 0·025% Congo red solution diluted to 50 c.c. should have the same tint as a mixture of 1·7616 grm. of potassium bichromate and 11·5537 grms. of sulphuric acid diluted to 50 c.c. The addition of methyl orange solution to the standards is necessary only when dealing with low concentrations of formaldehyde. The proportions of Congo red and methyl orange corresponding with different concentrations of formaldehyde are given in the following table, the mixtures being diluted to 50 c.c. and viewed in a 12 cm. column:—

Formaldehyde.	Congo red. (0·025% solution).	Methyl orange. (0·01% solution).
%	c.c.	c.c.
0·005	20·0	0
0·0033	11·0	0
0·0025	9·0	0
0·002	8·0	0
0·0016	5·0	0
0·00125	4·0	0
0·001	2·5	0
0·0005	0·85	0·4
0·0040	0·65	0·35
0·0002	0·23	0·18
0·00014	0·20	0·15
0·0001	0·13	0·10

To determine formaldehyde in urine, the phosphates present must be removed by treatment with sodium hydroxide solution and filtration before the above method is applied. Experiments with known quantities of formaldehyde showed that the method was more accurate than several other methods with which it was compared. The colorimetric method may be used to determine hexamethylenetetramine in urine, etc.; the latter is distilled without the addition of acid and the process applied to the distillate. If formaldehyde is also present in the urine, this must be determined previously and its quantity deducted from the total amount.—W. P. S.

Carbon dioxide from organic compounds; Dynamics of scission of ——. E. Baur and R. Orthner. Z. physik. Chem., 1916, **91**, 75—102.

The authors have studied the decomposition by heat of (i) basic ferric oxalate into ferrous oxalate and carbon dioxide, (ii) salicylic acid into phenol and carbon dioxide, and (iii) sodium salicylate into sodium phenoxide and carbon dioxide. It is shown in the case of basic ferric oxalate that an equilibrium is set up at temperatures between 160° and 200° C.; the equilibrium pressure was measured, and the mass action constant deduced. In the case of salicylic acid the mass-action constant was found to be $2{\cdot}7\times10^{-4}$ at 203° C.; the dissociation pressure of sodium salicylate at 220° and 230° C. was found to be 143 mm. and 183·5 mm. respectively. In no case could the equilibrium value be obtained from the other side, even when carbon dioxide, at pressures considerably above the dissociation pressure, was employed. The three cases investigated therefore represent reactions which proceed to an equilibrium that can only be obtained from one side.

Galactobiose; Biochemical synthesis of a ——. E. Bourquelot and A. Aubry. Comptes rend., 1916, **163**, 60—62. (See this J., 1915, 159.)

In experiments similar to those which led to the synthesis of gentiobiose (this J., 1913, 1080), a saturated aqueous solution of galactose treated with emulsin and kept for 5 months at the ordinary temperature yielded a small quantity of a galactobiose, which was not obtained in a crystalline condition.—J. H. L.

Hydrogen peroxide as a hydrolytic agent. Dubsky. *See* III.

Cetraria islandica [Iceland moss] as a protective colloid. II. Colloidal gold. III. Colloidal palladium. Gutbier and others. *See* X.

Urease content of certain beans, with special reference to the jack bean. Mateer and Marshall, jun. *See* XVIII.

Patents.

Sera and vaccines; Process for producing ——. O. Stiner, Berne, Switzerland. Eng. Pat. 14,972, June 23, 1914. Under Int. Conv., June 21, 1913.

Bacteria are subjected to the action of ultraviolet rays from a mercury vapour lamp or other source for a sufficient length of time completely to disintegrate them. For example, tubercle bacilli are suspended in a solution of sodium chloride, placed about 10 cm. from the lamp, and exposed to the action of the rays for 20 mins. The endotoxins of the bacteria pass into the suspension fluid, and a serum treated with this fluid has its capacity to destroy bacteria assisted. Tubercle bacilli in tuberculin and diphtheria bacilli in diphtheria toxin, when treated with the rays, yield a portion of their substance to the fluid, and on injecting this fluid into an animal, a serum is produced which acts against the toxin and endotoxin. At the same time, the treatment renders the toxins less poisonous, and suitable for direct injection.—J. H J.

Lecithin from vegetable materials: Preparation of —— completely free from bitter substances. H. Buer, Cologne. Ger. Pat. 291,494, June 10, 1914.

The crude lecithin is washed twice by prolonged agitation in a mixing apparatus with acetone containing 10—15% of water and with addition of 0·5—1% of sodium bicarbonate, and then with pure acetone until it again acquires a waxy consistency, after which it is dried *in vacuo* or otherwise at a low temperature. The purified lecithin is quite tasteless and odourless.—A. S.

Arsenic derivatives of acids and their salts; Preparation of ——. F. Heinemann, Berlin. Ger. Pat. 291,614, Feb. 22, 1914. Addition to Ger. Pat. 257,641.

Crystalline arsenic derivatives of phenylpropiolic acid or its derivatives, useful for therapeutic purposes, are prepared by the methods described in earlier patents (see Eng. Pats. 18,732 of 1912 and 10,378 and 10,379 of 1913; this J., 1913, 109; 1914, 218, 438). They are converted into soluble crystalline salts by treatment with alkalis, the halogen being removed.—A. S.

Hæmoglobin preparation from defibrinated blood from slaughterhouses; Production of a solid, stable ——. F. Sgalitzer, Munich. Ger. Pat. 291,911, Mar. 7, 1915.

Defibrinated blood is treated with a neutral salt, *e.g.*, magnesium chloride, which has no action on hæmoglobin, and is then cooled. The magnesium chloride prevents the liquid from solidifying, and the hæmoglobin is obtained in large crystals which can be readily separated by filtration. The crystals can be freed from any adhering magnesium chloride by washing with ice water. —A. S.

Methyl chloride from methane; Manufacture of ——. A. Hochstetter, Vienna. Ger. Pat. 292,089, Nov. 20, 1914. Under Int. Conv., Nov. 20, 1913.

Methyl chloride is prepared by the action of phosgene on methane at a high temperature, for example by leading a mixture of phosgene and methane over a catalyst capable of acting as a chlorine-carrier or of accelerating the reaction by surface condensation. A slight excess of methane is preferably used, and the phosgene may be diluted with inert gases. The reaction is represented by the equation:

$$CH_4 + COCl_2 = CH_3Cl + CO + HCl.$$

—A. S.

p-Aminophenyl salicylate: Preparation of a bromo-derivative of ——. I. Abelin, Berne, Switzerland, and S. Lichtenstein-Rosenblat, Berlin. Ger. Pat. 291,878, Apr. 21, 1915.

The α-bromoisovaleryl derivative of *p*-aminophenyl salicylate, $HO.C_6H_4.CO.O.C_6H_4.NH.CO.C_4H_8Br$, is obtained by the interaction of an α-bromoisovaleryl halide and *p*-aminophenyl salicylate or by the bromination of the isovaleryl derivative of *p*-aminophenyl salicylate. It possesses sedative, soporific, and anti-rheumatic properties, produces a gradual lowering of temperature, and acts as an internal disinfectant, and is only slightly toxic. —A. S.

Thymol; Preparation of soluble derivatives of ——. Chem. Fabr. H. Weitz Ges.m.b.H., Berlin. Ger. Pat. 291,935, Apr. 12, 1914.

Double compounds of thymol and alkali boroformates, soluble in water, are obtained by heating an aqueous solution of an alkali boroformate with an alcoholic solution of thymol.—A. S.

Hexamethylenetetramine; Preparation of derivatives of ——. J. D. Riedel A.-G., Berlin-Britz. Ger. Pat. 292,284, July 27, 1915.

Hexamethylenetetramine combines with perchloric acid to form a non-deliquescent salt, $(CH_2)_6N_4,HClO_4$, which is easily soluble in water and has an acid reaction. When treated in aqueous solution with bromine or iodine, this is converted into the dibromo- or di-iodo derivative, respectively. These are stable, insoluble compounds, non-explosive, and possessing a strong antiseptic action.—A. S.

Organo-metallic compounds; Manufacture of ——. W. Schlenk, Jena. Ger. Pat. 292,310, Jan. 13, 1914.

Compounds containing a C : C, C : N, or N : N linkage are suspended or dissolved in an indifferent medium, and treated with a finely-divided alkali metal, with exclusion of oxygen, moisture, and carbon dioxide. Disodiumdiphenylethane is obtained in this way from stilbene, disodiumdiphenyldianilidoethane from benzylideneaniline, and disodiumhydrazomethane from azomethane. When the products are treated with water, the alkali metal is replaced by hydrogen, whilst treatment with carbon dioxide converts them into alkali compounds of the corresponding carboxylic acids. —A. S.

2-Phenylquinoline-4-carboxylic acid; Preparation of soluble derivatives of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,393, July 23, 1914.

Salts of amino-2-phenylquinoline-4-carboxylic-ωmethylsulphurous acid are obtained by condensing amino-2-phenylquinoline-4-carboxylic acid with formaldehyde and a bisulphite. They are easily soluble in water, and possess advantages over other derivatives of 2-phenylquinoline-4-carboxylic acid for therapeutic purposes.—A. S.

4-Hydroxypiperidine: Manufacture of ——. B. Emmert, Würzburg. Ger. Pat. 292,456, Dec. 8, 1914.

4-Hydroxypiperidine is obtained by the reduction of 4-hydroxypyridine with an alkali metal and alcohol or with hydrogen gas in presence of a catalyst of the platinum group.—A. S.

Silver glycocholate and proteins or protein derivatives: Preparation of soluble compounds of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,517, May 26, 1915.

Silver glycocholate or a compound of the same is treated with a protein or a protein decomposition product, with or without addition of alkali, and the resulting solution is evaporated or treated with a suitable precipitant to isolate the reaction product. The products are soluble in water and serum, and have a neutral, amphoteric, or faintly acid or alkaline reaction. They are of value for therapeutic purposes.—A. S.

Glycineamide; Preparation of halogen derivatives of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 292,545, May 8, 1914.

Compounds of the type, $R_1R_2R_3XN.CH_2.CO.NH_2$, where R_1, R_2, and R_3 are alkyl groups, and X is a halogen, are obtained by the action of ammonia on alkyl esters of halogentrialkylglycine or of alkyl halides on dialkylglycineamide. They are easily soluble in water and can be used for therapeutic purposes, since they have not the high degree of toxicity characteristic of most organic ammonium compounds.—A. S.

Quinine and dialkylbarbituric acids; Compounds of ——. C. Diehl, Assignor to E. Merck, Darmstadt, Germany. U.S. Pat. 1,185,637, June 6, 1916. Date of appl., Sept. 13, 1912.

See Ger. Pat. 249,908 of 1911; this J., 1912, 952.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Photo-mechanical printing. C. Blecher, Berlin-Dahlem, Germany. Eng. Pat. 1197, Jan. 25, 1915.

In the preparation of a diapositive for intaglio printing, the picture area is coloured while the margin is left colourless, so that the carbon print obtained for transfer to the printing cylinder has a margin thicker than any part of the picture. This is a sufficient protection in the etching process and avoids the varnishing of the edges on the cylinder itself.—B. V. S.

Photographs in colours; Production of ——. J. G. Capstaff, Rochester, N.Y., U.S.A. Eng. Pat. 13,429, Sept. 21, 1915. Under Int. Conv., Sept. 21, 1914.

The usual colour negatives, after developing and washing, are bleached in an acid solution of ferricyanide, bromide, bichromate, and alum, which has a hardening effect on the film roughly proportional to the strength of the image. After thorough washing and drying, the films are dyed in suitable acid dyes, preferably salts of sulphonic acids, in each case complementary in colour to the taking screen. The dye is absorbed by the film in inverse proportion to the amount of hardening.
—B. V. S.

Colour photography. F. E. Ives, Philadelphia. U.S. Pat. 1,186,000, June 6, 1916. Date of appl., Mar. 13, 1915.

Prints are made from the usual colour negatives on sensitive film which has been coloured with an inert, non-actinic, water-soluble dye. After development the image is bleached in an acid bath of bichromate and bromide, which also hardens the film in proportion to the amount of image. The film may then be dyed with a suitable selective dye, or the soluble parts of the film may first be removed leaving an image in relief which is then dyed, the exposure in this case having been through the film support.—B. V. S.

Multicoloured screen plates, wholly of glass, for the production of photographs in natural colours. H. Wieland, Hamm, and E. Mohr, Magdeburg-Sudenburg. Ger. Pat. 291,575, Sept. 11, 1914. Addition to Ger. Pat. 283,551 (this J., 1915, 1168).

The glass globules of each colour have a different melting point from those of other colours, so that on heating, the globules of one colour melt first and then those of the other colours in succession. An even surface without colourless interspaces or formation of mixed colours at the contiguous edges of globules of different colours, is thus obtained.—A. S.

Photographic process. W. F. Fox, Assignor to Kinemacolor Co. of America, New York. U.S. Pat. 1,187,421, June 13, 1916. Date of appl., Dec. 17, 1913.

See Eng. Pat. 552 of 1914; this J., 1914, 1227.

XXII.—EXPLOSIVES; MATCHES.

Explosives: Fortieth Annual Report of His Majesty's Inspectors of —— *for* 1915. [Cd. 8272.]

Factories and magazines. The total number of factories was 158, of which 33 were under continuing certificate; 23 new factories were licensed during the year. There were 461 magazines, of which 83 were under continuing certificate; 10 new magazines were licensed during the year. Visits were paid to 207 factories and 464 magazines, in addition to factories established by the Ministry of Munitions. *Accidents.* The total number of accidents was 485, viz., in manufacture, 206, in which 21 persons were killed and 170 injured; in keeping, 3, in which 1 person was killed and 4 were injured; in use, and miscellaneous, 276, in which 48 persons were killed and 298 injured. *Importation.* With the exception of 150 lb. imported for the purpose of testing at Rotherham, no blasting explosives or detonators were imported. Fireworks were imported to the extent of 156,500 lb. *Chemical advisers' report.* Of 300 samples examined, 73 were rejected, 26 of these on account of low heat test. The high proportion of rejected samples is considered to be due largely to the greatly increased use of sodium nitrate, which is much less satisfactory than potassium nitrate. *Experiments.* Tests with boxes of percussion primers for 18-pounder quick-firing cartridges showed that these are not liable to explode in bulk. In the case of gaines No. 2, Mark 1., explosion was transmitted from one to another when they were touching, but not when they were packed in trays at a distance of 1½ ins. from centre to centre. An experiment is also described in which 25 lb. of gunpowder was exploded in a conical bronze hopper, ⅜ in. thick, covered with a wooden board, ½ in. thick. The hopper rested on stout baulks of timber on a platform, 9 in. thick, of concrete reinforced with expanded metal, which was mounted on wooden standards. On firing the powder at the lowest point of the hopper, the concrete platform was completely demolished and the hopper was blown to pieces. So large a quantity of gunpowder should therefore not be allowed on a floor above a loading room in which work-people are employed.
—A. S.

PATENTS.

Explosives. A. Aubert and S. Kristensen, Engene, Norway. Eng. Pat. 8129, June 1, 1915. Under Int. Conv., Mar. 1, 1915.

ORGANIC nitro compounds such as trinitrotoluene, picric acid, ammonium picrate, tetranitromethylaniline or the like (25 to 95%) are mixed with oxygen carriers (5 to 75%), such as nitrates or perchlorates of ammonium or potassium, which are made in the form of fused hardened globular or angular pieces and distributed evenly throughout the mass, so as to leave broad paths which will allow rapid transmission of detonation. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 6661 of 1886, 11,400 of 1901, and 26,146 of 1904; this J., 1886, 679; 1901, 932; 1905, 1084).—C. A. M.

Waste acids from nitrations: Treating —— with a solvent. J. W. Leitch, Huddersfield. Eng. Pat. 15,455, Nov. 2, 1915.

THE waste acid from which nitro-compounds are to be extracted, is run, together with a suitable quantity of solvent, into a mixing tank, which is kept at a suitable temperature, and the mixture then passes into settling tanks. The apparatus comprises a closed vessel in which is a vertical shaft carrying propellers surrounded by cylinders open at each end. The liquid drawn up by these comes in contact with other propellers in the shaft, which drive it downwards and outwards. After thorough admixture the liquid runs continuously through an overflow pipe into the settling tank.—C. A. M.

Detonator. W. Runge, Chester, Pa., Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,185,830, June 6, 1916. Date of appl., June 30, 1913.

THE casing, which is unobstructed at one end, contains a main charge of explosive which cannot be detonated directly by the flame of a fuse, and a priming charge composed of lead azide, an organic nitro compound (trinitrotoluene), and a binding material (gum arabic).—C. A. M.

Explosive charges; Method of manufacturing —— by means of liquid air. W. Weber, Hayingen, Germany. Eng. Pat. 8607, June 10, 1915.

SEE U.S. Pat. 1,157,270 of 1915; this J., 1916, 276.

Explosive; Gelatinised ——. A. Aubert, Saetre, Norway, and S. A. G. Nauckhoff, Liljeholmen, Sweden. U.S. Pat. 1,186,065, June 6, 1916. Date of appl., Jan. 25, 1915.

SEE Eng. Pat. 1283 of 1915; this J., 1915, 1118.

XXIII.—ANALYSIS.

Pyrometers; Characteristics of radiation ——. G. K. Burgess and P. D. Foote. Bull. U.S. Bureau of Standards, 1915, **12**, 91—178. (See also Waidner and Burgess; this J., 1905, 320.)

THE ordinary types of total radiation pyrometer met with in technical practice (including those of Féry, Foster, Thwing, and Brown) were studied, with special reference to methods of calibration, sources of error, and behaviour under varying conditions of use. The characteristics and proper methods of operating the several types are discussed, together with their application to the measurement of true temperatures. Methods of direct calibration by means of specially designed "black bodies" and of rapid secondary calibration by comparison with a standard pyrometer sighting on an electrically heated strip of oxidised nickel) are described, and methods of extrapolation are outlined. The thermoelectric pyrometer is considered more accurate than the spiral spring pyrometer, and, with the former, the potentiometer method of E. M. F. measurement is preferred for work of the highest accuracy, although a galvanometer has been found very satisfactory for most purposes. The principal errors result from imperfections in design and construction, and, in some cases (for example, when there is an appreciable lag in reaching equilibrium), it is important that the instrument be calibrated and used under similar conditions as regards distance from source, aperture of source, and time of exposure. Wide variations in the lag, ranging from a few seconds to an hour or more, were observed among apparently similar instruments. Other errors discussed are those due to stray reflection, convection currents in the pyrometer, atmospheric absorption, size of source, and tarnishing of the receiving mirror; errors of more than 100° C. are readily caused by dirt or oxide upon the surface of the mirror, and errors due to varying the focussing distance may amount to several hundred degrees if proper precautions be not taken. A method of obtaining approximately correct readings when sighting upon a source of insufficient size is described. The Stefan-Boltzmann law, $E = a(T^4 - T_0^4)$, is not, as a rule, exactly obeyed by radiation pyrometers, but the equation $E = aT^4T^{b-4}$, in which b is an empirical constant slightly different from 4, applies with sufficient accuracy for all instruments. The radiation pyrometer generally behaves as a "gray" receiver of energy for the ordinary range of temperatures; that is, the absorption coefficient is less than unity, but independent of the wave-length of the incident radiation. This is no longer true at extremely high temperatures; for example, the effect of selective reflection at the gold mirror of a Féry pyrometer becomes very serious with temperatures such as that of the sun, but it is not practically appreciable below 2500° C.—F. SODN.

Thorium: Separation of —— from iron with the aid of the ammonium salt of nitrosophenylhydroxylamine ("cupferron"). W. M. Thornton, jun. Chem. News, 1916, **114**, 13—14.

THORIUM is precipitated quantitatively from solutions containing no free mineral acid by a slight excess of a 5% "cupferron" solution, and since tartaric acid does not interfere with the precipitation a separation of thorium from iron is possible by this method. The solution of the two metals, containing sufficient tartaric acid to keep the bases in ammoniacal solution, is rendered slightly alkaline with ammonia solution, and colourless ammonium sulphide added in moderate excess. The ferrous sulphide is filtered off, and the excess of hydrogen sulphide boiled off after the addition of 5 c.c. of sulphuric acid to the filtrate. After cooling, 25 grms. of ammonium acetate is added, the volume made up to 400—500 c.c. and an excess of 5% ammonium nitrosophenylhydroxylamine solution added. The precipitate is filtered off, washed with 1% ammonium acetate, transferred to a tared platinum crucible, ignited to thorium dioxide, and weighed.—G. F. M.

Cadmium: New method for the determination of ——. S. Kragen. Akad. Wiss. Wien, Mar. 30, 1916. Chem.-Zeit., 1916, **40**, 530.

THE precipitate produced by the addition of pyridine to a solution of cadmium chloride has the composition of a double compound of 1 mol. of cadmium chloride with 2 mols. of pyridine; on heating in an air-bath at 120° C. half of the pyridine is expelled. The precipitate may be used for the gravimetric determination of cadmium. Alternatively, in the double salt containing 2 mols. of pyridine, the latter may be determined by alkalimetric titration, using Patent Blue as an indicator. The pyridine compound affords a means of separating cadmium from copper, but a satisfactory quantitative separation has not yet been devised.—J. F. B.

Washing precipitates for peptisation. [*Preparation of colloidal solutions.*] H. N. Holmes and R. E. Rindfusz. J. Phys. Chem., 1916, **20**, 522–527.

COMPARATIVE experiments with precipitated ferric arsenate indicated that to remove the adsorbed ions from a flocculent precipitate, the best method is to shake the precipitate with as much hot water as the filter paper will hold, preferably with addition of some clean sand. The mixture, with the exception of the sand, is thrown on to the filter to drain, the precipitate again transferred to the shaking bottle and the treatment with hot water, etc., repeated as many times as may be necessary.—A. S.

Data on the oxidation of automobile cylinder oils. Waters. *See* IIa.

Decomposition of tetrathionates in alkaline solution as a source of error in certain iodine titrations. Chapin. *See* VII.

Determination of total carbon in iron and iron alloys. Heinrich and Roger. *See* X.

New method of determining the gases in iron. Goerens and Paquet. *See* X.

The ammonia test for sulphite lyes. Oman. *See* V.

Recovery of ammonium molybdate from filtrates in the determination of phosphorus in steel and iron. Friedrich. *See* X.

Distribution of silver between metallic lead and litharge-containing slags. Dudley. *See* X.

Chemical assay of tin ores. Matheson. *See* X.

Determination of phosphoric acid by the citro-uranium method. Crispo and Tuinzing. *See* XVI.

Determination of sucrose in cane products by direct polarisation after destruction of the reducing sugars. Muller. *See* XVII.

Determination of lead [*in sugar solutions*] *as sulphite.* Pellet. *See* XVII.

Rapid determination of the sulphate content of wine. Pritzker. *See* XVIII.

Determination of essential oils [*essences*] *in liqueurs.* Roques. *See* XVIII.

Urease content of certain beans, with special reference to the jack bean. Mateer and Marshall, jun. *See* XVIII.

Determination of pectin in spices. Von Fellenberg. *See* XIXa.

Determination of "relative stabilities" in polluted waters carrying colloids. Lederer. *See* XIXb.

Control of the purification of waters with hypochlorite after elimination of active chlorine by sodium thiosulphate. Golse. *See* XIXb.

Determination of iodine and bromine in saline waters from petroleum-bearing strata. Popa. *See* XIXb.

Determination of small quantities of alkaloids. (1) Carlinfanti. (2) Carlinfanti and Scelba. *See* XX.

Determination of gum in officinal syrups. Luce. *See* XX.

Colorimetric determination of cinnamaldehyde in cinnamon. Von Fellenberg. *See* XX.

Colorimetric determination of vanillin in vanilla. Von Fellenberg. *See* XX.

Ninhydrin reaction with amino-acids and ammonium salts. Harding and Warneford. *See* XX.

Ninhydrin reaction with amines and amides. Harding and MacLean. *See* XX.

New salt of uric acid and its application to the determination of uric acid and phenol. Morris. *See* XX.

Colorimetric determination of free formaldehyde and hexamethylenetetramine. Collins and Hanzlik. *See* XX.

PATENTS.

Gas-analysing apparatus. H. L. Lowe, Pittsburgh, Pa. U.S. Pat. 1,186,014, June 6, 1916. Date of appl., Feb. 27, 1911.

THE gas is passed from a container through an absorbent to remove a desired constituent, and is then conducted into a second container; means are provided for measuring the ratio of the difference of the pressure of the gas before and after such treatment to its original pressure.—W. P. S.

Granular material; Process and apparatus for separating and analysing ——. J. C. Pearson, Chevy Chase, Md. U.S. Pat. 1,186,525, June [illegible], 1916. Date of appl., Apr. 26, 1916.

A DEFINITE quantity of the material is maintained in a continual state of movement by means of a downwardly directed current of gas; the mixture of gas and fine particles is then passed up a vertical tube at a uniform rate of flow and the suspended particles are removed at the upper end of the tube. The treatment is continued until the material is free from particles below a predetermined size, and the proportion of material thus separated is determined.—W. P. S.

Trade Report.

Prohibited exports. Amendments in and Additions to List. Order in Council, July 26, 1916.

THE following headings have been deleted from the list of prohibited exports (see this J., 1916, [illegible]):—(1) Anthracene oil; (1) Coal tar, all products (except creosote) obtainable from and derivatives thereof, suitable for use in the manufacture of dyes and explosives, whether obtained from coal tar or other sources, and mixtures containing such products or derivatives; (3) Creosote; (1) Green oil; (1) Sulphuric acid; (3) Oils, creosote, except wood tar oil; (3) Pitch, coal tar; (3) Pitch, [illegible]; (3) Pitch, wood; (2) Pitches derived from fats, greases, oils or fatty acids; (2) Rum and [illegible] rum; (3) Syrups which may be used as food for man, and molasses produced from cane sugar.

The following headings are added: (1) Cast iron pipes; (3) Anthracene oil and mixtures and preparations containing anthracene oil; (1) Coal tar, all products obtainable from and derivatives thereof, suitable for use in the manufacture of dyes and explosives, whether obtained from coal tar or other sources, and mixtures and preparations containing such products or derivatives (except anthracene oil and green oil and mixtures and preparations containing these oils); (3) Creosote and creosote oils (except wood tar oil) and mixtures and preparations containing such creosote or creosote oils; (3) Green oil and mixtures and preparations containing green oil; (1) Sulphuric acid and mixtures containing sulphuric acid; (1) Molasses; (3) Pitches and all mixtures, preparations and commodities of which pitch forms an ingredient; (3) Potable spirits of a strength of less than 43° above proof; (3) Quercitron bark extract; (3) Syrups which may be used as food for man.

Restrictions on importation.

THE following interpretations, rulings, and decisions respecting prohibitions of importation have been arrived at by the Department of Import Restrictions:—

Prohibited: Basalt lava stones, cement, [illegible] ware, fireclay goods, granulated crystal [illegible], oleine, sandstone, stearine.

Not prohibited: Acetic anhydride and [illegible] ware, barytes, casein, caustic potash, [illegible] glassware, graphite, magnesia mantle rings, [illegible]versed metal for hardening [illegible], oxalic acid, steatite, talcum powder.

A general licence has been given to H.M. Customs Authorities for the importation of [illegible] acetic acid and magnesite.

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London Section.

Meeting held at Burlington House on Monday, June 5th, 1916.

MR. A. R. LING IN THE CHAIR.

BACTERISED PEAT. THE PROBLEM IN RELATION TO PLANT NUTRITION.

BY PROFESSOR W. B. BOTTOMLEY, M.A.

(*Abstract.*)

The attempts that have been made in the past to increase the fertility of a soil by inoculating it with beneficial bacteria have proved abortive, probably because the investigators made use of a liquid culture medium. The remarkably stimulating effect of soil humates upon the nitrogen-fixing bacteria was established some time ago, and efforts were accordingly made to discover a solid medium rich in soluble humates. After much searching, natural peat, transformed by subjecting it to the action of certain aërobic organisms and sterilised at 26° C., was found to furnish the neutral medium required. The product obtained by treating peat with alkalis is also rich in soluble humates, but it is useless as a medium for the culture of azotobacter, and it does not contain the fertilising products of bacterial activity which are found in the bacterised variety. Thus, when *Azotobacter chroococcum* was cultivated in Beijerinck's medium containing an aqueous extract of the alcohol-soluble constituents of alkali-treated peat, and of bacterised peat, the nitrogen-fixation in the latter was over seven times greater than in the former, and the nitrogen ixed both in the raw peat extract and in the alkali-treated extract was less than that which accrued in the normal culture solution. Some extensive experiments with bacterised peat were carried out in 1913, 1914, and 1915 at Kew Gardens. Eleven different sorts of garden plants were selected, and there were four series of twelve plants of each kind, three of which were potted up in loam, sand, and varying proportions of bacterised peat, and for the fourth a compost of loam, leaf-mould, and sand was used. At the end of the experiments the Curator of the gardens eported that: "In a properly constituted soil, bacterised peat is capable of working a change n its productivity which, after a long experience with plant soils and plant foods, I am in a position o say, is very extraordinary. I have never seen anything to equal it."

The experiments at Kew led to the discovery hat the water-soluble extract of bacterised peat ontains a constituent of remarkable fertilising power, which is probably allied to the animal itamines, for, like these, it is precipitated by hosphotungstic acid and is active in very minute mounts. (For the preparation, etc., of the hosphotungstic and silver fractions of the lcohol-extract of bacterised peat and their influence on wheat seedlings see Roy. Soc. Proc., 1914, 88, B, 237—247, and also this J., 1914, 975.) The stimulating effect of such "auximones" (this J., 1915, 881) has been studied further on the common duck-weed (*Lemna minor*) in water culture solution. Thirty of these plants were grown in each of three dishes containing respectively, [A] 600 c.c. of Detmer's complete culture solution prepared with twice-distilled water, [B] the same with the addition of the decomposed phosphotungstic acid fraction of bacterised peat in the proportion of 17 parts of dry substance per million of solution, and [C] the same plus the silver-baryta fraction in the proportion of 0·35 parts per million. The number of plants was counted weekly, their area was measured or estimated, and the solutions were renewed twice weekly during 15 weeks. Owing to the rapid multiplication of the plants in [B] and in [C], they had to be divided into two on several occasions, and one half discarded, and at the end of the experiment the number actually in the dishes had to be multiplied by 256 to obtain the number corresponding to the original thirty. The growth was fairly uniform for the first five weeks, although from the beginning the area of the plants in [A] was much smaller than that of the plants in the other liquids. Thereafter the development of the former was much slower, and at the finish they were in a moribund condition. After 15 weeks, the number of plants in [A] was 143,104; in [B], 416,000; in [C], 299,520; and the average area of the leaves was 0·78, 3·99, and 3·37 sq. mm., respectively. That the increased surface development of the plants treated with auximones had not been obtained at the expense of the plant structure was proved by comparing the ratios of the areas of an equal number of plants in the three series with the ratios of their dry weights. The areas of one hundred representative plants in [A], [B], and [C] were as 1 : 5·1 : 4·3, and the corresponding dry weights as 1 : 7·1 : 5·7. The differences in internal structure between the control plants and those with auximones were very marked. In the former the air-spaces were large and the individual cells small, the nuclei were ill-developed and nucleoli were not observed; in the latter, the tissue was compact, the cells large, the protoplasm dense, and the large nuclei contained a well-defined nucleolus. It is suggested that the specific function of auximones may be to stimulate the nutrition of the cell nucleus.

Bacterised peat is essentially a humus manure, and it cannot be expected to give striking results when applied to soils already rich in organic matter. Thus, at the Midland and Dairy Institute, a dressing of 7 cwt. of bacterised peat per acre gave no results on wheat, hay, and potatoes, as the land had also received 15 tons per acre of farm yard manure. On the other hand, large-scale experiments on land at the Hampshire County Council Farm Institute, Sparsholt, Winchester, which had previously borne potatoes, and had only received dressings of superphosphate and ammonium sulphate at the rates of 2 and 1 cwt. per acre respectively, gave most encouraging results with potatoes when dressed with 15 cwt. per acre of bacterised peat. Seven different varieties of potato were grown, and in every case an increase over the control field was observed. These increases were very great—88·3% and 91%—in two cases, and the average crop increase was 2 tons 12 cwt. per acre. The price of bacterised peat is expected to be about £2 per ton.

Communications.

THE STABILITY OF VULCANISED RUBBER AND THE OPTIMUM CURE.

BY HENRY P. STEVENS, M.A., PH.D., F.I.C.

In the manufacture of vulcanised rubber goods the greatest care is taken to adjust the conditions of vulcanisation to suit the particular compound it is desired to vulcanise. If either the temperature (or corresponding pressure) be too high or the period of heating too long, the vulcanised product is termed "overcured" or "overvulcanised" and will not age satisfactorily. If the overcuring is very pronounced, the compound may exhibit inferior mechanical properties within a very short period of vulcanisation, but in most cases the freshly vulcanised compound at first exhibits good mechanical properties, and it is only after a period of months or years that the "over-curing" becomes apparent by the gradual perishing of the rubber.

It is generally agreed that pronounced "undercuring" also causes gradual deterioration, but the effect is not so marked as with overcured rubber and is more easily detected as the mechanical properties of undercured rubber are not fully developed. It is, in fact, common in the case of many goods for manufacturers when vulcanising to undercure rather than overcure the rubber so as to avoid the danger of over-vulcanising and consequent deterioration.

Thus far I have merely recapitulated what is common knowledge, but the subject has never been properly investigated and these experiments are a contribution to that end.

It is obvious that for each particular rubber compound there must exist certain conditions of vulcanisation (principally of time and temperature) which will produce the optimum results, and this cure has been termed the "optimum" or "perfect cure." Papers on this subject have been contributed by Schidrowitz (The Rubber Industry, 1914, p. 212 *et seq.*), and Eaton and Grantham (this Journal, 1915, 34, 989, Agric. Bull. F.M.S., 1915, 3, 176 *et seq.*, 218 *et seq.*, 397 *et seq.*, 442 *et seq.*, 4, 4 *et seq.*, 30 *et seq.*, 58 *et seq.*). The work of both authors was undertaken with a view to compare the vulcanising qualities of raw rubbers and, in the former case particularly, to evolve a standard method of testing. The method was outlined in the above mentioned paper but full details have not been published. So far as can be judged, this method, like that of Eaton and Grantham, is based on the figures for tensile tests made on simple compounds of rubber with sulphur only, vulcanised for varying periods under constant conditions of temperature. It is not easy to follow the somewhat complicated method of calculation adopted by Schidrowitz without further details, but the method adopted by Eaton and Grantham is extremely simple. They write (Agric. Bull. F.M.S., Feb., 1915, p. 181). "We have always taken as the optimum that point at which the product of the breaking load per unit cross section and the elongation is a maximum." Strictly speaking, this statement is not correct, as in their numerous determinations they have taken the final length at rupture, that is the elongation plus the original length, and multiplied this by the breaking load to give the product. This latter calculation appears to be the more correct. The figure obtained, which I term "Tensile product," represents the breaking load per unit cross sectional area of test piece when the latter is fully stretched, as the volume of a piece of vulcanised rubber does not show appreciable alteration on deformation. The specimen giving the maximum product is held by Eaton and Grantham to be that which has been subjected to the optimum cure. It is obvious that, if a number of vulcanisations be carried through with one compound for progressively increasing periods, some specimens may be undercured, some overcured, and one will lie in the neighbourhood of the correct cure, but it would be a mere chance if this last specimen were vulcanised for exactly the period required to produce the optimum effect. If the method be adopted there should be no difficulty in constructing suitable curves from the data obtained so that the actual optimum cure could be ascertained by calculation, as Schidrowitz proposes by his method. This, if necessary, could be checked by a single vulcanisation at the optimum cure previously arrived at by calculation.

Now, whether the optimum cure be based on the simple method of calculation of Eaton and Grantham or the more complex method of Schidrowitz, both methods fail to take into consideration the fact that the tensile properties of a vulcanised rubber are not constant but vary with the age of the specimen. The figures obtained from any form of tensile or stretching tests will vary with the time that has elapsed since the specimens were cured. Research work during the last few years has tended more and more to show that "vulcanisation" so-called proceeds after the actual vulcanisation process is completed and that vulcanisation takes place, although very slowly, at the ordinary temperature of the air. I regard the vulcanisation process as a sort of impulse and the momentum induced carries on the vulcanising effect after the vulcanisation process is complete. We may imagine the impulse applied in an upward direction to the further end of a rod hinged to a board and lying horizontally. If the impulse is insufficient to carry the rod into a position of unstable equilibrium we have the condition of undercuring and the rod falls back, corresponding with a gradual deterioration of the vulcanised product. If the impulse is too great, the rod will be carried beyond the position of unstable equilibrium and will fall with an accelerated velocity, corresponding with deterioration of the over-vulcanised product. The correct cure will correspond to an impulse so regulated that the rod possesses sufficient momentum to reach exactly the upright position of unstable equilibrium. If the rod is carried beyond this position, the time required for the acceleration to produce a perceptible movement will depend upon the extent to which the rod has passed this point. Similarly, the time required for an over-vulcanised rubber to exhibit appreciable deterioration depends upon the extent to which the vulcanisation process has exceeded that required for the correct cure. A specimen of vulcanised rubber, if tested at intervals of time over a given period, shows progressive changes during that period. Thus the product of the breaking strain and elongation of a specimen tested the day after vulcanisation will usually give figures which are lower than those obtained if the tests be made a week or a month after vulcanisation. Yet neither Schidrowitz nor Eaton and Grantham make any mention of this time factor and do not state at what period after vulcanising their tests were made or whether indeed they adopted any uniform interval between vulcanisation and testing. Nor do they consider the question of ageing in any aspect. It is obvious that, whatever excellent tensile properties a specimen of vulcanised rubber may possess shortly after vulcanising, these would be of no value if obtained by vulcanising under conditions which would cause the rubber rapidly to deteriorate. In fact the term "optimum" cure, if it is to have any practical meaning, must connote not only the physical properties of the freshly vulcanised rubber but also its ageing properties.

There is another guide to correct curing, namely, the figure for the coefficient of vulcanisation. With many types of compound this figure is difficult to ascertain even approximately, but in a simple type consisting entirely of rubber and sulphur it is only necessary to extract exhaustively with acetone and to determine the sulphur in the residual rubber, expressing the results as a percentage of the raw rubber originally taken. No experimental data of this description are given either by Eaton and Grantham or by Schidrowitz except in a recent note to which reference will be made later.

A general survey of Eaton and Grantham's conclusions was not in accordance with my previous experience. Specimens of rubber vulcanised to give the maximum figures for tensile product shortly after curing were in my experience more or less considerably over-vulcanised. I had not, however, at the time Eaton and Grantham's paper appeared, a comprehensive series of tests carried through with the compound they employed, composed of rubber with 10 % of sulphur. I have now, however, completed tests on such compounds and in each case the tests were carried out on the same lines as those of Eaton and Grantham, except that the vulcanised specimens were tested at intervals, the last test being put through approximately ten months after vulcanisation. The rubber was compounded with sulphur on hot mixing rolls without preliminary washing and in the ordinary manner, mastication being carried only far enough to produce a properly plastic mass. The mixed and sheeted compound was vulcanised at 134·5° C. for periods commencing at 2 hours and increasing by half-hourly intervals to 4½ hours, thus producing six vulcanised specimens of each sample of rubber. The physical tests were made on ring-shaped test pieces 25·4 mm. internal diameter and approximately 1·25 mm. thick. Sufficient rings were put by for subsequent tests. These rings were preserved in the dark but otherwise were exposed to the ordinary atmospheric changes of the testing room. The figures given are the average figures of five rings. There is always an element of uncertainty in the breaking strain figures but, by taking an average of five, the results may be considered reliable, provided that all five rings give similar figures.

The coefficient of vulcanisation was determined on the residual rubber a few days after curing and after extraction for at least 24 hours in an all-glass extraction apparatus (Analyst, 1913, p. 143). In this apparatus the rubber is exposed to the action of acetone at the boiling point. The pale crepe and smoked sheet rubbers employed were ordinary commercial samples.

Pale crepe.

Cure (hours).	Age in days.	2	2½	3	3½	4	4½
Breaking load (grms. per sq. mm.)	4	960	1230	1510	1690	2010	2480
	125	950	1550	1610	1930	1760	1760
	203	1010	1500	1630	1740	1480	490
	311	920	1400	1640	1480	1330	170
Final length (original length = 100)	4	1151	1098	1078	1013	987	953
	125	1016	1017	991	952	897	851
	203	1042	1032	1004	936	858	611
	311	1035	1009	993	894	822	372
Tensile product	4	110	136	162	170	199	236
	125	93	153	159	183	158	150
	203	105	155	163	163	127	30
	311	95	141	163	132	109	6
Coefficient of vulcanisation.....		2·0	2·6	3·2	4·1	4·5	5·0

Smoked sheet.

Cure (hours).	Age in days.	2	2½	3	3½	4	4½
Breaking load (grms. per sq. mm.)	4	980	1250	1490	1640	1840	2130
	125	1150	1510	1780	1800	1870	1850
	203	1170	1500	1640	1670	1620	1590
	311	1150	1530	1620	1640	1180	380
Final length (original length = 100)	4	1128	1094	1064	999	977	961
	125	1036	1033	998	957	903	873
	203	1022	1016	995	945	886	841
	311	1023	1019	1003	930	820	570
Tensile product	4	110	137	159	164	180	204
	125	117	156	178	172	168	162
	203	119	152	163	158	143	134
	311	117	156	163	152	97	22
Coefficient of vulcanisation		1·9	2·6	3·2	3·8	4·7	5·4

Taking the figures for the tests made four days after vulcanisation, we find the maximum figure for Tensile Product in both sheet and crepe to lie at 4½ hours. As this is the maximum time given for the cure in both series of experiments, it may be that an even longer cure would have given higher figures. For the moment, however, it is sufficient to show that neither rubber is overcured and that the optimum cure must lie at 4½ hours or more according to Eaton and Grantham's hypothesis. A glance at the tensile figures after varying periods of ageing clearly shows that both compounds are much over-vulcanised at 4½ hours.* Four months after vulcanising a considerable fall has taken place in all figures at this cure and after ten months both specimens, particularly the crepe rubber, are in a hard and perished condition, the tensile product in this case giving only one-fortieth of the original figure. Similar considerations apply to the cures at 3½ and 4 hours. All show eventual deterioration although some improvement may take place for a short time after vulcanisation. Thus the sheet rubber compound cured for 3½ hours gives higher figures for Breaking Strain and Tensile Product when tested at 125 days than at 4 days; but after 203 days these figures have fallen again to approximately their original value and after 311 days appreciably lower results are recorded, especially in the case of the crepe rubber compound. Passing now to the figures for the compounds cured for 3 hours, we note that in both cases the figure for tensile product is stationary, taking the last two periods of testing. The corresponding breaking strain figures show a small improvement in the crepe rubber but the reverse in the case of the sheet rubber. There is little doubt that with further ageing there will be a further fall in the tensile product in this latter case, but that 3 hours will approximately represent the correct cure for the crepe rubber compound. The figures also show that when deterioration begins to set in it proceeds with accelerated velocity.

These results prove conclusively that a rubber compound subjected to Eaton and Grantham's "optimum cure" is undoubtedly over-vulcanised (or over-cured) and that the word "optimum" is consequently incorrectly applied. If however

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* 4½ hours is a longer period than that given by Eaton and Grantham for the "optimum cure" in a number of instances recorded in their papers. These authors however vulcanise at 140° C. whereas I employed the lower temperature of 134·5° C. To compensate for this lower temperature a sample of rubber would require to be vulcanised for an hour or so longer to produce the same vulcanising effect and consequently a period of vulcanisation of 4½ hours in my experiments may be regarded as roughly equivalent to say 3½ hours in those of Eaton and Grantham. The equivalency of time and temperature in vulcanisation has not as yet been systematically investigated.

Eaton and Grantham's definition be modified so as to include the ageing factor, we have what appears to be a very good definition of the optimum or correct cure. It may be provisionally defined as that cure which gives the maximum figure for tensile product after a full period of ageing. It is not at present possible to define more exactly the period of ageing. With rubber compounded with sulphur only it is obvious that the period should exceed the 10 months allowed in the present experiments. Probably two or three years will be required. The vulcanised specimens must be preserved under suitable conditions and should not be exposed to light. It must not be forgotten that the temperature and possibly also hygrometric and other conditions of the atmosphere affect both the ageing qualities and the physical tests. How far refinements in these directions may be necessary to the elucidation of the problem cannot at present be ascertained.

It is noteworthy that the crepe rubber compounds cured for 3, 3½, and 4 hours all show greater deterioration over any given period than the corresponding sheet rubber compounds. I am inclined to attribute this to the method of preparation. Sheet rubber is merely squeezed after coagulation and retains the original shape of the coagulated rubber. On the other hand, crepe rubber is put several times through a differentially geared washing mill where it is torn up and ground in a stream of water. All my experience goes to show that the extent to which rubber is "worked" previous to vulcanisation tends to reduce the life of the vulcanised product, and to this I attribute the greater tendency to deterioration shown by the crepe rubber as compared with the sheet rubber specimens. So far this is confirmed by similar experiments in progress.

One very obvious regularity in the figures quoted in this paper may be noted, namely, the progressive reduction in the figures for final length (elongation) with (1) length of time of cure, (2) age of vulcanised sample. This applies to some extent to the under-cured as well as to the approximately correctly cured and over-cured specimens. The figures in this respect would have been even more regular had we recorded the elongation for a given fixed load instead of the breaking load. This emphasises the parallel behaviour of a rubber compound as a result of (1) prolonged curing and (2) prolonged ageing, and is an argument in favour of the essential similarity of the two processes.

The coefficient of vulcanisation can only be taken as an approximate guide to the condition or degree of vulcanisation. The variation in the figure between specimens correctly cured and over-cured may be very small and there is a limit to the accuracy with which the figure can be ascertained. The second place of decimals has little or no significance and an error may easily occur in the first place. Nevertheless, the figures are valuable as an approximate guide and it is apparent, not merely from the above figures but from a number of other determinations, that a figure for the coefficient exceeding 3·5 for a vulcanised rubber and sulphur compound is an almost certain indication of over-curing and in the instances here recorded it only slightly exceeds 3.

In a recently published note (India Rubber J., Apr. 8, 1916, p. 505), Schidrowitz and Goldsborough give some results of vulcanisation tests quoting the "correct cure" and "combined sulphur per cent." The cures vary from 1¾ to 4 hours and the combined sulphur from 2·03 to 4·86%. Only in two cases is the figure under 3·5%. As the compound consisted of rubber compounded with 8% of sulphur, the figures for coefficient of vulcanisation will be a trifle higher than those for the combined sulphur per cent. It would therefore appear highly probable that most of these specimens have been considerably over-cured and not *correctly* cured as stated by the authors. No ageing tests are given. The authors rely entirely on what they term "the optimum curve method" which is based on load and elongation figures. The evidence here submitted therefore points to the conclusion that such a method without material modification is valueless for technical purposes. Enough has already been said to justify the rejection of Eaton and Grantham's method. Consequently much doubt is thrown on the value of the deductions made by them as the result of the great mass of vulcanisation data they have published. It is curious to note that both Eaton and Grantham and Schidrowitz arrive at results showing very great variations in the time required to cure correctly typical commercial plantation rubbers. Although variation undoubtedly exists I have never met with such considerable variations as they have recorded. My own samples I know to be correctly cured for they have stood the test of time. From the above evidence I can only conclude that these authors have in many cases over-cured their compounds, being led astray by theoretical considerations which have not been tested against practical experience.

It may, however, be argued that the "optimum," "correct," or "perfect" cures, as they are variously described by the authors referred to, must have some significance and should bear some relationship to an optimum cure based on a correlation of physical properties and ageing tests. This is probably the case, but the relationship, so far as can be judged at present, is not a directly proportional one, and in any case the exact period allowed to elapse between vulcanising and testing must be stated. The absence of such information from the already published figures of these authors makes it impossible to draw further conclusions.

I am indebted to the Rubber Growers' Association for permission to publish the figures in this paper.

THE FUNCTION OF LITHARGE IN THE VULCANISATION OF RUBBER. PART II. THE INFLUENCE OF THE RESINOUS CONSTITUENTS.

BY HENRY P. STEVENS, M.A. PH.D., F.I.C.

At the International Congress of Applied Chemistry, 1912, a paper was read (Beadle and Stevens, vol. 25, p. 581), dealing with the nature of the resinous constituent of rubber and its influence on the quality of the vulcanised product. It was shown that the removal of the greater part of the resins in some manner retarded the cure and that the tensile properties of the rubber were greatly reduced.

It was also noted that the resin-extracted rubber perished rapidly as compared with the unextracted rubber, and that this deterioration was not due to the effect of heating with the solvent during extraction or to the particular solvent employed. The experiments were made both with *Hevea braziliensis* (plantation pale crepe) and *Ficus elastica* (Rambong sheet).

At the same congress a paper was contributed by L. E. Weber (Vol. 9, p. 95), on the action of resins on the vulcanising of rubber. The rubber used was plantation smoked sheet and the compound on which the tensile tests were made contained litharge, sulphur, and whiting, whereas Beadle and Stevens used a simple compound of rubber with 5 per cent. of sulphur and in some cases with the addition of zinc oxide. The conclusions reached by Weber were that "the resins play an active part in the vulcanisation and not merely the part of a catalyser, their presence eing absolutely essential," in fact the compound repared from the resin-extracted rubber "could ot be vulcanised." Weber based this statement n the poor tensile properties of the rubber, but analysis is given. Rubber may possess poor nsile properties and yet be vulcanised to some xtent or even over-vulcanised, and analysis is ecessary to show whether the rubber contains y "combined" sulphur, that is to say, sulphur nextractable with acetone. I published some rther vulcanisation tests with resin-extracted bber in 1914 (Koll. Zeits., **14**, 91) and obtained coefficient of vulcanisation of 2·71 as against 56 for the untreated rubber, so that the effect resin extraction on rate of vulcanisation was ry slight. The resin-extracted rubber showed pid deterioration as compared with the un- ated specimen. Weber's results therefore fer from my own in that he found the removal the resinous matter to produce a more marked ect on the vulcanisation, and does not appear have noted the greater tendency of resin- tracted rubber to deteriorate and perish.

It appeared probable that the highly specialised pe of compound employed by Weber was sponsible for these differences. I have already own that the degree of vulcanisation is largely ndent on the relative proportions of rubber, hur, and litharge in the compound (this Journal, 5, **34**, 524). I therefore carried out a series sts with Weber's compound and also repeated er experiments with simpler types and carried e experiments to a further stage. Incidentally has led to the accumulation of data which les a further study of the function of litharge he vulcanisation process.

wo types of plantation (*Hevea*) rubber were . one a pale (unsmoked) sheet and the other noked sheet. Portions of both were extracted over a considerable period in the cold, a further portion of the pale sheet being extracted with hot acetone to ascertain whether the heat to which the rubber is exposed during extraction affects the properties of the rubber. The specimens were mixed according to Weber's formula, viz., rubber 50, litharge 6·2, sulphur 3·1, and calcium carbonate (whiting) 40·7, and vulcanised in steam for 10, 20, 30, and 40 minutes respectively at 132° C.

The following "mixes" were vulcanised:—*Pale (unsmoked) plantation sheet rubber*, A, cold acetone extracted; B, hot acetone extracted; C, untreated; D, with additional resin extracted from A. *Smoked plantation sheet rubber*, E, cold acetone extracted; F, untreated; G, with additional resin extracted from E.

The cold acetone extraction was carried out by allowing the rubber to soak in a bottle of acetone, pouring off and distilling the acetone which was then replaced, and repeating the process every few weeks over a period of six months. The specimens were subjected to a very complete examination and were tested shortly after vulcanisation and again eight months later.

Table 1 gives the results of the vulcanisation with other data.

			A	B	C	D	E	F	G
Percentage acetone extract in original raw rubber.			0·55	0·50	1·8	2·3	0·9	3·9	4·8
Cures in minutes.	Age of test piece in days.								
20	7	Breaking strain	Too	Too	726	887	Too	1252	1385
		Final length	weak	weak	713	677	weak	656	654
		Tensile product	to test	to test	52	60	to test	82	91
	259	Breaking strain	Too	Too	735	957	Too	1197	1318
		Final length	weak	weak	646	676	weak	672	664
		Tensile product	to test	to test	47	65	to test	81	88
		Coefficient of vulcanisation	—	—	0·74	—	—	—	—
25	7	Breaking strain	Too	Too	771	1015	Too	1236	1446
		Final length	weak	weak	709	688	weak	667	659
		Tensile product	to test	to test	55	70	to test	82	95
	259	Breaking strain	Too	Too	971	1063	Too	1167	1221
		Final length	weak	weak	703	672	weak	656	641
		Tensile product	to test	to test	68	71	to test	77	78
		Coefficient of vulcanisation	—	—	1·02	1·36	—	—	—
30	7	Breaking strain	276	296	750	857	240	1212	1386
		Final length	746	711	707	676	665	660	660
		Tensile product	21	21	53	58	16	80	92
	259	Breaking strain	331	338	867	1040	407	1110	1249
		Final length	634	616	678	679	686	664	653
		Tensile product	21	21	59	71	28	74	82
		Coefficient of vulcanisation	0·58	0·58	1·14	1·42	—	—	—
40	7	Breaking strain	314	284	802	996	274	1227	1322
		Final length	702	667	718	688	642	679	665
		Tensile product	22	19	58	68	18	83	88
	259	Breaking strain	418	463	852	997	438	1099	1180
		Final length	661	662	682	684	663	678	664
		Teusile product	28	31	58	68	29	75	78
		Coefficient of vulcanisation	—	—	1·36	—	—	—	—

The breaking strain is given in grms. per sq. mm. using a ring shaped test piece 1 inch (25·4 mm.) internal diameter and 1·25 mm. thick. The final length gives the full length of the test piece at rupture, the original length being taken equal to 100. The "tensile product" is the product of breaking strain and final length divided by 10^4 to reduce it to a convenient figure. The specimens marked "Too weak to test" were so weak and the results in consequence so irregular that a figure could not be obtained.

These figures clearly indicate that with L. E. Weber's compound containing litharge, rubber vulcanises slowly although resin-extracted, and that it is hardly correct to say that it cannot be vulcanised under these conditions. Both Weber's resin-extracted rubbers and my own contain a small residue of matter soluble in acetone and, if this were completely removed, it is possible that no appreciable vulcanisation would take place. The compound containing litharge used by Weber appears to be hardly suited for the purpose of ascertaining the specific vulcanising properties of any particular rubber sample. It will be seen that the highest coefficient of vulcanisation amounts to less than 1·5 whereas fully vulcanised soft rubber mixings usually show double this figure. Corresponding with the low coefficient we also have low figures for tensile properties. Thus the maximum "tensile product" of the unsmoked sheet specimens is 71 which again is about one half the figure for fully cured soft rubbers.

The resin extracted specimens A, B, and E show steady improvement with increased length of cure and increased age (within the limits of the tests). This would be expected of under-cured specimens. The vulcanised specimens of untreated raw rubber, C and F, show little or no improvement with increased length of cure. The unsmoked sheet gives the best results with 25 or 30 minutes cure and the smoked sheet with 10 minutes cure. The falling off in the Tensile Product with ageing in the longer cures of the smoked sheet specimens is very noticeable. It undoubtedly appears that C and F are fully cured within the conditions of the experiments in spite of the fact that the coefficient of vulcanisation and physical properties are poor.

The specimens D and G contain added "resin," the effect of which has been to increase the rate of cure. This is apparent both from the figures for coefficient of vulcanisation and the physical tests. Taking, for instance, the figures for the 10 minutes cure, D gives higher figures than C while G appears to be over-cured as the tensile properties are lower on the specimen which has aged for 8 months.

It is also interesting to note that the smoked sheet specimens cure appreciably faster than the pale (unsmoked) sheet, which is in agreement with my general experience with soft rubber mixings containing no litharge.

The curing properties of this type of litharge compound may be examined in the light of my previous work (this Journal, 1915, 34, 524). This compound contains 6·2 parts of litharge which would require for complete reaction 0·9 part of sulphur. As 3·1 parts of sulphur are taken, there would remain for reaction with the 50 parts of rubber 3·1—0·9 = 2·2 parts of sulphur, that is to say 4·4 % calculated on the rubber, which should suffice to produce a much fuller degree of vulcanisation than that obtained. The quantity of "free" or "unaltered" sulphur remaining in these compounds is appreciable, amounting to 2—3 % calculated on the rubber. The "cures" given are short and, as the coefficient of vulcanisation increases steadily with the length of cure, it is apparent that, if these compounds were cured for 2 or 3 hours, as in my previous work, a much higher coefficient would be obtained. On the other hand, as some of these compounds are already "over-cured" in 40 minutes, they would be still more over-cured in 2 or 3 hours. I may here emphasize the fact that an essential criterion of a properly cured rubber is its ageing qualities. Any conclusion based on the coefficient of vulcanisation or on physical tests with the freshly vulcanised specimen without taking the ageing qualities into consideration may lead one very much astray (see accompanying paper on "The Stability of Vulcanised Rubber and the Optimum Cure").

That the compound containing litharge chosen by Weber is an unsuitable one for many purposes is also shown by the following tests made on the same samples of raw rubber vulcanised with 10 % of sulphur and no other ingredients.

The following compounds were vulcanised :—

AB 2. Acetone-extracted, pale (unsmoked) plantation sheet rubber, being a mixture of the raw rubber specimens used in compounds A and B.

C 2. Untreated pale (unsmoked) sheet rubber as used for compound C.

E 2. Acetone-extracted smoked sheet rubber as used for compound E.

F 2. Untreated smoked sheet rubber as used for compound F.

The vulcanised specimens were subjected to tensile tests shortly after vulcanisation and again after an ageing period of 8 months as in the former series. The specimens were vulcanised for 3 hours at 135° C.

TABLE 2.

		AB2	C2	E2	F2
Coefficient of vulcanisation.		2·86	3·75	3·82	4·40
Test piece 5 days old	Breaking strain	1020	1467	1520	1870
	Final length	1004	1138	983	1007
	Tensile product	106	149	149	188
Test piece 265 days old	Breaking strain	1531	2060	1470	2810
	Final length	836	947	747	976
	Tensile product	128	195	110	274

The effect of acetone extraction has been to lower the rate of cure as indicated by the figures for the coefficient of vulcanisation, but this effect is much less marked than in the case of the litharge compounds. As before, the smoked sheet samples E 2 and F 2 cure faster than the pale sheet specimens AB 2 and C 2. The last three specimens are probably over-cured although two of them still show improvement in tensile qualities on ageing for 8 months. AB 2 is approximately correctly cured and shows in some respects improvement, but E 2 has deteriorated appreciably. The improvement in AB 2 is perhaps more apparent than real for, although the figures for breaking strain and tensile product have risen, the elongation at rupture as indicated by the final length has fallen out of all proportion, indicating a tendency to hardness and brittleness. The low figures for final length for the acetone-extracted specimens AB 2 and E 2 may be compared with those for the untreated specimens C 2 and F 2. The effect of acetone extraction is also well shown by comparing C 2 and E 2 and F 2. It has reduced the coefficient of vulcanisation of the latter to approximately the same figure as C 2 and, when freshly cured, both C 2 and E 2 give similar tensile figures. But on ageing for 8 months the acetone-extracted specimen E 2 has deteriorated considerably while the untreated specimen C 2 has improved. The acetone-extracted specimens have also a pronounced harsh feel which indicates "perishing."

It appears therefore that the removal of resinous (acetone-soluble) matter from a raw rubber has two distinct effects on the rubber—(1) it lowers the rate of vulcanisation, particularly in litharge compounds of the L. E. Weber type, (2) it causes the rubber to harden and perish faster than it otherwise would do.

These points are further illustrated by another series of vulcanisation tests curing for progressively longer periods and using acetone-extracted rubber as in AB 2 and untreated rubber as in C 2, the acetone extracts being 0·7 and 1·8 % respectively. The compound consisted of rubber with 10 % of sulphur and no other ingredients.

TABLE 3.

		AB3			C3		
Hours cure.		2½	3	3½	2½	3	3½
Coefficient of vulcanisation.		—	3·91	—	—	4·02	—
Test piece 5 days old	Breaking strain	1000	1310	1470	1130	1390	1600
	Final length	1021	973	920	1059	1008	963
	Tensile product	102	127	135	120	140	154
Test piece 115 days old	Breaking strain	1060	131	89	1340	1360	1100
	Final length	890	399	278	1046	942	809
	Tensile product	95	5	2	141	128	89

In this series the effect of acetone extraction on rate of cure is less apparent than in the last series of tests because the extraction was less complete. It will be noted that the acetone-extracted specimens give almost as high tensile figures when freshly cured as the untreated specimens and that the vulcanisation coefficient in the 3 hours cure is almost as high for the acetone-extracted as for the untreated specimen. On the other hand, the deterioration of the acetone-extracted specimens is very striking. The effect is only slight for the 2½ hours cure but for the 3 and 3½ hours cure very considerable deterioration has set in. As regards the untreated specimens C 3, that cured at 2½ hours shows improvement but those cured at 3 and 3½ hours are over-cured and show deterioration, although to a far less extent than the corresponding specimens of AB 3.

We may therefore conclude that removal of resinous matter by acetone extraction not only brings about gradual deterioration of what would otherwise have been a correctly cured specimen, but considerably hastens the deterioration (or perishing) where the specimen has been somewhat over-cured.

With a view to elucidating the curious behaviour of L. E. Weber's compound containing litharge, some tests were made with a modification of this. The chalk was omitted but the relative proportions of rubber, sulphur, and litharge were retained. It was desired to ascertain what effect, if any, was produced by the chalk, which one would expect to function merely as a diluent. The mix had the following composition—Rubber (pale unsmoked sheet) 100 parts, sulphur 6·2 parts, and litharge 12·4 parts.

The specimens were vulcanised for 30, 40, and 50 minutes at 131·5° C. The results obtained are given in Table 4.

TABLE 4.

		AB4			C4		
Minutes cure.		30	40	50	30	40	50
Coefficient of vulcanisation.		—	0·91	—	—	2·02	—
Test piece 4 days old	Breaking strain	42	66	67	833	815	867
	Final length	761	845	798	937	946	946
	Tensile product	3	6	5	78	77	82
Test piece 125 days old	Breaking strain	47	78	128	—	1158	1179
	Final length	684	759	817	—	908	903
	Tensile product	3	6	10	—	105	106

It is apparent from these figures that the removal of the chalk from the compound has not altered its essential features. The acetone-extracted compounded rubber AB 4 vulcanises much more slowly than the untreated rubber. The only point of interest is the higher figure for coefficient of vulcanisation given by C 4. This figure now exceeds 2 whereas the corresponding figure previously obtained for the compound containing chalk with this untreated pale sheet rubber was 1·36. This would appear to indicate that the admixture of chalk hinders vulcanisation. Further confirmatory tests are however required.

A comparison of the figures for the rubbers compounded with litharge and those without shows clearly that the vulcanisation of the former is much more susceptible to the removal of the resinous matter than the vulcanisation of the latter. This experimental result is in accordance with the views originally put forward to explain the accelerating effect of litharge on the vulcanisation process. According to Esch and Auerbach (Gummi-Markt, 1911, p. 123), the acceleration is due to the liberation of heat brought about by the oxidation of lead oxide and sulphide to sulphate. The oxygen is supplied by highly oxidised substances removed in the acetone extract. Hence the temperature of the acetone-extracted rubber remains much lower during vulcanisation, and consequently the rubber vulcanises more slowly. The effect is more marked with rubber compounded with lead oxide because the removal of the acetonesoluble constituent of the rubber prevents the lead oxide exercising its ordinary accelerating action. This however does not explain the unstable nature of the acetone-extracted rubber, although this observation is in accordance with the ready oxidation of acetone-extracted unvulcanised rubber as recorded by Peachey. As already noted (Beadle and Stevens, *loc. cit.*) specimens of acetone-extracted unvulcanised rubber when put by for a time become brittle or "resinous."

CONCLUSIONS.

1. Certain types of litharge compounds cannot be sufficiently vulcanised to bring out their full tensile properties and coefficient of vulcanisation without "over-curing," that is without a deterioration or "perishing" with age.

2. The removal of resinous matter by acetone extraction retards vulcanisation as indicated by the tensile properties and coefficient of vulcanisation.

3. This retardation of vulcanisation is more apparent with compounds containing litharge than those without.

4. The removal of resinous matter reduces the "stability" of the vulcanised compound, that is, it "perishes" rapidly, and the effects of over-curing are more marked than with the untreated rubber.

5. The plantation smoked sheet rubber used in these experiments vulcanised faster than the air dried (pale) sheet. In other respects these two types behave similarly.

Obituary.

SIR WILLIAM RAMSAY, K.C.B., F.R.S.

By the death of Sir William Ramsay at the comparatively early age of sixty-three the world loses one of the most active, skilful and gifted experimental chemists of this or any other age. It is too soon to attempt an estimate as to the position which his name will ultimately occupy in the history of chemistry as it will appear to our successors a generation hence. But it may safely be predicted that it will be in no inferior rank, and for the simple reason that his fame among his contemporaries is based on the solid foundation of positive discovery.

He was not specially distinguished by the promulgation of original views in connection with the theory of chemistry, but he showed the elasticity of his mind by the readiness with which he confronted new doctrines and when approved adopted them into his teaching. He was the first to introduce to English readers Van't Hoff's gas theory of solutions. He accepted the Arrhenius hypothesis of free ions in dissolved electrolytes and was among the first to become an exponent of this view, so unpalatable to some of his contemporaries. He was in fact a born physical chemist, for although his first essay (on orthotoluic acid) was produced under the inspiration of his master, Fittig, and although in conjunction with his friend, J. J. Dobbie, he worked on some decomposition products of quinine, the whole of his published work, from the time he entered first on an independent position at Bristol, till fifteen years later, relates to physico-chemical questions.

Scientific chemistry, however, did not wholly occupy his mind. He held original views on education, and to the last objected to examination as a means of testing competitors for scholarships and prizes, or as a process leading to graduation in a University. He was a constant advocate at London of the system in which the accomplishment and acceptance of the "thesis" embodying work done by the candidate is the fundamental qualification. An exposition of his views on this and other educational questions was many times the subject of lectures, addresses and letters to the newspapers. So recently as January of this year six articles from his pen appeared in the Daily Dispatch under the title "Germany's Commercial War Machine." The second of these articles relates to English education, and the second paragraph is headed in thick type "Still on Wrong Lines." More cannot be said in this place, for education and politics are subjects which furnish material for inexhaustible controversy, and a man of Ramsay's active mind and eager patriotism is not likely to have held views immediately acceptable to the crowd.

The Transactions of the Chemical Society contain all his earlier papers on physico-chemical subjects, of which the first is on the volumes of liquids at their boiling points (1879). The method there used was extended to sulphur and some other elements (sodium, bromine, phosphorus, 1881) as well as to a number of aromatic compounds from which certain conclusions were deduced. In 1883 he published the first of a series of researches, undertaken jointly with Dr. Sydney Young, on the thermal properties of solids and liquids. In one of these papers the importance of wrapping cotton wool or asbestos round the bulb of the thermometer in the determination of boiling points at atmospheric pressure was for the first time pointed out, and the reason given. (Trans. Chem. Soc., 1885, 42.) In a second paper in the same journal and year (p. 640) a method is given for obtaining constant temperatures variable at will. The authors discuss in these papers the nature of dissociation and the constitution of liquids and the properties of liquids at the critical point. A few years later, in conjunction partly with Dr. J. Shields and partly with Miss Aston, Ramsay published several important papers on the molecular surface-energy of liquids which throw light on the degree of their molecular complexity.

While this work was going on other cognate subjects occupied his attention, such as the molecular weights of metals, the molecular weight of nitrogen peroxide, and the non-existence of nitrogen trioxide in the gaseous state.

Brownian or pedetic motion in relation to colloidal solutions was the subject of a communication by Ramsay to the Chemical Society in 1892, but it is probably not generally known that this interesting phenomenon had occupied his attention ten years earlier.

In 1882 he appears to have regarded the motion of fine particles as dependent not on the impact of individual molecules of the liquid, but as evidence that the molecules of liquids are associated into larger moving masses. "If molecules do not coalesce and move as a whole then they would appear to have no possible power of giving motion to a mass so much larger than themselves." This view expressed in a short paper communicated to the Bristol Society of Naturalists does not appear to be fundamentally changed in the communication to the Chemical Society ten years later.

The direction of Ramsay's researches was destined soon after this time to be concentrated into an entirely new and unexpected channel. For some years Lord Rayleigh had been studying the densities of the simple gases and in the case of nitrogen had encountered an anomaly which for some time received no explanation. He found that nitrogen isolated from various chemical compounds had a density which corresponded to the weight of 1·2505 gram per litre, while nitrogen from atmospheric air weighed 1·2572 gram per litre. Is the relative lightness of the chemical nitrogen due to an impurity such as hydrogen or marsh gas? Is the high density of the atmospheric nitrogen due to traces of unremoved oxygen or oxide? Is the chemical nitrogen lighter in consequence of partial dissociation? These and other questions were one after the other answered in the negative by specially devised experiments. Lord Rayleigh consulted many of his chemical friends, but one only entered seriously and sympathetically into consideration of the baffling problem. The happy result was the announcement, at the Oxford meeting of the British Association in 1894, of a new and remarkable constituent of the atmosphere. For several months immediately following this announcement the feeling generally prevalent in the chemical world was one of curiosity mixed with a large proportion of incredulity. But no one who was present at the special meeting of the Royal Society held on January 31st, 1895, in the Theatre of the University of London in Burlington Gardens will be likely to forget the excitement with which the large audience received from Lord Rayleigh and Professor Ramsay the detailed account of their joint work and the conclusion at which they had arrived, and the intense interest which the new gas, *argon*, with its strange properties, aroused in the minds of all the chemists present. The story is too long to repeat in this place, and moreover the argon group of elements is now familiar to everyone. But all students should read the details of this wonderful research in the paper entitled "Argon, a New Constituent of the Atmosphere," in the proceedings of the Royal Society (Vol. 57, p. 265). This occasion, remarkable as it was, was perhaps surpassed in dramatic interest when. less than two months later. at the Annual General Meeting of the Chemical Society on 27th March, the Faraday Medal having been presented to Lord Rayleigh, the discovery of terrestrial helium in the gases from clèveite was announced by Ramsay.

It is scarcely necessary to remind our readers that no one at that time ever expected to make a close acquaintance with helium. the hypothetical solar element distinguished by the characteristic line D_3, of which the wavelength had been given years before by Angström and by Cornu.

A complete account of the sources and properties of helium up to that date will be found in a paper communicated to the Chemical Society on 20th June, 1895. The story, however, does not end here, for on June 9th, 1898, a new constituent of atmospheric air, named by the authors *krypton*, was described by Professor Ramsay and Dr. Travers, and on the 16th of the same month another gas. *neon*, was found among the "Companions of Argon." Subsequently air was proved to contain a still heavier gas in small quantity to which the name *xenon* was applied.

What led Ramsay to look for these companions of argon he has told in the interesting Presidential Address delivered to the Chemical Section of the British Association at its meeting in Toronto in August, 1897. It is sufficient to recall the fact that in the original statement of the Periodic Law no place was reserved for elements of zero valency. But the relation of the atomic weight of helium to that of argon was sufficient to suggest to him the idea that these two elements were members of the same group of homologues and that there must be another element between them with an atomic weight differing from that of helium by about 16 units, just as sodium (23) differs from lithium (7) by the same amount. This hypothesis was verified by the discovery of neon and further justified by the later recognition of krypton and xenon with their anticipated atomic weights.

The discovery of radium by Madame Curie was announced in 1902, and naturally this remarkable, substance attracted a crowd of experimenters. Ramsay and Soddy added almost immediately a fact of fundamental importance when they identified the gas which is produced by the disintegration of radium emanation with helium.

The search which Ramsay undertook later (1907-8) for higher members of the same series was in one sense fruitless. But he placed the radium emanation to which he gave the name niton, in the list of inactive gases. In 1910 in conjunction with Dr. Whytlaw Gray he finally settled the density and hence the molecular and atomic weights of niton by direct estimations of its density. To appreciate the peculiar difficulties of this operation the original memoir must be read (Proc. Roy. Soc., Vol. 84, p. 586). It is sufficient to say here that the volume of gas weighed was 0·0658, or say 1/15 of a cubic millimetre, as an average of the five experiments, and that the weighings were performed by means of a modification of the Steele and Grant microbalance, which is capable of showing a sensibility of 1/250.000 milligram. The enormous chemical energy of radium emanation and the decomposition of water by contact with it led Ramsay to consider the hypothesis of transmutation among the known elements by its action. All that can be said now is that this is a problem of profound interest which requires and will in time, doubtless, receive further investigation.

The war came in 1914, and put an end to the pursuits of peace. With characteristic ardour Ramsay threw himself into every patriotic movement and never relaxed his efforts to rouse and inform the Government and to stimulate the Board of Inventions till overtaken by the dreadful disease which in a few months found the only possible relief in death. His mind, however, remained busy long after he knew that he had but a short time to live. His last word to the scientific world was received by the Royal Society so lately as April 1, 1916, and appears in the July number of the Proceedings under the title "A Hypothesis of Molecular Configuration in Three Dimensions of Space."

William Ramsay was born in Glasgow on October 2nd, 1852, the only son of his father, William Ramsay, C.E. His uncle, the late Sir Andrew Crombie Ramsay, F.R.S. (*d.* 1891), the well-known geologist, was from 1848 to 1851 Professor in University College, the institution in which more than thirty years later William Ramsay occupied the chair of chemistry.

It is interesting also to learn that the grandfather of the Chemist, another William Ramsay, took an interest in chemistry, and three papers are attributed to him in the Royal Society Catalogue. It has, however, been stated that the inherited capacity of the scientific discoverer came from the side of his mother, Catherine Robertson, in whose family a series of physicians of note gave indication of intellectual power.

William Ramsay described himself as a precocious dreamy youth, but there is no record of special distinction at school or college. After early years at the Glasgow Academy, he matriculated at Glasgow University in his fourteenth year. At 18 years of age he went to Germany, where he spent some time under Bunsen at Heidelberg. He then proceeded to Tübingen, where under Professor Fittig he secured his Ph.D.

Returning to Glasgow he was from 1872 to 1874 Assistant in the Young Laboratory of Technical Chemistry, and subsequently Tutorial Assistant in the University under Professor John Ferguson. During this period he was busily at work on various subjects, partly physico-chemical. He was a candidate for the chair of Chemistry at Belfast, which became vacant by the retirement of Dr. Andrews (*d.* 1885) in 1879. He also stood for the corresponding post in the Royal College of Science, Dublin. In these and some other cases he was unsuccessful, and it was only when a vacancy occurred in University College, Bristol. in consequence of the transference of Dr. Letts to Belfast, that he found his opportunity. He entered on his duties in Bristol in the spring of 1880, and was almost immediately appointed Principal of the College. Those were early days in the history of the College, but those who can look back to that time can remember with how much knowledge, tact and patience the affairs of the then only potential university were handled by the young Principal. He was no more than about 29 years of age, and the College had been. three years previously, practically forced on an indifferent and unsympathetic public. In Bristol Ramsay remained till 1887, when he was chosen to succeed the veteran chemist Williamson in the chair at University College, London.

It is, of course, superfluous to say that honours of all kinds came thick upon him toward the end of the century. He was elected a member of practically all the scientific academies and societies in the world. Honorary degrees were conferred on him by many Universities. He received the Davy Medal from the Royal Society (1895), the Longstaff Medal from the Chemical Society (1897), and several others from foreign institutions. In 1902 he was created K.C.B., being already Commander of the Crown of Italy, Officier de la Légion d'Honneur of France and Knight of the Prussian Order "Pour le Mérite." In 1904 he received the Nobel Prize for Chemistry, in the same year that the Nobel Prize for Physics was awarded to Lord Rayleigh. It is perhaps appropriate to recall the fact that names may be submitted to the Nobel Committee of the Swedish Academy only by a strictly limited number of persons, and a statement of the claims of the person whose name is proposed involves the preparation of a carefully considered document. There can be no impropriety now in mentioning that Ramsay's name was proposed to the Swedish Committee by Lord Avebury, as a Member of the Swedish Academy, and the proposal was supported by the signatures of the leading English Chemists. But it is probably not known generally in this country that a separate and entirely independent proposal was sent in to the Academy by Professor B. Brauner, of Prague. The statement drawn up by Professor Brauner occupied nine foolscap pages and gives evidence of the characteristic enthusiasm of its author. Naturally he lays particular stress on "the discovery of one whole missing group of elements in the periodic system of Mendeléeff and the production of helium from or through the radium emanation."

There is every reason for believing that, apart from the months of pain at the end, Ramsay's life must have been a very happy one. In 1881 he married, and throughout his career his wife was his constant companion not only in the home, but in the numerous journeys undertaken at different times to distant parts of the world. Soon after the discovery of the new gases he was invited to lecture before a large popular audience in Berlin. On occasions such as this his remarkable familiarity with languages other than his own did good service, and enabled him to address an audience of fifteen hundred people in German. The lecture was repeated before the Emperor and the Court in English. He also lectured to the Berlin Chemical Society, and the lecture is reported in full in the Berichte for 1898. About the same time he lectured to a Parisian audience on the same subject in French, and in 1909, at the opening meeting of the International Congress of Applied Chemistry held in the Albert Hall, with the Prince of Wales (now King George) by his side, some interest and amusement was created in the large audience by the readiness with which the President made use of the four official languages in succession.

Other journeys he took, to Iceland in company with Professor Sollas, to the United States to the International Congress of Arts and Science at St. Louis in 1904, where he gave an address on "Present Problems of Inorganic Chemistry," to India in order to advise the Government as to the organisation of Universities and Technical Schools in that country. It is to be hoped that some day an adequate account will be given of these expeditions, so full as they were of interesting occurrences and encounters.

Throughout his long career of ever rising distinction, Ramsay never forgot his old friends. The elation of conscious genius never concealed the kindly, hospitable and humane features of his character, and whether in the mood for fun or for serious talk, he was always what is called "good company." By his death a great light has been quenched, but the memory of it will stay with his contemporaries to the end, and the story of his ardent life and brilliant achievements should serve as a beacon to the younger generations of chemists.

Sir Wm. Ramsay was an original member of the Society of Chemical Industry. He was President of the Society in 1903-4, and during his year of office he took the Society to New York and thence to the St. Louis Exhibition.

—W. A. T.

August, 1916.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

Dialysis; The temperature effect in ——, and a simple rapid dialyzer. M. Neidle. J. Amer. Chem. Soc., 1916, 38, 1270—1272.

A MEMBRANE of parchment paper formed into a bag of about a litre capacity is suspended from the end of a piece of wide glass tubing, and a current of distilled water is passed through it by means of an automatic siphon. The membrane is immersed in the liquid to be dialysed, which is contained in a beaker and heated to any desired temperature (70°—90° C.). Colloidal ferric hydroxide may be prepared in 8—10 days instead of about a month, or a purer product in 20 days instead of six months.

—E. H. T.

PATENTS.

Filtration apparatus and system. M. B. Tark, Philadelphia, Pa., Assignor to The Sewage Clarification Co., Wilmington, Del. U.S. Pat. 1,188,310, June 20, 1916. Date of appl., Feb. 12, 1916.

A CYLINDRICAL, rotating filter, mounted on a horizontal axis, is provided with blades projecting radially outwards through openings in its periphery. The filtering surface is cleaned by a rotating brush arranged above the cylinder, and the blades are retracted by an internal cam as they approach the cleaning brush, and are simultaneously cleaned by the brush.—W. F. F.

Centrifugal-pressure filter. F. K. and E. F. Atkins, New York. U.S. Pat. 1,190,842, July 11, 1916. Date of appl., Nov. 13, 1915.

A bowl containing a filtering medium and rotating on a vertical axis, has ports in the portion of largest diameter for the discharge of solids. An annular valve surrounds the bowl and is movable vertically so as to open or close all the ports simultaneously.—A. S.

Furnace; Regenerative ——. H. E. Smythe, Assignor to The S. R. Smythe Co., Pittsburgh, Pa. U.S. Pat. 1,188,502, June 27, 1916. Date of appl., Apr. 1, 1915.

The regenerator chamber of a reversing furnace contains a series of superposed horizontal flues having their ends spaced from the side walls, thus forming vertical passages, whilst horizontal passages for the waste and fuel gases are also provided between the flues and the roof and floor respectively. The vertical passage nearest the furnace is closed at the top, while the other vertical passage is closed at the bottom. The furnace gases pass over the flues at the top, down through the farthest vertical passage, through the flues into the nearest vertical passage, and thence into the passage below the flues. Cleaning doors are provided in the walls opposite the ends of the flues.—W. F. F.

Comminuted materials; Apparatus for grading and quantitatively determining ——. N. C. Johnson, Englewood, N.J., Assignor to Concrete Appliances Co. Inc., New York. U.S. Pat. 1,189,961, July 4, 1916. Date of appl., May 5, 1915.

The material is passed through a tubular casing containing a number of oblique screens of progressively increasing fineness of mesh, each compartment thus formed being provided with a communicating receptacle for the graded material. The receptacles are provided with observation windows.—W. F. F.

Plastic material; Process of forming articles from ——. W. J. Burns, Assignor to The Peerless Vulcanite Co., Bridgeport, Conn. U.S. Pat. 1,190,510, July 11, 1916. Date of appl., Apr. 18, 1916.

The material is crushed into particles and placed in a mould in layers, each layer being heated to expel gases and vapour before the next layer is added. The material is then subjected to pressure in the mould.—W. F. F.

Drying; Process of ——. D. B. Banks, Baltimore, Md. U.S. Pat. 1,190,702, July 11, 1916. Date of appl., Apr. 21, 1914.

The substances to be dried are subjected to the pressure of saturated steam, which is then reduced gradually to less than atmospheric pressure while heat is supplied to maintain the steam superheated.—W. F. F.

Dryer. B. S. Harrison, Brooklyn, N.Y. U.S. Pat. 1,191,075, July 11, 1916. Date of appl., May 4, 1915.

A spiral track is mounted on the inner wall of a vertical cylindrical shell, and the substance to be dried is conveyed along the track in circular trays, the edges of which engage with rollers carried by an external rotating vertical shaft. Fans are provided on a central vertical shaft; below each fan is a bell with a central opening to direct the air to the centre, whilst above each fan is a baffle plate. —W. F. F.

Evaporator. P. Kestner, Lille, France, Assignor to Kestner Evaporator Co., Philadelphia, Pa. U.S. Pat. 1,191,108, July 11, 1916. Date of appl., May 13, 1915.

The upper part of a salt-separating chamber, having a vapour outlet at the top and a salt-discharge outlet at the bottom, connects from a point above the normal liquid level in the chamber, with the upper part of a tube evaporator. The feed tube to the bottom of the evaporator connects with the same chamber at a point between the liquid level and the salt-discharge outlet. The upper and lower parts of the chamber are separated by a funnel-shaped partition with a central opening, below the liquid level, which can be closed by a valve operated by a rod.—B. V. S.

Oil burning furnaces. J. R. Brown and E. E. Hall, Vancouver, B.C., Canada. Eng. Pat. 14,352, Oct. 11, 1915.

Drying and mixing material; Apparatus for ——. U. Ammann, Langenthal, Switzerland. U.S. Pat. 1,189,772, July 4, 1916. Date of appl., Jan. 28, 1913.

See Fr. Pat. 453,614 of 1913; this J., 1913, 780.

Drying apparatus. E. Disdier, Malaga, Spain. U.S. Pat. 1,190,127, July 4, 1916. Date of appl., Jan. 4, 1912.

See Fr. Pat. 436,057 of 1911; this J., 1912, 374.

Furnace; Reversible regenerative ——. A. Reynolds, London. U.S. Pat. 1,191,033, July 11, 1916. Date of appl., Oct. 18, 1912.

See Eng. Pats. 16,041 and 20,144 of 1911; this J., 1912, 1112.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Constitution of ——. D. T. Jones and R. V. Wheeler. Chem. Soc. Trans., 1916, **109**, 707—714. (See also this J., 1915, 1043.)

Coal is considered to have been formed from decayed vegetable matter by the action of pressure, and of temperatures which cannot have approached 300° C. By extraction with pyridine and re-extraction of the extract with chloroform or benzene, coal can be resolved into cellulosic and resinic portions. The former consists of compounds of the furane type and yields almost entirely phenols on destructive distillation. Compounds are also present having structures similar to that of the carbon molecule, but it is improbable that free elementary carbon is present in coal. The resinic derivatives consist of compounds in which alkyl, naphthene, and hydroaromatic radicles are attached to larger and more complex groupings, and under the influence of pressure they have become highly polymerised. The oxygenated resinic derivatives are chiefly oxides, probably of cyclic structure. Reactive oxygen in substances such as esters, ketones, acids, etc., is almost completely absent. It is doubtful whether aromatic groupings are present, and since the aromatic compounds in coal distillates are formed at a lower temperature than that at which hydrogen is eliminated from hydroaromatic compounds, the mode of formation is still somewhat obscure. Free hydrocarbons are present in small quantities in the resinic portions of coal. The main distinction between low temperature distillates from coal and petroleum, viz., the absence of phenols from the latter, is held to be corroborative evidence of the non-cellulosic origin of petroleum.—G.F.M.

Gas (Standard of Calorific Power) Act. Board of Trade Instructions. August, 1916.

The Gas (Standard of Calorific Power) Act has received the Royal Assent, and the Board of Trade have issued the following instructions relative to the making of applications for the change of standard as to the quality of gas from illuminating power to calorific value :

1.—Application for an Order may be made by letter addressed to the Assistant Secretary, Board of Trade (Gas and Water), 7, Whitehall Gardens, S.W. The application should state : (*a*) The standard of calorific power proposed ; (*b*) The titles and dates of all Acts of Parliament and Orders confirmed by Parliament regulating the undertaking of the company ; and (*c*) Whether the company have erected and worked, or are prepared to erect and work, suitable crude benzol-recovery plant for the production of toluol and benzol.

2.—Notice of the application must be published once in each of two successive weeks in some newspaper circulating within the company's limits of supply. The notice should state : (*a*) The purpose of the application, and the name of the Act under which it is made : (*b*) The standard of calorific power proposed by the company ; and (*c*) That any objections or representations with regard to the application may be made by letter addressed to the Assistant Secretary, Board of Trade (Gas and Water), 7, Whitehall Gardens, S.W., within fourteen days of the date of the first publication of the notice, and that copies of such objections or representations should at the same time be sent to the company.

3.—A notice to the same effect should also be sent, on or before the date of the first publication of the notice, to the council of every borough, urban district, and rural district situate, or part of which is situate, within the company's limits of supply.

4.—A copy of the notice sent to the councils should be forwarded to the Board of Trade endorsed with a list of the councils to which it has been sent, and a signed statement that the list includes the name of the council of every borough, urban district, and rural district situate, or part of which is situate, within the company's limits of supply. A copy of the newspapers containing the notice should also be forwarded to the Board of Trade.

Lignite samples obtained from the Province of Alberta : Results of the investigation of six ——. B. F. Haanel and J. Blizard. Canada Dept. of Mines, Rept. No. 331.

All the samples of lignite tested proved to be eminently suited for the production of gas when used in a producer, and in certain cases the nitrogen content of the lignite was sufficiently high for the profitable recovery of the nitrogen. Clinkering occurred in a few cases. No trouble was experienced in burning the gas in a gas engine. Boiler trials indicated that the moisture content of the fuels up to 30% does not materially affect the efficiency, but that the carbon : hydrogen ratio exercises the greater influence in this direction. Fuels of this class require a specially large combustion chamber and brick ignition arch, so arranged as to burn effectively the large percentage of volatile matter.

Gasoline from kerosene ; Catalysis in the formation of ——. G. Egloff and R. J. Moore. Met. and Chem. Eng., 1916, **15**, 67—69.

In a study of the three-phase method—gas, liquid, and solid—for the conversion of kerosene into gasoline, various catalysts were used, the kerosene employed being derived from a paraffin-base Pennsylvania crude petroleum and having a sp.gr. of 0·800 at 15·5° C. 400—500 c.c. of the kerosene was heated with 10% by weight of the solid catalyst in an 800 c.c. Kjeldahl flask fitted with a Glinsky still-head and with an inlet tube for hydrogen chloride or chlorine ; the time of reaction was about 3 hours. The amounts of gasoline produced by the catalytic action of magnesium, zinc, sodium, and aluminium in the presence of hydrogen chloride were 1·0, 4·9, 5·3, and 37·3% by volume of the original oil, respectively ; the corresponding figures for magnesium, aluminium, silicon, sulphur, phosphorus, and selenium in the presence of chlorine were 0·3, 15·9, 0·6, 0·7, 1·7, and 5·3% by volume of the original oil, respectively. Hypothetical reactions are suggested as indicating the possible mechanism of the conversion in the presence of aluminium chloride.—W. E. F. P.

Aromatic compounds [benzene, toluene, and xylene] from the cracking of a gas oil : Formation of ——. G. Egloff and T. J. Twomey. Met. and Chem. Eng., 1916, **15**, 15—18. (See also this J., 1916, 296.)

The gas oil used, derived from Pennsylvania crude petroleum, yielded 90% of distillate between 200° and 350° C. and had a sp.gr. of 0·841 at 15° C. Separate portions, 20 galls. each, were cracked at 1100°, 1200°, 1300°, 1400°, and 1500° F. (593°, 649°, 704°, 760°, and 816° C., respectively), under atmospheric pressure, in a gas-heated, steel tube, 11·6 ft. long and 8 in. in diameter. The amount of decomposition was small at 1100° F. but increased with the temperature to a maximum between 1200° and 1300° F., the recovered oil being composed of paraffins of high to medium molecular weight, olefines, and aromatic hydrocarbons of the benzene series. At 1400° F. the amounts of benzene, toluene, and xylene produced per 100 galls. of original oil were 3·3, 3·2, and 2·5 galls. respectively. The maximum amounts of these hydrocarbons in the recovered oils were : benzene, 8·5% at 1500° F. ; toluene, 8·5% at 1400° F. ; xylene, 6·8% at 1500° F.

—W. E. F. P.

Phenols from Solvay coke-oven tar. Shimada. *See* III.

Polymerisation of ethylene. De Montmollin. *See* XX

Patents.

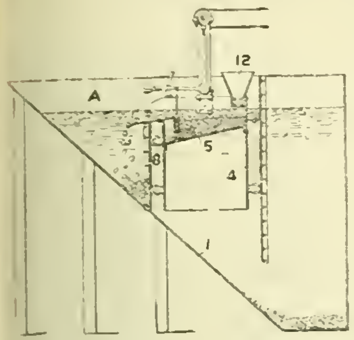
Coal ; Apparatus for cleaning ——. H. N. Wood, Newcastle-on-Tyne. Eng. Pat. 13,455, Sept. 21, 1915.

Two superposed helical shelves are fixed to a central post, the surface being also inclined downwards towards the post. The lower shelf is provided with a peripheral flange inclined upwards. Coal is fed from a shoot having a helical spreading discharge end, on to the upper shelf, and travels downwards by gravity. Impurities are separated by centrifugal force and fall on to the lower shelf. Separate discharge shoots are provided at the lower ends. The shelves may be constructed of plates, some of which are ribbed to retard the outward movement of the coal. To clean two sizes of coal simultaneously, three helical shelves are provided, coal being fed on to the upper two. The material on the intermediate shelf may be spread evenly by strips extending across the space between the upper and intermediate shelves.

—W. F. F.

Coal ; Process of washing —— *and separating refuse therefrom.* N. Shannon, Panama, Ill., Assignor to Link Belt Co., Chicago, Ill. U.S. Pat. 1,190,960, July 11, 1916. Date of appl., May 22, 1908.

Coal is discharged from a hopper, 12, into one end of a vessel having a perforated sloping bottom, 5, and downwardly extended side walls, 4, immersed in a tank of water, 1. The coal moves forward over the sloping bottom by the pressure of the fresh material, and the vessel is reciprocated vertically by an eccentric and rod to stratify the material. Fine, heavy material is discharged through the perforated bottom, 5, light material at the top is discharged into the pocket, A, and coarse, heavy material is discharged into the pocket, 8, and thence into the main body of water below.—W. F. F.



Fuel; Method for utilising pulverulent matter as ——. R. A. Fessenden, Brookline, Mass. U.S. Pat. 1,191,072, July 11, 1916. Date of appl., Dec. 26, 1911.

Pulverulent material is introduced in a predetermined ratio into compressed gas, and is maintained in suspension, and heated sufficiently to drive off volatile hydrocarbons. The proportion of pulverulent matter is governed by the variation in the amount of radiation passing through the chamber.—W. F. F.

Coal gas or the like; Extraction and recovery of vaporous constituents from ——. R. Lessing, London. Eng. Pat. 10,022, July 9, 1915.

Coal gas is passed through a vessel containing broken brick or coke soaked in heavy tar oil freed from low-boiling constituents. Steam is then blown through by means of perforated pipes, or the absorbent may be heated by steam coils or a steam jacket; the distillate is received in a water-cooled condenser, where the condensed water is separated. Alternatively the absorbent may be treated for the recovery of the dissolved vapours by a current of air or gas, or by reduction of pressure, or by a combination of these methods. —W. F. F.

Scrubbers for coal and like gas. British Coke Ovens, Ltd., and F. M. N. Schuster, London. Eng. Pat. 11,315, Aug. 5, 1915.

A number of tower scrubbers are connected in series, each scrubber being divided by horizontal baffles into a number of superposed towers. Each tower is separately connected to a receptacle through which the scrubbing liquid circulates back to the top of the same tower, all the receptacles being connected together in series. Fresh liquid enters the last collecting receptacle and overflows successively into each of the others, until on leaving the first receptacle it is saturated with the absorbed by-product. The plates separating the superposed towers are provided with short rising pipes having flanged hoods, the lower faces of the flanges being just immersed in the scrubbing liquid so as to increase the time of contact of the gas bubbles with the liquid.—W. F. F.

Gaseous fuel; Method of determining the total available heat of ——. H. F. Smith, Lexington, Ohio. U.S. Pat. 1,189,300, July 4, 1916. Date of appl., Sept. 20, 1912.

A known fraction of the gas passing through a main is burnt, the combustion products passed through a liquid, and the rise of temperature measured. The quantity of heat absorbed is multiplied by the appropriate factor to give the total available heat of the gas flowing in the main. —W. F. F.

Petroleum and the like; Distillation of ——. J. S. Smith, Ealing. Eng. Pat. 6660, May 4, 1915.

The petroleum is distilled in an apparatus comprising a tube or system of tubes surrounded by a steam jacket which is heated by means of a furnace. The intervention of the steam jacket prevents local overheating of the tubes, with deposition of carbon.—C. A. M.

Petroleum; Refining ——. D. M. Allan, jun., Assignor to Standard Oil Co., Bayonne, N.J. U.S. Pat. 1,187,797, June 20, 1916. Date of appl., June 25, 1913.

A stream of petroleum oil or other liquid is made to flow in contact with a stream of sulphuric acid, alkali solution, or other immiscible liquid, through an agitator which has inlets for the admission of fresh or partially spent reagent. The agitator is connected with a separator, where the liquids are separated by gravity, and part at least of the separated reagent is returned to the agitator to be brought into contact with the stream of petroleum oil prior to its meeting the stream of fresh reagent.—C. A. M.

Petroleum; Process of treating crude ——. C. B. Forward, Urbana, Ohio. U.S. Pat. 1,189,083, June 27, 1916. Date of appl., May 24, 1915.

Crude petroleum oil is superheated and atomised by means of a heated vapour under pressure, then introduced into a chamber where a pressure of not less than 75 lb. is maintained, and the volatilised products are drawn off, and clarified in their passage from the chamber.—C. A. M.

Oil; Cracking ——. A. A. Wells, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,187,874, June 20, 1916. Date of appl., Nov. 17, 1915.

The oil vapours are conducted into a bath of molten lead, which is heated to about 900° to 1000° F. (about 480°—540° C.) and violently agitated by mechanical means at the moment of contact.—C. A. M.

Lubricating oils; Process of refining ——. H. T. Maitland, Marcus Hook, Assignor to Sun Co., Philadelphia, Pa. U.S. Pat. 1,188,961, June 27, 1916. Date of appl., Aug. 5, 1915.

The lubricating oil fraction from the distillation of petroleum is first treated with sulphuric acid, and then, prior to complete settling, with ammonia gas to minimise the colouring effect of the acid. The precipitate is separated, and the neutralisation of the oil completed by the addition of alkali. —C. A. M.

Mineral [coal] washers. A. France, Liége, Belgium. Eng. Pat. 100,866, Aug. 3, 1915. (Appl. No. 8398 of 1916.)

Gases; Means for mixing and burning ——. L. Hall, Birmingham. Eng. Pat. 9988, July 9, 1915.

Coke ovens; Means for supplying steam to horizontal ——. Gebr. Hinselmann, Essen, Germany. Eng. Pat. 100,348, Feb. 24, 1916. Under Int. Conv., Apr. 23, 1915. (Appl. No. 2810 of 1916.)

See Ger. Pat. 289,618 of 1915; this J., 1916, 412.

Gas retorts; Settings of ——. H. A. Carpenter, Sewickley, Pa., and Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 8507, June 8, 1915.

See U.S. Pat. 1,174,390 of 1916; this J., 1916, 527

[Gas] retorts; Discharging vertical ——. A. McD. Duckham, Ashtead. U.S. Pat. 1,188,255, June 20, 1916. Date of appl., Dec. 17, 1915.

See Eng. Pat. 21,191 of 1914; this J., 1915, 860.

Obtaining from bauxite residues a material for purifying gas. Eng. Pat. 10,935. *See* VII.

Manufacture of bituminous substances. Eng. Pat. 9838. *See* IX.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Coals and other hydrocarbonaceous substances; Apparatus for treating ——. J. D. Scott, Detroit, Mich. U.S. Pat. 1,190,957, July 11, 1916. Date of appl., Oct. 23, 1914.

The coal or other substance is carried on superposed reticulated trays supported on the flanges of I-beams forming the side walls of a tray carrier which is open at the top and bottom. Means are provided for raising the trays bodily and withdrawing them endwise from the carrier.—W. F. F.

Comminuted carbon, and process of making same. P. R. Hershman, Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,188,936, June 27, 1916. Date of appl., Nov. 17, 1915.

By the destructive distillation of the hull bran of cotton seed a practically pure, very finely divided carbon is obtained, nearly free from ash and of a deep bluish tinge.—B. V. S.

Filaments; Process of making metallic [tungsten] ——. K. Farkas, Glen Ridge, N.J., Assignor to J. E. Walscheid, Weehawken, N.J. U.S. Pat. 1,188,057, June 20, 1916. Date of appl., Dec. 13, 1910.

Flexible metallic filaments, *e.g.*, of tungsten, for incandescence electric lamps, are produced by pressing continuously a filamentary thread of highly refractory oxides, and passing successively and continuously each portion of the pressed filament, whilst incandescent, through a continuously-flowing current of heated hydrogen, surrounded by a heated stationary atmosphere of hydrogen. The filament is thus reduced to a pure metallic state, and is afterwards shaped.—B. N.

Electrode. I. Ladoff, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,189,265, July 4, 1916. Date of appl., July 19, 1913.

An arc electrode is formed from titanium oxide, sodium fluoride, a barium mineral which gives a substantially white light in the arc, and a flux of cerium and thorium compounds also giving a substantially white light.—B. N.

Decolorising carbon; Process for regenerating ——. A. Wijnberg, Amsterdam, Netherlands. U.S. Pat. 1,189,896, July 4, 1916. Date of appl., Mar. 24, 1914.

See Eng. Pat. 17,432 of 1913; this J., 1914, 853.

Neon-tube. G. Claude, Boulogne-sur-Seine, France. U.S. Pat. 1,189,664, July 4, 1916. Date of appl., Feb. 12, 1915.

See Eng. Pat. 2020 of 1915; this J., 1915, 604.

Flaming or luminous arc; Method of producing a ——. J. L. R. Hayden, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,190,162, July 4, 1916. Date of appl., Apr. 25, 1911.

See Eng. Pat. 17,723 of 1911; this J., 1911, 1444.

III.—TAR AND TAR PRODUCTS.

Phenols from Solvay coke-oven tar. K. Shimada. J. Chem. Ind., Tokyo, 1916, **19**, 505—516.

The middle oil (130°—200° C.) from Solvay coke-oven tar was found to contain about 15·8% of crude phenols, and the latter to yield about 28, 22, and 12% of *m*-, *o*-, and *p*-cresol, respectively, in addition to about 16% of crystallised carbolic acid.—W. E. F. P.

Aliphatic nitrites; Conversion of —— *into nitro-compounds.* P. Neogi and T. Chowdhuri. Chem. Soc. Trans., 1916, **109**, 701—707.

Aliphatic nitrites are partially converted into the isomeric nitrohydrocarbons by the action of heat, the optimum temperature ranging from 120° to 130° C. At higher temperatures decomposition and oxidation occur, and at lower temperatures the conversion is scarcely appreciable. Traces of moisture appear to facilitate the change. The experiments indicate that the theory of isomeric conversion is inadequate to account for the formation of nitro-compounds by the interaction of alkyl iodides and metallic nitrites, and the formation of an unstable intermediate product of the type, $AgO.N(C_2H_5).OI$, which decomposes into AgI and $C_2H_5NO_2$, remains as the only alternative explanation.—G. F. M.

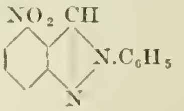
m-Phenetidine and some of its derivatives. II. F. Reverdin and J. Lokietek. Bull. Soc. Chim., 1916, **19**, 252—259. (Compare this J., 1916, 106.)

The nitration of acetyl-*m*-phenetidine (m.pt. 96°—97° C.) in presence of acetic anhydride at 5°—10° C. yields mainly the 4-mononitro compound (m.pt. 95° C.), together with the 6-isomer (m.pt. 147° C.). De-ethylation of the 4-isomer in toluene solution by means of aluminium chloride gives 4-nitroacetyl-*m*-aminophenol (m.pt. 262°—263° C.); on heating with concentrated sulphuric acid, 4-nitro-*m*-phenetidine (m.pt. 105°—106° C.) is produced. Hydrolysis of the 6-isomer with 15% hydrochloric acid gives 6-nitro-*m*-phenetidine (m.pt. 122°—123° C.), the decomposition of the diazo compound of which yields the ethyl ester of 6-nitroresorcinol (m.pt. 130°—131° C.). 4.6-Dinitro-acetyl-*m*-phenetidine (m.pt. 125° C.) gives on heating with concentrated sulphuric acid a mixture of 4.6-dinitro-*m*-phenetidine (m.pt. 169°—170° C.) and 4.6-dinitro-*m*-aminophenol (m.pt. 231° C.).—F. W. A.

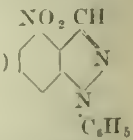
2.6-Dinitrobenzylaniline; Some derivatives of ——. S. Reich and M. Ghazarian. Bull. Soc. Chim., 1916, **19**, 259—264.

On reduction with stannous chloride, 2.6-dinitrobenzylaniline behaves in the same manner as *o*-nitrobenzylaniline (Paal, Ber., 1891, 959) and gives nitrophenylindazole (I.) of m.pt. 156°—157° C., an isomer of nitrophenylisindazole (II.) obtained by the action of nitrous acid on 2.6-dinitrobenzaldehyde phenylhydrazone. Reduction

(I.)



(II.)



with ammonium sulphide yields the normal product, 2-amino-6-nitrobenzylaniline (m.pt. 143°—144° C.), which yields with benzaldehyde 2-benzylideneamino-6-nitro-benzylaniline (m.pt. 157° C.). On addition of sodium nitrite to 2-amino-6-nitrobenzylaniline in the form of its hydrochloride, nitrophenyltriazoline (m.pt. 153°—154° C.) is produced. Reduction of 2.6-dinitrobenzylacetanilide (m.pt. 137°—138° C.) and

-benzanilide (m.pt. 145° C.) with ammonium sulphide yields the normal products, 2-amino-6-nitrobenzylacetanilide (m.pt. 160—161° C.) and -benzanilide (m.pt. abt. 134—136° C.), and not cyclic products as was expected from the fact that *o*-nitrobenzylacetanilide yields methylphenyldihydroquinazoline on reduction (Paal and Krecke, Ber., 1890, 2634).—F. W. A.

Benzothiazole and its homologues : New derivatives of ——. B. Rassow. W. Döhle, and E. Reim. J. prakt. Chem., 1916, **93**, 183—253.

The action of sulphur on dimethylaniline yields a mixture of benzothiazole (b.pt. 227°—233° C.). benzothiazolemethene sulphide, 1-anilinobenzothiazole (m.pt. 157°—158° C.), and 1-mercaptobenzothiazole (m.pt. 179° C.). Dimethyl-*o*-toluidine gives on similar treatment *o*-toluthiazole (b.pt. 252°—253° C.) and *s*-di-*o*-tolylthiourea, and the *para*-isomer yields *p*-toluthiazole (b.pt. 255° C.) and *p*-toluthiazolemethene sulphide (m.pt. 134° C.). On fusion with potash. *o*-toluthiazole yields 1.2.6-aminothiocresol, the disulphide (m.pt. 68° C.) of which was prepared. The 4-, 6-, and 7-sulphonic acids of benzothiazole were also prepared.—F.W.A.

Formation of aromatic compounds (benzene, toluene, and xylene) from the cracking of a gas oil. Egloff and Twomey. *See* IIa.

Kjeldahl modification for determination of nitrogen in nitro-substitution compounds. Cope. *See* XXII.

Patents.

Benzol ; Purification of ——. G. L. Moss, and Simon Carves Bye-Product Coke Oven Construction and Working Co. Ltd., Manchester. Eng. Pat. 10,066, July 10, 1915.

In place of the usual preliminary washing. crude benzol is distilled direct and the benzol vapour passed successively through sulphuric acid (160°—168° Tw.) and caustic soda solution (30°—40° Tw.). The process may be made continuous. It is claimed that the washing is more effective and that a substantial reduction in the amount of sulphur compounds is effected compared with other purification processes.—F. W. A.

Benzene : Elimination of sulphur compounds from ——. J. A. Wilson, Chesterfield. Eng. Pat. 14,152, Oct. 6, 1915.

Benzene is freed from carbon bisulphide. before or after rectification or treatment with sulphuric acid, by agitating with caustic alkali. *e.g.* caustic soda (20°—25° Tw.). at a temperature just below the boiling-point of the benzene.—F. W. A.

Chlorobenzene ; Preparation of pure ——. L. Rabinovitch. Montclair. N.J.. Assignor to Ellis-Foster Co. U.S. Pat. 1,189,736. July 4. 1916. Date of appl., Jan. 19. 1916.

Benzene is agitated with dry. air-free chlorine in presence of an intimate mixture of iron and ferrous chloride in the form of a very fine powder at 10°—15° C.—F. W. A.

IV.—COLOURING MATTERS AND DYES.

Dyestuffs, etc. : Proposed changes in import duties on —— *in the United States.* Board of Trade J., Aug. 10, 1916.

A Bill was passed by the House of Representatives on July 10th, entitled "A Bill to increase Revenue and for other purposes." Title V. of the Bill (Sections 400—402) deals with the Customs duties to be levied on dyestuffs imported into the United States of America or any of its Possessions (except the Philippine Islands, Guam, and Tutuila).

Free List.—Group I. Acenaphthene, anthracene, benzol, carbazol, cresol, cumol, fluorene, methylanthracene, methylnaphthalene, naphthalene, pyridine, quinoline, toluol, xylol, crude coal tar, pitch of coal tar, dead or creosote oil, anthracene oil, all other distillates which on being subjected to distillation yield less than 5% of tar acids in the portion distilling below 200° C., and all other products that are found naturally in coal tar, whether produced or obtained from coal tar or other source, and not otherwise specially provided for, shall be exempt from duty.

Dutiable List.—Group II. Amidonaphthol, amidophenol, amidosalicylic acid, aniline oil, aniline salt, anthraquinone, binitrobenzol, binitrotoluol, binitronaphthalene, binitrochlorbenzol, benzaldehyde, benzylchloride, benzidine, chlorphthalic acid, cumidine, dianisidine, dimethylaniline, dioxynaphthalene, diphenylamine, methylanthraquinone, metanilic acid, nitrobenzol, nitrotoluol, nitronaphthalene, nitraniline, nitrophenylenediamine, nitrotoluylenediamine, naphthylamine, naphthol, naphthylenediamine, phenol, phthalic acid, phthalic anhydride, phenylenediamine, phenylnaphthylamine, resorcin, salicylic acid, sulphanilic acid, toluidine, tolidine, toluylenediamine, xylidine, or any sulphoacid or sulphoacid salt of any of the foregoing, all other distillates which on being subjected to distillation yield 5% or more of tar acids in the portion distilling below 200° C., and all other products obtained, derived, or manufactured in whole or in part from the products provided for in Group I., all the foregoing not colours, dyes, or stains, photographic chemicals, or explosives, and not otherwise provided for, and provided for in the paragraphs of the Act of the 3rd October, 1913, which are hereinafter specifically repealed by Section 402—15% *ad valorem.*

Group III.—All colours, dyes, or stains, whether soluble or not in water, colour acids, colour bases, colour lakes, photographic chemicals, or explosives, not otherwise specially provided for, when obtained, derived, or manufactured in whole or in part from any of the products provided for in Groups I. and II., including natural alizarin and indigo—30% *ad valorem.*

In addition to the duties provided above, there shall be levied, collected, and paid upon all articles contained in Group II. a special duty of 2½ cents per pound, and upon all articles contained in Group III. (except natural and synthetic alizarin, and dyes obtained from alizarin, anthracene, and carbazol ; and natural and synthetic indigo and all indigoids, whether or not obtained from indigo) a special duty of 5 cents per pound. During the period of five years beginning five years after the passage of this Act, such special duties shall be annually reduced by 20% of the rate imposed by this Section, so that at the end of such period such special duties shall no longer be assessed, levied, or collected ; but if, at the expiration of five years from the date of the passage of this Act, there is not being manufactured or produced within the United States as much as 60% in value of the domestic consumption of the articles mentioned in Groups II. and III., the special duties imposed by this Section on such articles shall no longer be assessed, levied, or collected.

Patents.

[*Sulphur*] *dyestuffs : Process of making* ——. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co., U.S. Pat. 1,187,614, June 20. 1916. Date of appl., Jan. 21. 1916.

Sulphur Black is prepared by the action of an alkali sulphide on a mixture of dinitrophenol and cresol.—F. W. A.

Monoazo dyestuffs: Manufacture of blue ——. H. Eichwede. Assignor to Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,188,421. June 27, 1916. Date of appl., Apr. 9, 1915.

A DIAZOTISED 1-amino-8-naphtholmonosulphonic acid is combined with an aryl-1-naphthylamine-8-sulphonic acid. The monoazo dyestuffs produced dye wool from a slightly acid or a neutral bath blue shades of great fastness to washing, to milling, to rubbing, and to light. The dyestuff from diazotised 1-amino-8-naphthol-4-sulphonic acid and phenyl-1-naphthylamine-8-sulphonic acid is especially claimed.—F. W. A.

Leuco derivatives of sulphuretted gallocyanines and process of making same. G. Engi and F. Grieshaber, Assignors to Society of Chemical Industry in Basle, Switzerland. U.S. Pat. 1,188,259, June 20, 1916. Date of appl., Mar. 3, 1915.

SEE Eng. Pat. 2837 of 1915; this J., 1915, 1243.

Indigoid dyes; Treating insoluble ——. R. Hutzler, Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,188,543, June 27, 1916. Date of appl., Sept. 26, 1913.

SEE Fr. Pat. 462,079 of 1913; this J., 1914, 194.

1-*Amino-7-naphthol; Derivatives of* ——. *Azo dyes.* P. Julius and E. Fussenegger, Ludwigshafen, and L. Blangey, Mannheim, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pats. 1,188,544 and 1,188,545, June 27, 1916. Date of appl., July 9, 1914.

SEE Fr. Pat. 472,893 of 1914; this J., 1915, 486.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Silk; Amino-acids and the formation of —— *in the larva of Bombyx Mori. Experiments with aminoacetic acid.* L. Pigorini. Arch. Farm. Sperim., 1915, 20, 225—258. J. Chem. Soc., 1916, 110, i., 525—526.

To study the influence of amino-acids on the formation of silk, equal quantities of silk-worms were fed on (1) dry leaves, (2) leaves moistened with water, (3) leaves sprayed with 2·5% aminoacetic acid solution, and (4) 11·4% sucrose solution. The chrysalis of the second series attained the greatest total weight, followed by the third, first, and fourth. The order of decreasing weight of dry chrysalis was fourth, first, second, and third series; and of decreasing nitrogen content of dry substance, third, first, second, and fourth series. Even the individuals of the various series showed this constant difference in nitrogen content. The largest quantity of silk was provided by the dry substance of series 2, the least by series 4. The dry substance of the chrysalis of series 1 contained most nitrogen, followed in order by 3, 2, and 4. The silk itself, however, of series 3 contained most nitrogen, followed closely by 4. The varying manner of distribution of nitrogen between chrysalis and silk substance indicates that a nitrogen-free diet can replace nitrogen-containing substances in the chrysalis, these then being available for the synthesis of silk. The fibroin content, and also the weight and length of workable silk, was greatest in series 3, all these results pointing to the conclusion that the aminoacetic acid was absorbed and assimilated. Attempts to breed worms on leaves which were treated with a concentrated solution of aminoacetic acid revealed a considerable toxic action resulting in the ultimate death of the worms. This is attributed to decomposition products, particularly ammonia.

Textile fibres; Modifications of —— *by alkalis and acids and their consequences in the textile industries.* E. Seel and A. Sander. Z. angew. Chem., 1916, 29, 261—265.

CHEMICAL damage of the wool fibre, such as would depreciate its technical value, may be detected by microscopical examination under high magnifications (700—1000). Wool may be boiled with 1% sulphuric acid for an hour or more, under conditions comparable with those of the acid and chrome-mordant dye-baths, without sensible damage, and microscopical examination reveals no structural modification of the fibre. The action of alkalis, however, is very injurious; caustic alkalis act more powerfully than the carbonates, but ammonia is only perceptibly harmful on heating in fairly strong solutions. A series of photomicrographs shows the characteristic modification of the wool hair after the action of a 1% solution of sodium hydroxide for 15 mins. at from 40° to 80° C. Different varieties of wool differ in their degree of resistance. The initial indications of attack take the form of longitudinal striations due to the wrinkling of the epithelial scales, so that the surface of the hair assumes somewhat the appearance of a withered apple. For this observation the high power of the microscope must be focussed sharply on the surface of the hair, otherwise the longitudinal arrangement of the interior layer of fibre cells may lead to false conclusions. Water or glycerin jelly is the best mounting medium. The wrinkling proceeds from a mere swelling of the scales to the formation of pronounced furrows as the attack advances and the temperature is raised. At 70° C. disintegration of the epidermis layer begins and at 80° C. the separation of the cuticle from the fibre layer is complete. Wool which has previously been modified by the action of alkali becomes extremely sensitive to attack by hot dilute sulphuric acid. The apparent striations which are observed in this case differ distinctly from the wrinkling produced by the alkali alone. In alkaline dye-vats, the destructive action of the caustic alkali may be avoided by the use of carbonates, hydrosulphite, and ammonia. With careful control, damage due to vat dyeing, even when followed by acid dyeing, need not be a frequent occurrence. The authors consider that in the German wool industry damage is more often due to the severe conditions of scouring, solutions of sodium carbonate, even up to 10%, being employed, instead of the weaker alkaline soap baths usual in England. In the case of cotton and linen, microscopical examination under high powers shows no structural modification in fibres treated with acids, alkalis, or oxidising agents.—J. F. B.

Soda pulp; Effects of moisture introduced into the digester in the cooking of ——. S. D. Wells. J. Ind. Eng. Chem., 1916, 8, 601—602.

IT was shown previously (Surface, this J., 1914, 1151) in tests made by varying the steam pressure, the initial concentration, the amount of caustic soda per unit of wood, or the duration of cooking in the manufacture of soda pulp from aspen wood, whilst maintaining other conditions constant, that the amount of bleaching powder required to bleach the pulp to a standard white was constant for a given yield of pulp; in other words, variation of any of the conditions mentioned so as to obtain a pulp which could be bleached with a smaller consumption of bleaching powder, resulted also in a lower yield of pulp. In these tests the condensation during the digestion was about six times as great as in a commercial apparatus. Tests have now been made in which, whilst keeping other conditions constant, the amount of condensation was varied by using a combination of direct steam and indirect heating by means of a jacket in the lower portion of the digester. The working conditions were :—NaOH, 90 grms. per litre, 25 lb. per 100 lb. of chips ; maximum steam pressure, 120 lb. per sq. in. ; maximum pressure reached in 1 hour and maintained for 4 hours. Under these conditions the yield of pulp increased from 43·5 to 47% as the amount of condensed liquid (the difference between the total volume of liquor in the digester after maximum pressure was attained, and the original volume) increased from about 17 to 70 gallons per cwt. of chips, and at the same time the quality of the pulp improved and the consumption of bleaching powder fell from 13 to 11 lb. per 100 lb. of pulp. Aspen wood will adsorb 20% of its weight of caustic soda at 100° C. from solutions containing 60 grms. per litre. and apparently sufficient caustic soda to effect reduction is adsorbed by the chips, at nearly the original concentration, during the first hour of digestion. By the time the chips, are reduced to pulp. the concentration is considerably reduced and the remaining adsorbed caustic soda passes back to the solution. By increasing the amount of condensation, this removal of adsorbed caustic soda from the pulp is facilitated, and chemical action on the pulp is diminished, whilst owing to the increased volume of the liquor contamination of the pulp by reduction products is also diminished. —A. S.

Patents.

Protective coverings adapted to resist penetration. G. Lynch, London. Eng. Pats. 6900, May 8, 9366, 9490, and 9491, June 29, and 16,760, Nov. 27, 1915.

Puncture-proof material is obtained by impregnating or treating a sheet of loose wool or cotton wool with dry powdered resin. Material so treated may be used for surmounting barbed wire, for garments, helmets, gauntlets, etc., and as armouring for motor cars, gun carriages, aeroplanes, etc.—F. W. A.

Grease from fabrics ; Preparation for removing ——. S. Dyson, and J. Dyson and Co., Ltd., Elland, Yorks. Eng. Pat. 10,311, July 15, 1915.

A degreasing preparation for textile and felted fabrics consists of, for example, 1 gallon of potash soap solution (8% fatty matter), 1 gallon of carbon bisulphide, and $\frac{3}{4}$ lb. of white Australian or other oleine. The mixture is emulsified below 65° F. (18° C.) ; one pint of this preparation is added to 10—100 gallons of water for washing.—F. W. A.

Fabric and process for making the same. R. G. Dunwody and J. W. Wills, Atlanta, Ga. U.S. Pat. 1,187,890. June 20. 1916. Date of appl., Apr. 19. 1916.

Raw cotton, which may have been treated with gasoline and may have been afterwards made into sheets, is impregnated with a solution of collodion, rosin, and rubber, the product dried, and passed between heated rollers under great pressure to form thin flexible sheets ; a colouring matter may be introduced.—F. W. A.

Aeroplane wings.] *Stretched surfaces ; Manufacture of articles with* ——. C. Dreyfus, Basle, Switzerland. Eng. Pat. 100,180, Mar. 9, 1916. (Appl. No. 3539 of 1916.) Under Int. Conv., Mar. 13, 1915.

Textile fabrics impregnated or coated with cellulose esters, *e.g.* cellulose acetates, are stretched on the frames of aeroplane wings, etc., whilst still not dry or after being moistened or softened with suitable liquids or gases. An exceedingly taut surface is produced when the varnish is dry. —F. W. A.

Plastic composition [*acetylcellulose*]. W. G. Lindsay, Caldwell. N.J., Assignor to The Celluloid Co., New York. U.S. Pats. (A) 1,188,797 and (B) 1,188,798, June 27, 1916. Date of appl., May 23, 1912.

(A) A plastic composition is prepared from that variety of acetylcellulose which is freely soluble in acetone, methyl alcohol containing 3·5—7% of water, benzene, triphenyl phosphate, and *p*-ethyltoluenesulphonamide. (B) Acetylcellulose (100 parts) is mixed with an arylsulphonamide (30—10 parts), and chloroform (100 parts) containing 10—20 parts of a monohydric alcohol having not more than two carbon atoms.—J. F. B.

Acetylcellulose ; Solvent of ——. W. G. Lindsay, Caldwell, N.J., Assignor to The Celluloid Co., New York. U.S. Pats. (A) 1,188,799 and (B) 1,188,800, June 27, 1916. Dates of appl., May 23 and May 24, 1912.

(A) A solvent for the variety of acetylcellulose which is freely soluble in acetone, consists of about 60—70 parts by vol. of methyl acetate and 30—40 parts of methyl alcohol, and a plastic composition is prepared by the further addition of *p*-ethyltoluenesulphonamide and triphenyl phosphate. (B) The same variety of acetylcellulose is also soluble in a mixture of 50—62 parts of trichloroethylene and 50—32 of methyl alcohol by volume.—J.F.B.

Paper stock ; Machine for refining ——. G. D. Ryther, Assignor to Ryther and Pringle Co., Carthage, N.Y. U.S. Pat. 1,187,932, June 20, 1916. Date of appl., Oct. 30, 1915.

A machine for refining partly beaten paper stock consists of a cylindrical casing mounted on a base and provided with inlet and discharge orifices for the stock. Annular flanges are set in the casing at regular intervals and deflecting ribs of triangular cross-section are arranged radially on the flanges. A rotary shaft carried by two external standards passes concentrically through the casing, and circular discs are mounted on the shaft at equidistant intervals, alternating with the annular flanges on the casing ; triangular deflecting ribs are set on the discs at an angle to their diameters and forming planes ascending in the direction of the flow of the stock.—J. F. B.

Paper ; Manufacture [*sizing*] *of* ——. R. W. Sindall and W. Bacon, London. Eng. Pat. 10,320, July 15, 1915.

A colloidal emulsion for sizing paper is made with 10—15 parts of gelatin, 90 parts of water, and a quantity of alum equal to 10% of the combined gelatin and resin acids employed, mixed at 140°—170° F. (60°—75° C.) with resin acids, these being saponified and dissolved separately in sufficient hot water to produce a combined size containing 8—10% of gelatin ; the size is used at 140°—170° F.—J. F. B.

Textile material ; Production of ——. J. C. M. van Diggelen, Amsterdam, Netherlands. U.S. Pat. 1,189,756, July 4, 1916. Date of appl., Nov. 16, 1915.

See Eng. Pat. 10,899 of 1915 ; this J., 1916, 108.

Alkyl ethers of cellulose and process of making the same. L. Lilienfeld, Vienna. U.S. Pat. 1,188,376. June 20. 1916. Date of appl., June 26, 1912.

See Fr. Pat. 447,974 of 1912 ; this J., 1913, 420.

Nitrocellulose ; Process for spinning solutions of ——. E. Berl and M. Isler, Tubize, Belgium. U.S. Pat. 1,188,718, June 27, 1916. Date of appl., June 6, 1914.

See Ger. Pat. 273,936 of 1913 ; this J., 1914, 746.

Calcium carbonate manufacture. U.S. Pat. 1,188,505. *See* VII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Alizarin in dyed cotton fabrics; Determination of —— and an attempt to ascertain the composition of Turkey-red and other alizarin lakes. W. N. Leigh. J. Soc. Dyers and Col., 1916, **32**, 205—213.

FROM 1·5 to 3·0 grms. of cloth dyed with alizarin is dissolved in 10 c.c. of 80 % sulphuric acid at a temperature below 40° C., the viscous solution diluted to about 100 c.c., with stirring, and the precipitated alizarin filtered off through asbestos in a Gooch crucible. The alizarin in the filtrate and in the alcohol extract of the residue is estimated by the method of Knecht and Hibbert (this J., 1915, 1203). The method was tested by dyeing about 16 grms. of mordanted yarn fixed in phosphate in a dye-bath containing 0·236 grm. of alizarin; analysis of the dyed yarn gave 0·202 grm. of alizarin precipitated and 0·002 grm. of alizarin in filtrate; the dye-bath contained 0·035 grm. of alizarin; total alizarin found, 0·239 grm. In case arsenate has been used for dunging, an error may be introduced by its presence in the filtrate from the 80 % sulphuric acid process, as it is reduced to arsenic or a hydride by titanous chloride (Knecht and Hibbert); in this case a method suggested by Atack's colorimetric determination of alumina (this J., 1915, 936) is adopted; the filtrate is made ammoniacal to precipitate the alizarin combined with alumina, lime, etc., and the red lake is dissolved in hydrochloric acid and titrated directly for alizarin.

Estimations have also been made of the alumina, lime, and oil on the fibre, of a Turkey-red lake from the fibre, and of the chromium and iron lakes of alizarin, but no definite conclusions could be drawn as to the composition of commercial Turkey-red; the highest proportion of alumina to alizarin is 2·6 : 1, *i.e.* about seven times the theoretical amount of alumina. The Turkey-red lake is probably dissolved in an excess of the aluminium salts of the fatty acids of the oil on the fibre, for which glacial acetic acid is the only solvent (Driessen, Bull. Soc. Ind. de Mulhouse, 1902, 180). —F. W. A.

Modifications of textile fibres by alkalis and acids and their consequences in the textile industries. Seel and Sander. *See* V.

PATENTS.

Dyeings on the fibre; Production of fast —— [with azo dyestuffs]. A. G. Bloxam, London. From Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. Eng. Pat. 100,804, Feb. 1, 1916. (Appl. No. 1521 of 1916.)

FAST black dyeings are produced on the fibre by impregnating the goods with an arylide of 2.3-hydroxynaphthoic acid and treating with a diazotised *asym.*-dialkyl-*p*-diaminoazo compound. Suitable azo compounds are produced by combining diazotised *p*-nitraniline, 5-nitro-2-toluidine, or 5-nitro-2-anisidine with dimethylaniline, dimethyl-*m*-toluidine, dimethyl-*a*-naphthylamine, etc., and reducing the nitro-azo dyestuff produced, or by saponifying the corresponding acetylamino dyestuff. To increase the fastness to light the dyeings may be after-treated with a solution of a copper salt.—F. W. A.

Hanks of yarn on dyeing-sticks; Apparatus for changing the position of ——. J. Schlumpf, Brugg, Switzerland, Assignor to Niederlahnsteiner Maschinenfabr. G.m.b.H., Niederlahnstein, Germany. U.S. Pat. 1,187,864, June 20, 1916. Date of appl., June 13, 1911.

SEE Fr. Pat. 421,183 of 1910; this J., 1911, 486.

Yarn washing and dyeing machine. J. Schlumpf, Brugg, Switzerland, Assignor to Niederlahnsteiner Maschinenfabr. G.m.b.H., Niederlahnstein, Germany. U.S. Pat. 1,187,865, June 20, 1916. Date of appl., Apr. 9, 1912.

SEE Addition to Fr. Pat. 421,183 of 1910; this J., 1912, 227.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Calcium, strontium, zinc, and magnesium carbonates; Some reactions of ——. W. O. de Coninck. Ann. Chim. Analyt., 1916, 21, 131–133.

FINELY divided calcium carbonate dissolves slowly in a saturated solution of potassium sulphate, and calcium and zinc carbonates but not strontium or barium carbonates are dissolved by a concentrated solution of potassium bisulphate. Calcium and barium carbonates are dissolved slowly by a saturated solution of potassium nitrate, and strontium carbonate by a concentrated solution of ammonium nitrate. Barium and magnesium carbonates are gradually dissolved by a saturated solution of ammonium chloride.—T. C.

Metallic oxides; Action of oxygen on —— at high temperatures and pressures. J. Milbauer. Chem.-Zeit., 1916, **40**, 587.

WHEN heated in oxygen for an hour at 480° C., and 12 atm. pressure, most of the normal metallic oxides remained unchanged. The following exceptions were noted:—Potassium and barium oxides were converted into peroxides, lead oxide into red lead, antimony oxide into the tetroxide, and manganese oxide into sesquioxide; the lower oxides of nickel and cobalt yielded traces of nickelic and cobaltic oxides. Silver was converted into black crusts of, apparently, a peroxide, since on treatment with hydrochloric acid they yielded chlorine. Platinum remained unchanged. Experiments under similar conditions with metallic oxides intimately mixed with chromium sesquioxide, showed in many cases a more or less complete conversion into metallic chromate with absorption of oxygen. Thus, for example, the products obtained from chromium oxide and the following oxides (or carbonates) contained the annexed percentages of chromate respectively:—Silver oxide, 100% of chromate; magnesium oxide, 82·7%; calcium oxide, 56·9%; zinc oxide, 72%; and lead carbonate, 100%. The reaction is therefore available for the preparation of certain chromates, notably that of magnesium, which in many cases can be substituted for alkali chromates.—G. F. M.

Vanadic acid; Determination of ——, after reduction by metallic silver. G. Edgar. J. Amer. Chem. Soc., 1916, **38**, 1297—1302.

PORTIONS of sodium vanadate solution, containing 0·0702—0·1260 grm. of vanadium as V_2O_5, were acidified with about 2 c.c. of concentrated sulphuric acid, diluted to about 75 c.c., and then reduced with 1—2 grms. (accurately weighed) of pure silver, preferably electrolytic. The liquid was boiled for 20—30 minutes, *i.e.*, for about 10 minutes after the appearance of the pure blue colour indicating reduction of pentavalent to tetravalent vanadium. After filtering through asbestos in a perforated porcelain crucible, or through alundum, the residual silver was washed with hot water, and then heated for 30 minutes to a low red heat in a nickel dish and finally weighed. The vanadium in the filtrate was determined by titrating the hot solution with *N*/20 potassium permanganate, and in the same liquid the silver in solution was found by titration with $N/20$ ammonium thiocyanate. The results obtained by these three methods, which serve to check each other, were in very close agreement, and were exceedingly accurate. In a hydrochloric acid solution, the vanadium content can be calculated from the weight of silver chloride precipitated, but better results are achieved by first removing this acid with a slight excess of silver sulphate and then applying one or other of the methods described above. The reactions may also serve to standardise permanganate solutions against silver, and permanganate and thiocyanate solutions against each other.—E. H. T.

Radioactivity in minerals; New method for the determination of ——. R. C. Sabot. Soc. Chim. Genève, May 11, 1916. Chem.-Zeit., 1916, **40** 596—597.

Two grams of the powdered mineral is placed in a receptacle surrounded by lead foil, and a photographic plate, divided into sections, 3 × 3 cm., is exposed to the radioactive rays. The sections of the plate are exposed for different periods and, when developed, give images of different densities, which are measured by means of a Lummer photometer. A similar test is made with uranium oxide from Colorado carnotite or Joachimsthal pitchblende, using powder of the same degree of fineness and receptacles of the same size. Specimens of monazite, columbite, euxenite, ampangabeite, and ilmenite from Madagascar were found to be radioactive and, notably in the case of ampangabeite, the radioactivity was greater than corresponded with the chemical composition. Instead of the value 4·6—4·7 found by Curie for the ratio : activity of 1 grm. of uranium in mineral ÷ activity of 1 grm. of uranium in UO_2, the euxenite, which was slightly decomposed, gave the value 5·73, whilst ampangabeite, which is a strongly hydrated euxenite, gave values of 7·49 and 7·53. This concentration of radioactive elements may be due to absorption of radioactive solutions by the porous mineral or to decomposition of the euxenite in presence of water containing salts which form insoluble compounds of radium and mesothorium.—A. S.

Carbon; Colloidal —— and the decomposition of organic liquids by the electric arc. S. Tarczynski. Z. Elektrochem., 1916, **22**, 252—254.

The passage of the electric arc between carbon electrodes immersed in various organic liquids, such as carbon tetrachloride, chloroform, benzene, etc., contained in an ice-cooled flask, resulted always in the formation of both precipitated and colloidal carbon. After filtration the latter gave an olive-green or reddish-brown solution, which was extremely stable, showed the Tyndall effect, and gave, on heating, a black amorphous precipitate of carbon. That the carbon was actually produced from the organic compound was shown by the fact that an experiment with platinum electrodes gave the same result. In addition to these products, chlorine, tetrachloroethylene, hexachloroethane, and hexachlorobenzene were formed in the decomposition of carbon tetrachloride, and all these substances, together with hydrogen chloride and tetra- and pentachloro-ethane, from chloroform. The final products of the decomposition are carbon, chlorine, and hexachlorobenzene, which are always formed in the largest amount; the others are all intermediate products.—G. F. M.

Potassium bichromate as an analytical standard. Bruhns. *See* XXIII.

Titration of oxalic acid with methyl orange as indicator. Bruhns. *See* XXIII.

Molecular transformations of precipitates. Villiers. *See* XXIII.

Patents.

Oxalic acid: Process of producing —— from sugar and other carbohydrates. E. von Portheim, Prague, Austria. Eng. Pat. 14,234, Oct. 7, 1915.

The sugar is oxidised by means of nitrogen oxides in presence of an oxide of molybdenum or vanadium, either singly or admixed, which acts catalytically. Thus, nitrogen peroxide may be passed over a thin layer of the mixed sugar and catalyst, or the sugar may be dissolved in water or in nitric acid, containing the oxide, *e.g.*, Mo_3O_8, and the gas passed in. In the latter case the oxalic acid separates on cooling, and after its removal the residual liquid is used again. To obviate the sudden evolution of heat and the decomposition of oxalic acid, the sugar may be preheated in a current of the gas in the absence of the catalyst. The reduced nitrogen oxides are oxidised by admixture with air, and then separated from atmospheric nitrogen either by liquefaction, or by absorption in sulphuric acid, or by passing over zinc oxide and then heating the mixture of zinc nitrate and nitrite so obtained.—E. H. T.

Aluminous compounds; Manufacture of ——. H. Spence, W. B. Llewellyn, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 10,166, July 13, 1915.

Crude aluminium sulphate, such as is obtained by digesting bauxite with dilute sulphuric acid, is purified from ferric iron by treating it under suitable conditions with a sodium or ammonium salt, with or without the addition of a potassium salt, whereby the iron is precipitated as basic ferric salt. The aluminium sulphate solution must contain an excess of base and be diluted to sp.gr. 1·2—1·3; the sodium or ammonium salt (sulphate) is then added and the liquid warmed and agitated continuously in presence of the undissolved matter. If a potassium salt is also used, it is added after a partial purification has been effected with the other salt. A solution of aluminium sulphate containing about 6% excess of alumina and of sp.gr. 1·29, is rapidly purified by potassium sulphate at about 50°—55° C., but neither sodium nor ammonium sulphate is effective under these conditions. If, however, the excess of alumina be raised to 12%, and the sp.gr. be lowered to about 1·2, then either of the latter salts effects purification at the temperature named. Increase of temperature hastens the action, but beyond a certain point the process becomes uneconomical owing to the increased consumption of alkali salt and the precipitation of basic aluminium sulphate.—E. H. T.

Aluminates from alunite: Production of ——. P. R. Hershman and R. D. Cooke, Chicago, Ill., Assignors to Mineral Products Corporation, New York. U.S. Pat. 1,189,254, July 4, 1916. Date of appl., Mar. 21, 1916.

Alunite is calcined in the presence of carbonaceous matter and in a non-oxidising medium (*e.g.*, steam), at a temperature sufficiently low to render the alumina soluble in alkali. Potassium aluminate and alumina are recovered from the product.—F. Sodn.

Aluminates from alunite; Producing ——. P. R. Hershman, Chicago, Ill. U.S. Pats. (a) 1,191,104, (b) 1,191,105, and (c) 1,191,106, July 11, 1916. Dates of appl., (a) and (b), Jan. 18, and (c) Feb. 1, 1916.

(a) Alunite is heated at 1400° C. with an alkaline-earth oxide, alone or with a flux or with superheated steam, or with both, and the potassium aluminate is dissolved out from the resulting mass under pressure: caustic alkali may be used in the extraction to ensure solution of the excess alumina. (B) Alunite is calcined under reducing conditions, with, if necessary, the aid of steam or of fluxes, and the resulting mass extracted with water under pressure or with caustic alkali solution. (C) Alunite is boiled under pressure with a solution of a salt of an alkaline-earth giving an insoluble sulphate. By using barium hydroxide, the excess alumina is dissolved as barium aluminate.—B. V. S.

Nitrogen; Fixation of ——. [*Production of aluminium nitride.*] P. R. Hershman, Chicago, Ill., Assignor to The Mineral Products Co., New York. U.S. Pat. 1,188,651, June 27, 1916. Date of appl., Dec. 21, 1914.

Calcined alunite, freed from most of its potash (*e.g.*, by volatilisation), is heated with carbon in the presence of nitrogen, at a temperature (about 1650° C.) suitable for fixing the gas.—F. Sodn.

Nitrogenous compounds from aluminium waste products: Method of producing ——. *Continuous process of producing nitrogenous compounds of aluminium. Production of nitrogenous compounds.* P. R. Hershman, Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pats. (A) 1,188,769, (B) 1,188,770, (C) 1,188,771, and (D) 1,188,772, June 27, 1916. Dates of appl., (A) and (B) Nov. 25, 1913, (C) Nov. 8, 1915, and (D) Jan. 10, 1916.

(A) A mixture of aluminium carbide with about 0·1—1% of a catalytic agent capable of combining with nitrogen, to which may be added 2—5% of carbonaceous matter and 1—2% of calcium oxide, is heated in the presence of nitrogen, preferably at 1700°—1800° C. (B) A mixture of alumina and a reducing agent, together with an ingredient to react with the carbon monoxide formed in the process, is heated in the presence of nitrogen, preferably at 1700°—1800° C. As an example, the mixture may contain 6 parts of alumina, 1 of carbonaceous matter, and 1 of lime, together with a small proportion of a catalytic agent capable of combining with nitrogen. (C) A mixture of alumina and carbon, to which may be added a carrying agent capable of combining with nitrogen in more than one proportion, is heated in the presence of carbon monoxide, or of a gas consisting principally of carbon monoxide and hydrogen, but practically free from nitrogen, and then in the presence of a gas containing nitrogen or nitrogen and hydrogen. The compound of carrying agent and nitrogen in a higher proportion is reduced by the hydrogen. (D) A mixture of alumina, with sufficient carbon to reduce it, and a carrying agent, as in (C), is heated at a reaction temperature in a current of nitrogen or of nitrogen and hydrogen.—F. Sodn.

Purifying gas; Obtaining from bauxite residues a material for ——. J. H. Ramsay and F. R. Lowe, Low Fell, Durham. Eng. Pat. 10,935, July 3, 1915.

The residue obtained after the extraction of alumina from bauxite is heated with 20% of coal, coke, coke breeze or the like, to 600° C. for 4 hours, and the soda extracted by lixiviation with water. The residue is treated with sulphur dioxide and the resulting aluminium sulphite treated for the recovery of alumina. The final residue is suitable as an absorbent for hydrogen sulphide. The bauxite residue may be converted directly into an absorbent for hydrogen sulphide by heating to 600°—800° C.—W. F. F.

Lead sulphate; Method of manufacturing ——. B. S. White, Assignor to Picher Lead Co., Joplin, Mo. U.S. Pat. 1,187,949, June 20, 1916. Date of appl., Oct. 16, 1915.

Litharge is volatilised and the vapour is mixed with air and sulphur dioxide in amount slightly greater than that required theoretically to produce lead sulphate of the desired composition. On heating the mixture of vapour and gases, the metallic sulphate is obtained in a finely divided state. By using relatively less of the gases, a basic sulphate may be similarly obtained.—E. H. T.

Lead sulphate; Manufacture of basic ——. B. S. White, Assignor to Picher Lead Co., Joplin, Mo. U.S. Pat. 1,187,950, June 20, 1916. Date of appl., Oct. 16, 1915.

Normal lead sulphate is heated with litharge that has been separately prepared by volatilisation Both materials are used in a state of fine division. —E. H. T.

Calcium carbonate manufacture. N. Statham, Boonton, N.J., Assignor to Industrial Chemical Co., New York. U.S. Pat. 1,188,505, June 27, 1916. Date of appl., Dec. 13, 1915.

Waste lime sludge, produced in re-causticising soda for soda pulp manufacture, which contains calcium carbonate and hydroxide, is purified by mixing with water and screening, and the liquor carbonated by spraying through furnace gases containing carbon dioxide. The liquid is filtered off and the moist cake dried and carbonated further by agitating it in a rotating chamber in a current of furnace gases which are moving in the same direction as the material.—W. F. F.

Titaniferous products and method of producing same. L. E. Barton, Niagara Falls, Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,189,229, July 4, 1916. Date of appl., Sept. 11, 1914.

Titaniferous material is digested with sulphuric acid, the product is dissolved in water, and calcium chloride, or similar substance, is added. Afte removal of the precipitated metallic sulphate, and digestion of the residual liquor, the titani acid which separates is filtered off, washed, and dried.—E. H. T.

Liquefying gas-mixtures [*air*]: *Process of* —— *and for separating the constituents.* R. Mewes Berlin, Germany. U.S. Pat. 1,188,191, June 20 1916. Date of appl., May 12, 1913.

Air or other gaseous mixture under pressure i passed on to an expansion point and meets a curren of the expanded gas, a certain amount of liquefaction occurring. The liquid is passed into rectifier and vaporised by the heat from th compressed gases, the rectifying columns bein cooled by the expanded gases. By continuin this process of alternate heating and cooling of th liquefied gases, the oxygen and nitrogen of the ai may be separated.—B. V. S.

Bromine; Method of extracting ——. A. F Schaefer, Assignor to The Dow Chemical Co Midland, Mich. U.S. Pat. 1,188,838, June 27 1916. Date of appl., Aug. 1, 1910.

Brine, containing bromide, is oxidised to liberat the bromine, and the bromine blown over with a which contains chlorine, the chlorine being obtaine by a further oxidation of another portion of th same brine.—B. V. S.

Cyanogen compounds; Method for production ——. A. R. Lindblad, Ludvika, Sweden. U. Pat. 1,187,633, June 20, 1916. Date of appl Nov. 17, 1914.

See Eng. Pat. 22,852 of 1914; this J., 1915, 90

[*Radioactive*] *salt for use in baths.* T. T. Bake London. U.S. Pat. 1,189,653, July 4, 191 Date of appl., Aug. 5, 1914.

See Fr. Pat. 477,429 of 1915; this J., 1916, 63

Hydrogen under pressure ; Apparatus for working with ——. C. Bosch. Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,188,530, June 27, 1916. Date of appl., Feb. 5, 1912.

See Fr. Pat. 441,695 of 1912 ; this J., 1912, 922.

VIII.—GLASS ; CERAMICS.

Patents.

Sheet glass ; Method and apparatus for drawing ——. W. J. Mellersh-Jackson, London. From Toledo Glass Co., Toledo, Ohio, U.S.A. Eng. Pat. 15,314, Oct. 26, 1915.

The glass is drawn from the molten mass in the form of a sheet, the sides of which are kept cooler than the centre, more drawing power being applied to the edges of the sheet than to the middle, so as to prevent the sheet pulling to a string or thread. Two hollow rolls (cooled internally by water) draw the sheet out of the molten glass, and as the edges are drawn from the cooler portions of the mass of molten glass, they are thicker than the main body of the sheet. The extra thickness is reduced by passing the edges of the sheet between milled rolls driven from variable speed pulleys.—A. B. S.

Cement for mounting eye-glasses ; Method of making ——. H. A. Gill, London. From G. S. Johnston Co., Chicago, Ill., U.S.A. Eng. Pat. 9473, June 29, 1915.

Grog particles of various sizes are mixed in such proportions as will yield a minimum percentage of voids, and sufficient molten shellac (30—40 %) is then added to fill the voids completely and coat the particles. The product may be cast into small bars or ground to powder. The grog may be composed of flint and ground glass. Of four mixtures mentioned, the following is specially commended : shellac 30 %, flint 15 %, very finely ground glass 20 %, ground glass 35 %, the degree of fineness being such that 41·8 % passes a 200-mesh screen, 61·4 % passes a 100-mesh screen, and 100 % passes a 50-mesh screen ; of the 41·8 %, 30 % is shellac and 11·8 % grog.—A. B. S.

Fire bricks and the like ; Making —— *and cores for use therewith.* E. Williams, West Monkseaton, and W. H. Girling, Newcastle-on-Tyne. Eng. Pat. 100,823, Feb. 19, 1916. (Appl. No. 2532 of 1916.)

IX.—BUILDING MATERIALS.

Patents.

Bituminous substances ; Manufacture of ——. C. Richardson, New York. Eng. Pat. 9838, July 6, 1915. Under Int. Conv., July 25, 1914.

The stability of bituminous substances is increased by mixing them intimately with clay paste and removing the water by evaporation. With highly colloidal clays, the paste consists of three parts of water to one of clay. The amount of dispersed colloid should be at least 2 %, but may be increased to any percentage at which the final mixture will melt and flow.—A. B. S.

Bituminous [paving] compositions ; Process of treating ——. L. Kirschbraun, Chicago, Ill. U.S. Pat. 1,188,081, June 20, 1916. Date of appl., June 18, 1914.

Old bituminous pavements and similar materials are broken into small pieces, and further subdivided and mixed in a tubular retort, through which they pass continuously. Highly superheated steam is used to raise the contents of the retort to a temperature above the melting point of the binder (above 400° F.) so that the material can be used again, either alone or mixed with fresh bitumen.—A. B. S.

Kilns for burning cement, lime, etc. Steiger-Krauer et Cie., Assignees of Steiger und Co., Zurich, and O. Frey, Laufenburg, Switzerland. Eng. Pat. 10,388, July 15, 1915. Under Int. Conv., July 16, 1914.

A shaft kiln is provided with an automatic rotary grate arranged as a boring device or with a fixed grate and rotary borer and ribs above it. The borer perforates the clinker, separates the pieces, and delivers them to the ribs, which discharge them uniformly from the kiln.—A. B. S.

Artificial building material [lime-sand bricks], trimmings, etc. ; Composition for ——. E. J. Guay, Swampscott, Mass., Assignor to General Ceramic Manufacturing Co. U.S. Pat. 1,188,759, June 27, 1916. Date of appl., May 6, 1911.

A wet mixture of 5 to 15 % of hydrated lime and 85 to 95 % of silica or other suitable material is moulded under pressure, and the articles are covered with a suitable material during the hardening process so as to protect them from the direct action of the steam and enable them to absorb a maximum amount of water before they became hard.—A. B. S.

Kiln [for hardening sand-lime bricks]. M. H. Avram, New York, Assignor to Standard Silica Brick Machinery Co., Wilmington, Del. U.S. Pat. 1,189,904, July 4, 1916. Date of appl., Sept. 16, 1913.

A chamber for hardening lime-sand bricks by means of steam is made of reinforced concrete. The chamber is tubular, with a flat bottom, and has a sliding gate at each end. The bricks are carried on trucks which run on rails inside the chamber. —A. B. S.

Artificial stone ; Process for the production of ——. W. J. de Bas, The Hague, Netherlands. U.S. Pat. 1,187,717, June 20, 1916. Date of appl., Dec. 27, 1912.

See Eng. Pat. 27,632 of 1912 ; this J., 1913, 659.

[Road-making] material ; Apparatus for drying or heating ——. T. and F. Coleman, Derby. U.S. Pat. 1,189,062, June 27, 1916. Date of appl., Dec. 31, 1913.

See Eng. Pat. 20,161 of 1913 ; this J., 1914, 468.

Heat-insulating compounds and process of producing same. C. J. Beindorff, Assignor to Beindorff and Co., The Hague, Netherlands. U.S. Pat. 1,189,780, July 4, 1916. Date of appl., Dec. 22, 1914.

See Eng. Pat. 21,437 of 1914 ; this J., 1915, 1196.

X.—METALS ; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Sulphur in the blast-furnace : Behaviour of ——. B. Osann. Stahl u. Eisen, 1916, 36, 210—214. Z. angew. Chem., 1916, 29, Ref., 316—317.

The reduction process in the blast-furnace is regarded as taking place in a semi-solid magma, the iron crystals produced by reduction uniting with other components of the mass to form mixed crystals. When the iron oxide in the mixed crystals has been completely reduced, reduction of silicon, manganese, and phosphorus begins, and also carburisation and fusion of the iron, and formation of slag. Towards the end of the reduction process the sulphur is present almost entirely in the iron as iron sulphide, and desulphurisation begins only after reduction of the iron oxide is practically complete. At this stage carbon separated from carbon monoxide exerts a desulphurising action in conjunction with lime and manganous oxide :

$$FeS + CaO(MnO) + C = Fe + CaS(MnS) + CO.$$

Desulphurisation proceeds more readily the higher the proportion of manganese present, whilst the chief function of the lime is to raise the melting point of the slag. One of the most important points in connection with desulphurisation is the maintenance of the requisite high temperature, which is attained by using a high proportion of coke and a high blast temperature. Ferrous oxide present in the slag has no desulphurising action, but segregation of the sulphides of iron and manganese, whereby they are brought into closer contact with the slag, probably plays a part.—A. S.

Iron ; Cementation of ——. S. A. Fechtchenko-Tchopovsky. Rev. Soc. russe de Métall., 1914. **1**, 245—310. Rev. Mét., 1915. **12**, Ext., 518—522.

From experiments made under strictly comparable conditions, the author has drawn the following conclusions. *Plain charcoal cements.* The best charcoal for use in cementation is produced by carbonising the more compact forms of wood for 4 hours at 400° C. The maximum useful duration of cementation at 1000° C. is 10 hours from the time this temperature is attained in the interior of the box. Rate of cementation (depth of penetration into the iron) and the quantity of carbon concentrated on the surface, must both be considered in judging of the carburising power of a charcoal. Leather and lampblack are useless additions to pure wood charcoal cements, but the addition of animal charcoal is beneficial. The size of the grains should not exceed 1·5 to 3 mm. The temperature inside the box should be maintained at 900° C. *Compound cementing materials.* Certain compounds, such as the carbonates of sodium and potassium, when mixed with the charcoal, facilitate carburisation by their action on the iron surface, and by accelerating the formation of large quantities of carbon monoxide. The rate of cementation is, however, constant for each temperature and does not depend on the composition of the cement. It increases very rapidly between 850° and 900° C., and falls off again between 900° and 950° C. The thickness of the pearlitic layer is constant at 900° C. and higher temperatures. The layer of cementite grows with increasing rate of cementation. The expansion of a carburised object is 0·009 mm. for each mm. of thickness of the hypoeutectic zone, 0·01 mm. for each mm. of the eutectic zone, and 0·05 mm. for each mm. of the hypereutectic zone. For small objects the increase in volume is appreciable. The shrinkage of the carburising powder is greater with leather and animal charcoal than with wood charcoal, and is greater also with compound cements owing to the volatilisation of the mineral ingredients.—T. St.

Steel ; Correlation of the magnetic and mechanical properties of ——. C. W. Burrows. U.S. Bureau of Standards, 1916. Scient. Paper No. 272, Mar. 29, 1916 (38 pages).

From a review of the work done in correlating the magnetic and mechanical properties of steel, it is concluded that there is only one set of mechanical properties corresponding to a given set of magnetic characteristics ; and conversely. The practical utility of this generalisation is limited by the complexity of the relations due to the large number of variables and the lack of sufficient quantitative data, and the application of the magnetic tests by practical difficulties in testing irregular shapes. The magnetic uniformity of a piece of steel is an index of mechanical homogeneity, and when the treatment necessary for a given steel is definitely known, a magnetic test may be used to determine whether or not the material has been brought into the desired condition. Before the magnetic properties of steel can become of general practical value, however, much additional investigation is required, involving accurate determinations on specimens of known chemical composition and heat treatment. Permeability, residual induction, coercive force, and hysteresis energy are among the magnetic characteristics available for indicating the mechanical properties of steel ; and as each of these may be taken in connection with any one of a large number of magnetising forces, a preliminary investigation is necessary to determine the most suitable magnetic data and the minimum amount which will give the desired information in any particular case.—W. E. F. P.

Trading in war material. Board of Trade J., July 13, 1916.

In pursuance of the powers conferred upon him by Regulation 30 (A) of the Defence of the Realm (Consolidation) Regulations, 1914, the Minister of Munitions has ordered that the war material to which the regulation applies shall include the following :—

Metallurgical coke of the following classes and descriptions :—Derbyshire, Durham and Northumberland, Lancashire, South Wales and Monmouthshire, Staffordshire, Yorkshire, Midland Counties. Pig iron of the following classes and descriptions :—Hematite, Cleveland, Derbyshire, Leicestershire and Nottinghamshire, Lincolnshire, Northamptonshire, Scottish, Staffordshire, Shropshire, and Worcestershire. Bar iron. Steel of the following classes and descriptions :—Angles, tees, channels, flats, bulb angles, zeds and other sections, of which the prices are customarily based on the price of angles ; joists ; ship plates ; boiler plates ; rails (railway) ; sheet and tin plate bars ; blooms and billets, ordinary mild steel ; blooms and billets, special ; rounds and squares (untested). High speed tool steel.

Board of Trade Iron and Steel Industries Committee.

The Departmental Committee on the Iron, Steel, and Engineering Industries has now been reconstituted, and a separate Committee has been appointed by the Board of Trade to consider the position after the war of the iron and steel industries. This Committee comprises : Mr. G. Scoby-Smith, Chairman ; Sir Hugh Bell, Bart., Mr. Archibald Colville, Mr. John Hodge, M.P., Mr. James Gavin, Mr. George Mure Ritchie, Mr. Henry Summers, Mr. Benjamin Talbot, Mr. John King, and Mr. John E. Davison. It was appointed "to consider the position of the iron and steel industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary, or desirable in order to safeguard that position."

In order to carry out its investigations, the Committee desires to elicit exact and detailed information from a number of representative and individual firms, and from industrial, commercial, and labour organisations, with respect to :—(1) The extent and area of trade, and capital normally employed. (2) The dependency upon resources external to this country for supplies of material and plant. (3) Labour relations, labour restrictions (if any), and comparative conditions in the industry. (4) British methods of conducting foreign business contrasted with foreign methods of conducting export business. (5) The effects of manufacturing and commercial co-operation upon trade at home and abroad. (6) The extent to which British industry is adversely affected, whether as regards (*a*) the retention of business hitherto or previously secured, or (*b*) its capacity for expansion, by the existence of foreign tariffs, preferential arrangements, bounties, subsidies, or special facilities granted by foreign governments, railways, or trade combinations, to their manufacturers or exporters; and what, in your opinion, is the remedy. (7) Terms of payment and of credit. (8) Technical education, skill, and nature of employees. (9) The effect, if any, of wayleaves and mining or other royalties upon the industry, either as regards home or export trade. (10) The effect, if any, of railway and shipping rates upon the industry, as regards home or export trade. (11) General information.

The Committee invites the active support and assistance not only of individuals, but also of industrial organisations. The Committee suggests that the various trade organisations should submit a general statement of their views and suggestions. The Secretary is Mr. C. Roland Woods, 6, Whitehall Gardens, S.W.

Steel production in the United States in 1915.

"Special Bulletin No. 3" of the American Iron and Steel Association gives the production of steel in the United States during the last three years as follows:—

	1913.	1914.	1915.
	Tons.	Tons.	Tons.
Basic openhearth ...	20,344,626	16,271,129	22,308,725
Acid openhearth	1,255,305	903,555	1,370,377
Bessemer	9,545,706	6,220,846	8,287,213
Crucible	121,226	89,869	113,782
Electric	30,180	24,009	69,412
Miscellaneous	3,831	3,622	1,527
Total	31,300,874	23,513,030	32,151,036

Of the total production last year, 31,284,212 ons was in the form of ingots and 866,824 tons n direct castings. Included in the basic openearth steel is 1,781,491 tons made by the duplex rocess—that is partly treated in bessemer conerters aud finally purified in the openhearth urnace.

The production of alloy steel in 1915 was .021.147 tons, of which 643.791 tons was basic penhearth, 267.353 acid openhearth, 41.111 tons essemer, 40.948 tons crucible, and 27,944 tons lectric steel.

Titanium, vanadium, and nitrogen. Influence of vanadium and titanium on the nitrogen content of iron and its alloys. N. Tchigevsky and N. Blinow. Rev. Soc. russe de Métall., 1914, **1**, 636—646. Rev. Mét., 1915, **12**, Ext., 473—475. (See also this J., 1915, 1012.)

Ferrovanadium containing V 33·5 and Fe 66·35% nd titanium containing Ti 83·2, Fe 15·9, C 0·12, nd Mn 0·21%, were heated in a current of pure ry nitrogen, at different temperatures from 400° o 1500° C., for exactly 30 minutes in each test, nd then rapidly cooled. The proportion of itrogen in each product was then determined, and s iron is unacted upon by nitrogen, the comosition of the vanadium and titanium nitrides ormed at each temperature could be calculated. n both cases the products changed in colour ith increasing nitrogen content. The products ormed were not affected by strong sulphuric or ydrochloric acids, and the determination of itrogen had to be made by fusing 0·2 to 0·3 grm. with seven times this weight of a mixture of equal parts of chromate, peroxide, and oxide of lead. The mixture was heated in a porcelain boat in a Heræus furnace to a temperature not exceeding 1200° C., and the gases evolved were collected in a burette and analysed. As the temperature was raised the titanium combined with a rapidly increasing amount of nitrogen, and there was no falling off of the nitrogen content (21·5%) at 1500° C., thus showing that the dissociation of titanium nitride in metallurgical furnaces can only be very feeble at the most. Vanadium combined with nitrogen at an increasing rate from 800° C. to 1200°—1300° C., when a maximum of about 8% N was reached. At higher temperatures the nitrogen content diminished rapidly, showing that in metallurgical furnaces vanadium nitride suffers considerable dissociation. Both titanium and vanadium nitrides are soluble in iron, and therefore, in view of the stability of these nitrides, not only is it not possible to eliminate nitrogen from steel by titanium or vanadium, but these metals may even lead to an increase of the nitrogen content in steel, especially in the presence of manganese and silicon. The duration of the operations in the manufacture of titanium and vanadium steels should therefore be shortened as much as possible. The authors confirmed these conclusions by experiment. In one case 30 grms. of Bessemer steel containing N 0·0105, Mn 0·93, and Si 0·16%, was melted with 0·3 grm. of ferrovanadium. The product contained 0·063% N.

—T. St.

Lead sulphate; Decomposition and reduction of ——. W. Mostowitsch. Bull. Amer. Inst. Min. Eng., May, 1916. Met. and Chem. Eng., 1916, **15**, 46.

The decomposition of lead sulphate by heat alone commences at 800° C., with evolution of sulphur trioxide, and proceeds slowly up to 950° C. but rapidly above this temperature. Fusion takes place between 950° and 1000° C., but only after partial decomposition; and no volatilisation of lead oxide occurs until the temperature exceeds 1000° C. In the presence of silica the dissociation temperature of lead sulphate is not lowered, but marked decomposition occurs at 950° C. and increases with the temperature. The decomposing effect of silica is not proportional to the amount present but appears to depend on the viscosity of the lead silicate formed. In bi- and tri-silicate mixtures the lead sulphate is enveloped by viscous slag which retards further action; and the most rapid decomposition, accompanied by the lowest loss of lead by volatilisation, occurs with mixtures containing 10—15% SiO_2, *i.e.*, between the mono- and the bi-silicate proportions. The reduction of lead sulphate by carbon monoxide commences at 600° C., sulphur dioxide being liberated and the salt darkened; at 630° C. metallic lead becomes visible, the phenomena indicating the occurrence of the reactions, $PbSO_4 + PbS = 2Pb + 2SO_2$, and $3PbSO_4 + PbS = 4PbO + 4SO_2$. The reduction of lead sulphate by carbon, accompanied by evolution of sulphur dioxide, begins at 550° C., proceeds more rapidly at 630° C., and is complete (to lead sulphide and metallic lead) at 700° C. At 630° C. the reducing action of carbon on lead sulphate is only about half that of carbon monoxide. Considered in relation to blast-furnace practice, the results are regarded as showing that the elimination of sulphur from lead ore is largely the result of reaction between lead sulphate and sulphide in the upper part of the furnace, blast-roasted ore possessing the advantage that most of its sulphur is present as sulphate and thus readily eliminated as sulphur dioxide without increasing the matte-fall.—W. E. F. P.

Aluminium: The binary alloys of ——. H. Schirmeister. Stahl u. Eisen, 1916, **35**, 648, 873, and 996. Rev. Met., 1915, **12**, Ext., 464—470.

The author has studied the influence of the twenty most important technical metals on the properties of aluminium, particularly with regard to the rolling properties, tensile strength, elongation, and hardness of the resulting alloys. The alloys with a density below 3 are specially considered. *Zinc-aluminium.* The greatest technical improvement of aluminium is produced by the addition of zinc, and amongst low density alloys those containing Zn 12 to 11% are the most important technically. These alloys give nearly the same elongation as pure aluminium, with a tensile strength of 20 kilos. per sq. mm. Alloys with Zn 25 to 30% are much stronger, but have a lower elongation, and are too heavy. Zinc alloys do not appear to be suitable for making castings. *Magnesium-aluminium.* Alloys with Mg less than 3 and over 10% resist atmospheric attack relatively well; with Mg 6% the resistance is least; with Mg above 6 to 7% rolling is impossible; shrinkage is least pronounced with between 3 and 4% Mg; for castings the magnesium should be between 8 and 12%, the alloys richer in magnesium becoming too brittle. *Copper-aluminium* alloys resist atmospheric corrosion well, this being the most important practical advantage of adding copper to aluminium; they can be rolled hot with up to 12% Cu, the most advantageous percentage of copper, for rolling purposes, being between 3 and 4; for castings, richer alloys with 10 to 15% Cu are preferable. *Nickel-aluminium.* Manufacturing considerations impose a limit of 16 to 18% Ni; alloys with up to 11 to 12% Ni roll easily when hot, those with about 4% Ni being generally employed; alloys with Ni 10 to 12% are used for castings. *Cobalt-aluminium* alloys offer no advantages over the nickel alloys. Rolling is not possible with over 12% Co. *Iron-aluminium* alloys have no technical importance, but an addition of 2 to 3% Fe has no harmful effects; it is even advantageous to add up to 1% Fe to aluminium for castings. *Antimony-aluminium.* The addition of antimony to aluminium does not confer any increased strength, and alloys with more than 6% Sb offer little resistance to atmospheric corrosion. *Silicon-aluminium.* The addition of silicon is favourable as the specific gravity of the alloys is nearly the same as that of pure aluminium. The best proportions are 5 to 7% Si for rolled objects and 10 to 12% Si for castings. Alloys with under 8% Si suffer less corrosion in water than pure aluminium; annealing renders the alloys more susceptible to corrosion. *Cadmium-aluminium* alloys have no technical interest. *Tin-aluminium* alloys resist atmospheric corrosion relatively well. They can be cold-rolled easily but crack when rolled hot. The elastic properties are however prejudicially affected by the addition of tin. *Lead-aluminium.* It is not possible to alloy more than 4% Pb with aluminium, and whilst such additions have no bad effects, they do not confer any technical advantages. *Bismuth-aluminium* alloys have no technical value. *Chromium-aluminium.* Amongst the rarer metals, chromium is the only one which has a well-marked favourable influence. The maximum amount of chromium attainable in alloys in practice is 5 to 6%. Rolling can be carried out at 500 C. with up to 4 to 5% Cr, but for rolling purposes not more than 1% Cr is added, and up to 3% for castings. *Manganese-aluminium.* Up to 5% Mn can be added, and the alloys roll easily. The addition of manganese confers little practical advantage as regards the elastic properties. It can be added nevertheless to the extent of 1 to 2% for rolled objects and 3 to 5% for castings. *Tungsten-aluminium.* Tungsten is more soluble in aluminium than are chromium and manganese, but it affects the properties of aluminium very little. (The tungsten used in the investigation was, however impure, especially as regards phosphorus.) *Molybdenum-aluminium* alloys have no particular technical importance, the most useful containing 0·5 to 1% Mo. *Vanadium-aluminium* alloys roll easily at 500° C. The addition of 1 to 2% V has a certain utility, and castings may contain 3 to 4% V. *Titanium-aluminium* alloys are easily prepared with up to 5% Ti, and are easy to roll, but appear to have no special technical advantages. The elastic properties are improved somewhat by the titanium. *Zirconium-aluminium* alloys are very similar to the titanium-aluminium alloys. *Tantalum-aluminium* alloys have no technical utility. (See also this J., 1911, 692.)—T. St.

Germanium in zinc materials; Occurrence of ——. G. H. Buchanan. J. Ind. Eng. Chem., 1916, **8**, 585—586.

In a report on the presence of gallium in residues from the distillation of spelter (Hillebrand and Scherrer, this J., 1916, 473; see also Browning and Uhler, this J., 1916, 514), it was stated that germanium had been detected spectroscopically in certain American zinc ores. A by-product from Wisconsin zinc blende, examined by the author, was found to contain a quantity of germanium equivalent to 0·25% GeO_2. The germanium was recognised and isolated by a method based on the volatility of its tetrachloride (b.pt. 86 C.), the insolubility of the sulphide in strongly acid solutions, and the formation of an insoluble double fluoride of potassium and germanium.—A.S.

New method for determination of radioactivity in minerals. Sabot. *See* VII.

Patents.

Iron or steel: Method of polishing and preserving —— *from rust.* A. A. van der Meulen, Hilversum, Holland. Eng. Pat. 16,979, Dec. 2, 1915.

A solution prepared by leaving lead scrap, preferably filings, covered with cottonseed oil in a closed vessel for 10 days, is used for polishing iron or steel and preserving it from rust. The residual lead may be used again after exposure to the air for a suitable time.—A. S.

Iron-melting furnaces; Method of operating reverberatory ——. J. A. Swindell, Pittsburgh, Pa. U.S. Pat. 1,188,111, June 20, 1916. Date of appl., June 8, 1915.

The furnace is operated with natural draught until the iron is completely melted, and "forced draught" is then applied upwards through the fuel bed to finish the heat; during this latter stage steam is introduced beneath the grate to diminish the formation of clinker.—A. S.

Coating small iron articles with lead or tin; Centrifuge for use in ——. C. Koch, Duisburg. Ger. Pat. 292,231, June 9, 1914.

A number of electro-magnets are arranged horizontally in a closed metal vessel, and vertical, scoop-shaped pole-pieces are arranged, side by side, in a circle, with their lower ends inclined towards the axis of the vessel and closed by a metal hemisphere. The apparatus is specially suitable for coating small hollow articles, which are held by their bases against the metal vessel by means of magnetic force, and the whole immersed in the coating bath. The vessel is set in rotation by means of a motor, and then slowly withdrawn from the bath, whereupon superfluous coating metal is removed by centrifugal force.—A. S.

Ores; Concentration of ——. A. C. Howard, and Minerals Separation, Ltd., London. Eng. Pat. 5454, Apr. 10, 1915.

In an agitation-froth process, applicable more particularly to sulphide copper ores, a small quantity of a concentrated solution of ammonia, caustic soda, sodium silicate, or soda ash is added to the circulating liquid immediately before the frothing operation.—W. E. F. P.

Sulphide ores; Separation of mixed ——. Minerals Separation, Ltd., London, Assignees of Amalgamated Zinc (De Bavay's), Ltd., Melbourne, Australia. Eng. Pat. 10,478, July 19, 1915. Under Int. Conv., July 28, 1914.

Preferential flotation of the galena in mixed lead-zinc sulphide ores may be effected by adding bleaching powder, with or without a small quantity of a frothing agent such as eucalyptus oil, to the circuit water. In many cases it is advantageous to add also an alkali persulphate or an alum, or one or more of the salts mentioned in Eng. Pat. 11,939 of 1913 (this J., 1914, 698) to the water. —A. S.

[*Metals.*] *Apparatus for determining the hardness of a body.* Vickers, Ltd., Westminster, and R. L. Smith, Erith, Kent. Eng. Pat. 11,936, Aug. 18, 1915.

The method consists in causing a hard steel ball, by a single blow of a hammer, to make impressions simultaneously on a bar of standard hardness and on the surface to be tested. The standard bar is held in a holder which also constitutes the anvil to be struck, the ball being held below and contiguous to the bar, and protruding to some extent from the holder. A resilient member having an aperture therein may be interposed between the ball and the bar so as normally to keep the ball out of contact with the bar, and provide sufficient friction to retain the holder in any position to which it is moved along the bar.—T. St.

Anodes for electroplating. G. Jones, Birmingham. Eng. Pat. 17,328, Dec. 10, 1915.

Nickel or cobalt anodes are made in the form of balls or pellets of pure metal, contained in a celluloid case perforated on opposite sides, so that circulation of the electrolyte may readily take place through the anode. The balls rest upon, and make connection with, current leads of the same metal at or near the bottom of the case, or each compartment of the case.—B. N.

Precious metals; Apparatus for the recovery of —— *from metalliferous earths.* P. N. Ramsey, New York. U.S. Pat. 1,187,927, June 20, 1916. Date of appl., Oct. 16, 1897.

The material is delivered by a central feeding spiral to a separator having inner and outer screens. Perforated feeding spirals, provided with sluiceways through the spirals, are arranged between the central spiral and inner screen, and between the screens, and means are provided for removing from the separator the "metal-carrying gravity portion" of the coarse material separately from the rest of the coarse material. A second washer and separator act on the finer valuable material to divide it into fine and less-fine portions, the fine material being then treated directly in an amalgamator. The coarse and the less-fine materials are treated with mercury in separate receptacles, which are given suitable movements to allow of the separation of the metal from the waste material by gravity and mercury.—T. St.

Soldering flux. F. E. J. Litot, Wilkinsburg, Pa. U.S. Pat. 1,188,188, June 20, 1916. Date of appl., Mar. 22, 1915.

A mixture of zinc chloride, 1, and animal fat, 5 parts.—W. E. F. P.

Smelter-fumes; Recovering noxious and other materials from ——. C. Barrett, Assignor to G. Morrow, Salt Lake City, Utah. U.S. Pat. 1,188,237, June 20, 1916. Date of appl., Jan. 15, 1915.

The smelter-fume is caused to pass through a solution of an alkali- or alkaline-earth bisulphide, to convert the sulphur dioxide into a soluble salt (thiosulphate) and the metallic constituents into insoluble sulphides. The latter are separated from the liquid during the progress of the treatment, the solution being employed in a closed circuit.—W. E. F. P.

Magnetic metals; Method of and apparatus for giving heat treatment to ——. R. B. Fehr, State College, Pa. U.S. Pat. 1,188,430, June 27, 1916. Date of appl., Sep. 28, 1914.

Steel to be heat-treated is made to form part of a magnetic circuit, the rest of which is external to the source of heat. The latter portion is provided with a magnetising coil in which the current can be varied. A coil inductively related to the magnetic circuit remote from the source of heat controls a dead-beat indicator whereby repeated and instantaneous indications of the magnetic condition of the steel can be obtained. By this means it is at once known when the steel has passed through the decalescent point, and it may then be quenched, annealed, or tempered.—T. St.

Ores; Apparatus for treating ——. C. W. Singer, Linden, Wis., Assignor to Campbell Magnetic Separating Co. U.S. Pats. (a) 1,188,566 and (b) 1,188,567, June 27, 1916. Dates of appl., Dec. 3, 1914, and June 23, 1915.

(a) A rotary furnace constructed of metal has a number of sockets secured to it, and T-irons, to which notched guides and wedges are fixed, are held loosely in the sockets. The position of the wedges relative to the guides can be adjusted. A track ring, encircling the furnace, rests on the wedges and is loosely retained by the notches in the guides, so that the ring and the furnace are free to rotate independently of each other. (b) A rotary roasting furnace for treating ores preparatory to magnetic separation, consists of an unlined metallic shell formed of frusto-conical sections secured together. A "blast of heat" is projected into the furnace, which has an air inlet at one end, and an air outlet at the other end of less cross-sectional area than the feed end of the furnace, so that the draught is confined to a space not extending to the inner wall of the furnace. An ore feed pipe extends through, and delivers below the lowest point of the periphery of the air outlet, and the inner wall of the furnace is provided with projections of such size that they agitate the ore without forcing it into the line of draught through the furnace.—A. S.

Metals [*manganese, zinc, etc.*]; *Process for the recovery of* —— *from ores and the like.* C. S. Vadner, Butte, Mont. U.S. Pat. 1,188,705, June 27, 1916. Date of appl., Feb. 14, 1916.

To recover manganese and other metals from naturally oxidised or sufficiently roasted sulphide ore, the latter—in the form of finely-ground pulp—is sprayed into furnace gases containing sulphur dioxide. The resulting solution is oxidised, treated in the cold with finely-divided calcium carbonate to precipitate iron, etc., then heated with fresh calcium carbonate to precipitate zinc, and finally heated with lime and blown with air to precipitate manganese as peroxide.—W. E. F. P.

Furnace; Open-hearth ——. B. P. Wheeler, Duluth, Minn., Assignor to T. S. Blair, jun., Chicago, Ill. U.S. Pat. 1,188,867, June 27, 1916. Date of appl., Feb. 21, 1916.

An auxiliary chamber for melting the "finals" adjoins the tap-hole of the main combustion chamber of the furnace and is open to and heated by the latter. The tap-holes of both chambers are adjacent.—W. E. F. P.

Metal baths ; Flux for coating ——. J. H. Maddy, New York, and B. H. Schubert, Weehawken, N.J., Assignors to The Lohmann Co., New York. U.S. Pat. 1,189,373, July 4, 1916. Date of appl., Feb. 2, 1915 ; renewed, Dec. 2, 1915.

A solution of zinc chloride saturated with ammonium chloride is applied to the surface of a molten metal such as lead, zinc, or tin, in amount insufficient to cover the surface, and ammonium chloride added until the mixture covers the surface. Ferrous articles to be coated with the molten metal are first immersed in a liquor of cleansing acid mixed with a mercury salt, and then passed through the melted flux into the molten metal.—T. St.

Electrolytic cell and the process of electrolysing metal [magnesium]. C. Dantsizen, Scotia, N.Y., Assignor to General Electric Co. U.S. Pat. 1,190,122, July 4, 1916. Date of appl., Mar. 20, 1915.

Metallic magnesium is isolated from fused magnesium salts, by employing an inert anode, and a cathode of iron, the surface of which is alloyed with zinc. The cathode is not fused during the electrolysis, but the zinc is wetted by the liberated magnesium and slowly alloys with it.—B. N.

Values [copper, silver, gold] ; Process of recovering —— from ores. H. Hirsching, Oakland, Cal. U.S. Pat. 1,190,549, July 11, 1916. Date of appl., Nov. 28, 1913.

Roasted or unroasted ore is treated with aqueous ammonia to dissolve copper and silver, and ammonia is then expelled from the solution so as to precipitate oxides of these metals. After settling and decanting, the precipitate is dissolved in sulphuric acid, and the copper deposited electrolytically. The ore residue is treated for the recovery of gold.—A. S.

Silico-spiegel ; Process of making ——. H. Schagrin, South Bethlehem, Pa. U.S. Pat. 1,190,678, July 11, 1916. Date of appl., Aug. 3, 1914.

Waste clinker containing oxides of zinc, aluminium, iron, manganese, and silicon, is mixed with carbon, and heated in a reducing atmosphere to a temperature sufficient to volatilise the zinc and produce an alloy of iron, manganese, silicon, and aluminium.—A. S.

Ferromanganese alloys ; Process of producing ——. H. Schagrin, South Bethlehem, Pa. U.S. Pat. 1,190,679, July 11, 1916. Date of appl., Oct. 25, 1915.

A charge containing oxides of iron, manganese, zinc, and silicon, together with limestone and carbon, is fed by gravity to the fusion zone of a furnace, and heated in a reducing atmosphere to 1300°—1550° C. The volatilised zinc is recovered, whilst any volatilised manganese is condensed on the cooler portion of the charge and returns to the fusion zone, where a ferromanganese alloy containing silicon is produced.—A. S.

Flue dust and other metal fines ; Process for reducing ——. S. L. Boggs, Pittsburgh, Pa. U.S. Pat. 1,190,712, July 11, 1916. Date of appl., Apr. 9, 1914.

Blast-furnace flue-dust or other metal fines is mixed with the molten metal flowing from the blast-furnace, the mixture is poured into a receptacle, a layer of coke breeze is applied to the surface, and the flue dust is reduced by a blast of gas from the blast-furnace directed on to the surface of the mixture.—A. S.

Samples of flowing pulp, slimes, ores or the like ; Apparatus for taking ——. A. Davies, London. Eng. Pat. 100,870, Mar. 13, 1916. (Appl. No. 3746 of 1916.)

Steel ; Making ——. E. Humbert, Chicago, Ill. U.S. Pat. 1,187,623, June 20, 1916. Date of appl., Jan. 29, 1913.

See Fr. Pat 461,459 of 1913 ; this J., 1914, 204.

Concentrating ores ; Apparatus for ——. G. E. Ohrn, Stockholm, Assignor to Minerals Separation, Ltd., London. U.S. Pat. 1,187,772, June 20, 1916. Date of appl., Oct. 4, 1913.

See Eng. Pat. 22,346 of 1913 ; this J., 1914, 1160.

Metalliferous materials ; Process of treating —— for roasting, reducing, sintering, and like processes. F. C. W. Timm, Hamburg, Germany. U.S. Pat. 1,189,313, July 4, 1916. Date of appl., Oct. 30, 1913.

See Fr. Pat. 465,951 of 1913 ; this J., 1914, 599.

XI.—ELECTRO-CHEMISTRY.

Electro-chemical industries. Report issued by the Development of Resources Committee of the South African Institute of Electrical Engineers, Jan., 1916.

The report deals with the possibility of manufacturing in South Africa articles of commercial value at present imported, especially those obtainable at the high temperature of the electric furnace, and which are necessary for agriculture and mining. For the production of calcium carbide, limestone occurs in very large quantities in many districts, while coal is obtainable as Natal anthracite containing about 75% of carbon or as cheaper varieties containing about 60% of carbon. The estimated factory cost for local production of calcium carbide is £35,850 for an output of 2600 tons, the value of that quantity imported in 1913 being £60,000. The total cost of the plant for producing that amount per annum, including £7500 for working capital, is given as £27,500. Calcium cyanamide, obtainable by passing nitrogen over red-hot calcium carbide, cost £13 per short ton at South African ports prior to the war, while the estimated factory cost of local production is £9 per short ton. The cost of a plant to produce 4000 tons of commercial calcium cyanamide is given as £13,000, including working capital for three months. The report also deals with the production of sodium cyanide by the fusion of calcium cyanamide with carbon and salt, and the subsequent treatment with sulphuric acid, the liberated hydrocyanic acid being passed into caustic soda, and figures are given for the cost of materials. Other derivatives of calcium cyanamide are mentioned, such as ammonia, obtained by the action of superheated steam, which can be oxidised to nitric acid by the Ostwald process ; and also dicyandiamide obtained by leaching calcium cyanamide with hot water and precipitating lime with carbon dioxide. The cost of electricity for the above figures is given as 0·35 penny per unit with a modern steam generating plant, assuming a capacity of about 5000 kilowatts and a load factor of 83%, which compares favourably with the costs of some English stations given. With a water power station the total cost should be under 0·2 penny per unit. With still cheaper electrical energy methods of fixing atmospheric nitrogen would become practicable, and iron and steel manufacture by the electric furnace offers a wide field.—W. G. C.

Quartz vacuum tubes ; Absorption of gas by ——. R. S. Willows and H. T. George. Proc. Physical Soc. London, 1916, **28**, 124—131. J. Chem. Soc., 1916, **110**, ii., 365—366.

A NEW quartz tube, through which an electrodeless discharge is passed, does not absorb air. If the tube is previously filled with hydrogen, which is absorbed by the quartz when the discharge passes, it is found to have acquired the power of absorbing air under the influence of the current. If discharges in hydrogen are alternated with those in air, the bulb can be made to absorb large quantities of either gas, and the activity towards both air and hydrogen gradually increases. In explanation of the observations, it is suggested that oxidation products are formed when the discharge is passed through air, and that these products are reduced by hydrogen. In support of the theory, it has been found that the readiness with which hydrogen is absorbed diminishes when the quartz tube is subjected to the action of reducing agents after the air treatment.

Colloidal carbon and the decomposition of organic liquids by the electric arc. Tarczynski. *See* VII.

PATENTS.

Battery cell of the mercuric oxide type ; Galvanic ——. J. N. Brönsted, and Hellesens Enke and V. Ludvigsen, Copenhagen, Denmark. Eng. Pat. 9684, July 2, 1915.

THE cell is of the type in which a zinc anode, an alkali electrolyte, and a depolariser of mercuric oxide and graphite are employed. The electrolyte is composed of a highly concentrated alkali solution, containing at least six or seven, or even as much as ten, equivalents of alkali hydroxide, preferably potassium hydroxide, per litre.—B. N.

Electrode for storage batteries. C. C. Carpenter, Buffalo, N.Y., Assignor to U.S. Light and Heat Corporation, Niagara Falls, N.Y. U.S. Pat. 1,190,982, July 11, 1916. Date of appl., Feb. 3, 1909.

THE central core of the battery plate is composed of an alloy of lead and antimony, and parallel ribs are formed on the opposite faces of the core. The ribs are of pure lead, which may be electrochemically formed, and are united integrally with the core, the bases of the ribs being thickened to reinforce them at their junction with the core. The superficial area of the plate is thus increased, and pockets are formed between the ribs for retaining the active material.—B. N.

Electrolytic apparatus. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,187,903, June 20, 1916. Date of appl., June 30, 1913.

A HORIZONTAL diaphragm is interposed between stationary horizontal electrodes, the diaphragm being given a differential oscillating motion, so as to facilitate the removal of the non-adherent electrode material from the electrolyser.—B. N.

Electron discharge apparatus (X-ray) and method of operating the same. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 9690, July 2, 1915.

THE X-ray tube is operated by a current varying periodically, an electrostatic field being applied about the cathode, and the field changed in synchronism with the voltage variations. A conductive member, surrounding the cathode, is thus charged in a relatively negative or positive sense over the portions of each current half-wave, when the voltage is near the minimum and maximum values respectively. The discharge over a portion of each period is suppressed and over another period promoted, thus increasing the production of " hard " rays of high penetrating power.—B. N.

Carbon electrodes ; Connecting together —— used in electrochemical and electrometallurgical processes. R. Haddan, London. From Soc. Franç. des Electrodes, Lyons, France. Eng. Pat. 18,222, Dec. 31, 1915.

A SCREW-THREADED conical projection, the edges of which have acute angles, is formed on the end of one electrode, and the extremity of the other electrode is provided with a similarly screw-threaded conical recess.—B. N.

High temperatures ; Method of and apparatus for producing ——. [Electric resistance material.] E. F. Northrup, Princetonborough, N.J. U.S. Pat. 1,189,725, July 4, 1916. Date of appl., Oct. 8, 1915.

AN integral tubular graphite resistor is provided with a slot extending throughout its length, and a number of neighbouring slots extending from opposite ends, thus forming the resistor material into a current path extending longitudinally backwards and forwards. Current connections are arranged on opposite sides of and adjacent to the first-named slot.—B. N.

Furnace ; Electric ——. M. M. Kohn, New York. U.S. Pat. 1,187,630, June 20, 1916. Date of appl., May 5, 1914.

THE furnace is provided with an outer casing, surrounding an inner chamber composed of a number of blocks of diatomaceous material arranged in staggered relationship. The blocks are provided with recesses for receiving ribs on the outer surfaces of removable supports for the heating units. The heating units are in the form of reversible blocks of refractory material ; they are removable independently and fit in longitudinal recesses on the inner surface of the supports. A heating medium is associated with each of the heating unit supports, and means are provided for supplying a gas from the walls to the interior of the chamber.—B. N.

Furnace ; Electric ——. J. W. Brown, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,190,856, July 11, 1916. Date of appl., Aug. 12, 1912.

THE furnace is composed of a number of units, adapted to contain charges to be heated, and contained in a supporting frame. The frame may be moved by a conveyor, so that different units on the support may be successively placed between the electrodes used for heating the charges.—B. N.

Insulating composition and process of producing it. Plastic composition and process of making it. H. C. Tazewell, Wilmington, Del. U.S. Pats. (A) 1,190,814 and (B) 1,190,815, July 11, 1916. Date of appl., Feb. 1, 1915.

(A) SHELLAC and rosin are incorporated with heated creosote oil, and alum is dissolved in the heated homogeneous mass. Suitable proportions are used to form a composition easily melted, non-inflammable when melted, and sufficiently liquid to flow and set hard without appreciable shrinkage. (B) A filling material is added to heated creosote oil to form a stiff pasty mass, and shellac is incorporated with it. Alum is added to lessen the liability to ignition, magnesium carbonate to lighten the mass, and hydrated lime to make it set more effectively when moulded. Articles may be produced from it as insulators of heat and electricity.—B. N.

Electric furnace. P. Eyermann, Witkowitz, Austria-Hungary. U.S. Pat. 1,189,356, July 4, 1916. Date of appl., Dec. 5, 1912.

See Eng. Pat. 9381 of 1913; this J., 1914, 145.

XII.—FATS ; OILS ; WAXES.

Cotton seed in storage : Biochemical changes in ——. J. B. Rather. J. Ind. Eng. Chem., 1916, **8**, 604—607.

A 5000 lb. lot of cottonseed, harvested dry, was stored in a pile 12 ft. by 12 ft. by 6 ft. for 77 days, and samples were analysed at intervals and the temperature in different parts of the pile observed. The moisture content dropped from 13·77 to 10·94 %, and heating took place, the maximum temperature attained being 109° F. (43° C.). The most notable changes during the storage period were increases in the free fatty acids and total acidity. Experiments were also made with small samples of heated cottonseed stored in air-tight bottles. It is concluded that even a short period of heating causes the hydrolysis of 10 % of the fat of cottonseed, whilst a long period of heating or the storage of heated seed may lead to the hydrolysis of 70 % of the fat and 33 % of the protein, and increase of the total acidity to seven times the original value: such cottonseed is practically worthless except as a source of soap stock and fertiliser. Increase in the acidity and free fatty acids of stored cottonseed is due to the heating and not to ageing, for such increases are not observed in samples taken from unheated parts of the pile.—A. S.

Rancid fats ; New method for the analysis of ——. G. Issoglio. Atti. R. Accad. Sci. Torino, 1916, **51**, 582—605. J. Chem. Soc., 1916, **110**, ii., 401—402.

The number of mgrms. of oxygen necessary to oxidise the organic compounds removed by the distillation of 100 grms. of a fat in a current of steam is termed the "oxidisability number." Between 20 and 25 grms. of the fat, exactly weighed, and about 100 c.c. of water are introduced into a long-necked distilling flask and distilled in a current of steam, 100 c.c. of distillate being collected in ten minutes. Ten c.c. of the mixed distillate, 50 c.c. of distilled water, 10 c.c. of 20 % sulphuric acid, and 50 c.c. of $N/100$-potassium permanganate solution are then heated to boiling and kept boiling for five minutes in a flask fitted with a ground-in condenser. After the flask has cooled somewhat, 50 c.c. of $N/100$-oxalic acid is introduced, and the contents then titrated with $N/100$-permanganate. If X c.c. of the latter are used, and the volume required for a blank test in which the fat is replaced by 10 c.c. of distilled water is x, the oxidisability number will be given by the expression $80(X—x)/P$, P being the weight of fat taken. For normal, fresh fats used as foods, the oxidisability number varies from 3 to 10, rancid fats giving higher values; a number exceeding 15 justifies the statement that the fat has undergone alteration.

Croton oil ; Identification of ——. Comte. J. Pharm. Chim., 1916, **14**, 38—39.

When croton oil (from *Croton tiglium*) or a mixture of oils containing croton oil is shaken with twice its volume of absolute alcohol, the clear alcoholic solution poured on to a highly concentrated solution of sodium or potassium hydroxide in a test-tube, and the mixture warmed for 30 seconds in a boiling water bath and allowed to stand, an intense reddish-brown or reddish-violet ring forms at the junction of the two liquids. This reaction is characteristic of croton oil.—T. C.

Patents.

Catalytic agent [for treating oils and fats] and process of making same. J. Oswald and W. H. Doering, Assignors to Fels and Co., Philadelphia, Pa. U.S. Pat. 1,187,775, June 20, 1916. Date of appl., June 10, 1910.

A finely divided catalytic metal, recently reduced by means of hydrogen, is incorporated with just sufficient saturated fat or the like to protect it from the action of the air during storage or use. —C. A. M.

Oil from whale blubber : Process for extracting ——. K. T. Fossheim, Christiania, Norway. U.S. Pat. 1,188,922, June 27, 1916. Date of appl., Oct. 4, 1915.

Oil free from blood is obtained by heating the blubber by means of steam or dry heat, or both, sufficiently to coagulate the blood, prior to expressing the oil.—C. A. M.

Waste water from oil factories ; Treatment of —— D. A. Hansen, Christiania. Eng. Pat. 17,915, Dec. 22, 1915. Under Int. Conv., Jan. 7, 1915.

Waste waters from whale oil factories, etc., are treated with a coagulating agent, such as ferric chloride, and the resulting gelatinised mass evaporated to dryness. The dry nitrogenous residue may be used in the manufacture of feeding stuffs or manures.—C. A. M.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Patents.

Orange mineral and method of manufacturing same. J. A. Schaeffer, Assignor to Picher Lead Co., Joplin, Mo. U.S. Pat. 1,187,933, June 20, 1916. Date of appl., Sept. 24, 1915.

Orange mineral of a greater degree of fineness than that obtained from corroded white lead, is prepared by volatilising litharge, collecting the condensed fume, and calcining the finely divided product in an oxidising atmosphere at about 859° F. (455° C.).—J. F. B.

Light-transforming compositions [varnishes]. P. C. Hewitt, Ringwood Manor, N.J., Assignor to Cooper-Hewitt Electric Co., Hoboken, N.J. U.S. Pats. (A) 1,188,655, (B) 1,188,775, (C) 1,188,776, (D) 1,188,777, June 27, 1916. Dates of appl., (A) July 23, 1910, (B, C, and D) Oct. 20, 1913.

(A) A varnish for light-transforming purposes is formed by mixing approximately 70 % cellulose acetate, 10 % glycerin, and 20 % acetic acid, and then adding acetone to form approximately a 12 % solution, or 90 to 95 % of cellulose acetate and 5 to 10 % of glycerin may be used. A fluorescent dyestuff, such as Rhodamine, is added in the proportion of 0·05 to 0·005 %. (B) A mixture of "cellet," glycerin, acetic acid, and Rhodamine is made, with sufficient "technical acetone" to give about 12 % of acetone in the resulting solution. The mixture is dried, thereby leaving "cellet," Rhodamine, and glycerin. (C) The composition contains cellulose acetate, a fluorescent dyestuff dissolved in a volatile solvent, glycerin, and sufficient acetic acid to modify the structure of the cellulose acetate on drying. (D) A colour-fast varnish is made by dissolving cellulose acetate in acetic acid, then mixing with glycerin and a fluorescent dyestuff dissolved in suitable volatile solvents.—B. N.

Painting structures, filling joints, and like purposes ; Composition for ——. P. Dauphin, Lyons, France. Eng. Pat. 10,029, July 9, 1915.

Resinous materials ; Process for the production of ——. C. Granel, Bouseat par Lesperon, France. U.S. Pat. 1,190,889, July 11, 1916. Date of appl., Apr. 11, 1913.

See Fr. Pat. 453,881 of 1912 ; this J., 1913, 876.

Method of polishing and preserving iron or steel from rust. Eng. Pat. 16,979. *See* X.

Insulating composition. Plastic composition U.S. Pats. 1,190,811 and 1,190,815. *See* XI.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

Patents.

Rubber articles ; Vulcanised —— and method of making same. Goodyear's Metallic Rubber Shoe Co., Assignees of C. D. Mason, Naugatuck, Conn., U.S.A. Eng. Pat. 100,727, Mar. 9, 1916. Under Int. Conv., June 18, 1915. (Appl. No. 3529 of 1916.)

See U.S. Pats. 1,183,022 and 1,183,023 of 1916 ; this J., 1916, 747.

Caoutchouc ; Producing substances resembling ——. H. S. A. Holt and G. Steimmig, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,189,110, June 27, 1916. Date of appl., Sept. 26, 1913.

See Fr. Pat. 440,173 of 1912 ; this J., 1912, 735.

Rubber latex : Apparatus for coagulating ——. S. C. Davidson, Belfast, Ireland. U.S. Pat. 1,189,351, July 4, 1916. Date of appl., Oct. 14, 1915.

See Eng. Pat. 22,489 of 1914 ; this J., 1916, 59.

XV.—LEATHER ; BONE ; HORN ; GLUE.

Activated-sludge process in treatment of tannery wastes. Eddy and Fales. *See* XIXb.

Patents

Tanning hides and skins ; Composition for ——. M. B. Larson, Molson, Wash., U.S.A. Eng. Pat. 11,024, July 29, 1915.

See U.S. Pat. 1,147,178 of 1915 ; this J., 1915, 915.

Plastic casein ; Process for the preparation of ——. F. Lebreil, Villeurbanne, and R. Desgeorge, Lyon, France. U.S. Pat. 1,189,841, July 4, 1916. Date of appl., Dec. 8, 1911.

See Addition of Dec. 6, 1911, to Fr. Pat. 435,239 of 1910 ; this J., 1913, 439.

XVI.—SOILS ; FERTILISERS.

Nitrate formation in acid soils ; Some factors that influence ——. E. B. Fred and E. J. Graul. Soil Sci., 1916, **1**, 317—338. J. Chem. Soc., 1916, **110**, i., 550.

Four representative types of Wisconsin soils were used : (1) a neutral silt loam, (2) an acid sand, (3) an acid silt loam, and (4) an acid peat. The last three required respectively 13,050 lb., 20,420 lb., and 5985 lb. of calcium carbonate per acre to neutralise the top six inches of soil. All four types were found to contain nitrifying organisms : when, however, they were inoculated into a culture medium, the two silt loams nitrified much more rapidly than the sand and peat. In the soils themselves nitrification was very slow in the acid sand and peat, although the production of ammonia from casein in these soils was very rapid. In the silt loams nitrification was much more rapid. The form of nitrogen seems to play an important part, organic nitrogen being more readily nitrified in acid soils than ammonium sulphate, whilst in non-acid soils the reverse is observed. These results and the fact that the source of the nitrifying bacteria is immaterial indicate that acid soils are not provided with nitrifying organisms especially resistant to acidity. When organic nitrogenous compounds are present, addition of calcium carbonate has a temporary stimulating effect on nitrification which is reversed later on, coincidently with a great increase in nitrate-assimilating bacteria. The conclusion is drawn that, under laboratory conditions, the beneficial effects of calcium carbonate on plants are not due to the direct effect on nitrification, which takes place before the plants require large amounts of nitrates. The rapid accumulation of nitrates, due to liming, may, moreover, result in a loss of nitric nitrogen through leaching.

Sugar-beet : Dependence of the resorption of the potassium ion on the presence of the sodium ion in the organism of the ——. J. Stoklasa. Biochem. Zeits., 1916, **73**, 260—312. J. Chem. Soc., 1916, **110**, i., 539—540.

The chlorides of potassium and sodium when added singly in solution to a soil of mixed sand and peat cause an increase in both the bulk of a sugar-beet plant and of the sugar content as compared with plants grown in a similar way but receiving the same amount of water without salts. The increase in mass and sugar caused by $N/10$-potassium chloride is markedly more than that caused by $N/10$-sodium chloride. Concentrations of more than $2N/10$-sodium chloride act deleteriously on the plant, and the growth is less than with the lower ($N/10$) concentrations. The plants can, however, tolerate a higher concentration of the potassium salt : $3N/10$-potassium chloride causes a depression in the amount of dry substance in the plant, but has no harmful influence on the amount of sugar in the beet. The best results in regard to plant growth are produced by a mixture of the two salts (each in $N/10$-concentration), and the toxic action of $3N/10$-potassium salt can be counteracted by the addition of $2N/10$-sodium salt. Addition of calcium carbonate improves the action of a mixture of sodium and potassium chlorides, and antagonises the deleterious action of either salt when added in excess. Calcium chloride exerts a somewhat similar action, especially as regards the sugar content of the plant. The best results as regards sugar production are obtained by the use of a mixture of the chlorides of sodium, potassium, and calcium. The potassium ion plays a considerable part in improving the turgescence, the chlorophyll production, and consequently the assimilation processes ; the sodium ion appears to influence chiefly the growth of the cell-walls of the epidermis. The resorption of potassium and sodium by the plants reaches its maximum when both salts are employed together, each in the concentration $N/10$. The relationships between the relative amounts of potassium and sodium adsorbed under various conditions were also determined.

Magnesium in leaves and the assimilation process : Relation between the presence of ——. G. André. Bull. Soc. Chim., 1916, **19**, 266—269.

The relations between organic magnesium (possibly including magnesium other than that present in the chlorophyll molecule) and phosphorus, extracted by treatment with ether and alcohol, and the residual magnesium and phosphorus have been determined in the leaves of the horse-chestnut, lilac, and chestnut during the spring and summer months. The maximum weight of organic magnesium is attained before the ratio organic to residual magnesium reaches a maximum ; assuming that the time of the latter maximum corresponds to the maximum activity of the assimilation process, it is concluded that this process is most intense at the beginning of May in the case of lilac, throughout May in the horse-chestnut, and from May to the middle of June in the chestnut. In the case of horse-chestnut leaves the maximum ratio, organic to residual phosphorus, is attained at the same time as the maximum magnesium ratio, but the times do not agree so closely in the case of lilac and chestnut leaves. The factor CO_2/O_2 for the horse-chestnut exceeds unity during March and April, but is less than unity during June.—F. W. A.

Patents.

Fertiliser. L. Cheeseman, Glenburn, Pa., Assignor to Witherbee, Sherman and Co., Port Henry, N.Y. U.S. Pat. 1,188,898, June 27, 1916. Date of appl., Aug. 8, 1913.

The fertiliser contains, *inter alia*, barium sulphide and a basic material, *e.g.*, quicklime.—E. H. T.

Treatment of waste water from oil factories. Eng. Pat. 17,915. *See* XII.

XVII.—SUGARS ; STARCHES ; GUMS.

Dependence of the resorption of the potassium ion on the presence of the sodium ion in the organism of the sugar beet. Stoklasa. *See* XVI.

Disturbing influence of certain physiologically important substances on the colour reaction between iodine and starch. Clementi. *See* XXIII.

Patents.

Diffusion apparatus and process. J. Stewart, Salt Lake City, Utah. U.S. Pats. 1,189,502 and 1,189,503, July 4, 1916. Dates of appl., Jan. 20 and Feb. 2, 1916.

A perforated rotary cylinder is mounted lengthwise in a long trough and fitted internally with a screw conveyor and externally with a spiral blade, so disposed that the material to be extracted is conveyed through the cylinder in the opposite direction to that of the water in the trough.—J. H. L.

Mills for pressing juice from fibrous vegetable matter [sugar cane, etc.] ; Three-cylinder ——. G. Nicolai, Pilsen, Austria. Eng. Pat. 10,876, July 27, 1915. Under Int. Conv., July 29, 1914.

Process of producing oxalic acid from sugar and other carbohydrates. Eng. Pat. 14,234. *See* VII.

XVIII.—FERMENTATION INDUSTRIES.

Enzymes of brewers' yeast ; Sensitiveness of some ——. T. Bokorny. Allgem. Brauer- u. Hopf.-Zeit., 1916, **56**, 395—397, 433—434, 465—467. Z. angew. Chem., 1916, **29**, Ref., 319.

Brewers' yeast, after having been in contact with absolute alcohol for several days, exhibits undiminished inverting power when removed from the alcohol. Invertase of yeast is also relatively insensitive to acids. It is destroyed in 24 hours by 1% caustic soda solution but not by 5% formaldehyde. Maltase is injured even by 10% alcohol, and by 1% acetic, lactic, or hydrochloric acid within 24 hours. It is destroyed by 1% caustic soda solution in a few hours, but is not noticeably affected in 24 hours by 0·02% or 0·1% solutions. Formaldehyde acts injuriously at a concentration of 0·1%. Solutions of neutral salts of 10% or higher concentration injure zymase, but at lower concentrations are harmless or, in some cases, exert a favourable action. The activity of zymase is destroyed within 24 hours by 50% but not by 20% alcohol. It is diminished by 0·5% sulphuric acid and destroyed within 24 hours by 1% sulphuric or hydrochloric acid. Lactic, acetic, and butyric acids at 5% concentration destroy the activity within 24 hours, but not at 2% concentration. The zymase activity is destroyed within 48 hours by 0·05% ammonia and within 24 hours by 1% formaldehyde.—A. S.

Wine ; Influence of partial deacidification and of temperature on the decomposition of the acids of ——. H. Müller-Thurgau and A. Osterwalder. Landw. Jahrb. Schweiz, 1915, 391—399. J. Chem. Soc., 1916, **110**, i., 531.

Five 1-litre quantities of self-expressed grape juice were partly deacidified by the addition of 0·6, 1·3, 2·0, 2·66, and 4 grms. of calcium carbonate respectively, and after five hours were transferred to sterilised fermentation flasks and kept at 11° C. in order to prevent decomposition of the acids during the fermentation. When fermentation was complete the wine, filtered from the lees, was placed in 300 c.c. sterilised flasks filled to the neck, and maintained at 15° C. The contents first became quite clear, and then again cloudy at the commencement of the acid decomposition, clarifying once again towards the end of that process. In the strongly deacidified wines this decomposition occurred within a month, but in those deacidified only slightly or not at all, only after about two months. The duration of the process with the latter wines was also longer than with the former ; it varied from ten to twenty days. Whilst the decrease in acidity during the alcoholic fermentation varied on account of the varying content of tartar owing to the different amounts of calcium carbonate that had been added, the fall in acidity during the second fermentation was in every case almost the same, 4·2—4·39%. This, together with the almost uniform volatile acid and lactic acid content, shows that in each case an equal quantity of malic acid had been decomposed, and that no lactic fermentation had occurred. In conformity with the authors' previous experience, the fermentation was exclusively due to *Bacterium gracile*. Tables are appended showing the complete composition of the wines in question. Temperatures of 20°—26° C. were most favourable for the acid fermentation, but temperatures as low as 13°—17° C. were sufficient to complete the action in the course of several months. Temperatures under 10° C. were unfavourable, whilst at 31·5°—36° C. no acid fermentation occurred.

Acetaldehyde ; Formation of —— *in wine during and after fermentation.* H. Müller-Thurgau and A. Osterwalder. Landw. Jahrb. Schweiz, 1915, 408—420. J. Chem. Soc., 1916, **110**, i., 531—532.

The authors have deduced from the results of previous experiments that acetaldehyde appears as an intermediate product in alcoholic fermentation, and are now able to confirm this deduction by combining the aldehyde with sulphur dioxide during the fermentation, thus protecting it from further action. Samples of sterilised grape-juice were fermented and small quantities of potassium metabisulphite added at varying intervals of time. After completion of fermentation the wine contained considerable quantities of combined sulphur dioxide, and the distillate obtained from it after being rendered alkaline with sodium carbonate gave reactions for acetaldehyde. Similar experiments were carried out with solutions of sucrose and of dextrose. Calculated on 100 grms. of fermented sugar, the distillate from four wine samples contained 890, 350, 634, and 454 mgrms., from the sucrose solutions 431 and 879 mgrms., and from the dextrose solution 583 and 1180 mgrms. of acetaldehyde. These quantities naturally do not represent more than a fraction of the acetaldehyde produced, since free sulphur dioxide was only present during a small portion of the total time during which fermentation was going on, whilst acetaldehyde is being formed during the whole period as an essential intermediate product of the sugar degradation. In finished wines, acetaldehyde may be produced by the oxidation of the alcohol; it can be caused either by exposure to the air or by storing in partly filled vessels. Treatment with sulphur dioxide removes it.

Alcoholic fermentation in fruit and grape juice; Prevention of —— by means of sulphurous acid. H. Müller-Thurgau and A. Osterwalder. Landw. Jahrb. Schweiz, 1915, 421—432. J. Chem. Soc., 1916, **110**, i., 532—533. (See also this J., 1915, 1066).

The amount of sulphur dioxide requisite to kill yeast and prevent alcoholic fermentation is not the same for all fruit juices. In certain juices a considerable portion of the added sulphurous acid is rendered inactive by combination with fruit aldehydes (compare preceding abstract), and, moreover, the efficacy of the sulphur dioxide remaining free is variable, depending on the number and type of yeast cells present and the chemical composition of the juice. A higher percentage of tartaric, malic, or tannic acid increases the activity of the free sulphurous acid. Thus the juice from over-ripe grapes with 197 and 168 mgrms. of free sulphur dioxide per litre commenced in some of the flasks to ferment, whilst three samples of juice from early red fruit containing only 106, 136, and 134 mgrms. per litre did not ferment. Similarly with pears, one juice containing 453 mgrms. of sulphur dioxide per litre fermented, whilst another with 82 mgrms. per litre did not. A favourable food medium for the yeast cells increases their powers of resistance. If the sulphurous acid present is insufficient to kill all the cells, the remaining ones will multiply again and cause fermentation; it is not necessary for all the acid present to be oxidised to sulphate before this can occur, nor for the sulphur dioxide to be combined with aldehyde produced by the oxidation of the alcohol, as suggested by Martinand (this J., 1909, 1057). On the other hand, the yeast growth is possible even in the presence of considerable quantities of sulphur dioxide, but when fermentation is scarcely perceptible, aldehyde is formed, not as the result of oxidation, but in consequence of the degradation of sugar (see preceding abstract), and the free sulphur dioxide is then rapidly removed by combination.

Urease; Adsorption of —— and its activity in insoluble form. M Jacoby. Biochem. Zeits., 1916, **74**, 93—96. J. Chem. Soc., 1916, **110**, i., 517.

Soya urease can be adsorbed by fibrin, and can still exert its activity on urea in the adsorbed form. The enzyme is also active when it has been rendered insoluble by treatment with alcohol.

Urease; Auxo-action of amino-acids on ——. M. Jacoby. Biochem. Zeits., 1916, **74**, 105—106. J. Chem. Soc., 1916, **110**, i., 517.

Hippuric acid, unlike glycine, does not act as an auxo-substance to urease, but inhibits slightly its action.

Urease; Action of antiseptic substances on ——. M. Jacoby. Biochem. Zeits., 1916, **74**, 107—108. J. Chem. Soc., 1916, **110**, i., 517—518.

The action of soya urease is not affected by toluene, but is inhibited by mustard oil and by sodium fluoride.

Oxidising enzymes; Chemical nature of the ——. A. W. van der Haar. Arch. Sci. Phys. Nat., 1916, **41**, 312—315. J. Chem. Soc., 1916, **110**, i., 518.

A résumé of experiments previously described, from which the conclusion is drawn that the peroxydase of *Hedera* is a glucoprotein which has an oxidising action that is accelerated catalytically by manganese. Neither the peroxydase of *Hedera* nor the peroxydase of potatoes is coagulated by boiling. In presence of proteins they are separated mechanically when the proteins are coagulated by heat.

Spirits; Production of —— in the United Kingdom.

The Chancellor of the Exchequer announced on July 26 that the production and distribution of home-made spirits in the United Kingdom during the year ended March last was:—

	Proof gals.
Used for methylation	9,539,547
Used in arts and manufactures	1,165,148
Used for fortifying wines, ships' stores, etc.	544,555
Exported	9.186,002
Detained for home consumption (potable)	28,949,519
Distilled	49,135,199
Allowed for deficiencies, etc.	6,503,080

The quantity in bonded warehouses on March 31 was 140.926,120 gals. Of this total 106.730,173 gals. represented Scotland.

XIXa.—FOODS.

Bread crumb: Staling of —— from the physiologico-chemical point of view. I.—III. J. R. Katz. Z. physiol. Chem., 1915, 95, 104—129, 136—146, 147—151. (See also this J., 1913, 304.)

I. The softening of bread crust as the bread becomes stale may be explained simply by absorption of moisture from the air or from the crumb. The changes occurring in the crumb are not explicable by loss of moisture, for crumb becomes stale even when no such loss can take place. The author's experiments indicate that when bread is kept at the ordinary temperature, even if all loss of moisture is prevented, the starch in the crumb becomes harder and loses to a considerable extent its capacity for swelling in cold water, and the amount of water-soluble polysaccharides diminishes. In the gluten, on the other hand, no such changes of hardness, swelling power, or solubility occur. These transformations in the starch commence as soon as the freshly baked bread is cooled, and continue until it is quite stale. No change occurs in the amount of sugars present, and the sweeter flavour of new as compared with stale bread is probably due to the former containing more soluble polysaccharides, on which the saliva acts more rapidly than on insoluble starch. As bread becomes stale there occurs also, probably as a result of the changes in the starch mentioned above, a transference of moisture from the starch granules to the surrounding gluten; the granules shrink and become more readily separable from the gluten, and in consequence the bread becomes more crumbly.

II. During the baking of bread the starch becomes softer, its capacity for swelling in water increases, and the quantity of polysaccharides soluble in cold water augments. These changes proceed in such a way as to suggest an approach to a condition of equilibrium dependent on the temperature; they proceed farther the higher the temperature. The transformations associated with staling (see above) are simply a reversal of those produced by baking, or a return to the condition of equilibrium for low temperatures. Such a reversal may be prevented by keeping the bread hot, provided loss of moisture is avoided. The characteristic transformation of the baking process is thus an incomplete gelatinisation of the starch, which undergoes reversion again at low temperatures (cp. Maquenne and others, this J., 1904, 124, 197, 261).

III. Experiments with starches and flours from various plants indicated that the reversal at low temperatures, of the partial gelatinisation produced by heating with small quantities of water, is common to all starches, though with quantitative differences.—J. H. L.

Bread; Alteration of the microscopic structure of —— on becoming stale. E. Verschaffelt and E. van Teutem. Z. physiol. Chem., 1915, **95**, 130—135.

In new bread the starch granules were found to be closely enveloped by gluten; but after the bread had become stale in a closed vessel (to prevent drying), narrow air spaces were observed between the granules and the gluten, indicating a shrinkage of the former (cp. preceding abstract, *I.*). The air spaces were best observed after staining with aqueous safranine solution. When fresh bread was moistened with water on the microscope slide, many of the starch granules exhibited jerky movements as if under tension, probably owing to the swelling power of the starch (*loc. cit.*) and the absence of air spaces, for no such movements were observed with stale bread.—J. H. L.

Milk: The so-called neutralisation precipitate of cows' ——. L. S. Palmer. J. Assoc. Off. Agric. Chem., 1916, **2**, 4—8.

When the casein of milk is precipitated by acetic acid, and the liquid filtered and neutralised, the precipitate obtained consists essentially of a mixture of di- and tri-calcium phosphates together with a small quantity of protein, probably casein or albumin. The phosphates are possibly derived from the caseinogen of the milk, but attempts to prove this, using casein precipitated by rennet, have so far been unsuccessful. The very small amount of protein contained in the precipitate precludes its being an important factor in the determination of casein or heat-coagulable proteins. —W. P. S.

Milk; Acetone in ——. N. O. Engfeldt. Z. physiol. Chem., 1915, **95**, 337—350.

Acetone may be isolated from milk by distillation, after albumin has been removed by precipitation with tannic acid. The amount in the distillate from fresh milk can be determined by titration with $N/10$ iodine solution, and also by the author's colorimetric method (Berlin. Klin. Wochens., 1915, Nos. 18, 20). For the former method, a burette accurate to 0·02 c.c. is necessary, and the acetone content is given by multiplying the number of c.c. of $N/10$ iodine by 0·000967. Other substances, *e.g.*, phenols, nitrous and nitric acids, which react with iodine, are not present in fresh milk, and alcohol does not react in the cold. For stale milk, it is necessary first to remove reducing agents by distillation with potassium hydroxide and pure hydrogen peroxide, according to the author's method of determining acetone in urine. Milk that has undergone lactic fermentation cannot be tested by the iodine method. The following results in mgrms. per litre were obtained for different kinds of milk: cows' milk 1·45—2·43, mean 1·85; asses' milk 0·48—0·97, mean 0·71; sheeps' milk 0·48—0·68, mean 0·56; goats' milk 0·97—1·45, mean 1·07; human milk 0·48—1·16, mean about 0·57.—E. H. T.

Milk; New way of carrying out the peroxydase reaction in ——. W. Grimmer. Milchw. Zentr., 1915, **44**, 246—247. J. Chem. Soc., 1916, **110**, ii., 403—404.

The use of guaiacol and ethyl hydroperoxide is recommended for the detection of peroxydase in milk, since dilute solutions of these two substances remain stable for several years; they possess, therefore, a distinct advantage over guaiacum tincture and hydrogen peroxide solution. The test is carried out by mixing a few c.c. of milk with two drops of guaiacol solution (1 grm. of guaiacol dissolved in 10 c.c. of alcohol and diluted with water to 100 c.c.) and adding two drops of a 0·1% ethyl hydroperoxide solution. Unheated milk yields a brick-red coloration, whilst boiled milk remains colourless. The ethyl hydroperoxide may be prepared by the method described by Baeyer and Villiger (J. Chem. Soc., 1901, i. 308).

Protein substances; Decomposition products of —— obtained by the action of nitric acid. C. T. Mörner. Z. physiol. Chem., 1915, **95**, 261—309.

The amount of oxalic acid produced by the action of nitric acid upon protein substances depends upon many factors, particularly upon the concentration and the amount of the acid used, the temperature and the period of the reaction. The following percentage yields of oxalic acid (anhydrous) are to be regarded as minimum yields: serum-albumin 28·6, egg-albumin 20·9, casein 26·5, ovomucoid 36·8, hæmoglobin 22·5, keratin (sheeps' wool) 40·9, glutin 28·6. The extent to which the oxalic acid produced is further decomposed depends chiefly on the temperature (there is little or no action in the cold) and on the amount of nitric acid present. Of the primary products of the hydrolysis of proteins, very few (tyrosine, tryptophane, and two others) were decomposed when subjected to the action of nitric acid of 60% or higher concentration, at 80°—90° C. The presence of any considerable quantity of lower oxides of nitrogen, however, caused a reaction in every case, oxalic acid being produced in yields varying from 3% to over 50%. Nitrogen oxides are formed when nitric acid acts upon protein substances, and the conclusion is drawn that the formation of oxalic acid is due to the primary hydrolytic products. In addition to oxalic acid, small quantities of *p*-nitrobenzoic acid (1—3%, crude), terephthalic acid (0·11%, crude), picric acid (0·6%, crude), and a very small amount of benzoic acid, are also formed. *p*-Nitrobenzoic acid is easily obtained by the action of nitric acid, containing free nitrogen oxides, upon phenylalanine, but is not obtained when any other primary constituent of the protein molecule is treated similarly: hence, when *p*-nitrobenzoic acid appears as a product of the action of nitric acid on a protein substance, it may be inferred that the latter contains phenylalanine. From similar observations on the action of nitric acid on tyrosine, phenylalanine, and tryptophane, it is thought probable that the picric acid originates from these primary decomposition products of the protein molecule.—E. H. T.

Maize germs; Some constituents of ——. E. Winterstein and F. Wünsche. Z. physiol. Chem., 1915, **95**, 310—336.

The composition of maize germs is in many respects different from that of wheat, particularly in regard to the absence of crystalline nitrogen-compounds derived from the decomposition of albumin. Further, neither arginine nor glutamic acid (except in the minutest traces) was found in either of the two different samples of maize investigated, but the presence of guanidine, which is absent from wheat, was established, and associated with it was a base of unknown composition, not related to hordenine. The greater part of the nitrogen in the maize germ is present as albumin, and autolytic experiments showed that proteolytic enzymes were absent. The nitrogen content is lower in maize than in wheat, and there is a corresponding difference in the albumin content. On hydrolysis the albumin yields, in addition to the normal products, an asparaginic acid having abnormal properties. Maize germs are comparatively rich in soluble albumin; small amounts of globulins were detected, but attempts to isolate a nucleic acid were unsuccessful. The fat content is high—about four times that of wheat—and the fat contains glycerides of solid and liquid fatty acids, together with sitosterol and phosphatides. A glucoside is most probably present, and pentoses were found in the products of autolysis, indicating the presence of pentosans Inositol phosphate occurs in considerable quantity.—E. H. T.

Lichens as foodstuffs and as fodder; Use of ——. O. Hesse. J. prakt. Chem., 1916, 93, 254—270.

The value of lichens as foodstuffs and as fodder is discussed. Iceland moss gelatin in the form of chocolates, etc., cannot be distinguished from jellies produced from sago or agar-agar. The variety *Cetraria nivalis* has been recommended as a cheap, pleasant tasting foodstuff. Air-dried *Cetraria islandica* contains 13—14% of water and 80% of carbohydrates; the bitter taste is removed by treatment with 1% potassium carbonate solution.—F. W. A.

Biochemical changes in cottonseed in storage. Rather. *See* XII.

New method for the analysis of rancid fats. Issoglio. *See* XII.

Disturbing influence of certain physiologically important substances on the colour reaction between iodine and starch. Clementi. *See* XXIII.

Patents.

Milk; Substitute for ——, *made from soya and arachide and the treatment of the residues.* W. J. Melhuish, Poole, Dorset. Eng. Pat. 9626, July 1, 1915. (See Eng. Pat. 24,572 of 1913; this J., 1915, 196.)

About 200 pints of purified water is heated to 80° C. and made alkaline with 400 grms. of potassium phosphate; a suitable quantity of malted dextrin syrup is then added and 40 lb. of arachis nuts which have been shelled, boiled with sodium carbonate, partially dried, and ground to a coarse powder. The mixture is well stirred and the temperature maintained for half-an-hour. The liquid is then strained and ¼ oz. of butyric acid stirred in gradually. Next about 18 lb. of soya beans is stirred into 100 pints of hot water, a little sodium phosphate added to ensure alkalinity, and the temperature maintained for ¾ hr. The mixture is then strained. The two extracts are drawn into a vacuum pan in the form of a spray. There are also added at the same time a further quantity of dextrin syrup, 250 grains of calcium phosphate, and 500 grains of sodium phosphate. The mixture is boiled for 30 mins. The milk produced is drawn off, strained, and made up to 300 pints. It is treated with a culture of lactic bacteria to produce acidity, pasteurised at 60°—70° C. for 20 mins. and cooled. About 0·1% of citric acid is added to the completed product. The residual meals from the above extractions are dried and used as cattle food.—J. H. J.

Cream, whole milk, or skimmed milk; Process of treating [drying] ——. W. B. Gere, Assignor to Merrell-Soule Co., Syracuse, N.Y. U.S. Pat. 1,188,755, June 27, 1916. Date of appl., Oct. 5, 1912.

A practically sterile milk powder is made by heating milk by injection of live steam, and then immediately spraying the hot milk at a temperature above 160° F. (71° C.) in a desiccating atmosphere.—J. H. L.

Preserving fruits, vegetables, grain, and other organic substances; Process and apparatus for ——. S. A. Kapadia, London. Eng. Pat. 9916, Aug. 14, 1914.

The products of combustion of a flameless surface combustion furnace fired with gas or liquid fuel are drawn by a rotary blower through a water seal to reduce their temperature to 60° F. (15·5° C.). They are then forced successively through a refrigerating chamber where they are cooled to 45°—55° F. (7°—13° C.), and through a desiccating chamber where they are dried. The gas is now passed under pressure into an air-tight chamber containing the material to be preserved, so as to displace the air, and is kept in constant or intermittent circulation through the chamber. Oxygen and gaseous disinfectants may be introduced along with the combustion gases.—J. H. J.

Fruits and vegetables; Apparatus for dehydrating ——. E. C. R. Marks, London. From Air Utilities Co., Inc., New York. Eng. Pat. 100,771, Jan. 26, 1916. (Appl. No. 1274 of 1916.)

The apparatus consists of a casing divided into a series of drying cells connected with an overhead air supply trunk and a lower air delivery trunk through vertical air flues arranged on each side of each cell. The flues are provided with valves and dampers for throwing the cells into and out of the air circuit and for regulating the horizontal level of the air in passing through the cells; also with baffles for delaying the air current. The air used is deprived of moisture, heated to 70° F. (21° C.), and passed through the apparatus until the amount of water absorbed in unit time decreases, when the temperature is raised to 100° F. (38° C.) and subsequently to 150° F. (65·5° C.) until the moisture in the material is reduced to about 5% of the original.—J. H. J.

Meat; Process for the preservation of ——. R. Santillan, Buenos Aires, Argentina. Eng. Pat. 100,775, Feb. 18, 1916. (Appl. No. 2467 of 1916.)

The animal is slaughtered by bleeding from the left carotid artery without breaking its neck. When bleeding has ceased, a 0·5% solution of sodium chloride, at 37·5°—38° C., is injected at ordinary pressure until the solution flows away clear from the jugular vein. The vein is then closed, and a preservative liquid, sodium chloride in water, at the body temperature of the animal is injected under pressure. The artery is then closed, and the carcase stored either whole or cut up.—J. H. J.

Cereal flakes; Puffed —— *and method of preparing same.* Postum Cereal Co., Ltd., Assignees of F. B. Martin, Battle Creek, Mich., U.S.A. Eng. Pat. 13,094, Sept. 13, 1915. Under Int. Conv., Apr. 29, 1915.

The cereal in an air-dry state is seasoned with salt and sugar and cooked under pressure with sufficient water to soften the grains. It is then removed, partially dried, and placed in tubs at the ordinary temperature for some hours to allow the remaining moisture to become evenly distributed in each grain. Then the grains are passed through a flaking machine, producing rather thick flakes. These are roasted at 300° F. (about 150° C.) which hardens the exterior, and then at 440° F. (about 225° C.), when the contained moisture is converted into steam and breaks through the surface, leaving little bubbles or puffs on each side of the flake. The roasting is completed at 380° F. (about 190° C.). The added sugar is caramelised during the process.—J. H. J.

Grain products : Apparatus and process for making ——. J. E. Boss, Toronto, Canada. U.S. Pats. (A) 1,187,702 and (B) 1,187,703, June 20, 1916. Date of appl., Nov. 1, 1913.

(A) The apparatus comprises means for carrying out in succession the operations of the following process. (B) The grain is hydrated, and the grain cells, distended with water, are disrupted by external pressure, so that soluble constituents of the bran transfuse into the liberated cell-contents. The bran is subsequently removed, *e.g.*, after drying and grinding, and the product is converted into flour.—J. H. L.

Flour : Apparatus for maturing and bleaching ——. J. I. Logan, Chicago, Assignor to Industrial Appliance Co. U.S. Pat. 1,188,665, June 27, 1916. Date of appl., Aug. 3, 1914.

The apparatus includes a storage cylinder containing a treating agent gaseous at ordinary temperatures and pressures, and a mechanism for controlling and measuring the flow of gas to the delivery pipe. This mechanism comprises a thin disc with a minute perforation, arranged across the gas duct, against which the pressure of gas is maintained constant at any required value by means of reducing valves, and this pressure is indicated in terms of the rate of flow of gas through the disc.—J. H. L.

Flour ; Process of purifying —— during manufacture. G. T. Smith, South Bend, Ind., U.S.A. Eng. Pat. 9793, July 5, 1915.

See U.S. Pat. 1,154,547 of 1915 ; this J., 1915, 1111.

Wheat and other cereals or cereal products ; Treatment of ——. W. Watson, Assignor to Woodlands, Ltd., Dover. U.S. Pat. 1,189,023, June 27, 1916. Date of appl., July 6, 1915.

See Eng. Pat. 16,664 of 1914 ; this J., 1915, 881.

Treatment of waste water from oil factories. Eng. Pat. 17,915. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Water ; Use of ammonia in the chlorination of ——. J. Race. Lancet, July 8, 1916. Pharm. J., July 22, 1916.

As tested with *B. coli communis*, in raw Ottawa River water, the germicidal value of a solution of ammonium hypochlorite (prepared by the double decomposition of calcium hypochlorite and ammonium oxalate) was found to be 20—30 times that of a solution of calcium hypochlorite containing the same proportion of available chlorine (0·3 part per million). This was traced to the presence of chloramine, apparently formed by the spontaneous decomposition of the ammonium hypochlorite in accordance with the equation, $NH_4OCl = NH_2Cl + H_2O$. Chloramine is known to have a much greater germicidal action than an equivalent of chlorine, and to be produced by the action of ammonia on calcium hypochlorite in dilute solution. Practically no absorption of chlorine was found to occur when water was treated with a mixture of hypochlorite and ammonia. For example, in parallel experiments with Ottawa River water containing 10 parts per million of available chlorine in the form of (a) calcium hypochlorite alone and (b) calcium hypochlorite previously treated with an equivalent of ammonia, the proportions of available chlorine absorbed, at 60° F. (15·5° C.), were (a) 35 and 60% in 5 and 60 mins., and (b) 1·4 and 3·2% in 1 and 20 hrs., respectively. The process has not yet been successfully applied on a practical scale.
—W. E. F. P.

Sewage ; Development of the purification of —— by aeration and growths at Lawrence, Mass. H. W. Clark. J. Ind. Eng. Chem., 1916, 8, 653—651.

At the Lawrence Experimental Station, work has been done both on the activated sludge process (this J., 1914, 523, 1122; 1915, 508, 937 ; 1916, 153, 555) and also in tanks containing pieces of slate spaced apart, filling about 3—7% of the space. Brown and grey spongy gelatinous growths soon form on the slates, and the suspended matter and a large portion of the colloidal matter of the sewage is collected by these growths. Compared with the activated sludge process, the slate tank treatment generally requires more time but less air to give a stable effluent. For example in comparative tests practically the same degree of purification, calculated upon removal of organic matter, was obtained in 10 hours in a slate tank as in 8 hours in an activated sludge tank, and the consumption of air in the former case was 37% of that in the latter.—A. S.

Sewage ; Purification of —— by activated sludge in winter at the Sewage Testing Station, Milwaukee, Wis., U.S.A. W. R. Copeland. J. Ind. Eng. Chem., 1916, 8, 642—643.

The winter temperature of Milwaukee sewage averages about 51° F. (10·5° C.) and occasionally falls to 40° F. (4·5° C.) or lower. By increasing the air supply from 1·6 to 2·3 cub. ft. per gallon of sewage, it has been possible to remove about 90% of the bacteria and suspended matter by the continuous flow, activated-sludge process. The sludge contains about 98% of water, but this can be reduced to 75% by pressing, without addition of lime, and the sludge press-cake is easily handled and can be converted into a fertiliser. On a 10% moisture basis the sludge contains about 5% of nitrogen, calculated as ammonia, 1·75% of available phosphoric acid, and 0·4% of potash. It is estimated that 1,000,000 gallons of Milwaukee sewage, containing about 260 to 440 parts of suspended matter per million, will yield 3000—4000 galls. of sludge containing 98% of water, equivalent to about $\frac{1}{2}$ ton on a 10% moisture basis.—A. S.

Sewage disposal experiments at Brockton, Mass., U.S.A. R. S. Weston. J. Ind. Eng. Chem., 1916, 8, 647—648.

Owing to increase in the amount of sewage, and addition of an increasing amount of shoe-factory waste, the sand filter-beds in use at Brockton, Mass., U.S.A., became overworked and gave unsatisfactory results. Preliminary treatment of part of the sewage by means of a trickling filter proved inadequate as a remedy. It was not found possible to obtain a highly nitrified effluent using the activated-sludge process alone, but the process proved valuable as a means of relieving the overworked filter-beds. When the effluent from the activated sludge process is applied to a sand filter-bed, a highly nitrified final effluent can be obtained at a rate exceeding 200,000 galls. per acre per day (500,000 galls. in a small experimental bed), and the beds remain free from sub-surface clogging.
—A. S.

Packing-house sewage ; Treatment of —— by aeration in the presence of activated sludge. P. Rudnick and G. L. Noble. J. Ind. Eng. Chem., 1916, 8, 651—652.

In an experimental plant at Chicago, packinghouse sewage is aerated for 10 hours in a tank, 10 ft. by 20 ft. by 10 ft., divided by a partition so that the path of flow is 40 ft. long. Sludge containing 99·5% of water, which has been aerated for 3 hours, is introduced with the raw sewage at the rate of 30% of the quantity of sewage. Air is introduced through $\frac{3}{4}$-inch pipes with $\frac{1}{25}$-in. perforations, the pipes being placed at 4 ft. intervals at right angles to the line of flow; the tank has underflow and overflow baffles. The air supply, including that used in siphoning the sludge from one tank to another, is 3 cb. ft. per gallon of sewage. The sewage flows from the aeration tank nto a settling chamber where it remains for 10—60 mins.; the effluent overflows continuously, nd the sludge is siphoned into a storage tank. The effluent is fairly clear, practically odourless, nd non-putrescible for at least 4 days by the nethylene blue test. The treatment removes bout 96% of the albuminoid nitrogen, 71% of the mmonia nitrogen, 66% of the total organic nitro- en, 70% of the organic matter, and 95% of the uspended solids. Calculated to a 10% moisture asis the sludge contains an average of 4·6% of itrogen, 5·5% of fat, 2% P_2O_5, and 0·4% K_2O, but cheap method of reducing the water content to 0% is needed; sludge containing 50% H_2O an be readily and cheaply dried in the usual orms of dryers. Tests with pipes, 14 in. diam., nd 36 ft. and 18 ft. high respectively, indicated at good results can be obtained in tanks up to 5 ft. high. The number of organisms in the udge is increased by aeration for 3—4 hours, ut then falls somewhat if the aeration is con- nued. The organisms grow better at 20° C. than 37° C.—A. S.

annery wastes; Activated-sludge process in treatment of ——. H. P. Eddy and A. L. Fales. J. Ind. Eng. Chem., 1916, **8**, 649—651.

account of experiments on the application of e activated-sludge process to the treatment of ste liquors from a tannery, in which promising ough not entirely satisfactory results have been tained.—A. S.

lysulphides and thiosulphate in lime-sulphur solutions; Separation and determination of ——. S. D. Averitt. J. Ind. Eng. Chem., 1916, **8**, 623—627.

e chief constituents in commercial lime-sulphur utions are calcium polysulphides and calcium iosulphate, other substances being present in gligible quantities. The polysulphides can be composed quantitatively by titration with line or with dilute hydrochloric acid, and the osulphate then determined by titration with line; when acid is used in the first titration, hydrogen sulphide formed can be eliminated boiling, without appreciable decomposition of thiosulphate; methyl orange or methyl red, led towards the end, is used as indicator in the ration with acid. In the double iodine titration thod, sodium nitroprusside can be used as an ernal indicator to ascertain when the sulphide been completely decomposed: a crystal of roprusside is added when the solution has ome very faintly yellow by addition of iodine, l the titration continued until the purple colour ust discharged. The total sulphur is taken as sum of the polysulphide sulphur and thio- phate sulphur. Another method of determining osulphate in lime-sulphur solutions consists in dising both the polysulphide and thiosulphate titrating with iodine, adding a slight excess of ium sulphide to reconvert tetrathionate into sulphate, making slightly acid with dilute lrochloric acid, boiling to expel hydrogen hide, and titrating the thiosulphate with ine.—A. S.

Patents.

rifier. S. Brickman, Assignor to A. Cohen, San rancisco, Cal. U.S. Pat. 1,188,893, June 27, 916. Date of appl., Oct. 11, 1915.

apparatus consists of a chamber of double ical form with a filter screen across the abutting bases of the two cones. The liquid to be purified enters at the bottom by a vertical pipe with a hooded mouth, and leaves at the top through the apex of the cone. The impurities are retained in the lower cone and are removed through a pipe from the inverted apex. A cylindrical casing surrounding the chamber is fitted with means for circulating hot water round the lower cone and cold water round the upper cone.—J. H. J.

Insecticide [lead arsenate]; Manufacture of ——. F. P. Dewey, Washington, D.C. U.S. Pat. 1,188,740, June 27, 1916. Date of appl., Sep. 18, 1909.

An arsenide is oxidised and the arsenic acid produced is neutralised with caustic soda, dissolved in water, the solution filtered from the insoluble residue, lead acetate added, and the insoluble lead arsenate separated. The filtrate from the lead arsenate is decomposed with sulphuric acid, and the acetic acid liberated is converted into lead acetate which is used over again.—J. H. J.

Filtration, aeration, and gasification of liquids; Apparatus for the ——. T. K. Irwin, London. U.S. Pat. 1,189,114, June 27, 1916. Date of appl., Sept. 8, 1915.

See Eng. Pat. 19,901 of 1914; this J., 1915, 885.

Sewage-sludge; Gasification of ——. N. Testrup, London, and T. Rigby and G. W. Andrew, Dumfries, Assignors to Wetcarbonizing, Ltd., London. U.S. Pat. 1,189,638, July 4, 1916. Date of appl., July 11, 1914.

See Eng. Pat. 16,800 of 1913; this J., 1914, 938.

Treatment of waste water from oil factories. Eng. Pat. 17,915. *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Opium assay; Comparison of the methods of —— of the United States and British Pharmacopœias. C. E. Smith. Amer. J. Pharm., 1916, **88**, 292—301.

The U.S.P. (8th Rev.) and the B.P. (1914) methods for the assay of opium showed no marked differences in the amount of morphine in a sample of normal opium. The crude precipitated morphine obtained by both methods contained about 2·3% of its weight of codeine, as well as variable quantities of precipitated substances, such as calcium ammonium meconate, insoluble in both alcohol and lime water, which, if the crude alkaloid be subsequently titrated, neutralise mineral acid and hence are returned as morphine. These sources of error may be avoided by extracting the crude morphine obtained from 5 grms. of opium with about 50 c.c. of neutral absolute alcohol, filtering off and washing the insoluble matter with alcohol, and titrating the filtrate with *N*/10 acid, using methyl red as indicator. The alcohol is then evaporated from the titrated solution, a slight excess of caustic alkali is added to convert the morphine into morphinate, the alkaline solution extracted with chloroform, the residue from the chloroform solution titrated with C *N*/10 acid, and the amount required deducted from the amount required in the first titration.—T. C.

Alkaloids of some Egyptian Solanaceæ. F. Hughes. Ministry of Agric., Egypt. Techn. Sci. Service, Bull. 3, 1916. J. Chem. Soc., 1916, **110**, i., 536. (Compare Dunstan and Brown, this J., 1898, 1177; 1901, 66.)

The Egyptian *Hyoscyamus muticus* may contain only 0·6% of alkaloid if collected after the ripening of the seed, and from 1·5—2% about the time of flowering. Great care is necessary in drying the material. A sample of expressed juice which was evaporated under reduced pressure was found to have lost the whole of the alkaloid by hydrolysis.

Algerita root [; *Alkaloids in* ——]. M. C. Hart. Amer. J. Pharm., 1916, **88**, 301—302.

Algerita root, from *Odostemon trifoliatus* (Moric.) Heller (*Berberis trifoliatus*, Moricand), a shrub growing most abundantly in Western Texas, New Mexico, and Mexico, yielded 1·49 % of berberine, and about 0·1 % of associated alkaloids but no hydrastine.—T. C.

Rhamnus barks : Analysis of ——. O. Tunmann. Apoth.-Zeit., 1915, **30**, 493—496. J. Chem. Soc., 1916, **110**, ii., 404. (Compare this J., 1916, 273.)

A weighed quantity of 1·6 grms. of the dry, powdered bark is boiled with 100 grms. of sodium hydroxide solution (a 4 % solution in the case of *Rhamnus frangulus* and *R. carniolicus*, and a 3 % solution with *R. purshianus* and *R. catharticus*), shaken for ten minutes, allowed to settle, and the liquid portion filtered. The insoluble portion is again shaken for ten minutes with 60 grms. of the sodium hydroxide solution, filtered, and washed with sodium hydroxide solution and water. The united filtrates and washings are acidified, shaken for thirty minutes with 160 grms. of chloroform, and, after two hours, the chloroform layer is separated, filtered, and 120 grms. of it is shaken with 120 grms. of the sodium hydroxide solution. The alkaline solution is filtered. 100 c.c. of the filtrate is acidified with hydrochloric acid, and, after about fifteen hours, the precipitate formed is collected on a weighed filter, washed with 1 % hydrochloric acid, dried at 60° C., and weighed. The following quantities of anthraquinones were obtained from the various barks : *R. frangulus*, 3·8 % ; *R. carniolicus*, 4·1 % ; *R. purshianus*, 1·8 % ; *R. catharticus*, 0·8 % to 2·7 %. In the case of *R. catharticus*, the quantity of anthraquinones appears to increase with the age of the bark. The precipitates obtained are not quite free from ash. If *frangula* bark is shaken with cold sodium hydroxide solution, the foam produced is coloured red ; *sagrada* bark yields a light, brown-coloured foam under similar conditions.

Volatile oil from Liquidamber formosana Lance. K. Kafuku. J. Chem. Ind., Tokyo, 1916, **19**, 516—520.

The leaves and twigs of the plant yielded about 0·05 % of a volatile oil having a pale, greenish-yellow colour and terpenic odour ; sp.gr. 0·8655 at 20° C. ; $n_D^{20} = 1\cdot4755$; $\alpha_D = -3\cdot3°$ (100 mm.) ; relative viscosity $\eta = 1\cdot69$ at 20° C. ; acid value, nil ; ester value, 5·9 ; ester value after acetylation, 25·2. The oil consisted chiefly of terpenes : camphene, *a*-pinene, and dipentene were identified with certainty, while nopinene and a phellandrene were also indicated. Traces of aldehydes or ketones, partially unrecoverable from bisulphite compounds, were also present.
—W. E. F. P.

Chloropentanes ; Hydrolysis of —— *as affected by high pressure. Synthetic fusel oil.* H. Essex, H. Hibbert, and B. T. Brooks. J. Amer. Chem. Soc., 1916, **38**, 1368—1373. (See this J., 1915, 170.)

Monochloropentane (1-, 2-, or 3-) was heated in a steel bomb under pressures varying from 240 to 6000 lb. per sq. inch, and at temperatures between 190° and 300° C., with various hydrolytic agents. The yield of amyl alcohol was practically the same with sodium carbonate as with sodium hydroxide, and sodium acetate gave a higher yield than either, under the same conditions. When glacial acetic acid was used as a solvent, the more stable amylacetate was obtained in larger yields and at much lower pressures ; but anhydrous sodium acetate gave better results than the free acid. The amount of diamyl ether formed in these experiments was small, never exceeding 8 %. When 213 grms. of the chloropentane was heated with 740 c.c. of 25 % sodium hydroxide for 8½ hours at 250° C. under 1200 lb. pressure, the yield of fusel oil was 20·5 % ; the maximum yield, 38 %, was obtained with 580 c.c. of the alkali at 240° C. under 3300 lb. pressure. Sodium carbonate (223 grms.) gave with 300 grms. of the chloropentane a yield of 51·2 % at 235° C. under 6000 lb. pressure. The same amount of chloropentane heated alone with 600 c.c. of water for 6 hours at 250° C. and at a pressure of 1700 lb., gave 23 % of the alcohol. The addition of cuprous chloride or of basic lead acetate to the reaction mixtures did not affect the rate or extent of the action. The high pressures were produced by using 300—500 c.c. of ether in the bomb.—E. H. T.

Ethylene ; Polymerisation of ——. De Montmollin. Bull. Soc. Chim., 1916, **19**, 242—247.

The oil (" ethylene petrol ") which collects in the receiver when ethylene is prepared by the action of phosphoric acid on alcohol (Newth, this J., 1901, 757), has been found to be a complex mixture of hydrocarbons, mainly polymethylenes (cyclohexane homologues) together with saturated and unsaturated aliphatic hydrocarbons and aromatic hydrocarbons. The following were isolated in a state of purity : di-isopropyl (b.pt 58°—59° C.), dimethyldiethylmethane (b.pt. 86°—87° C.), hexahydro-*m*-xylene, and hexahydro-*p*-xylene ; other hydrocarbons, such as hexahydrocumene, hexahydrocymene, decanaphthene, dodecanaphthene, and tetradecanaphthene, were shown to be present but were not isolated in a pure condition.—F. W. A.

Iodo-albumin. A. Oswald. Z. physiol. Chem. 1915, **95**, 351—352.

When albumin, *e.g.*, casein, is made to combin with iodine in the cold, and an excess of th halogen is avoided, the product has a snow-whit colour and is not affected by light. Commerciall pure casein is dissolved in water containing th requisite amount of caustic alkali, the liquid i cooled to 0°—1° C., and then an excess of alkal is added to unite with the hydriodic acid liberate in the next stage. A solution of iodine in potassium iodide, cooled to the same temperature, i added slowly and with constant agitation until sample removed from the main bulk is found t contain excess of the halogen. When this exces has disappeared, more iodine solution is introduced, and this is repeated until the excess remain after standing some time. Thereupon the reactio mixture is cooled to 0°—1° C. (when the exces again disappears), and then dialysed in parchmen tubes until the circumambient distilled water i free from iodide. The iodo-albumin is then precipitated by adding dilute acetic acid ; it shoul be dried over sulphuric acid in an evacuate desiccator and then powdered. So prepared dissolves readily in dilute alkalis.—E. H. T.

Hydrosols of mercury and of its oxygen compound C. Amberger. Kolloid Zeits., 1916, **18**, 97—10 J. Chem. Soc., 1916, **110**, ii., 380—381.

Stable, therapeutically active, colloidal mercu can be obtained by the use of albumins or the products of decomposition as protective agent Solid hydrosols containing up to 80 % of mercu have been prepared by the addition of a soluti of mercuric chloride to mixtures of glutin or dextr with pyrogallol, catechol, or certain aminophenol whereby a yellowish-white precipitate is obtaine On the addition of alkali reduction takes plac and colloidal mercury is obtained. If glutin dextrin is mixed with a solution of an alkali a a mercuric salt added, colloidal mercuric oxide is obtained. By the reaction of colloidal mercury with colloidal mercuric oxide, prepared as described above, stable preparations of colloidal mercurous oxide are obtained.

Colloidal carbon and the decomposition of organic liquids by the electric arc. Tarczynski. *See* VII.

Titration of oxalic acid with methyl orange as indicator. Bruhns. *See* XXIII.

Patents.

Readily resorbable, durable, non-hygroscopic lime-preparation; Manufacture of a ——. H. Sefton-Jones, London. From J. A. Wülfing, Berlin. Eng. Pat. 17,274, Dec. 8, 1915.

A double lactate of sodium and calcium, containing 2 mols. of the sodium salt to 1 mol. of calcium salt and 4 mols. of water of crystallisation, is non-hygroscopic and suitable for supplying calcium to the body for medicinal purposes. It is prepared, for example, by mixing 238 grms. of calcium lactate containing 9% of water, with 280 grms. of sodium lactate syrup containing 20% of water, the mixture gradually solidifying.—B. V. S.

Ethyl ether; Purifying ——. G. Michaelis, Albany, N.Y. U.S. Pat. 1,189,602, July 4, 1916. Date of appl., Apr. 23, 1915.

Commercially pure ether is boiled with caustic alkali in a vessel fitted with a reflux condenser and stirring apparatus, until free from all the usual impurities.—B. V. S.

Colloidal solutions in organic substances not miscible with water; Process of producing ——. H. Karplus, Berlin. U.S. Pat. 1,189,696, July 4, 1916. Date of appl., June 26, 1915.

See Eng. Pat. 8641 of 1915; this J., 1916, 823. To obtain a colloidal solution of silver in vaseline, sodium naphthenate is dissolved in a silver hydrosol, and is then converted into a naphthenate insoluble in water and soluble in vaseline; the precipitate, which carries down the colloidal silver, is filtered off, dried, and mixed with vaseline.

Methyl chloride and methylene chloride; Process of manufacturing ——. B. S. Lacy, Sewaren, N.J. U.S. Pat. 1,190,659, July 11, 1916. Date of appl., Sept. 28, 1914.

Chlorine gas (1 vol.) is caused to interact with methane (from 3 to less than 10, preferably 4—8, vols.) at 400° to 600° C., and the heat of the reaction is utilised to maintain the required temperature without application of external heat.—B. V. S.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Photographic colour printing process. J. E. Thornton, London. Eng. Pat. 8300, June 4, 1915. Addition to Eng. Pat. 13,711, June 5, 1914 (this J., 1915, 818).

The process described in the chief patent for the production of coloured pictures on a paper or other opaque support, is extended to the formation of transparencies by the use of glass or similar support. Where a regular pattern screen is used in the formation of a kinematograph film, the position of the pattern, but not of the picture, in relation to the perforations is varied from one picture to the next so as to prevent the pattern being visible. The fineness of grain recommended is from about 1000 to the inch for ordinary transparencies to 150—200 to the inch for kinematograph films.—B. V. S.

Developing compositions. T. J. Brewster, Chester, Pa., U.S.A. Eng. Pat. 9331, June 25, 1915.

By the use of a developer containing *p*-phenylenediamine and a nitrite, development over a much wider range of exposures than usual is possible, passable results being obtained with extreme under-exposure or with extreme over-exposure. A formula containing 10 grains *p*-phenylenediamine, 10 grains sodium sulphite, 10 grains sodium nitrite, and 2 grains sodium carbonate to 8 oz. water is given as an example.—B. V. S.

Photographic reproductions; Preparation of ——. J. G. Capstaff, Rochester, N.Y., U.S.A. Eng. Pat. 13,430, Sept. 21, 1915. Under Int. Conv., Sept. 21, 1914.

The images of two positives taken from two colour negatives are projected simultaneously on to opposite sides of a film coated on both sides with sensitive emulsion. The resultant negatives are converted into coloured positives by a suitable process, such as that described in Eng. Pat. 13,429 of 1915 (this J., 1916, 868). The method is particularly adapted to the production of coloured kinematograph films. The first negative is taken through alternate red and green screens and a positive taken from this. The positive is passed through the double gate of a duplex kinematograph apparatus, two pictures (one "red" and one "green") at a time, and by a suitable arrangement of mirrors or prisms the images are projected simultaneously on to opposite sides of a kinematograph film sensitised on both sides.—B. V. S.

Colour photograph or film and method of producing same. F. E. Ives, Philadelphia, Pa. U.S. Pat. 1,188,939, June 27, 1916. Date of appl., Dec. 14, 1915.

The complete picture consists of three differently coloured pictures in register in the same gelatin film. After formation of the first (red) image photographically, the film is sensitised with bichromate, exposed, and the second image coloured blue-green by selective absorption of a dye; the third (yellow) image is transferred by imbibition from a preformed image on a separate support. —B. V. S.

Colour photography and colour printing. J. and E. Rheinberg, London. U.S. Pat. 1,191,034, July 11, 1916. Date of appl., Aug. 31, 1914.

See Eng. Pats. 22,938 of 1913 and 22,764 of 1914; this J., 1914, 1116; 1915, 513.

XXII.—EXPLOSIVES; MATCHES.

Nitrogen in nitro-substitution compounds; Kjeldahl modification for determination of ——. W. C. Cope. J. Ind. Eng. Chem., 1916, 8, 592—593.

The following method gives good results with picric acid and nitro-derivatives of toluene, but not with tetranitro-aniline, tetranitromethylaniline and dinitronaphthalene. About 0·5 grm. of the substance is dissolved in 30 c.c. of 96% sulphuric acid containing 2 grms. of salicylic acid, in a Kjeldahl flask, and 2 grms. of zinc dust is added, in small portions, with cooling. After standing for 1½—2 hours, with shaking at intervals of 10—15 mins., the flask is left overnight, then heated over a small flame until fumes are no longer evolved. The solution is boiled for 1½—2 hours, cooled slightly, and after adding 1 grm. of yellow mercuric oxide, it is again boiled for 1—1½ hours, cooled, treated with 7·5 grms. of potassium sulphate and 10 c.c. of sulphuric acid, and again boiled for 1½—2 hours; if the solution is not clear and almost colourless, 1 grm. more of potassium sulphate is added, and boiling continued for a further ½—1 hour. After cooling and adding 250 c.c. of water, the solution is treated with 25 c.c. of potassium sulphide solution (80 grms. per litre), 1 grm. of granulated zinc, and 85—90 c.c. of sodium hydroxide solution (750 grms. per litre), and the ammonia distilled off.—A. S.

Patents.

Blasting cartridges using liquid air. W. Weber, Hayingen, Germany. Eng. Pat. 18,024, Dec. 24, 1915.

The liquid air is introduced into cartridges of the type described in Eng. Pat. 8607 of 1915 (U.S. Pat. 1,157,270; this J., 1916, 276) immediately before their insertion into the shot hole.—C. A. M.

Nitro-starch explosives. J. B. Bronstein and C. E. Waller, Allentown, Pa., Assignors to Independent Non-Freezing Powder Co., Newark, N.J. U.S. Pats. (A) 1,188,244, (B) 1,188,245, and (C) 1,188,246, June 20, 1916. Dates of appl., Aug. 7, 1913 (renewed Jan. 8, 1916), July 1, and July 6, 1914.

(A) Nitro-starch is incorporated with not more than 35% of a mixture of ammonium nitrate and trinitrotoluene, with or without the addition of a hard, granular, readily oxidisable carbonaceous material (not exceeding 10% of the total weight), barium nitrate (not exceeding 40%), and sulphur (not exceeding 10%). (B) Nitro-starch is incorporated with not more than 10% of granular cereal screenings or other carbonaceous material, and sufficient oxygen-conveying substance to yield an excess of oxygen, with or without sulphur. (C) Nitro-starch is incorporated with 20 to 40% of barium nitrate, with or without sodium nitrate and sulphur (not exceeding 8%).—C. A. M.

Explosives; Manufacture of primary ——. R. Calvet, Barcelona, Spain. U.S. Pat. 1,189,238, July 4, 1916. Date of appl., June 6, 1913.

See Eng. Pat. 9597 of 1913; this J., 1913, 960.

XXIII.—ANALYSIS.

Potassium bichromate as an analytical standard. G. Bruhns. J. prakt. Chem., 1916, **93**, 312—338. (See this J., 1916, 618.)

The assertion of Wagner that the bichromates have a stronger oxidising action on hydrogen iodide than monochromates, and that thereby the "excess value" of the former compared with sodium chloride or other reliable analytical standard can be explained, was not confirmed. Further, the hypothesis that chromic acid has an activating effect on the action of dissolved oxygen on hydrogen iodide and gives lower results if the oxygen is previously expelled from the solution by carbon dioxide, is regarded as quite unjustified, as a diminished value of only 0·012% was found, a figure which lies within the limits of experimental error. From a series of experiments on the time reaction between very dilute bichromate solutions and hydrogen iodide, the conclusion is drawn that in order to accelerate the oxidation and prevent a subsequent liberation of iodine, it is preferable to increase the concentration of the acid rather than that of the iodide. Thus practically correct titrations were obtained after 5 mins. with dilute bichromate solutions to which only 1 c.c. of *N*/2-potassium iodide, but 10 c.c. of 9·2 *N*-sulphuric acid, or 6 *N*-hydrochloric acid, were added. The use of hydrochloric acid is preferable, as the same quantity of sulphuric acid causes a considerably greater after-liberation of iodine.—G. F. M.

Oxalic acid; Titration of —— with methyl orange as indicator. G. Bruhns. Z. anal. Chem., 1916, **55**, 321—340.

The bicarbonates of alkaline-earth metals, including magnesium, may be titrated with oxalic acid, using methyl orange as indicator, if alkali metals are only present in small amounts. The determination of the alkalis alone or in presence of boric or carbonic acid by means of oxalic acid, using methyl orange as indicator, is made possible not only by the addition of calcium, strontium, or barium chloride, but also by the addition of zinc, cadmium, or manganous sulphate, or silver or lead nitrate; these latter may also be used in the determination of citric and tartaric acids by means of alkali, using methyl orange as indicator. Ammonia may also be titrated with oxalic acid, using methyl orange as indicator, after addition of calcium or barium chloride. *N*/10 Ammonia solution to which 35 grms. of crystallised boric acid per litre has been added is quite stable. In preparing standard oxalic acid solutions, distilled water free from carbon dioxide must be used.
—F. W. A.

Precipitates; Molecular transformations of ——. A. Villiers. Ann. de Chim., 1916, **5**, 109. J. Pharm. Chim., 1916, **14**, 49—51.

Many precipitates, particularly metallic sulphides, when freshly precipitated are in an unstable form, termed the protomorphic state, in which they possess properties differing from those they possess in the final state to which they gradually pass. Thus nickel and cobalt sulphides at the moment of formation are soluble in hydrochloric acid. The rate of change from the protomorphic to the final state depends on the nature of the substance and on the temperature, the concentration, and the presence of soluble salts. Increase of temperature or of concentration, or addition of soluble salts, or increase of concentration by freezing the aqueous suspension increases the rate of change to the final state. (See also this J., 1895, 373, 389.)—T. C.

Aluminium; Determination of —— as oxide. W. Blum. J. Amer. Chem. Soc., 1916, **38**, 1282—1297.

A detailed study of all the factors concerned in the estimation of aluminium as oxide has led to the recommendation of the following method of procedure. The solution containing the aluminium salt (in amount equivalent to 0·10 grm. alumina) is treated with ammonium chloride in the proportion of at least 5 grms. to 200 c.c. of solution, a few drops of a 0·2% alcoholic solution of methyl red are added, and the liquid is heated until it just boils. Dilute ammonia solution is introduced drop by drop until the solution becomes yellow, whereupon the liquid is boiled for 1—2 minutes and then filtered immediately. The precipitate is washed thoroughly with a hot 2% solution of ammonium chloride or nitrate. A platinum crucible is used for the ignition, and after the carbon has been burnt off, it is heated with a blast flame for 5 minutes, then covered immediately and cooled in a desiccator. A second heating for a like period is recommended. The weighings must be performed with the crucible well covered. Experiments made with a hydrogen electrode and with various indicators showed that aluminium is precipitated completely by ammonia when the hydrogen ion concentration is reduced to $10^{-6\cdot5}$—$10^{-7\cdot5}$, and that this point is given approximately by the colour changes of methyl red and of rosolic acid. The presence of ammonium chloride during the precipitation reduces the solubility of the hydroxide and tends to coagulate it. The addition of glycerol or of tannic acid is not recommended, but macerated filter paper aids filtration, especially of large amounts of precipitate. The conditions of precipitation are suitable for the co-precipitation of ferric iron, and for the separation of both metals from barium, strontium, calcium, and magnesium. The addition of a little ammonia to the wash-water is not advised. The covering of the crucible during drying and weighing is necessary, as alumina is decidedly hygroscopic; 0·10 grm. of ignited material absorbed 1 mgrm. of moisture in 5 minutes. When the amount of oxide does not exceed 0·1—0·2 grm., heating with the blast flame for longer than 5—10 minutes is unnecessary; and the presence of ammonium chloride during ignition causes no appreciable loss of material.—E. H. T.

Calcium and strontium; Determination of —— in the presence of phosphoric acid and a small amount of iron. O. B. Winter. J. Ind. Eng. Chem., 1916, 8, 603—604.

McCrudden (this J., 1910, 170) found that calcium could be determined in presence of phosphoric acid and small quantities of iron by precipitating it very slowly as oxalate in a boiling solution containing a small quantity of free hydrochloric acid: the precipitate is coarsely crystalline and does not appear to occlude soluble salts. The author found that this method gives low results for strontium, but accurate results can be obtained by adding alcohol after precipitating as oxalate. If both calcium and strontium are present, the precipitate is ignited, the oxides dissolved in nitric acid, the solution evaporated, and the dehydrated nitrates treated with alcohol and ether to separate the calcium and strontium (U.S. Dept. Agric., Bureau of Chem., Bull. 162, 44).—A. S.

Iodine and starch; Disturbing influence of certain physiologically important substances on the colour reaction between ——. A. Clementi. Arch. Farm. Sperim., 1915, 20, 258—268. J. Chem. Soc., 1916, **110**, ii., 400.

The blue iodine-starch coloration is destroyed by furfural. The velocity of decolorisation is directly proportional to the amount of furfural and inversely proportional to that of iodine, and with a large quantity of iodine or a very small quantity of furfural decolorisation is not produced. Certain proteins (albumins, globulins, plant proteins, albuminoids, and phosphoproteins) also cause a more or less rapid decolorisation. Glycine, alanine, leucine, and asparagine do not possess this property, but tyrosine and adrenaline probably do.

Determination of vanadic acid after reduction by metallic silver. Edgar. *See* VII.

New method for determination of radioactivity in minerals. Sabot. *See* VII.

New method for the analysis of rancid fats. Issoglio. *See* XII.

Identification of croton oil. Comte. *See* XII.

New way of carrying out the peroxydase reaction in milk. Grimmer. *See* XIXa.

Separation and determination of polysulphides and thiosulphate in lime-sulphur solutions. Averitt. *See* XIXb.

Comparison of the methods of opium assay of the United States and British Pharmacopœias. Smith. *See* XX.

Analysis of Rhamnus barks. Tunmann. *See* XX.

Kjeldahl modification for determination of nitrogen in nitro-substitution compounds. Cope. *See* XXII.

Patents.

Specific gravity measuring means. H. P. Dodge, Toledo, Ohio. U.S. Pat. 1,189,431, July 4, 1916. Date of appl., June 30, 1913.

A tubular float, closed at the top and open at the bottom, has air in its upper part, and floats in an upright position, partly submerged, in the liquid to be tested. It is free to move vertically relative to a fixed tube which projects vertically upwards through the open end of the float into the air-space at the top. The other end of the fixed tube communicates with a liquid pressure gauge calibrated to show specific gravities, for as the float rises and falls according to the densities of the liquids under test, the pressure of the air in the float, and therefore the indications of the gauge, undergo corresponding change.
—J. H. L.

Method of determining the total available heat of gaseous fuel. U.S. Pat. 1,189,300. *See* IIa.

Trade Report.

Trade after the war. Committee appointed to consider commercial and industrial policy.

The Prime Minister has appointed a Committee to consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the Economic Conference of the Allies, and to the following questions:—(*a*) What industries are essential to the future safety of the nation: and what steps should be taken to maintain or establish them. (*b*) What steps should be taken to recover home and foreign trade lost during the war, and to secure new markets. (*c*) To what extent and by what means the resources of the Empire should and can be developed. (*d*) To what extent and by what means the sources of supply within the Empire can be prevented from falling under foreign control.

The Committee is composed as follows:—The Right Hon. Lord Balfour of Burleigh, K.T., G.C.M.G. (Chairman), Mr. Arthur Balfour, Mr. H. Gosling, Mr. W. A. S. Hewins, M.P., Mr. A. H. Illingworth, M.P., Sir J. P. Maclay, Bart., The Right Hon. Sir A. Mond, Bart., M.P., Mr. Arthur Pease, Mr. R. E. Prothero, M.P., Sir Frederick H. Smith, Bart., Mr. G. J. Wardle, M.P., together with the following gentlemen who are presiding over Board of Trade Committees on the position of important industries after the war:—Sir H. Birchenough, K.C.M.G., Lord Faringdon, Sir C. G. Hyde, The Hon. Sir C. A. Parsons, K.C.B., F.R.S., Lord Rhondda, Mr. G. Scoby-Smith. Mr. Percy Ashley, of the Board of Trade, and Mr. G. C. Upcott, of the Treasury, have been appointed Secretaries to the Committee.

Prohibited exports. Order in Council, Aug. 15, 1916.

The following headings have now been added to the list of prohibited exports (see this J., 1916, 620):—(2) Cadmium, alloys of cadmium, and cadmium ore; (1) cryolite; (1) lead coated sheets; (3) linoleum; (2) silico-spiegel. The exportation of tin plates and terne plates and receptacles made therefrom is now prohibited to all destinations.

Prohibited imports. Notification No. 6.

The following rulings and decisions have been arrived at:—*Not prohibited.* Aluminium powder; leather board. *Prohibited.* Aluminium tanks, cylinders, pipes, and parts of machines made of aluminium; felspar.

Chemical, drug, and dye manufacture in Japan. Board of Trade J., July 6, 1916.

The Japanese Home Office has been encouraging the production of chemicals and drugs in Japan in order to make up the shortage in the imports of these goods resulting from the European war. As the result of a recent official investigation it is stated that the following, amongst other chemicals and drugs, are now being produced in Japan:—Acetanilide, acetic acid, acetic anhydride, aloin, alum, ammonia, ammonium oxalate, antipyrine, aspirin, barium chloride, benzol, bismuth subnitrate, bromine, calcium carbonate, calcium chlorate, calcium sulphate, carbon bisulphide, castor oil, caustic soda, citric acid, creatine, crude arsenious acid, crude sodium carbonate, digitalin, ether, ethyl alcohol, formalin, glycerin, hydrochloric acid, ichthyol, iodine, iodoform, lactic acid, magnesium carbonate, magnesium oxide, magnesium sulphate, menthol crystals, metallic sodium, morphine hydrochloride, naphthalene, nitric acid, opium, peppermint oil, phenacetin, protargol, phosphoric acid, quinine hydrochloride, salicylic acid, salol, sodium bicarbonate, sodium peroxide, sodium salicylate, saltpetre, sulphuric acid, tannic acid, and yellow prussiate.

The enormous rise in the price of dyestuffs has caused dye-making concerns to be started in various places in Japan. The production of vegetable dyes, for some time neglected, has been recommenced and the processes of making synthetic dyes are being studied. Already the manufacture of synthetic black and brown dyes has been started on a small scale. The output of phosphorus by Japanese works is increasing, as is also the production of sulphate of ammonia. The total quantity of sulphate of ammonia which will be manufactured in Japan this year is estimated to be 41,800 tons. It is considered that the Japanese demand for oxygen for industrial purposes can be nearly satisfied by the output of Japanese companies, which is said to amount to about 2,000,000 cubic feet per annum.

Books Received.

Standard density and volumetric tables. U.S. Bureau of Standards, Circular No. 19. Fifth edition. Mar. 30, 1916. 67 pages. Govt. Printing Office, Washington. Price 15 cents.

This circular contains tables of specific gravities of solutions of ethyl and methyl alcohols, sucrose, and sulphuric acid, conversion tables for Baumé hydrometers, tables of temperature corrections and of the data used in graduating hydrometers and in density and specific gravity determinations.

Invar and related nickel steels. U.S. Bureau of Standards. Circular No. 58. Apr. 4, 1916. 68 pages. Govt. Printing Office, Washington. Price 10 cents.

Sampling and analysing flue gases. By H. Kreisinger and F. K. Ovitz. U.S. Bureau of Mines. Bull. 97. 70 pages. Govt. Printing Office, Washington. Price 15 cents.

Vocabulary of Indian Medicinal Substances and Drugs. By C. M. Gupta. Khosla Bros., Railway Road, Lahore. xiv. + 229 pages, 9¾ × 6 in. Price 11s. 4d. (8R. 8A.).

The book commences with an index giving the names, botanical, native, and British, of all the drugs dealt with, following which is the vocabulary proper, arranged alphabetically according to the Urdu or Bhasha names, with their equivalents in Sanskrit, Arabic, Persian, and English, together with a very brief description of each. Other sections of the book give, in the same languages, the various species and parts of plants used in medicine, names of medicinal preparations, and medical terminology.

A Senior Experimental Chemistry. By A. E. Dunstan and F. B. Thole. Methuen and Co., Ltd., 36, Essex Street, London, W.C. 522 pages, 7⅛ × 4½ in. Price 5s.

A textbook for students of the upper forms of Secondary Schools and in Technical Institutes. A brief introduction to chemical theory is followed by chapters on the various elements and their compounds, numerous experiments being suggested. There are appendices dealing with qualitative and volumetric analysis and giving the melting and boiling points of the commoner elements.

Digest of Comments on the Pharmacopœia of the United States of America and on the National Formulary for 1914. By M. I. Wilbert. Hygienic Laboratory, Bull. No. 105. Government Printing Office, Washington. 516 pages, 9 × 5¾ in. Price 50 cents.

Metal Mine Accidents in the United States during 1914. By A. H. Fay. U.S. Bureau of Mines. Tech. Paper 129. 96 pages, 9¼ × 5⅞ in.*

Some Engineering Problems of the Panama Canal in their relation to Geology and Topography. By D. F. MacDonald. U.S. Bureau of Mines, Bulletin 86. 88 pages, 9⅛ × 5⅞ in.*

La Science Française. Ministère de l'Instruction Publique. In two vols. 800 pages, 8¾ × 5¾ in.

These volumes were prepared by the French Minister of Public Instruction for the International Exposition at San Francisco in 1915, and they give brief accounts of the contributions which France has made to scientific progress in its various branches. The work is illustrated with numerous portraits, including those of Lavoisier and Pasteur, and contains a preface by M. Poincaré.

Summary Report of the Mines Branch of the Department of Mines for 1914. Canada Dept. of Mines. Report No. 346. 232 pages and 12 plates, 9¾ × 6½ in. Price 25 cents.

Canada: the Country of the Twentieth Century. By Watson Griffin. Department of Trade and Commerce, Ottawa. 283 pages, 9¾ × 6½ in.

This book is published by authority of the Minister of Trade and Commerce of Canada, and contains a comprehensive review of the Dominion of Canada, especially in regard to its agricultural, forest, and mineral resources, its industrial and commercial development, and its geographical relation to the markets of the world. It contains ten maps and numerous illustrations.

Results of the investigation of six lignite samples from the Province of Alberta. By B. F. Haanel and J. Blizard. Canada Dept. of Mines. Report No. 331. viii. + 110 + xx. pages, 9¾ × 6½ in.* (See page 832, Class IIa.)

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* A certain number of these publications can be obtained free on application to the respective Government Departments.

In the case of the U.S. Government publications, when this supply is exhausted copies can be obtained at the prices mentioned from the Superintendent of Documents, Washington, D.C., U.S.A.

Journal of the Society of Chemical Industry.

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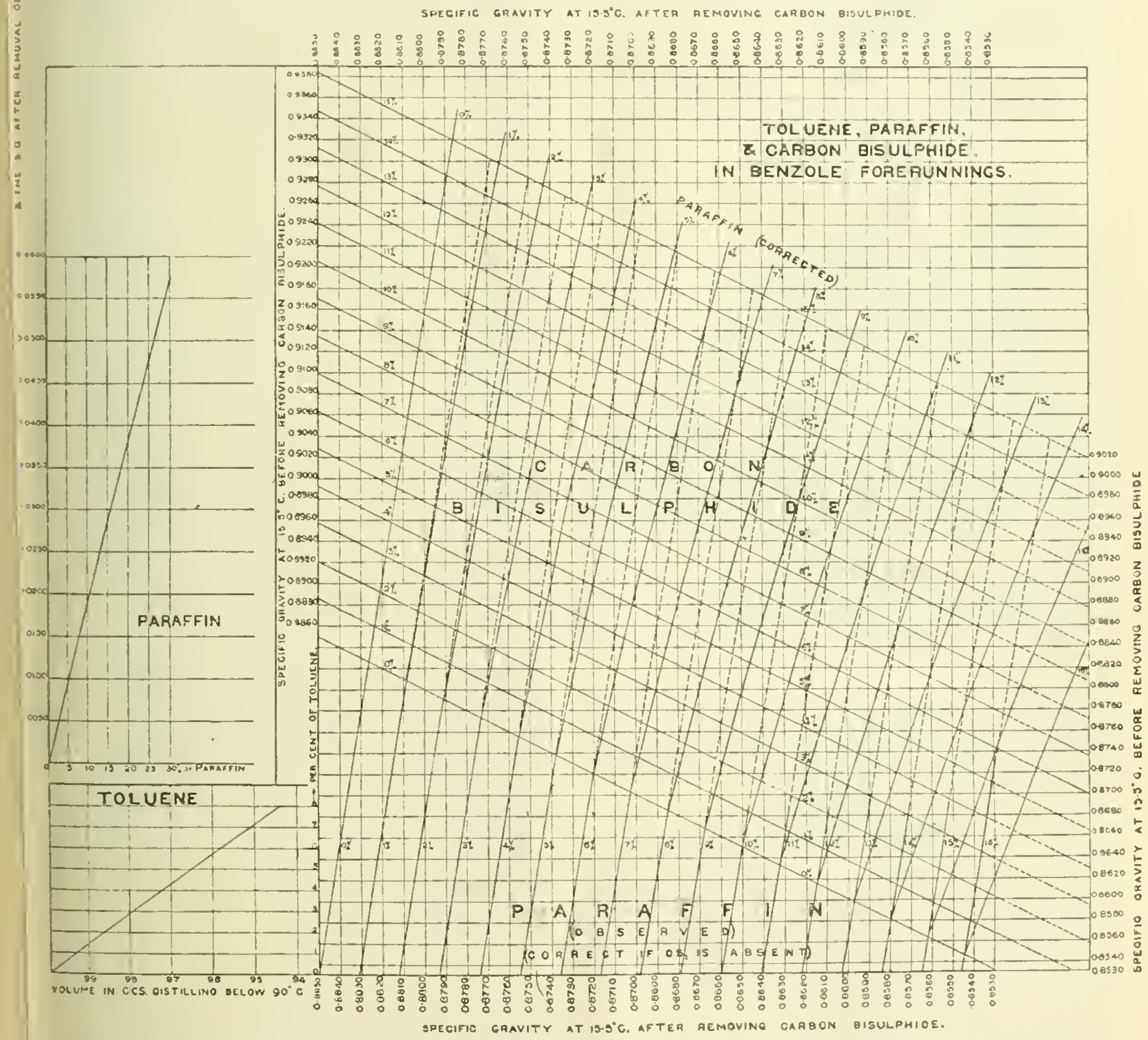
Communication.

THE ANALYSIS OF BENZOL FIRST-RUNNINGS.

BY PERCY E. SPIELMANN, PH.D., B.SC., F.I.C., AND F. BUTLER JONES, B.A.(CANTAB.).

Experiments have been carried out in order to ascertain whether the method for the analysis of commercial benzols (this Journal, April 15th, 1916, p. 396) is applicable to first-runnings.



This fraction differs from the benzol fraction mainly in containing up to 10% or 15% (and rarely as much as 65%) of carbon bisulphide, and up to 15% paraffin, together with very small proportions of a number of other substances.

From a known mixture it was found that even 65% of carbon bisulphide gave a distillation test corresponding to the amount of toluene added (5%) within the limits of accuracy of the earlier benzol analysis.

It was found, further, that water-soluble substances were insufficient in quantity to affect estimation by specific gravity, and also that a severe washing with sulphuric acid to remove other impurities did not cause alteration.

The method previously described can therefore be applied directly to the evaluation of benzol first-runnings with the following modifications:—

1. *Carbon bisulphide.*—The estimation of a high percentage of carbon bisulphide is most conveniently carried out by diluting the sample with up to five times its volume of benzene, which has been previously purified from any carbon bisulphide that it may contain.

2. *Paraffin.*—The specific gravity of the paraffin of this fraction is 0·700.

If the percentage of paraffin is such that it lies outside the graph, its quantity can be determined most easily by employing the simpler of the two benzol graphs (*loc. cit.*), ascertaining the specific gravity of the benzene-toluene mixture by its means, and determining the difference between this and that of the sample under examination after removal of CS_2: the resulting difference is then evaluated by means of the paraffin graph in the present paper.

Further, it becomes necessary to take into consideration the percentage of carbon bisulphide present and to correct the quantity of paraffin found by differences of gravities.

If, for instance, 10 % of carbon bisulphide is present, the quantity of paraffin found will be that present in 90 c.c. of liquid and the value, therefore, will have to be diminished in the ratio of 90 : 100.

In general, paraffin (true figure) = paraffin found multiplied by the fraction $\frac{100-x}{100}$, where x is the percentage of CS_2.

This correction need not actually be calculated as it can be obtained directly in the accompanying graph (p. 911).

The following examples of known mixtures indicate the mode of employment :—

(1) Mixture taken : 4 % toluene, 3 % paraffin, 12 % CS_2, 81 % benzene.

Distillation of 100 c.c. up to 90° C. gives 97·5 c.c., equivalent to 3·6 % toluene.

Specific gravity after removal of CS_2 : 0·8762.

Junction of 3·6 % toluene with gravity 0·8762 line is at 4·3 % paraffin.

Specific gravity of original sample : 0·9205.

Specific gravity after removal of CS_2 : 0·8762 = 12·5 % CS_2.

In order to obtain a correct value for the paraffin, the point representing the observed percentage is moved upwards continuously, equidistant from the continuous and then discontinuous straight lines, until it reaches the point representing the carbon bisulphide percentage : this point gives the correct value of 3·8 % paraffin.

(2) The mixture taken consisted of :—4 % toluene, 11 % paraffin, 50 % carbon bisulphide, 35 % benzene.

Distillation of 100 c.c. to 90° C. yields 97·1 c.c. = 4 % toluene.

As the mixture has a gravity of 1·0496, which is outside the graph, exactly 15 c.c. was diluted five times, *i.e.*, to 75 c.c., with pure benzene. The specific gravity of this mixture 0·9150, the specific gravity after removal of CS_2 : 0·8794 = 10 % CS_2 = (5 × 10 =) 50 % on the original.

The junction of 4 % toluene and the 0·8794 line is at 2·6 % paraffin ; this figure corrected as before shows 2·3 % paraffin, which equals (5 × 2·3 =) 11·5 % on the original.

It will be realised that for high percentages of carbon bisulphide and paraffin the results will be less accurate than those obtained in the analysis of benzols, but at the same time, that there are no serious deviations from the true values.

REPORT OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH FOR THE YEAR 1915-1916. [Cd. 8336.]

The Committee constituted by Order in Council dated July 28th, 1915 (see this Journal, 1915, 783), has issued its first report, which, after noting previous Government action in connection with research during the present century, deals at some length with the White Paper issued by the President of the Board of Education [Cd. 8005] describing the Government Scheme for organising and developing research. Early in its deliberations the Committee decided to give science in its applications to industry preference over pure science, realising that the "practical business world" had to be dealt with. This course was also desirable in view of the fact that the Universities have been so depleted of students and teachers that they have neither the leisure nor the detachment of spirit essential to original research. The Committee therefore determined to pursue a system of careful inquiry and consultation. The first inquiries showed that there were certain researches being conducted or directed by professional associations in the period preceding the war which stood in grave jeopardy of enforced abandonment; in order to secure the continuance of as many of these researches as possible, it was decided to recommend the payment of suitable grants to the societies concerned (a list of these is given in Appendix III.). The Chairman and other officers of the Committee have interviewed representatives of a large number of the principal scientific and technical societies, "in all cases with gratifying results." It is noted that the most highly organised industries are generally those which have made the most use of research and are consequently more ready for, though possibly not most in need of, the encouragement it is the duty of the Committee to afford. It is stated that "the chemical trades for the most part are so divided and individual in outlook that the various professional societies have had neither the influence nor the means necessary to enable them to take a large share in promoting research in connection with those industries." In the meantime the Universities and Technical Colleges of the country had been invited to form a register of researches actually in progress at the outbreak of war, and a survey is now being made of the amount and the character of the provision made in our higher educational institutions for research work. The possibility of inducing firms in some of our industries to inform the Committee, in confidence, of problems in hand or in contemplation, is also being considered. In the latter connection mention is made of the spirit of co-operation which is growing up in many of the industries. The Committee has caused inquiries to be made in the Universities and Technical Colleges as to the existence of students or teachers not engaged on war duties who might be retained for scientific research if the Committee would assist them. As a result the Committee has recommended grants to some 40 individuals, amounting in all to about £6000. It is also hoped to give assistance in correlating the researches being made into the same problem by encouraging the interchange of information. Something in this direction has already been achieved, as in the cases of the researches of steam nozzles and optical glass.

At an early date the Committee became convinced that it would be necessary to form a series of strong Standing Committees to assist them in surveying fields of research, in constructing panels of referees, and in dealing with applications for grants. Three such Committees have now been set up, namely a Committee on Metallurgy under the chairmanship of Sir Gerard Muntz, with special sections for ferrous and non-ferrous metallurgy ; a Committee on Engineering under the chairmanship of Sir Maurice Fitzmaurice ; and a Committee on Mining under the chairmanship of Sir William Garforth, with a section on the mining of iron, coal, and hydrocarbons, and a section on the mining of other minerals. The formation of other Committees is in contemplation, probably including Committees on fuel, rubber, cotton and paper, textiles, etc.

Reference is made to the work of the Glass Research Committee of the Institute of Chemistry, and of the efforts made in Staffordshire to produce Seger cones and laboratory porcelain, etc. A grant has been recommended for the erection and maintenance of research laboratories and workshops in connection with the Stoke Pottery School.

Referring to the movement towards trade association, the report states that it is evident that the difficulties of tradition, trade organisation, and national temperament which stand in the way of combination, must be squarely faced if progress is to be made and must be dealt with as part of a comprehensive plan. The Committee expects to have in growing measure the help and sympathy of manufacturers in the work that lies ahead, and note is made of the willingness which has been shown by certain manufacturers to support researches undertaken in the interests of their industries.

One of the chief impediments in the way of organisation of research is thought to be the small scale on which most British industrial firms have been planned. It may be desirable for the State to take special pains to encourage those scientific industries which are recognised as being essential to the national well-being, and accordingly the State may be well advised to support researches in these industries to a greater degree than in ordinary cases. Among the industries mentioned in this connection are the manufacture of optical and chemical glass, porcelain, fine chemicals, dyestuffs, synthetic drugs, and high explosives. Further, if a healthy condition of inquiry is to be fostered in these industries, the Committee recognises the need for convincing the manufacturing world in general that scientific research is a paying proposition. The shortest means to this end is believed to be an attack upon the pressing problems of manufacture which arise in the course of the ordinary routine. The Committee declares that unless the generality of British firms can be induced to alter their present attitude, it will have failed profoundly in one of its appointed tasks.

It is recognised that the Universities must be the main sources of research in pure science, but that they can also with their existing organisation assist smaller firms and less important industries to solve the problems immediately in front of them, and also attack certain fundamental problems of research in applied science. The present organisation of some of the special technological departments of the Universities and technical schools may need modification if they are successfully to carry the burden that will be put upon them in the future. In the new laboratories at Stoke and the proposed Research Institute for Glass at Sheffield University, the departments are to be conducted by special Committees or delegacies consisting of representatives of the parent body and of the industries concerned.

The question of organisation of research in the whole British Empire is also engaging the attention of the Committee, and memoranda on the subject have been received from several of the Colonial Governments. It is probable that one of the first preliminaries to joint research will be the making of a systematic survey of the mineral and other resources of the Empire.

The two principal conditions which must be secured if the objects for which the Committee were established are to be attained, are first, a largely increased supply of competent researchers, and secondly a hearty spirit of co-operation among all concerned—men of science, men of business, working men, professional and scientific societies, Universities and Technical Colleges, Local Authorities and Government Departments. The first condition can only be fulfilled if a larger number of well-educated students can be induced to enter the Universities: that is the problem which the Education Departments have to solve. As regards the second condition, progress in co-operative effort is undoubtedly being made in many directions, but there are specially strong reasons for more co-operation between the various firms in each industry and between the industries and the State in the furtherance of research. Fundamental research demands a very large expenditure of brains and equipment, and also requires continuous effort. If the general level of manufacture can be rapidly raised by co-operative effort in the exchange of information between firms, and in the support of national trade institutes for research, as well as in the improvement of the conditions and efficiency of labour, this country will have gone far towards establishing its industrial prosperity on a firm basis.

GOVERNMENT COMMITTEE ON SCIENCE.

In pursuance of the arrangements which the Government have made for reviewing the system of education as a whole, the Prime Minister has appointed a Committee to inquire into the position occupied by Natural Science in the educational system of Great Britain, especially in secondary schools and universities; and to advise what measures are needed to promote its study, regard being had to the requirements of a liberal education, to the advancement of pure science, and to the interests of the trades, industries, and professions which particularly depend upon Applied Science. The Committee consists of: Sir J. J. Thomson, O.M., D.Sc. (Chairman), the Rt. Hon. F. D. Acland, M.P., Professor H. B. Baker, D.Sc., F.R.S., Mr. Graham Balfour, Sir William Beardmore, Bt., Sir G. H. Claughton, Bt., Mr. C. W. Crook, Miss E. R. Gwatkin, Sir Henry Hibbert, M.P., Mr. William Neagle, Mr. F. G. Ogilvie, C.B., Dr. Michael Sadler, C.B., Professor E. H. Starling, M.D., F.R.S., Mr. W. W. Vaughan. Secretary: Mr. F. B. Stead, H.M. Inspector of Schools.

Obituary.

ARTHUR FRANK HESS.

A. F. Hess was born in 1884 at Leeds. He was educated at Harrogate, Rugby, and Oxford, and was subsequently engaged at various oil and stearine works, tar distilleries, and by-product coke oven works. In 1906 he joined the firm of Adolph Hess and Brother, Ltd., oil distillers and refiners, of Leeds and Hull, and in 1912 became a director. For many years he had been attached to the Leeds Volunteers and Territorials, and soon after the outbreak of war acted as Adjutant to General Baldock, having attained the rank of Captain. Later he joined the West Yorkshire Regiment and was promoted to the rank of Major. He was wounded in August, 1915, and again on July 1st last, and died of his wounds on July 14th.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.

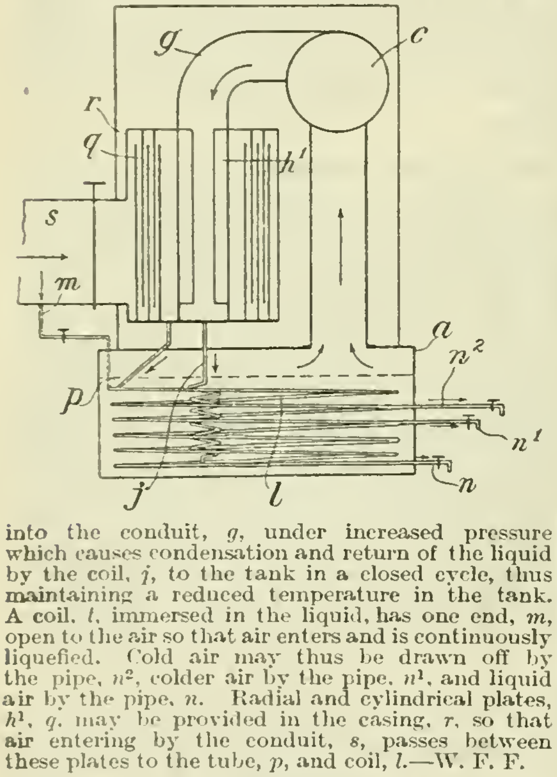
French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Ferou 8, Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Cooling liquids and gases; Method of and means for ——. G. James, London. Eng. Pat. 6275, Apr. 27, 1915.

Liquid, *e.g.*, liquid air, is contained in the tank, *a*, and is evaporated under reduced pressure produced by the fan, *c*. The saturated vapour is delivered into the conduit, *g*, under increased pressure which causes condensation and return of the liquid by the coil, *j*, to the tank in a closed cycle, thus maintaining a reduced temperature in the tank. A coil, *l*, immersed in the liquid, has one end, *m*, open to the air so that air enters and is continuously liquefied. Cold air may thus be drawn off by the pipe, n^2, colder air by the pipe, n^1, and liquid air by the pipe, *n*. Radial and cylindrical plates, h^1, *q*, may be provided in the casing, *r*, so that air entering by the conduit, *s*, passes between these plates to the tube, *p*, and coil, *l*.—W. F. F.



Regulating and measuring the proportional flow of liquids or liquids and gases; Method of and means for ——. J. E. Lea, Manchester. Eng. Pat. 9067, June 21, 1915.

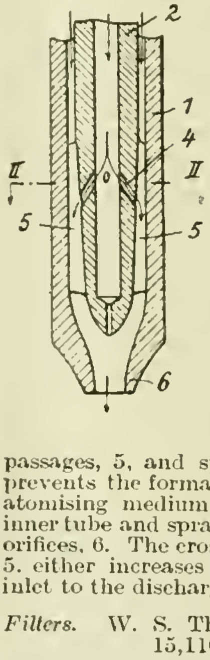
The liquid, the flow of which is to regulate that of the other, passes through a tank provided with a V-notch or a weir, and with a float which operates a rotary or wedge-shaped cam. The second liquid, the flow of which is to be regulated, passes through a pipe fitted with a valve, to which is applied a lever which is acted upon at its free end by the cam. The contour of the cam embodies the formulæ of the "rates of flow" of the one liquid over the V-notch and the other liquid through the pipe controlled by the valve. As the float rises and falls with the variation in the flow of the first liquid, so the cam opens or closes proportionately the valve through which the second liquid passes. In the case of a gas and a liquid, the apparatus is the same, the gas passing through the pipe with the valve, and being delivered into the tank holding the regulating liquid.—J. H. J.

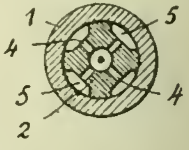
Extracting and discharging condensate and air from a condenser; Method of and apparatus for ——. Ges. für Kälteindustrie m. b. H., Berlin. Eng. Pat. 9724, July 3, 1915. Under Int. Conv., July 4, 1914.

An ejector of the water filter-pump type is used to extract the air and condensed water from a condenser. The supply of water to operate the ejector is distinct from the cooling water supply, and is circulated by a rotary pump on the pressure side of which the ejector is fixed.—W. H. C.

Atomisation of liquids, and in particular of liquids having a considerable viscosity. A. V. Lipinski, Zürich, Switzerland. Eng. Pat. 10,040, July 9, 1915. Under Int. Conv., July 9, 1914.

The apparatus consists of an outer cylindrical casing, 1, and an inner tube, 2, of polygonal shape, which forms a number of chambers, 5, into which the oil or other liquid to be atomised is fed. The gaseous atomising medium is delivered into the inner tube, 2, and a portion of it passes through the inclined orifices, 4, into the passages, 5, and spreads the liquid as a film, and prevents the formation of drops. The rest of the atomising medium passes from the end of the inner tube and sprays the liquid through the nozzle orifices, 6. The cross-sectional area of the passages, 5, either increases or remains constant from the inlet to the discharge end.—W. H. C.





Filters. W. S. Thompson, Dundee. Eng. Pat. 15,110, Oct. 26, 1915.

Cylindrical filter elements are supported so that they can be rotated on one or more shafts which pass through, and project for a considerable distance beyond one end of, the filter chamber. When it is necessary to clean or renew the filtering medium, the end of the outer chamber is removed and the filter elements are moved along the shafts out of the chamber.—W. H. C.

Filter for liquids containing suspended organic matter; Drum ——. M. Hosch, Berlin-Halensee. Ger. Pat. 292,754, June 23, 1914.

The filter-drum rotates in a trough containing the liquid to be filtered, and a surging motion is imparted to the liquid by the introduction of compressed air or by other means. The compressed air is preferably introduced below the drum and in a direction approximately tangential to the ascending part of the drum. The separated solids are removed from the surface of the drum by a roller and scraper. The outlets for the solids and for the filtered liquid are adjustable, so that they can be arranged at different levels according to the direction of rotation of the drum. The surging motion of the liquid prevents clogging of the filtering surface.—A. S.

Air filters. G. A. Mower, and Sturtevant Engineering Co., Ltd., London. Eng. Pat. 100,876, Mar. 18, 1916. (Appl. No. 4063 of 1916.)

In an air filter of the type in which the dust is collected in suspended filter bags which are periodically shaken, a valve-operating rod is moved periodically to open the filtering chamber to suction during the filtering period, and to the atmosphere during the shaking period. The shaking device is also operated in proper sequence by the same rod. Two or more groups of filter bags may be combined so that one group is being shaken while the other is in use.—W. F. F.

Evaporating liquids; Apparatus for ——. A. Redlich, Vienna. Eng. Pat. 100,250, Mar. 28, 1916. Under Int. Conv., Apr. 6, 1915. (Appl. No. 4555 of 1916.)

A number of hollow horizontal discs, separated by distance-pieces, are carried by a rotating hollow central shaft and contained in a cylindrical casing. Steam is supplied through the shaft to the interior of the discs, and the condensed water passes upwards, through short pipes connecting the discs at their peripheries, to an annular gutter at the top of the casing from which it is discharged. Liquid to be evaporated passes from a pocket on the outer wall of the casing and is projected through nozzles between the discs towards the centre, afterwards travelling outwards over the discs by centrifugal force. Several units may be combined to form a multiple-effect apparatus. —W. F. F.

Furnace-setting for concentration pots. F. H. Nickle, Midland, Mich. U.S. Pat. 1,191,338, July 18, 1916. Date of appl., Dec. 18, 1915.

The liquor to be concentrated is contained in pots of circular horizontal cross-section, each being surrounded by a concentric casing. The casing is enlarged at one point to form a combustion chamber, which is bounded on one side by a radial wall in contact with the pot, so that the hot gases are made to travel horizontally round the pot, thus causing a circulation of the liquid in the same direction.—W. F. F.

Evaporating pans; Cover for ——. L. N. Moody, Plover, Iowa, Assignor to A. M. Tower, Barton, Vt. U.S. Pat. 1,191,982, July 25, 1916. Date of appl., Mar. 5, 1915.

A cover for evaporating pans comprises a cylindrical casing with a closed top and an inner partition composed of overlapping, slightly separated plates, rising from the opposite side walls towards the centre, and the lowest plate on each side forming a gutter by contact with the side wall. Another gutter is formed on the walls just below the first gutter, and both are provided with drain pipes to carry off the condensed liquid.—W. F. F.

Ball grinding machines. Deutsche Waffen- und Munitionsfabriken, Berlin. Eng. Pat. 100,319, Apr. 20. 1916. Under Int. Conv., Feb. 3. 1915. (Appl. No. 5852 of 1916.) Addition to Eng. Pat. 10,688 of 1914.

To effect a better distribution, the balls are collected towards the centre by funnel-shaped plates and delivered from the apex to the ridge of the roof-shaped bottom of the feed chamber. The gathering of the balls to the centre is also assisted by providing in the feed space two oppositely rotating winged shafts.—W. H. C.

Ball-mills [for grinding bacteria and bacterial products]. J. P. McGowan, Edinburgh. Eng. Pat. 100,719, Mar. 11, 1916. (Appl. No. 3644 of 1916.)

A glass or porcelain mill with glass or porcelain balls is used for grinding bacteria. The entrance to the mill is placed on the rim, and the size of the balls is varied according to the nature of the material to be ground. The interior surface has only rounded curves, so that the partially ground material cannot collect away from the grinding action of the balls. When charged the mill is fixed to a rotating disc, and when the operation of grinding is over, the mill is removed for emptying and cleaning.—W. H. C.

Grinding-machine. F. N. and F. E. Gardner, Assignors to L. W. Thompson, Beloit, Wis. U.S. Pat. 1,189,557, July 4, 1916. Date of appl., Nov. 23, 1912.

A normally vertical grinding cylinder is rotated within a casing, and a rack and pinion mechanism, which can be operated by hand, is provided to tilt the cylinder.—W. H. C.

Drying materials in sacks and the like: Method of and apparatus for ——. H. P. Dinesen, Herlov, Denmark. Eng. Pat. 100,697, Jan. 10, 1916. (Appl. No. 411 of 1916.)

The sacks or other flexible receptacles are placed separately over apertures in a conduit so that each forms, by its own weight, a sufficiently tight joint. A lowering of pressure produced in the conduit causes air to pass through the sacks and the material therein, thus drying the material. If necessary the air may be heated.—W. H. C.

Dryers. C. A. Wendell, Joliet, Ill. U.S. Pats. (A) 1,187,584 and (B) 1,187,585, June 20, 1916. Date of appl., June 12, 1915.

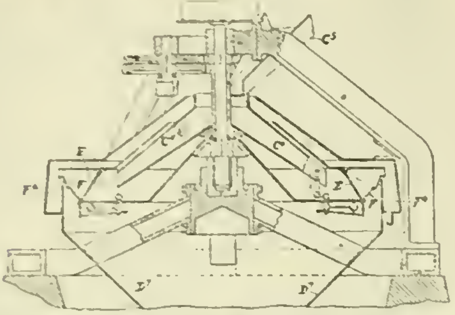
(A) A centrifugal dryer consists of a dish-shaped screen and a shoot which are inclined upwards and outwards at different angles and are rotated at the same speed about a common axis. The material is fed into the screen, and a scraper is provided which travels over the surface of the screen and across the shoot substantially at right angles to the line of travel of the material across the screen. The scraper is rotated at a different speed from that of the screen and shoot. (B) The material is fed into the dryer from a supply device which is rotated in the same direction, but at a different rate from the dryer. The drying compartment has a series of separately mounted screen sections, which are either tilted, or rotated at a different speed, to discharge the dried material. The liquid is received into a receptacle which is always in position outside the screen sections, and the solids are received in a receptacle which is in communication with the interior of the section at the time of discharge only.—W. H. C.

Drying apparatus. W. Bartholomew, Assignor to Troy Laundry Machinery Co., Ltd., Chicago, Ill. U.S. Pat. 1,189,777, July 4, 1916. Date of appl., Aug. 28, 1914.

The articles being dried are contained in a rotary cylinder within an outer casing which also encloses heating coils, a rotary cleaning screen, a rotary brush for cleaning the latter, and a fan. Air passes from the cylinder through the screen to the fan and thence over the heating coils back to the cylinder.—W. H. C.

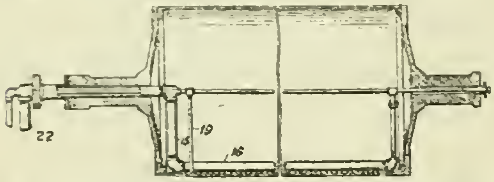
Dryer. C. A. Wendell, Joliet, Ill. U.S. Pat. 1,190,829, July 11, 1916. Date of appl., June 12, 1915. Renewed, May 19, 1916.

In a centrifugal dryer, a feed shoot, C^5, C^4, delivers the material to the inner side of an inclined screen, E, constructed in sections, each provided with a deflecting plate, F, to direct the liquid passing through the screen into an outer receptacle, F^4. Means are provided for swinging the screen sections (together with the deflecting plates) to permit the dried material to escape into a second receptacle, D^7.—J. H. L.



Drying-cylinder. A. H. White, Brooklyn, N.Y. U.S. Pat. 1,189,761, July 4, 1916. Date of appl., Oct. 22, 1914.

Steam is passed through the fixed pipe, 22, 15, 16, into the interior of the rotary drying cylinder, the perforated portion of the pipe, 16, being always submerged in the condensed water, which collects in the cylinder. The water is thus maintained at a high temperature, and serves to transmit heat from the steam to the surface of the cylinder. A pipe, 19, is provided to remove excess water of condensation.—W. H. C.



Drying mechanism. W. R. Macklind, Assignor to G. A. Martin, Cleveland, Ohio. U.S. Pat. 1,191,921, July 18, 1916. Date of appl., Aug. 10, 1912.

A horizontal, annular drying table is provided with a fixed central column on which is mounted a removable sleeve carrying a rotatable frame with radial arms extending over the drying table. The material to be dried is fed to and removed from the table by means carried by the radial arms and operated electrically through contacts carried by the frame and by the centre of the table.—W. F. F.

Dryer. R. Buskiewicz, Bythin. Ger. Pat. 293,153, Jan. 13, 1914.

A tapering drum mounted horizontally and having a helical groove on its outer surface, rotates inside a casing of similar shape, which is heated externally by fire gases or the like. The material to be dried is introduced at the wider end of the casing and travels along the helical groove to the narrower end. The distance between the drum and the casing is somewhat greater at the wider than at the other end, and the drum can be moved longitudinally so as to vary the space between it and the casing according to the nature of the material being dried.—A. S.

Vaporised volatile liquids from gaseous mixtures; Apparatus for separating ——. W. E. Lummus, Lynn, Mass. U.S. Pat. 1,189,711, July 4, 1916. Date of appl., Mar. 18, 1912.

The mixture of gas and vapour is compressed, and the cooled and compressed mixture is washed to remove condensed liquid. The washed compressed gas is then expanded in stages and is used to cool the compressed mixture in a heat-exchanging apparatus.—W. H. C.

Fire-extinguishing compounds. F. P. Harris, Cranford, N.J. U.S. Pats. (a) 1,190,160 and (b) 1,190,161, July 4, 1916. Date of appl., June 2, 1914.

The compounds consist of (a) acetylene tetrabromide, carbon tetrachloride, and trichloroethylene; and (b) bromoform, carbon tetrachloride, and trichloroethylene, the bromoform being 10% of the total.—J. H. J.

Gas; Apparatus for charging liquor with ——. A. Dirian and W. Biel, Chicago, Ill. U.S. Pat. 1,191,952, July 25, 1916. Date of appl., Apr. 16, 1915.

A closed, vertical, cylindrical tank is provided inside with a conical shell depending from the cover, and having at its apex a valve actuated by a float in the tank through the medium of a central vertical rod. Gas is admitted through the valve and liquid is also supplied to the apex of the cone, which is provided with internal oblique deflecting vanes.—W. F. F.

Filling material for absorption and reaction towers; Cylindrical ——. F. Raschig, Ludwigshafen. Ger. Pat. 292,622, May 6, 1915. Addition to Ger. Pat. 286,122.

The cylinders (see Eng. Pat. 6288 of 1914; this J., 1914, 907) are made of cast metal or of ceramic material.—A. S.

Gases; Electrostatic method for the purification of ——. J. Kraus, Brunswick. Ger. Pat. 292,694, Jan. 8, 1914.

Electrodes of non-conducting material are used, of which the side not in contact with the current of gas is electrically charged, whilst the side in contact with the gas is either not charged or has a lower charge than the other side. For example, the electrode may be hollow and its outer surface charged electrically, whilst the gas is directed by guide-plates against the uncharged or less highly charged inner surface. The suspended particles in the gas are attracted to the charged or less highly charged face entirely or chiefly by charges induced from the other face.—A. S.

Stirring, agitating, or mixing liquids; Apparatus for ——. B. Goldman, Charlottenburg, Germany. U.S. Pat. 1,191,585, July 18, 1916. Date of appl., Feb. 18, 1914.

See Eng. Pat. 24,587 of 1913; this J., 1914, 469.

Drying mechanism; Vapour-removing apparatus for ——. W. R. Macklind, Assignor to G. A. Martin, trustee (Sherwin-Williams Co.), Cleveland, Ohio. U.S. Pat. 1,192,084, July 25, 1916. Date of appl., Aug. 4, 1915.

See Eng. Pat. 19,409 of 1913; this J., 1914, 849.

Emulsions; Production of ——. S. H. Blichfeldt, Southall, Assignor to Flakes A./S., Copenhagen. U.S. Pat. 1,192,492, July 25, 1916. Date of appl., Aug. 25, 1914.

See Eng. Pat. 23,653 of 1913; this J., 1914, 1167.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Solvent naphtha; Export of ——. Board of Trade J., Aug. 24, 1916.

The War Trade Department is now prepared to consider licences for the export of solvent naphtha (provided that it contains less than 5% of toluol) to the British Colonies, United States, and allied countries with the exception of France.

Gas engines; Formation of deposits in ——. Spettmann. Tech. Blätter, 1915, **5**, 131. Chem.-Zeit., 1916, **40**, Rep., 231.

Deposits formed in gas engines owing to the use of unsuitable lubricating oils may be easily avoided, but deposits are also encountered, the formation of which is independent of the quality of the lubricating oil, but is greatly facilitated by the presence of sulphur vapour or sulphur dioxide in the gas. A black amorphous deposit, agglomerated into lumps, found in an engine using producer gas, contained 43% of tarry constituents soluble in ether, 13% of carbon, etc., insoluble in ether, 4·9% of free sulphur, 4·3% of combined sulphur, and 34·5% of ferric oxide. In laboratory tests it was found that sulphur combines with lubricating oil, and that the compounds formed are more easily decomposed by heat than the pure oil.—A. S.

Gas oils; Valuation and efficiency of ——. R. C. Downing. J. Gas Lighting, 1916, **135**, 160—161.

Commercial gas oils consist largely of paraffins, but thirteen other kinds of hydrocarbons have also been found, in addition to small quantities of nitrogen, oxygen, and sulphur compounds. A good sample should not contain more than about 0·3% sulphur, but black oils from Texas, Mexico, and California frequently contain more than 1%. To ascertain the yield and quality of the gas obtainable under working conditions the author has subjected samples of the oil to destructive distillation in silica tubes, 30 to 48 in. long and 1 to 2 in. in diameter, heated to a regulated temperature, the oil being admitted from a burette at the upper end, and the gas passed through a condenser, scrubber, and meter into a holder at the other end. By plotting the total yields of gas and of illuminants in the gas per gall. of oil as abscissæ and the temperatures as ordinates, it was found that the yield increased up to 1300° to 1400° F. (about 700°—760° C.) and then steadily decreased. The bromine absorption afforded information as to the nature of the gas. Bromine combines with paraffins and naphthenes in sunlight, but not in the dark, whereas it is absorbed by unsaturated hydrocarbons under all conditions. Gas oil containing products from the "cracking" of crude petroleum shows a high bromine absorption. For gas-making the paraffins and naphthenes are the most valuable constituents. The nature of the products formed in the decomposition of octane and decane by heat has been investigated by Tocher (this J., 1894, 231). By extending the time of contact similar decompositions are effected at lower temperatures. At diminished pressure the yield of gas is increased, less free hydrogen is produced, and formation of carbon is prevented. Comparative tests indicated that the maximum candle power was obtained with gas produced at 1250° to 1300° F. (about 680°—700° C.), and the greatest calorific value at about 1400° F. (760° C.). Between 1250° and 1400° F. the photometric results varied 10%, whereas between 1350° and 1520° F. (about 730°—830° C.) the calorimetric value only varied 2%. At 1300° F. an oil should yield about 60% of gas, 30% of tar, and 10% of carbon and waste. The oil may also be tested in the presence of a suitable quantity of "blue" water-gas to reproduce working conditions. It was found that at low temperatures hydrogen was absorbed from the mixed gases. Methane increased steadily with the temperature; ethane appeared at 1200° F. (about 650° C.), and reached a maximum of 3 to 4% at 1400° F. The hydrogen sulphide was usually about 100 grains, about 70% of which was derived from the coke and 30% from the oil. A contact time of 5 secs. showed 9% greater oil efficiency than one of 10 secs. A variation of 19% in the candle power and of 3% in the heating capacity was possible within the limits of 1¼ and 10 seconds' contact. The gas obtained by short contact was nearly as stable as that obtained with longer contact. In the former case a hot fire in the generator was necessary; in the latter the "cracking" was carried too far. The illuminating efficiency increased with the feed of oil, up to 5 galls. per 1000 cb. ft., but decreased beyond that limit, whilst the B.Th.U. decreased with the input. The presence of carbon dioxide in the water gas reduced the yield of gas from the oil, and increased the amount of tar. —C. A. M.

Asphalts; Differentiation of natural —— from industrial pitches. Hutin. Caoutchouc et Gutta-Percha, 1916, **13**, 8994.

In general, natural products such as asphalts, bitumens, Judæan pitch, etc., are insoluble in "bakelite A" (liquid form), whereas industrial pitches obtained as residues in the distillation of petroleum, coal, wood, fatty acids, etc., are soluble in all porportions when heated with that solvent for a short time on the water-bath.—C. A. M.

Montan wax. A. Grün and E. Ulbricht. Chem. Umschau, 1916, **23**, 57—60. Z. angew. Chem., 1916, **29**, Ref., 371.

A sample of montan wax, containing 66% of montanic acid and 34% of unsaponifiable matter, was reduced by sodium and amyl alcohol, and the reduction product was saponified, and extracted with ether. An amorphous, transparent, neutral, unsaponifiable substance, resembling ceresin, was thus separated, which crystallised from ethyl acetate in small matted needles, m.pt. 59°—60° C. It is a secondary alcohol, montanol, which is formed from the ketone, montanone, forming the unsaponifiable constituent of the wax. Montanone, m.pt. 59·6° C., can be isolated directly from the wax. (See also this J., 1909, 878, 991.)—A. S.

Olefines; Action of sulphur on —— under pressure. W. Friedmann. Petroleum, 1916, **11**, 693—697. Z. angew. Chem., 1916, **29**, Ref., 358.

The action of sulphur on olefines under pressure was studied. From hexylene the compounds, $C_6H_{12}S$, sp.gr. 0·862 at 20° C., b.pt. 40°—41° C. at 10 mm.; $C_{12}H_{24}S$, sp.gr. 0·882 at 20° C., b.pt. 112°—113° C. at 10 mm.; $C_{18}H_{34}S_2$, sp.gr. 0·907 at 20° C., b.pt. 128° C. at 10 mm.; $C_{24}H_{40}S_3$, b.pt. 142° C. at 10 mm., and a hard asphalt of the composition, $C_{24}H_{20}S_2$, were isolated. Octylene yielded the compounds, $C_8H_{16}S$, sp.gr. 0·886 at 15° C., b.pt. 70°—71° C. at 13 mm.; $(C_8H_{16})_2S$, sp.gr. 0·903 at 15° C., b.pt. 163° C. at 13 mm.; and $C_{24}H_{42}S_3$. Hexadecylene yielded a compound, $C_{16}H_{32}S$, sp.gr. 0·927 at 22° C., b.pt. 188°—190° C. at 13 mm. It is considered that it is not the olefines, but feebly saturated or unsaturated cyclic compounds, including terpenes, that constitute the raw materials from which asphalts are formed.—A. S.

Unsaturated compounds [hydrocarbons]; Action of anhydrous aluminium chloride on ——. W. E. Henderson and W. C. Gangloff. J. Amer. Chem. Soc., 1916, **38**, 1382—1384.

Dried acetylene is not absorbed by freshly prepared aluminium chloride at ordinary temperatures, but at 60°—62° C. dense vapours are produced and a reddish-brown sublimate changing to a black amorphous complex substance. Ethylene shows a similar behaviour. When acetylene is passed into a solution of aluminium chloride in absolute alcohol to complete saturation, small, colourless, well-defined crystals having the formula,

$AlCl_3.2C_2H_2.2H_2O$, separate after several days. These are very unstable and lose acetylene and hydrogen chloride on standing. Ethylene gives similarly an unstable, crystalline substance having the formula, $AlCl_3.3C_2H_4.H_2O$.—T. C.

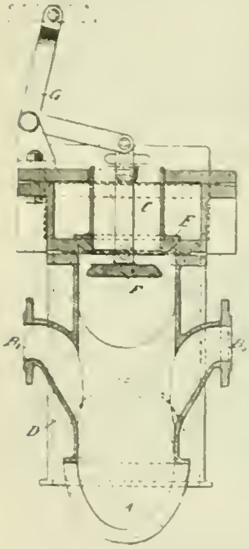
Determination of small quantities of sulphide sulphur. Drushel and Elston. *See* VII.

An adiabatic calorimeter. Daniels. *See* XXIII.

PATENTS.

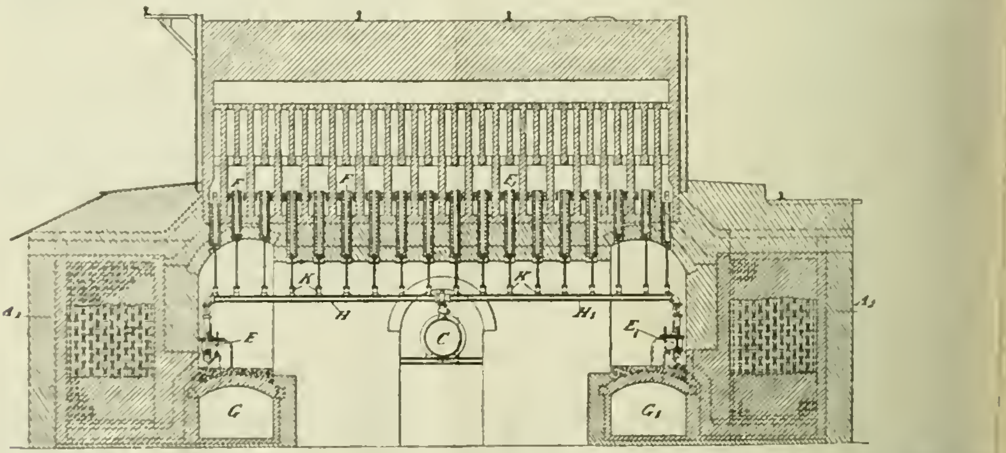
Coke ovens: Reversing valve for regenerators for combined ——. O. Imray, London. From M. G. Christie, British Expeditionary Force, France. Eng. Pat. 8945, June 17, 1915.

THE valve is used in conjunction with the oven described in Eng. Pat. 8944 (see following abstract). If used with coke-oven gas, which does not require preheating, branches B_1 and B_2, are cut off from the gas main by valves. In the position shown in the figure, the valve, F, is opened, admitting air through space, C, and pipe, A, to the regenerator. To reverse, the lever, G, is pulled to the left, closing the passage, C, lifting valve, E, and thus opening connection, D, from regenerator to chimney flue. All movements are carried out in correct sequence, air being cut off before any connection to chimney flue is made. If used with lean gas, valve, F, is drawn up to the body of the valve, E, by bolts. Then, alternately, lean gas is fed into the regenerators by pipes, B_1 and A, or waste heat leaves by the pipe, A, the opened valve, E, and pipe, D, to chimney flue.—J.E.C.



Coke oven: Regenerative ——. O. Imray, London From M. G. Christie, British Expeditionary Force, France. Eng. Pat. 8944, June 17, 1915.

THE oven is a modification of the Otto underfired oven adapted for the use of rich, lean or mixed gas in the flues. If worked as a regenerative oven the main, C, delivers coke-oven gas for one period to the left-hand series of burners fed by the main, H. Air is delivered from the flue, G, through a special valve E, and regenerators, A_1, to combustion chambers, F. The products of combustion pass down the flues on the right to the regenerators, A_2, valve E_1, and flue, G_1, to the chimney. The direction of these currents is reversed at required intervals and the coke-oven gas is not heated. If lean gas is to be used, after preheating, it is fed into the main, C, and all the individual burner valves, K, are closed. During one period the gas passes by the main, H, to alternate valves, E, and regenerators, A_1, and thence to combustion chambers, F. Alternate regenerator chambers are used for heating gas and air respectively, the two meeting in the combustion chambers. The reversing is carried out as in the former instance.—J. E. C.



Coke: Process of making ——. H. W. Buhler and C. J. Emerson, Assignors to G. D. Haskell, Boston, Mass. U.S. Pat. 1,191,943, July 25, 1916. Date of appl., Nov. 7, 1914.

COAL is subjected to a partial coking in a closed oven to expel the more volatile substances under conditions preventing combustion, and the byproducts are extracted from the gases. The purified gas is then burnt by means of air under pressure in the oven chamber itself to complete the coking.—J. E. C.

Coke: Process of cooling —— by means of inert gases. Wärme-Verwertungs-Ges., Siemensstadt. Ger. Pat. 287,043, June 21, 1914.

THE mass of coke is discharged from the oven into a chamber where it is cooled by a current of inert gases. Movable hinged plates are provided which shut off the free space in the chamber around the mass of coke, so that the gases are forced to pass through the coke; and the passage of the gases may be facilitated by breaking up the mass of coke.—A. S.

Acetylene gas: Storing compressed or dissolved ——. T. G. Allen, London. Eng. Pat. 100,911, May 29, 1916. (Appl. No. 7617 of 1916.)

ACETYLENE gas, dissolved in a solvent such as acetone, absorbed in a porous material, may be stored safely under pressure. The invention comprises the use of materials of the class known as kapok for the absorbing material.—J. E. C.

Gas generator. D. D. Barnum, Worcester, Mass., Assignor to The Riter-Conley Manufacturing Co., Pittsburgh, Pa. U.S. Pat. 1,192,729, July 25, 1916. Date of appl., Dec. 20, 1913.

HORIZONTAL retorts are arranged in vertical rows. Each retort is coupled on the right and left to tw vertical stand-pipes. One of these stand-pipe is coupled to a rich gas main, the other to a poor gas main. By means of valves, the gases from the retorts may be selectively delivered to different receptacles at will.—J. E. C.

Natural gas ; Process for extracting light liquefiable hydrocarbons from ——. E. D. Kendall, Elizabeth, N.J., Assignor to W. A. Megrath, Brooklyn, N.Y., and exors. of J. B. Haggin. U.S. Pat. 1,192,529, July 25, 1916. Date of appl., Dec. 4, 1912.

Liquid hydrocarbons heavier than gasoline are sprayed into a current of natural gas. The mixture of gases and sprayed particles is then passed through screens of varying mesh, causing the liquid particles to coalesce and releasing the fixed gases.—J. E. C.

Heavy oils, oil residues, and bitumens ; Distillation of ——. W. A. Hall, New York. Eng. Pats. 1598, Mar. 24, 7209, May 13, and 7778, May 25, 1915.

The oil is mixed with not less than its own weight of coke or similar porous material and heated by external heat to about 475° C., and the vapours are condensed. Thus the coke may be heated in a retort into which the oil is constantly introduced in regulated proportion, the admixture being effected by means of a helical screw. Under these conditions the distillates of low boiling point closely correspond in composition, whatever the nature of the original crude oil.—C. A. M.

Heavy oils, oil residues, and bitumens : Distillation of ——. W. A. Hall, London. Eng. Pat. 8836, June 15, 1915. (See preceding abstract.)

Coke or other combustible porous material is contained in a vertical retort and is kept burning at its lower end. Heavy oil, oil residue, or bitumen, in quantity less than the weight of the coke, is admitted to the hot mass at a point where the temperature is about 490° C., and subjected to the action of the rising non-oxidising combustion products. A uniform quality of lighter oils is distilled off and condensed.—W. F. F.

Heavy hydrocarbon oils ; Cracking ——. W. Higgins, London. Eng. Pat. 9418, June 28, 1915.

The crude oil is made to pass through an undulating pipe of copper or other metal which is constructed in loops or bends, each of which is heated by means of a Bunsen burner or other device. The oil vapours leaving the pipe are condensed in a suitable condenser.—C. A. M.

Gasoline : Process of making ——. F. S. Low, New York. U.S. Pat. 1,192,653, July 25, 1916. Date of appl., Apr. 24, 1913.

High boiling oils are converted into lower boiling oils by spraying them against a plate having a surface of catalytic material. This plate is maintained at a temperature sufficiently high to crack the high boiling oils without forming substantial amounts of gas and is situated in a vessel of lower temperature. The high boiling petroleum material is atomised by hydrogen under pressure and the vapours of low boiling products from the vessel are condensed and collected.—J. E. C.

[Lubricating] oil : Process for purifying ——. W. F. Garrity and A. Jarvis, Bayonne, N.J. U.S. Pat. 1,190,538, July 11, 1916. Date of appl., June 1, 1914.

Lubricating oil is boiled and filtered through sheets of cotton held between sheets of Turkish towelling, or through alternate layers of such filtering medium and of fuller's earth.—C. A. M.

Asphaltic compounds : Separation of —— *from gangue.* C. L. Cook, San Francisco, and J. R. Price, Oakland, Cal. U.S. Pat. 1,190,633, July 11, 1916. Date of appl., Feb. 17, 1914.

The gangue is heated in water to a temperature sufficient to cause the asphaltic substances to separate partially and rise to the surface. The temperature is then raised to, say, 250° F. (about 120° C.) so as to cause the asphalt particles to coalesce, whereby the entangled particles of gangue are released and fall to the bottom.—C.A.M.

Distilling petroleum, tar, or other substances under vacuum : Apparatus for ——. L. Steinschneider, Brünn, Assignor to P. Porges, Vienna, and R. Neumann, Brünn, Austria-Hungary. U.S. Pat. 1,192,581, July 25, 1916. Date of appl., Oct. 8, 1914.

See Eng. Pat. 20,353 of 1914 ; this J., 1915, 1133.

Apparatus for burning lime [using lignite as fuel]. U.S. Pat. 1,191,752. *See* VII.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Patents.

Reducing [pine] stumps ; Process and apparatus for ——. A. T. Ratliff, Hattiesburg, Miss., Assignor to Free Stump Remover Manufacturing Co., Laurel, Miss. U.S. Pat. 1,190,006, July 4, 1916. Date of appl., June 11, 1915.

A portable retort is placed over the stump in the ground, heat is applied, and the vapours are led to a condenser. The retort is enclosed in a casing, and a forced draught device is provided for supporting combustion in the intermediate space. —A. S.

Wood-distilling apparatus. J. W. Spurlock, Folkston, Ga. U.S. Pat. 1,190,478, July 11, 1916. Date of appl., Feb. 25, 1916.

Distilling chambers are arranged on opposite sides of the longitudinal centre of a rectangular casing, and flues are provided between the chambers, and between the chambers and the side walls and one end wall of the casing. Two furnaces at one end of the casing communicate with the outer longitudinal flues and the transverse flue, and one furnace at the other end communicates with the central flue. Stacks are provided at the ends of the flues opposite the furnaces, and doorways at the end of the distilling chambers opposite the transverse flue. The flues are divided into upper and lower sections by horizontal longitudinal partitions.—A. S.

"Volatiles" from coals, shales, lignites, etc. ; Method and apparatus for extracting —— *and for refining the same.* C. C. Bussey, New York, Assignor to Coal By-Products Co. U.S. Pats. 1,191,869 and 1,191,870, July 18, 1916. Date of appl., May 12, 1914.

The material is fed progressively into the top of a deep conical retort. Suitable gases at a temperature of 800° F. (about 430° C.) are admitted from a furnace at the bottom by means of a circumferential flue to the interior of the retort. These gases pass upwards round the particles of material and expel the volatile constituents, without producing any chemical action in the material. Volatile matter and gases are withdrawn from the top of the retort, whilst the solid residue is withdrawn from the bottom by means of an endless conveyor. —J. E. C.

Exhaust steam ; Utilising —— *for heating purposes.* L. J. R. Bouhon, Cheltenham. Eng. Pat. 11,018, July 29, 1915.

Exhaust steam is led through a regulating chamber to a system of heating coils in a chimney, or flue, etc. The reheated and dried steam is utilised in any heating or drying operation, and is then led to the condenser, and condensed in the usual manner. The circulation of the exhaust steam may be assisted by an injector-compressor operated by live steam. A perforated pipe is provided through which steam or air is blown to clean the outside of the heating coils.—J. E. C.

Gas furnaces. E. W. Harvey, London. Eng. Pat. 17,543, Dec. 15, 1915.

To attain more uniform heating in steel furnaces, glass furnaces, etc., and to secure better admixture of gas and air near the flame port, air ports are so situated on each side of the gas port that the air issues from the ports in a direction at right angles to the gas currents. Contraction of the area of the gas port by inclining the sides, etc., brings about compression of the gas before it mixes with the air. Alternatively the air port may have inclined sides and be situated between gas ports. A mixing chamber is situated in front of the gas and air ports and is so constructed as to compress the mixed gases before admitting them to the furnace proper.—J. E. C.

Flaming arcs; Production of stable ——. Planiawerke A.-G. für Kohlenfabrikation, Ratibor. Ger. Pat. 293,158, Mar. 7, 1914.

THE negative electrode is made from a carbon mixture containing at least 30% of graphite and having as low an electrical resistance as possible. —A. S.

Oils, spirits, and gases from peat or other materials; Method and apparatus for obtaining ——. A. N. Macnicol, Melbourne, Australia. Eng. Pat. 11,481, Aug. 9, 1915.

SEE U.S. Pat. 1,165,889 of 1915; this J., 1916, 247.

Tungsten filaments; Making ——. E. Aeuer, Berlin, Assignor to General Electric Co., New York. U.S. Pat. 1,191,552, July 18, 1916. Date of appl., Aug. 10, 1910.

SEE Fr. Pat. 421,427 of 1910; this J., 1911, 410.

Process for coagulating latex by wood distillation gases. Eng. Pat. 11,615. *See* XIV.

III.—TAR AND TAR PRODUCTS.

Naphthalene; Thermal decomposition of the aliphatic hydrocarbon derivatives of ——. [*Formation of benzene and toluene.*] G. Egloff. Met. and Chem. Eng., 1916, **15**, 125—127.

THE oil used consisted mainly of alkyl and alkylene derivatives of naphthalene, and was obtained from a tar oil by removing the tar acids and bases in the usual manner and afterwards extracting naphthalene and anthracene by refrigeration. On distillation, the purified oil yielded 6·3, 75·0, 15·0, and 3·1% by volume of fractions boiling between 150° and 200°, 200° and 250°, 250° and 300°, and 300° and 325° C. respectively, the specific gravities of these fractions at 15·5° C. being 0·958, 0·995, 0·999, and 0·998 respectively. Cracking was effected by passing the oil at a definite rate through an electrically heated tube, the experiments being conducted at 600°, 650°, and 700° C. under pressures of from 1 to 14 atmospheres. The decomposition of the oil was considerably influenced by both temperature and pressure, but more particularly by the former; an increase in both resulted in an increased formation of carbon, of which latter a quantity corresponding to 29% of the original oil was produced at 700° C. and 14 atmospheres. The yield of benzene and toluene in the recovered oil increased with temperature, that of toluene increasing to a maximum and then decreasing as the temperature and pressure increased. The maximum benzene formation, 3·2% by volume of the original oil, was obtained at 650° C. and 14 atmospheres pressure. The proportion of toluene produced at 600° C. and 14 atmospheres, and at 650° C. and 11 atmospheres, was 2% by volume of the original oil. The formation of benzene and toluene is assumed to take place by (1) direct decomposition of methylnaphthalenes, (2) formation and subsequent decomposition of xylenes, and (3) by synthesis from acetylene and allylene, the three reactions occurring successively or simultaneously. —W. E. F. P.

Differentiation of natural asphalts from industrial pitches. Hutin. *See* IIA.

Existence of trisulphur dichloride. Richter. *See* VII.

PATENTS.

Tar; Apparatus for vaporising liquids, especially ——. H. Vogt-Gut A.-G., Arbon, Switzerland Ger. Pat. 292,195, July 11, 1915.

A PEAR-SHAPED rotary still is mounted in a furnace setting in an inclined position, and the preheated tar is supplied continuously through a passage i the neck. The tar flows down the neck, in countercurrent to the issuing vapours, to the more strongly heated enlarged part of the still. A bent pipe passing through the lower end of the still, an which can be turned by a handle, serves for running off the liquid pitch, the flow being controlled by a tube passing through the still and connected a one end with the bent pipe and at the other en with the outer air.—A. S.

Amines; Manufacture of aromatic ——. J. Y Johnson, London. From Badische Anilin u Soda Fabr., Ludwigshafen, Germany. Eng Pat. 5692, Apr. 15, 1915. Addition to Eng. Pat 13,149, May 28, 1914 (see Ger. Pat. 282,568 o 1913; this J., 1915, 708).

THE copper to be used as catalyst is prepared b reducing, at a temperature below a red heat copper oxide prepared by precipitating a solution o a copper salt, and not pyrogenetically as claime in the main patent. *Example:* Hot caustic sod solution is added gradually to a solution of 118 grms. of copper nitrate crystals, 38 grms. of silve nitrate, and 252 grms. of magnesium nitrat crystals, and the precipitate washed; 130 grms. o pumice-stone lumps is treated with 20 grms. o the precipitate, a small amount of water, and the 20 grms. of 40% sodium silicate solution adde and the pasty mass obtained heated at 200° in a current of hydrogen; on passing a mixture hydrogen and nitrobenzene vapour over thi catalyst at 200°—210° C., aniline is produced. —F. W. A.

Aniline, other aromatic amines, or other bodies in volving catalytic hydrogenation [*reduction*]; *Manu facture of* ——. J. Y. Johnson, London. Fro Badische Anilin und Soda Fabrik, Ludwigshafe Germany. Eng. Pat. 6409, Apr. 29, 191 (Compare Eng. Pat. 13,149 of 1914; this J 1915, 790.)

CATALYTIC hydrogenation (reduction) is effected b employing carbon monoxide or gases containi carbon monoxide together with water vapour comparatively low temperatures. *Exampl* Nitrobenzene vapour mixed with an excess of reducing gas containing at least one volume water vapour for each three volumes of carb monoxide is passed over a contact mass containi copper, *e.g.*, obtained by coating 130 grms. pumice stone with a mixture of 24·3 grms. of cupr carbonate, 2·7 grms. of zinc carbonate, and 20 grm of concentrated sodium silicate solution a

reducing at a low temperature; the temperature is maintained at 200°—220° C. during the reaction; a good yield of aniline is produced.
—F. W. A.

Organic chemical process. [*Hydroxy-compounds; Manufacture of aromatic* ——.] C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,191,880, July 18, 1916. Date of appl., Mar. 18, 1916.

Aromatic hydrocarbons are sulphonated by means of strong sulphuric acid maintained in a practically anhydrous condition, and the sulphonated material is neutralised by means of sodium carbonate; the dried sodium sulphonate is fused with caustic soda, and gases containing carbon dioxide are passed into an aqueous solution of the fused material; the sodium carbonate liquors are separated and employed to neutralise the acid sulphonated material.—F. W. A.

9.10-*Dihalogenanthracene-β-monosulphonic acids; Preparation of* ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,590, Sept. 11, 1914.

9.10-Dihalogenanthracenes are sulphonated with oleum in the presence of an inert substance, *e.g.*, nitrobenzene.—A. S.

Anthraquinone; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292,681. June 23, 1914.

Anthraquinone is prepared by heating anthracene, dissolved or suspended in a neutral or alkaline medium, with oxygen under pressure in presence of a catalyst. For example, 100 parts of a 30% aqueous anthracene paste is mixed with 3000 parts of water, 250 parts of 25% ammonia, and 5 parts of copper oxide in a vessel capable of resisting pressure, a quantity of oxygen corresponding to 3 atoms per mol. of anthracene, or the corresponding quantity of air, is forced in, and the mass is stirred and heated for 20 hours at 170° C. After cooling, the anthraquinone is separated and freed from copper compounds by washing with ammoniacal water. Nickel, cobalt, iron, and lead compounds may be used as catalysts instead of copper oxide.—A. S.

IV.—COLOURING MATTERS AND DYES.

Chlorophyll-like colouring matter; Alleged synthesis of a ——. T. Jona. Monit. Scient., 1916, **6**, 149—150.

The author questions the identity of the colouring matter prepared by Albert and Mary (this J., 1915, 790) with chlorophyll. The colour reactions described are quite inconclusive, and the spectrum described is not the well-known spectrum of chlorophyll, and any resemblance to spectra of impure specimens of chlorophyll may be attributed to chance. Moreover, the formula ascribed to the synthetic chlorophyll and the equation representing its formation are not supported by the experimental observations.—C. A. M.

Mononitrophenyl ethers. H. I. Jones and A. N. Cook. J. Amer. Chem. Soc., 1916, **38**, 1534—1550.

The *o*- and *p*-nitrophenyl ethers were prepared by the action of potassium phenoxide on *o*- or *p*-bromonitrobenzene in the absence of a solvent, according to the equation. $(NO_2)C_6H_4Br + C_6H_5OK = (NO_2)C_6H_4.O.C_6H_5 + KBr$. The phenoxide was prepared by the addition of molten potassium hydroxide to molten phenol, whereby a snow-white product was obtained. The *o*-nitrophenyl ether is a yellow liquid at all temperatures down to —80° C.; it boils at 195°—197° C. at 45 mm. pressure, with partial decomposition, is readily converted into a rather unstable, hygroscopic monosulphonic acid, m. pt. 90° C. (with decomp.), and on reduction with tin and hydrochloric acid is reduced to *o*-aminophenyl ether. *p*-Nitrophenyl ether and its derivatives are much more stable than the corresponding *o*-compounds. The ether forms crystals, m.pt. 123·5° C., and sublimes and distils unchanged. Its sulphonic acid can be obtained only by the action of fuming sulphuric acid, but it is more readily reduced than its isomeride to the amine, which melts at 95° C. Both the sulphonated and unsulphonated amines of the *o*- and *p*-series were converted into azo-dyes of which a full description is given. It was observed in general that the *o*-aminophenyl ether dyes tend mostly to reds and browns, though a few purple and yellow dyes were obtained. The *o*-dyes are more brilliant than the *p*-dyes, whilst the sulphonated dyes are less brilliant than the unsulphonated.—G. F. M.

Triarylcarbinols; Tautomerism of ——. M. Gomberg and N. E. Van Stone. J. Amer. Chem. Soc., 1916, **38**, 1577—1606.

Various substituted derivatives of *p*-hydroxytriphenylcarbinol, containing the substituent (CH_3, OCH_3, Cl, Br) in the ortho position with respect to the hydroxyl group, were prepared by condensation of benzophenone chloride with ortho-substituted phenols. In some cases no catalyst was required, but in others the yields were increased by the use of aluminium chloride. All the products, like *p*-hydroxytriphenylcarbinol itself (see Gomberg, *ibid.*, 1913, 1035), were found to exist in two crystalline desmotropic modifications, one coloured and possessing a quinonoid (quinocarbonium) structure, and the other colourless and doubtless the true benzenoid carbinol. The colourless form was obtained by dissolving the substance in alkali, precipitating by carbon dioxide, and crystallising from benzene, ether, or alcohol, whilst the coloured form was prepared by crystallising from 60—70% acetic acid after heating with the solvent for some time if necessary. Transformation of the colourless into the coloured modification occurred under the influence of heat or light. The coloured form invariably possessed a lower melting point than the colourless one, and also underwent dehydration much more readily, yielding the corresponding fuchsone.—J. H. L.

Desoxyhydrocatechin-tetramethylether. H. Ryan and M. J. Walsh. Scient. Proc. Roy. Dublin Soc., 1916, **15**, 113—120.

Veratroyl chloride (m.pt. 68°—69° C.), obtained by the action of thionyl chloride on veratric acid (m.pt. 178°—180° C.) prepared from vanillin, was condensed with the ethyl homologue of phloroglucinol-trimethylether, prepared by a slight modification of the method of Herzig and Erthal (Monatsh. Chem., 1911, **32**, 481); reduction of the resulting veratroyl-ethylphloroglucinol-trimethylether (m.pt. 123°—124° C.) by means of sodium and alcohol should yield 3-ethyl-2.4.6.3′.4′-pentamethoxydiphenylmethane, identical with desoxyhydrocatechin-pentamethylether in case the coumarane formula of von Kostanecki and Lampe (Ber., 1907, **40**, 720) for catechin is correct; the oil obtained, however, resisted all attempts to crystallise it, even when inoculated with the pentamethylether prepared according to the method of von Kostanecki and Lampe; hence it has not been possible to decide between the coumarane formula and the chromane formula of Perkin and Yoshitake (Chem. Soc. Trans., 1902, **81**, 1169) for catechin.
—F. W. A.

Patents.

Acid wool dyestuffs indifferent to copper : Manufacture of ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 12,249, Aug. 25, 1915. Addition to Eng. Pat. 1611 of 1915 (this J., 1916, 301).

The dyestuffs obtained by combining *o*-diazophenol or -naphthol derivatives with β-ketone-aldehyde derivatives in which the aldehyde hydrogen is replaced by an alkyl, aryl, alkoxy, or arylamino group, *e.g.*, aceto- or benzoyl-acetic ester, acetyl- or benzoyl-acetone, or aceto- or benzoyl-acetanilide, or with benzoylacetic-o-carboxylic acid, or with such multinuclear isocyclic or heterocyclic ring compounds as contain a CH_2 group capable of coupling, *e.g.*, diketohydroindene, *peri*-naphthindandione, 3-hydroxy-1-thionaphthene, ketocoumarane, or indoxyl, are converted into compounds containing copper as described in the main patent. The dyestuffs produced are soluble in water, are indifferent to copper, and dye animal fibres direct from an acid bath bright greenish-yellow, orange-brown, brown, red, violet, blue to black tints fast to washing and to light. *Example :* 21 grms. of the dyestuff obtained by combining diazotised 1.2.4-aminonaphtholsulphonic acid with hydroxythionaphthene is dissolved in 700 grms. of water, and a solution of 13 grms. of copper sulphate in 50 grms. of water added at 70° C. ; the blue copper compound precipitated is neutralised with sodium carbonate, separated, and dried ; it gives on wool from an acid bath very pure violet-blue dyeings fast to washing, alkali, and light.—F. W. A.

Phthaleins and their halogen derivatives containing selenium : Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 291,883, Apr. 4, 1914. Addition to Ger. Pat. 290,540.

Products similar to those described in the chief patent (this J., 1916, 595) are obtained by the use of selenium oxychloride instead of selenium chlorides.—A. S.

Aminoanthraquinone-sulphonic and -carboxylic acids; Preparation of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,100, June 3, 1914.

Halogenanthraquinone-sulphonic or -carboxylic acids are condensed with arylsulphamides by heating in aqueous alkaline solution, and the arylsulpho group is eliminated from the resulting arylsulphamino compounds. The products are dyestuffs or may be converted into dyestuffs. —A. S.

Sulphur dyestuffs ; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,101, Sept. 25, 1913.

The ethylene or ethyl derivatives of amines of the benzene, diphenyl, or naphthalene series are fused at a high temperature with sulphur and benzidine or its homologues or analogues. The resulting sulphur dyestuffs give reddish-brown shades which on treatment with dilute acids are changed to clear yellow shades of great fastness to boiling, to chlorine, and to cross dyeing.—A. S.

Sulphur dyestuffs ; Preparation of yellow ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,187, Feb. 23, 1915. Addition to Ger. Pat. 292,118.

Sulphur dyestuffs are prepared, as described in the chief patent (this J., 1916, 832), from mixtures of benzidine with N-diacetyl derivatives of primary diamines of the diphenyl series methylated in the nucleus, or with nitro- or amino-substitution products of these diacetyl derivatives. The products give somewhat redder shades of yellow than the dyestuffs obtained from the non-acetylated diamines.—A. S.

Trisazo dyestuffs ; Manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,181, Mar. 7, 1914.

Diazo compounds of the benzene or naphthalene series are converted into trisazo dyestuffs in the usual way, using as end component 2-amino-8-hydroxynaphthalene-6-sulphonic acid in a faintly acid solution or a solution made alkaline with bicarbonate. The dyestuffs are faster to light than the commercial disazo dyestuff, Neutral Grey, obtained by coupling diazotised aniline with α-naphthylamine, again diazotising, and coupling with 2-amino-8-naphthol-6-sulphonic acid.—A. S.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Textile fabrics ; Determination of the permeability to heat of ——. O. Bauer. Mitt. K. Materialprüf., 1915, 33, 290—305.

A simple method of determining the permeability to heat of textiles, paper, etc., is described. A copper bottle with a flat bottom of 5·5 cm. diameter, surrounded by a layer of cotton woo and an insulating casing, rests on a piece of felt on a wooden block. The bottle is provided with thermometer and contains 200 c.c. of hot water steam is passed through it until the temperatur reaches 100° C., when the junction of an iron constantan thermo-element is placed between th bottom of the copper bottle and the piece of felt and the temperature noted by means of a galvanometer at intervals of 2 mins. during a perio of 90 mins. A similar test is made with a pie of the material under examination placed betwee the bottom of the bottle and the felt. Curves ar plotted with temperature and time as co-ordinates and the ratio F ÷ f, where F and f are the area inclosed by the curves obtained in the "blank test and in the test with the textile or other materia is called the "heat-protection number" of th material. Tests with a number of differen textile fabrics showed that there is no definit relation between the "heat-protection value" a material and its nature, thickness, specifi gravity, etc., and the relative values of differen fabrics for protection against cold can only b ascertained by actual tests on the materials.—A.

Nitro-fibroin : Hydrolysis of —— *with hydrochlor acid.* T. B. Johnson and A. J. Hill. J. Ame Chem. Soc., 1916, **38**, 1392—1398. (See also th J., 1915, 1047.)

Fibroin when treated for a long time at ordinar temperatures with nitric acid of sp.gr. 1·1 yields 70 % of its weight of nitro-fibroin, a orange-coloured powder of definite compositio α_D = 43·39° to 44·10° in aqueous hydrochlor acid solution. On prolonged hydrolysis wit concentrated hydrochloric acid at 120°—130° nitro-fibroin yields 5·74 % of optically inact 3-nitrotyrosine as the hydrochloride, m.pt. 237° 25·36 % of glycocoll, and 10 % of optically inacti alanine, together with end products of oxidati reactions, such as oxalic acid and ammoniu nitrate.—T. C.

Hat bodies prepared from rabbits' fur ; Chemi study of ——. E. A. Romegialli. Annali Chi Appl., 1916, **5**, 305—338.

The composition of the hat bodies, before bleachi and dyeing, was found to be : carbon, 40·9 hydrogen, 9·88 ; nitrogen, 16·33 ; sulphur, 3·1 sulphur present as sulphuric acid, 0·88 ; ph phorus, 0·13 ; ash, 0·45 ; water (loss at 100° 11·47 ; oxygen (by difference), 16·71 %. The a contained : SiO_2, 34·75 ; Al_2O_3, 20·34 ; Fe_2

3·17; P_2O_5, 6·14; CaO, 7·14; MgO, 3·35; CuO, 10·41; CO_2, SO_4, Na_2O, K_2O, etc. (by diff.), 14·67%. When the fur is treated with acid mercuric nitrate solution in the "carroting" process, in order to improve its felting properties, it appears to combine chemically with mercury. If the treated fur be boiled with water, the solution after being concentrated does not give a reaction for mercury, but mercury can be detected by the usual reactions after treating the fur with concentrated nitric acid. For bleaching the hat bodies preparatory to dyeing, the most satisfactory results are obtained with hydrogen peroxide in presence of a small quantity of sodium carbonate. Tests of the physical properties of the hat bodies, experiments on the action of nitric and sulphuric acids, water at high temperatures, and bleaching powder, and laboratory dyeing tests with synthetic dyestuffs are described.—A. S.

Imitation parchment and "pergamyn" papers; Test for grease-proof properties of ——. C. Bartsch. Mitt. K. Materialprüf., 1915, 33, 441—445.

THE "blister" test and the oil of turpentine test commonly employed for grease-proof papers have been the subject of controversy as to their relative validity, and both possess the disadvantage of standing in no direct relation to the actual use for which the paper is required and of being incapable of numerical comparison. In devising a quantitative method it was preferred, therefore, to employ butter or lard as the greasy medium, and standards had to be fixed to express the degree and time of resistance. In the test now prescribed, sheets of the grease-proof paper, 13 × 18 cm. in size, are smeared with a layer of fat 1 mm. thick and 25 sq. cm. in area. The fat is applied by means of a zinc template having a square hole of the correct area, and the excess is scraped off with a celluloid straight-edge. The treated paper is laid on a sheet of white engine-sized notepaper and supported on a glass plate, another glass plate oaded with a 500 grm. weight being superposed. The results are classified by an examination of he sheet of notepaper after a given time as follows:—(0) Perfectly grease-proof, no stains or only one or two stains due to minute pinholes: (1) Grease-proof, not more than 15 small, practically isolated stains; (2) Fairly grease-proof, between 15 and 50 small stains, mostly isolated; (3) Slightly grease-proof, numerous stains, largely confluent, covering about half the area under reatment; (4) Not grease-proof, stains spreading over the greater portion of the area. A large number of observations have shown that lard has a greater penetrating power than butter, consequently lard has been suggested as the standard reagent and one hour as the standard time. None of the imitation parchment or pergamyn papers possesses grease-proof properties approaching hose of the real vegetable parchments, but the degree of resistance may be determined in relation o the purpose for which the paper is required n a manner similar to the ink-resistance of sized writing papers.—J. F. B.

Determination of small quantities of sulphide sulphur. Drushel and Elston. *See* VII.

Utilisation of crude wool fat in the soap industry. Schrauth. *See* XII.

Red prussiate for blue print paper. *See* XXI.

PATENTS.

Waste silk materials; Extraction and recovery of loading ingredients from ——. E. Beisenherz, Essen-Ruhr, Germany. Eng. Pat. 11,186, Aug. 3, 1915. Under Int. Conv., Aug. 3, 1914.

n the process of extracting tin from loaded silk by the action of oxalic acid or acid oxalates (Eng. Pat. 4901 of 1915; this J., 1916, 596), the presence of salts of alkalis, alkaline earths, and aluminium in the waste silk material causes an excessive consumption of oxalic acid and interferes with its recovery. This difficulty is overcome by subjecting the waste silk to a preliminary treatment in a 1—2% solution of hydrochloric or other mineral acid at 40°—50° C., which removes basic matters without dissolving more than traces of the tin.—J. F. B.

Drying textile fabrics, paper, and other materials of a continuous character; Means for ——. W. W. Beaumont and L. N. Burt, London. Eng. Pat. 16,064, Nov. 12, 1915.

THE fabric travels in a zigzag path over a series of rollers enclosed in a chamber, and hot air is passed over it from two sources independently, one inlet and outlet being near the entrance for the fabric and the others near the outlet for the fabric. The more volatile constituents of the liquid saturating the fabric are thus carried off by the first air current and may be recovered by condensation, while aqueous vapour is separately removed by the second air current.—W. F. F.

Plastic composition. W. A. Beatty, New York. U.S. Pat. 1,188,356, June 20, 1916. Date of appl., Apr. 16, 1915.

THE composition consists of a cellulose ester (nitrocellulose), a crystalline condensation product of a hydroxy derivative of an aromatic hydrocarbon (dihydroxydiphenyldimethylmethane), a camphor substitute, and a solvent (amyl acetate, with or without acetone).—E. W. L.

Pulp and the like for use in the manufacture of paper; Apparatus for bleaching ——. T. H. Nash, St. Paul's Cray, Kent. Eng. Pat. 100,993. May 23, 1916. (Appl. No. 7325 of 1916.)

THE pulp is charged by means of a conveyor through a backwardly inclined, open-ended trough containing bleach liquor, into the first of a series of concrete containers, preferably with semicylindrical bottoms, provided with agitators carried by horizontal shafts. The containers may be arranged either in step-formation or vertically one above the other and are connected together at their upper parts by overflow conduits, so that the overflow level from each container is lower than that from the container immediately preceding it. The overflow orifices are preferably arranged alternately at opposite corners of the containers, and valves are provided in the bottoms for discharging the whole contents of the system, if desired, and for flushing purposes. The bleached pulp overflowing from the last container is diluted with water so that it may be delivered through a pump.—J. F. B.

Paper making machines; Fourdrinier ——. E. C. R. Marks, London. From Rice, Barton and Fales Machine and Iron Co., Worcester, Mass., U.S.A. Eng. Pat. 10,528, July 20, 1915.

THE frame of a Fourdrinier paper machine of the non-shaking type is provided with a number of supporting surfaces on which table sections carrying the table rolls are directly supported. On the frame are placed a number of transverse rails which may be removable, and the tables are provided with supporting wheels normally out of contact with the rails. By the operation of rotary cams the rails may be moved upwards to engage the wheels and lift the table sections off the supporting surfaces so that they may be removed transversely along the rails. Additional rails are provided in alinement with the transverse rails, outside the frame, to receive the tables when they are removed from the machine for changing a wire.—J. F. B.

Paper and similar material; Treatment of ——. H. C. Mitchell, London. Eng. Pat. 12,873, Sept. 8, 1915.

A SURFACE coating of graphite, lampblack, or other colour, removable by means of indiarubber, is applied in the form of a powder to paper by means of a bronzing or other equivalent machine, and the excess of powder is removed by brushing.—J. F. B.

Cellulose esters; Process for the preparation of new ——. J. Koetschet and M. Theumann, Lyon, Assignor to Soc. Chim. des Usines du Rhône, Paris. U.S. Pat. 1,191,439, July 18, 1916. Date of appl., Sept. 5, 1914.

SEE Eng. Pat. 10,822 of 1915; this J., 1915, 1086.

Plastic substances from the derivatives of cellulose; Process of manufacturing ——. F. Lehmann and J. Stocker, Berlin. U.S. Pat. 1,191,801, July 18, 1916. Date of appl., Mar. 16, 1914.

SEE Fr. Pat. 469,925 of 1914; this J., 1915, 25.

Pulp-digesters; Method of removing scale from heating apparatus for ——. E. Morterud, Jelöen, Norway. U.S. Pat. 1,191,451, July 18, 1916. Date of appl., Aug. 6, 1914.

SEE Ger. Pat. 278,827 of 1913; this J., 1915, 276.

Acid magnesium sulphite solution; Production af an —— for the manufacture of sulphite-cellulose]. J. L. Jardine, Penicuik, Scotland. U.S. Pat. 1,192,640, July 25, 1916. Date of appl., Jan. 29, 1916.

SEE Eng. Pat. 2509 of 1915; this J., 1916, 533.

Process for converting cellulose into fermentable carbohydrates. Ger. Pat. 292,482. *See* XVIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

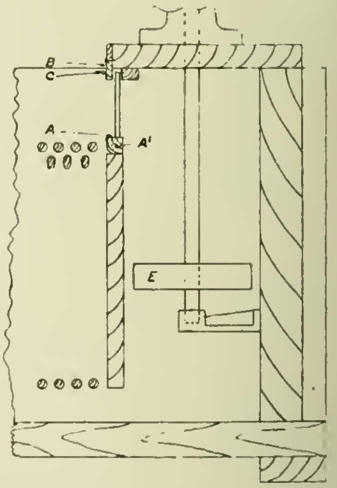
Silk; Theories of the weighting of —— and their present position. P. Heermann. Mitt. K. Materialprüf., 1915, **33**, 446—453.

THE phenomena of dyeing, mordanting, and weighting may be classified as primary or substantive and secondary or adjective, and whereas the latter are generally explainable on the basis of salt or lake formation, double decomposition, etc., the primary or direct affinities are less clearly defined; among these are comprised the mordanting of cotton with chromium chloride and the weighting of silk by stannic chloride or tannic acid. When silk is dipped in stannic chloride solution, drained, and washed exhaustively with water, stannic hydroxide is fixed in the fibre and the process may be repeated with cumulative effect. The simple theory of mechanical impregnation followed by hydrolysis does not account for the fact that stannic chloride is withdrawn from the bath and concentrated in the silk. This absorption in the case of pure materials takes place without disturbance of the normal composition of the stannic chloride. The reaction in its full degree is specific for silk and the stannic hydroxide is uniformly distributed through the fibre. The evidence in favour of the formation of an additive chemical compound between stannic chloride and silk fibroin is not convincing; no molecular ratios have been established. Such a compound, which becomes hydrolysed in presence of water, has been prepared with α-alanine and stannic chloride but only by heating in a sealed tube at 150° C., conditions very different from those of the weighting of silk. The author favours an electrical, so-called "ionetic" theory as offering the most rational explanation of the facts. He has observed that heavier weightings are obtained, the higher the state of electrolytic dissociation or conductivity of the stannic chloride solution, and that when at certain concentrations, the electrolytic dissociation of the stannic chloride is reduced to a minimum, the property of weighting silk is also suppressed. The silk fibre possesses in a special degree the property termed "electro-affinity" and it is suggested that the attraction of a mordant to a fibre is most highly developed when the dissociation of the mordant solution corresponds with a maximum difference between the electro-affinities of the mordant ions and of the fibre. Although in an acid medium silk readily acquires a positive charge, it is known to be highly susceptible to a reversal in sign of its electrical charge; it is therefore assumed that in a dissociated stannic chloride bath the silk becomes negatively charged. According to the degree of dissociation of the bath the tin cations are attracted to the negatively charged silk and retained by it in union with the hydroxyl ions of the aqueous medium. The chlorine anions, migrating later, are also attached to the silk in union with the hydrogen ions of the water, being removed in the form of hydrochloric acid in the subsequent washing.—J. F. B.

PATENTS.

Yarn dyeing machines: Guard for use with ——. P. Crayton and W. E. Shaw, Birkenshaw. Eng. Pat. 17,761, Dec. 20, 1915.

To prevent the material to be dyed from coming into contact with the propellers, E, a toothed guard of wood, aluminium, or other acid-resisting material, A, with end dowels, A′, journaled into the sides of the vat, is fitted transversely across the upper part of the vat between the dyeing chamber and the circulating chamber; the guard rises and falls automatically according to the direction of flow of the dye-liquor and may be locked clear of the dyeing chamber during the insertion or withdrawal of the material by means of a hinged drop lid, B, and side-bolt, C.—F. W. A.



Bleaching process. H. Wade, London. From Deutsche Gold- und Silber-Scheide Anstalt. vorm. Roessler, Frankfort, Germany. Eng. Pat. 10,916, July 27, 1915.

IT is not necessary to raise the temperature of an alkali peroxide bleaching bath gradually to 80° C. as suggested in Fr. Pat. 460,959 of 1913 (this J. 1914, 76); it is preferable to heat the bath immediately to 85° C. The time of bleaching is shortened, better whites are produced, and dark Egyptian cotton may be bleached at the same cost as ordinary cotton. A stabilising catalyser, *e.g.*, stannic acid, colophony, dextrin, or gelatin, is added to the bath; thus a suitable bath for Egyptian yarn is a 0·28 % solution of sodium peroxide to which has been added 0·025 % of sodium silicate, 0·02 % of magnesium chloride, and 0·07 % of Monopol soap. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 23,110 of 1900, 14,385 of 1905, and 15,137 of 1907; this J., 1902, 48; 1906, 280; 1908, 682.)—F. W. A.

Sizing yarns; Apparatus for ——. W. A. Nivling, Arlington, Mass., U.S.A. Eng. Pat. 10,866, July 27, 1915.

See U.S. Pat. 1,153,245 of 1915; this J., 1915, 1050

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Magnesium salts; Precipitation of —— *by ammonium carbonate.* F. Fichter and R. Osterwalder. Z. anal. Chem., 1916, **55**, 389—392.

When magnesium sulphate solution is treated with ordinary ammonium carbonate solution (this solution reacts as a mixture of ammonium carbonate and bicarbonate), crystalline hydrated magnesium carbonate, $MgCO_3.3H_2O$, is precipitated gradually; the precipitate forms more quickly when the mixture is warmed. If ammonia is added previously to the ammonium carbonate solution so that the proportion of ammonia to carbon dioxide corresponds with the formula $(NH_4)_2CO_3$, crystals of the hydrated magnesium carbonate appear within 30 minutes; by heating the mixture to 40° C., an amorphous precipitate of *magnesia alba* is formed which changes into the hydrated carbonate when the mixture is cooled. When the ammonium carbonate solution contains an excess of ammonia, basic magnesium carbonate *magnesia alba*) is first formed and this changes after a few hours into the hydrated carbonate; f. however, the precipitation is made from a hot olution, the basic carbonate remains as such when he mixture is cooled. A double carbonate, $NH_4)_2CO_3,MgCO_3.4H_2O$, is obtained by treating, n the cold, 1 equivalent of magnesium sulphate with 10 equivalents of ammonium carbonate, $NH_4)_2CO_3$.—W. P. S.

Sulphur; Determination of small quantities of sulphide ——. W. A. Drushel and C. M. Elston. Amer. J. Sci., 1916, **42**, 155—158.

ULPHUR present as sulphide can be determined ith great rapidity (10 mins.) and with fair ccuracy by treatment with dilute acid, causing he hydrogen sulphide to impinge upon lead acetate paper, and comparing the colour produced with series of standard tints. The latter were obtained ith a simple apparatus comprising a 100 c.c. ask fitted with a cork through which passed an pright tube, 15 cm. long, and 18 mm. diam., rawn out at the base to enable it to pass through he cork. A solution of sodium sulphide in nitrite-ee distilled water, and of known sulphur content, as placed in the flask together with 25 c.c. of bout 0·5 % hydrochloric acid: the liquid was oiled gently and the hydrogen sulphide escaping ade to traverse a piece of filter paper previously aked in lead acetate solution, which was tied er the top of the outlet tube. The excess of ad acetate was washed out of the paper, and the ter dried and labelled. In this way stains corresponding to 0·0008—0·002 % of sulphide sulphur re prepared. The determination of sulphide lphur was performed in a precisely similar manner, but a narrower outlet tube was used when the sulphur content was less than 0·001 %. The maximum error with the latter was 0·0003 % and with the wider tube 0·001 %. The method was tested against other approved methods and was found to be applicable to the determination of sulphur in coke and in paper, and of hydrogen sulphide in gaseous mixtures.—E. H. T.

Lead chlor-arsenate or artificial mimetite: Preparation and properties of ——. C. C. McDonnell and C. M. Smith. Amer. J. Sci., 1916, **42**, 139—145.

A compound approximating in composition to the mineral mimetite, $Pb_4(PbCl)(AsO_4)_3$, was obtained as a gelatinous precipitate by pouring a solution of di-lead arsenate in 10 %, boiling ammonium chloride solution, into cold water. It was also produced by digesting the lead salt with sodium, ammonium, or potassium chloride in aqueous solution, the action being very rapid when heat was applied. Sodium chloride in 2 % or 10 % solution was particularly effective in yielding a compound practically identical in composition with the mineral. The same product was obtained when solutions of the arsenate and lead chloride were warmed together. So prepared, the substance was almost entirely amorphous, but by adding lead acetate solution to the lead arsenate dissolved in dilute hydrochloric acid, until incipient precipitation occurred, and then cooling, a homogeneous crystalline mass was obtained, the crystals consisting of hexagonal prisms bounded by pyramids. Fine hexagonal crystals of practically the same composition as the mineral were obtained by adding about 30 grms. of arsenic acid to 2 litres of boiling, saturated sodium chloride solution, precipitating with lead acetate, filtering, and adding 600 c.c. of boiling water to the filtrate. The lead-chlorarsenate separated quickly, and was washed repeatedly with boiling water until the wash water was entirely free from chloride. Its sp.gr. was 7·15 (natural mimetite 7·0—7·25); it had a slight yellow tint, and the crystals were uniaxial; the mineral is usually biaxial.—E. H. T.

Margarosanite, a new lead-calcium silicate from Franklin, N.J. W. E. Ford and W. M. Bradley. Amer. J. Sci., 1916, **42**, 159—162.

Analyses showed that this new mineral consists essentially of a double silicate of lead and calcium together with some manganese, and the formula $Pb(Ca,Mn)_2(SiO_2)_3$ was deduced. It is colourless and transparent, of hardness 2·5—3, sp.gr. 3·991, possessing three well-defined cleavage planes, and probably belonging to the triclinic system. It is decomposed by nitric acid with separation of silica. The name margarosanite was given to it on account of its nacreous lustre and lamellar structure (Gr. *margarites*, pearl, and *sanis*, tablet or board). —E. H. T.

Uranyl-potassium oxalates. A. Colani. Comptes rend., 1916, **163**, 123—125.

Study of the system: uranyl oxalate, normal potassium oxalate, and water at 15° and 50° C. respectively, showed that besides potassium oxalate, $K_2C_2O_4,H_2O$, and uranyl oxalate, $UO_2C_2O_4.3H_2O$, there exist as solid phases, $K_2(UO_2)(C_2O_4)_2.3·5H_2O$ at 15° C., $K_2(UO_2)(C_2O_4)_2$ at 50° C., and $K_2(UO_2)_2(C_2O_4)_3,4H_2O$ and $K_6(UO_2)_2(C_2O_4)_5,10H_2O$ at both temperatures. The compounds appear to be of the nature of double salts, for even in presence of a large excess of potassium oxalate, they give the customary reactions of uranyl salts.—A. S.

Rare earth cobalticyanides. C. James and P. S. Willand. J. Amer. Chem. Soc., 1916, **38**, 1497—1500.

The rare earth cobalticyanides have the general formula $R_3(CoC_6N_6)_2.9H_2O$. They form heavy microcrystalline precipitates, sparingly soluble in water, and varying in solubility in dilute hydrochloric acid (sp.gr. 1·050) from 10·75 and 10·41 parts per 1000 in the case of cerium and lanthanum to 2·78 parts with yttrium and 0·38 part with ytterbium. Since the yttrium salt is more than three times as soluble as the erbium salt, the cobalticyanide method is excellent for their separation. A separation of oxides containing dysprosium, holmium, and yttrium with traces of erbium, terbium, and neodymium was also effected, the yttrium appearing in the more soluble and the dysprosium and holmium in the less soluble fractions.—G. F. M.

Conductivity of pure water ; The specific —— in equilibrium with atmospheric carbon dioxide. J. Kendall. J. Amer. Chem. Soc., 1916, **38**, 1480—1497.

By calculation from the ionisation constant of carbonic acid, the mobility of the $—HCO_3$ ion, the carbon dioxide content of the atmosphere, and the solubility of carbon dioxide in water under atmospheric conditions, the values $0·65 \times 10^{-6}$, $0·75 \times 10^{-6}$, and $0·80 \times 10^{-6}$ were obtained for the temperatures 0°, 18°, and 25° C. respectively for the specific conductivity of pure water in equilibrium with carbon dioxide, figures which agree closely with those obtained by direct measurement of the conductivity of carefully purified water in contact with air. The conclusion is accordingly drawn that purified conductivity water really consists of a saturated solution of carbonic acid under the partial pressure of the carbon dioxide in the atmosphere, and contains no other conducting impurities in any appreciable quantity. —G. F. M.

Selensulphur from Hawaii ; Composition of the ——. G. V. Brown. Amer. J. Sci., 1916, **42**, 132—134.

The specimen examined, obtained from the United States National Museum, was a piece of slag-like lava, resembling pumice in appearance, and impregnated with an orange-red to yellow crystalline mineral. After crushing coarsely, the yellow to orange mineral portion was picked out by hand, and its selenium content determined by the method of W. Smith (this J., 1915, 1090). It contained 0·68 % of selenium, 12·44 % of sulphur, and 3·16 % of matter volatile at 103° C. (moisture). Deducting material other than sulphur and selenium, the percentage composition of the mineral was calculated to be: sulphur 94·82 %, selenium 5·18 %. The very low proportion of selenium to sulphur (1 : 45·5) indicated that the mineral should be regarded as a "seleniferous sulphur" rather than as selensulphur, a mineralogical term used to connote a naturally occurring isomorphous mixture of the two elements.—E. H. T.

Trisulphur dichloride ; Existence of ——. M. M. Richter. Ber., 1916, **49**, 1024.

Michaelis (Ber., 1890, **23**, 553) has shown that thionyl chloride acts under certain conditions as a mixture of sulphur dichloride and sulphuryl chloride : $2SOCl_2 = SCl_2 + SO_2Cl_2$. Sulphur chloride reacts with *p*-chlorophenol as a mixture of sulphur dichloride and trisulphur dichloride : $2S_2Cl_2 = SCl_2 + S_3Cl_2$, yielding a practically equimolecular mixture of 5.5′-dichloro-2.2′-dihydroxydiphenyl monosulphide (m.pt. 174° C.) and trisulphide (m.pt. 133° C.). The yield of trisulphide is increased by addition of sulphur to the sulphur chloride, as this converts any dichloride into monochloride which can then form trisulphur dichloride.—F. W. A.

Hydrogen ; Production of —— from formates and from carbon monoxide [and bases]. M. G. Levi and A. Piva. Annali Chim. Appl., 1916, **5**, 271—301. (See this J., 1914, 310.)

Calcium formate in an atmosphere of nitrogen begins to decompose at about 375° C., and barium formate at about 350° C. ; in both cases the residue is free from oxalate and consists almost entirely of carbonate (compare Vignon, this J., 1911, 121). In presence of calcium hydroxide the temperature of decomposition of calcium formate is lowered ; the gaseous decomposition products contain less carbon monoxide and more hydrogen, and in presence of sufficient lime, carbon dioxide and methane disappear from the gas. With quicklime instead of slaked lime, less gas is produced and this contains some carbon dioxide and methane, whilst the solid residue is dark-coloured owing to the presence of carbonaceous matter. A mixture of sodium formate and calcium hydroxide yields nearly pure hydrogen. Interaction of calcium hydroxide and carbon monoxide begins at about 300° C. with dry carbon monoxide and at 250°—280° C. with moist carbon monoxide. The yield of hydrogen increases with the temperature, reaching 90 % at 400° C and 99 % at higher temperatures. Low velocity o carbon monoxide and great surface of contact between the gas and lime are favourable to th yield of hydrogen. The gas contains only carbo monoxide in addition to hydrogen, except fo traces of methane, etc. (compare Vignon, *loc. cit.*) The solid residue contains formate when th reaction temperature does not exceed 400° C., bu not when a temperature of 500°—700° C. is used In presence of steam, carbon monoxide interact with calcium hydroxide to form formate at 250°— 300° C., and carbonate and hydrogen abov 300° C., but the reaction is much slower than wit sodium hydroxide. At 500°—600° C., howeve the formation of hydrogen is almost quantitati provided the elements of water are always present In presence of sodium hydroxide, even in sma quantity, lime reacts at a considerably low temperature, and it is possible to obtain a yield 50 % of hydrogen even at 300° C.—A. S.

Red prussiate for blue print paper. See XX

Hygroscopic properties of sodium, potassium, a ammonium nitrates, potassium chlorate, a mercury fulminate. Taylor and Cope. *See* XXI

Use of ferric oxide as standard in the volumetr determination of iron in hydrochloric acid solutio Brandt. *See* XXIII.

Patents.

Lime ; Apparatus for burning —— [using lignite fuel]. P. A. and E. J. Walsh, Round Roc Tex. U.S. Pat. 1,191,752, July 18, 1916. Da of appl., Nov. 18, 1914.

Lignite is burnt in a side combustion chamb provided with a grate having bars spaced apa to permit burning particles to fall through. air-distributing chamber, with front and r walls converging in a downward direction, located below the grate, the inner surfaces of walls being smooth to prevent the accumulati of burning particles. An ash-pit, with a c stricted air inlet, is located below, and is connect to the lower end of the distributing chamber an inclined air shaft, equal in width to that of grate but of less depth. The front and r walls of the distributing chamber have a grea inclination to the vertical than the front and r walls of the air shaft. Particles of lignite fall from the rear portion of the grate are conveyed the rear wall of the chamber on to the rear wall the air shaft, but from the front portion of grate the particles are caused by the front wall of the chamber to fall the entire length of the air shaft. The particles of lignite, which are only partially consumed in the grate, are thus burnt in the air shaft or the ash-pit, producing a long flame in the lime kiln.—B. N.

Ammonium phosphate; Manufacture of ——. H. Hilbert, Neuss. Ger. Pat. 292,530, Apr. 10, 1914.

Phosphoric acid is added continuously to a solution containing di-ammonium phosphate, in such proportion that a slight excess of the latter is always present, whereby primary ammonium phosphate is precipitated and can be removed continuously.—A. S.

Scandium: Direct separation of —— from other rare earths. M. Speter, Charlottenburg. Ger. Pats. (A) 282,657, Nov. 17, 1911, and (B) 292,257, Jan. 24, 1912.

(A) The mineral is decomposed with sulphuric acid, hydrochloric acid, or the like, or first fused with alkali and then treated with acid. The acid solution is heated to boiling and treated with hypophosphoric acid or a hypophosphate. Under these conditions scandium, unlike other trivalent rare earths, forms an insoluble compound. The precipitate is separated, decomposed by sulphuric acid, and the scandium precipitated from the solution as oxalate, which is further purified by known methods. (B) Pyrophosphoric acid or metaphosphoric acid or their salts, or mixtures of them, are used instead of hypophosphoric acid to precipitate the scandium. The precipitate contains other rare earths in addition to scandium, but is easily purified.—A. S.

Graphite; Expanded ——. J. W. Aylsworth, East Orange, N.J., Assignor to Condensite Co. of America, Bloomfield, N.J. U.S. Pat. 1,191,383, July 18, 1916. Date of appl., Dec. 4, 1914.

Particles of flake graphite, too large to pass through a 200-mesh screen, are covered with an oxidising agent, so as to form graphitic acid as films on the laminæ of the individual flakes. Heat is applied to dissociate the acid, and the particles become distended, like the leaves of an open book, with mechanically-entrapped gas between the laminæ. The mass is afterwards heated to redness.—B. N.

Carbon articles; Process of making ——. A. T. Hinckley, Niagara Falls, N.Y., Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,192,062, July 25, 1916. Date of appl., Oct. 11, 1912.

Ammonium sulphate is mixed with coke and pitch to substantially 5 to 15% of the pitch content, and the mixture heated, formed into articles, and then baked to set the binder.—B. N.

Hydrogen from iron and steam; Shaft-furnace for production of ——. A. Messerschmitt, Stolberg. Ger. Pat. 291,902, Feb. 12, 1914.

The annular reaction chamber is divided into sections by vertical projections from the walls or by partitions.—A. S.

Sulphides of phosphorus; Manufacture of ——. F. C. Frary, Minneapolis, Minn., U.S.A. Eng. Pat. 14,962, Oct. 22, 1915. Under Int. Conv., Feb. 3, 1915.

See U.S. Pat. 1,153,054 of 1915; this J., 1915, 1054.

Chromates of lead: Process of preparing ——. International Color and Chemical Co., Inc., Assignees of A. S. Ramage, Detroit, Mich., U.S.A. Eng. Pat. 100,300, Mar. 2, 1916. Under Int. Conv., Apr. 16, 1915. (Appl. No. 3175 of 1916.)

See U.S. Pat. 1,168,417 of 1916; this J., 1916, 309.

Calcium cyanamide; Rotary tube furnace for producing continuously ——. J. H. Lidholm, London. U.S. Pat. 1,191,804, July 18, 1916. Date of appl., Feb. 14, 1914.

See Eng. Pat. 3516 of 1914; this J., 1914, 644.

Neon: Method for separating —— from gases with which it is mixed. G. Claude, Paris. U.S. Pat. 1,191,495, July 18, 1916. Date of appl., June 17, 1913.

See Fr. Pat 456,691 of 1912; this J., 1913, 1068.

Utilising the waste products of garnet works. U.S. Pat. 1,192,394. *See* X.

VIII.—GLASS; CERAMICS.

Water-glass glazes. Berge. Sprechsaal, 1916, **49**, 2—3, 9—10, 17—18. Z. angew. Chem., 1916, **29**, Ref., 342.

Leadless red glazes for ordinary earthenware fired at Seger cone 08—010, can be prepared by the use of soda water-glass and behave like leadless frit-glazes in regard to crazing, and action on colouring oxides or underglaze colours. The chief technical difficulty lie in the fact that the glaze mass after mixing with water is soon spoiled owing to the separation of gelatinous silicic acid by the action of atmospheric carbon dioxide. This separation can be retarded by addition of calcium carbonate, but not entirely prevented, as the quantity of lime required would diminish the fusibility of the glaze too much. Like leadless frit-glazes, water-glass glazes must be fired in a slightly reducing atmosphere; they give results at least equal to those obtained with lead glazes. —A. S.

Patents.

Glass; Composition of ——. E. Weintraub, Lynn, Mass., Assignor to General Electric Co., New York. U.S. Pat. 1,191,630, July 18, 1916 Date of appl., May 8, 1912.

See Eng. Pat. 18,300 of 1912; this J., 1913, 1157. The magnesium borosilicate glass has a thermal coefficient of expansion less than $3{\cdot}5\times10^{-6}$.

Glass batch or mixture. E. L. Elliott, New York, Assignor to Macbeth-Evans Glass Co., Pittsburgh, Pa. U.S. Pat. 1,192,048, July 25, 1916. Date of appl., July 17, 1914.

A foundation of colourless glass is combined with an excess of a sulphate which will not affect or be affected by any silica or alkalis in the mixture, and with aluminium and fluorine compounds in such proportions that the elements aluminium and fluorine are present in equal quantities by weight.—A. B. S.

Glass. W. C. Taylor, Assignor to Corning Glass Works, Corning, N.Y. U.S. Pat. 1,192,474, July 25, 1916. Date of appl., Sept. 17, 1914. Renewed Dec. 27, 1915.

A glass containing silica, boric oxide, and lithi (with or without alumina) in proportions to produce a coefficient of expansion less than 0·0000036.—A. B. S.

Kiln. C. Carstens, Grossflottbek. Ger. Pat. 292,140, Mar. 5, 1912.

A kiln for burning ceramic ware, etc., consists of a series of movable wagon-chambers, which run on two parallel sets of rails, the two rows being connected at the ends by U-shaped chambers running on transverse rails.—A. S.

[Glass] annealing furnaces or leers [lehrs]. L. Steelman, Millville, N.J., U.S.A. Eng. Pat. 100,899, Feb. 8, 1916. (Appl. No. 1882 of 1916.)

See U.S. Pats. 1,178,549 and 1,178,550 of 1916; this J., 1916, 635.

Artificial stone for flooring material, paving, stoneware, etc. Ger. Pat. 292,645. *See* IX.

IX.—BUILDING MATERIALS.

Iron-Portland cement; Examination of —— after hardening in air and under water. M. Gary. Mitt. K. Materialprüf., 1915. **33**, 271—290.

Permission was granted on March 6, 1909, by the German Minister for Public Works for the use of iron-Portland cement in place of Portland cement if, in addition to complying with the prescribed requirements for Portland cement (see this J., 1910, 1107), it gives satisfactory results after hardening in air. Tests have now been made with representative samples of iron-Portland cement, using mixtures of the cement with Freienwald sand in the proportions 1 : 2, 1 : 5, and 1 : 7 by weight and by volume respectively, in addition to tests with the customary mixture with standard sand in the proportion of 1 : 3 parts by weight. In the case of the mixtures with Freienwald sand, one set of test-pieces was hardened for 1 day in air and then up to 90 days under water, and another set for the whole period in air, but covered with wet sacks from the second to the seventh day. The results show that in both cases the strength increases uniformly with the time, and that the curves for the air-hardened and water-hardened test-pieces are practically parallel. With the 1 : 5 and 1 : 7 mixtures, the air-hardened test-pieces were stronger than those kept under water, whereas with the 1 : 2 mixture, the water-hardened samples were stronger than those kept in air from about the fourteenth day onwards. In consequence of these results it has been decided by the German Minister for Public Works that special air-hardening tests are no longer necessary for iron-Portland cement and that this product may be substituted as desired for Portland cement.—A. S.

Patents.

Firebricks [lime-sand bricks] and method of making same. S. H. Nordin, Tacoma, Wash. U.S. Pat. 1,192,099, July 25, 1916. Date of appl., Aug. 7, 1914.

Quartz and limestone are separately calcined at 1500 C., and the quartz is ground so that one-third consists of particles 1·5—2 mm. diameter, and the remainder of smaller particles. The quartz is mixed with 6% of the ground lime, and the mixture is made into a paste with about 6% water, moulded, and hardened by steam under high pressure.—A. B. S.

Lime mortar; Manufacture of ——. W. Olschewsky, Coswig. Ger. Pat. 292,561, Aug. 13, 1914.

Paper pulp, in a very fine state of division, is intimately mixed with the slaked lime.—A. S.

Artificial stone for flooring material, paving, stoneware, etc. Radeburger Ton- u. Chamottewerke F. L. Strack und Co., Radeburg. Ger. Pat. 292,645, Apr. 25, 1914.

Ground syenite is mixed with syenite-containing clay which has been dried and ground, and the mass is mixed with a small quantity of water and moulded and fired in the usual manner.—A. S.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Passivity of iron. A. Smits. De Ingenieur, 1915, 357—359. Chem.-Zeit., 1916, **40**, Rep., 225—226.

A theory of the passivity of iron is developed, based on the assumption that in addition to uncharged atoms and free electrons, the metal contains two different kinds of ions of different valency, viz., α ("base") ions and β ("noble") ions. These two kinds of ions are in equilibrium and the production of the passive state is to be ascribed to destruction of this equilibrium. In the anodic solution of a metal, polarisation occurs because the metal tends to dissolve more rapidly than the equilibrium mentioned is established, so that a concentration of "noble" ions takes place at the surface of the metal. Ordinary iron always contains hydrogen, and it is known that hydrogen ions, like halogen ions, greatly accelerate the change from the passive to the active state, *i.e.*, they catalytically accelerate the establishment of equilibrium between the two kinds of ions. In the anodic solution of iron, a portion of the hydrogen also dissolves, and as the concentration of hydrogen in the iron thus falls, so the tendency for the equilibrium to be disturbed increases. By increasing the current density so that the potential rises to the value corresponding to the anodic evolution of oxygen, hydrogen is removed completely from the surface of the iron, and the disturbance of the equilibrium (production of passive state) reaches a maximum. This condition persists for a short time when the current is cut off, but hydrogen soon diffuses from the interior to the surface of the iron, where it catalytically accelerates the re-establishment of equilibrium, and hence of the active state. When iron is immersed in strong nitric acid, the α ("base") ions dissolve with great rapidity and hydrogen ions are also removed from the surface of the metal, so that the passive condition is established. In ferrous chloride solution, on the other hand, passivity is not produced, because both the chlorine ions and the halogen ions catalytically accelerate the change from the passive to the active condition. Active iron in dissolving sends ferrous ions almost exclusively into solution, and it would be anticipated from the usual formula for expressing the single potential, that the potential would be more strongly negative in a ferric than in a ferrous solution. Actually the reverse is the case, and the following explanation is suggested. Since iron sends ferrous ions almost exclusively into solution, the solution with which iron is in electromotive equilibrium must likewise contain ferrous ions almost exclusively. When immersed in ferric sulphate solution, iron tends to alter the composition of the solution so as to make it approach that of a solution in electromotive equilibrium with the metal, *i.e.*, the iron sends ferrous ions into the solution with a velocity greater than that with which ionic equilibrium in the iron is established; hence there is a concentration of ferric ions at the surface of the iron, and the potential becomes more positive.—A. S.

Mild steel; Tests with cold-drawn and reheated ——. O. Bauer. Mitt. K. Materialprüf., 1915, **33**, 395—407.

The tests were made with pieces cut from a rod of mild steel which had been cold drawn in one operation from 41·5 mm. to 39 mm. diameter. The steel contained: C 0·29, Si 0·08, Mn 0·98, P 0·031, S 0·018, Cu 0·06, and Cr 0·015%. One piece was tested in its original (cold-drawn) condition and ten others were heated respectively, in an oil bath to 100°, 200°, and 300° C., and in a Heraeus electric furnace to 400°, 450°, 500°, 550°, 600°, 700°, and 900° C.; the piece heated at 900° C.

(for ½ hour) was cooled in the air, whilst the others, after heating for 2 hours at the temperatures mentioned, were cooled more slowly in the oil bath or in the furnace. The hardness, determined by the ball method, began to diminish distinctly when the reheating temperature reached 400° C., fell to a minimum value after heating at 700° C., and then increased again slightly. The corrosion by 1% sulphuric acid diminished continuously as the reheating temperature was increased; this affords a better means of detecting whether a steel has been reheated than does a determination of the hardness. No relation could be traced between the degree of corrosion in a 1% solution of sodium chloride and the reheating temperature. The resistance to impact diminished after heating at the lower temperatures, then began to increase again, until after heating at 450° C. nearly the same value was obtained as for the cold-drawn metal; above 500° C. the resistance to impact increased greatly as the temperature of reheating was augmented. The tensile strength and limit of elasticity fell and the elongation increased as the temperature of reheating was increased above 400° C.; test-pieces from near the edge of the rod gave higher values for the limit of elasticity than test-pieces from the centre.—A. S.

Steel: Alumina inclusions in ——. A. Sauveur. Met. and Chem. Eng., 1916, **15** 149—151.

From micrographic examination of specimens comprising ingot steel to which aluminium had been added during teeming, thermit iron produced with an excess of aluminium, ingot iron melted with aluminium, and ingot iron melted with alumina, it is concluded that alumina inclusions may be distinguished from others commonly present in steel by their small size, dark colour, and more especially by a complete absence in them of elongation in the direction of rolling or forging.—W. E. F. P.

Flotation of oxidised ores. O. C. Ralston and G. L. Allen. Min. and Eng. World, 1916, **45**, 137—140.

Flotation of oxidised ores is preceded in all cases by more or less thorough sulphidising, which may be accomplished by (1) hydrogen sulphide acting on the crushed, dry or wet, ore, (2) sulphides of sodium or calcium, (3) sulphur vapour, (4) oils containing loosely combined sulphur, or (5) colloidal sulphur. *Lead carbonate ores.* When the dry ore was treated with hydrogen sulphide, satisfactory extraction by flotation could not be obtained until the particles had been sulphidised to the core. Treatment of the wet pulp, however, resulted in the formation of a film of sulphide after a short time, and extraction was satisfactory; hence the wet method is more economical. Sodium sulphydrate gave the best results with this class of ore, the normal sulphide being slightly less effective; 10—20 lb. is required per ton of ore, with a pulp ratio of 1 : 1. Calcium polysulphide was more sluggish in its action. The other three sulphidising agents gave poor results. Some of the ores tested showed an extraction of 73—83% of the lead and 48—80% of the silver. A plant for the treatment of tailing dumps is being erected at Pioche, Nev. *Oxidised copper ores.* Hydrogen sulphide applied to the wet pulp seems to be the best sulphidising agent, and is in use at Magma, Ariz. *Oxidised zinc ores* have not yet been treated successfully by any of the above methods.
—W. R. S.

Joplin [*zinc blende*] *tailing; Flotation experiments on* ——. W. A. Whitaker, G. Belchic, R. Neal, and H. L. van Velzer. Met. and Chem. Eng., 1916, **15**, 131—137.

The tailing used, about 4% of which was retained on a 200-mesh sieve, was much finer than the average material for the district and contained Zn 3·60, Pb 0·31, Fe 0·53 (all as sulphides), and "insoluble" 91·72%. Mixtures of tailing (100 grms.) with water (2000 grms.) and varying amounts of oil were agitated in a laboratory machine of the Lyster or Hoover type, after which the froth removed by skimming and overflow was dried, weighed, and assayed for zinc. Tests were made at 20° and 70° C. in neutral, acid, and alkaline solutions and with 28 different oils comprising drying, semi-drying, and non-drying vegetable oils, animal oils, petroleum oils, and products from the distillation of wood and coal. From the results it is concluded that the tailing in question is readily amenable to successful flotation under many simple and economical conditions. Generally speaking, vegetable oils and the lighter wood distillates exerted a good selective action on blende in neutral and acid pulps and yielded rich concentrates; whereas phenolic and creosotic oils were less selective towards blende although yielding high total extractions. The richest concentrates and highest extractions were obtained in the more highly acid pulps. Probably a mixture of "concentrating" and "extracting" oils (the terms being used in the preceding sense) would give the most effective results.
—W. E. F. P.

Tungsten-molybdenum ores: Concentration of ——. A. J. Robertson. Bull. 64, Geol. Survey of W. Australia. Eng. and Min. J., 1916, **102**, 126—127.

An ore from the Murchison Goldfields containing molybdenite 2, scheelite 10, wolframite 1½, and gangue 86½%, was treated in the laboratory by flotation to recover the molybdenite, then by gravity concentration to obtain the tungsten minerals. It was found that crushing to 80-mesh caused sliming of the clayey gangue, the fine dust coating the molybdenite and preventing flotation. Better results were obtained with ore crushed to pass a 30-mesh screen, but it was not possible to obtain high-grade molybdenite by a single treatment. The best results were obtained by floating carefully sized material (30—40 mesh), screening the float through a 90-mesh screen, and rejecting the undersize consisting mostly of gangue. The tungsten minerals were satisfactorily extracted from the 30-mesh flotation tailings by panning.—W. R. S.

Agglomerates: Manufacture and properties of globular ——. C. A. Brackelsberg. Z. angew. Chem., 1916, **29**, 281—285.

The agglomerates are produced in a plant consisting of a mixer, an agglomerating drum, and a dryer (see Ger. Pat. 287,606; this J., 1916, 243); they may be made from almost any powder and any solution which crystallises out or leaves a crusty residue upon evaporation. The finished product consists of balls that resist crushing, yield very little powder on breaking, and possess a high degree of porosity due to evaporation of the liquid. Hence the action of gases, such as occurs in roasting and smelting, is much more rapid and thorough than on briquettes or sintered products. Copper, lead, bismuth, antimony, gold, silver, and zinc may be volatilised by the action of hydrochloric acid gas on agglomerates containing them, and thus be separated from iron, manganese, and nickel.—W. R. S.

Preparation and properties of lead chlor-arsenate. McDonnell and Smith. *See* VII.

Margarosanite, a new lead-calcium silicate from Franklin, N.J. Ford and Bradley. *See* VII.

Use of ferric oxide as standard in the volumetric determination of iron in hydrochloric acid solution. Brandt. *See* XXIII.

Patents.

Steel; Process of tempering or hardening ——. J. B. Moore, Latrobe, Pa. U.S. Pat 1,190,937, July 11, 1916. Date of appl., Feb. 24, 1915.

To harden high-speed steel, the surface of the metal is cleaned, wetted with water, the wet surface covered with boric acid, and the metal heated first until the boric acid is converted into a glaze and subsequently to a white heat, and then quenched. After the first coating of boric acid has been melted, a second coating may be applied and likewise melted, before heating the metal to a white heat.—A. S.

Ores; Separation of —— [*by flotation*]. H. V. Seale and W. Shellshear, Broken Hill, N.S.W. Eng. Pat. 10,666, July 22, 1915. Under Int. Conv., July 30, 1914.

In an agitation-froth process, the ore pulp is delivered into the open top of a pipe which extends from the bottom of the feed box to beneath the surface of the liquid in the separating-box, aeration of the charge being effected, without mechanical agitation, by air entrapped by the pulp flowing through the pipe. The separating-box is provided with a baffle below the feed-pipe, a peripheral overflow for concentrate, and an adjustable discharge opening at the bottom for residues. In practice a number of separating- and feed-boxes are arranged in series, one above the other alternately, the residues from the uppermost separating-box passing to the next feed-box below, and so on.—W. E. F. P.

Concentrating metallic ores by flotation; Process of ——. H. T. Yaryan, Toledo, Ohio. U.S. Pat. 1,191,053, July 11, 1916. Date of appl., Mar. 29, 1916.

The comminuted ore is agitated in water to which is added a mixture of 65% of oil and 35% of sodium resinate, petroleum constituting upwards of 50% of the mixture, and the froth formed, carrying the metallic particles, is recovered by flotation.—A. S.

Tin on iron and other metallic surfaces; Process for electrolytically depositing ——. P. Marino, London. Eng. Pat 11,011, July 29, 1915.

The electrolyte is prepared by dissolving the chloride, citrate, or tartrate of tin in hydrochloric acid, then adding phosphoric acid and a solution of a salt of an alkali metal, such as potassium bitartrate, sodium pyrophosphate, or ammonium chloride.—W. R. S.

Metal sheets, bars, rods, wire, castings and the like, and of articles made therefrom; Treatment or preservation of the surfaces of ——. F. and T. Williams, Warrington. Eng. Pat. 11,917, Aug. 18, 1915.

After being slightly heated, the metal is successively coated with a mixture of red-lead, linseed oil, and gold size, allowed to "dry," until the coating becomes "tacky," and rubbed or pressed with powdered graphite or such other substances as will give hardness to the coating, *e.g.*, graphite mixed with one or more of the following: red-lead, aluminium, pumice, whiting, or ferric oxide. —W. E. F. P.

Aluminium or alloys thereof; Solder for the jointing of ——. J. B. Solloway, Willesden, Middlesex. Eng. Pat. 13,109, Sept. 14, 1915.

The solder is composed of aluminium, 0·75; tin, 16; zinc, 5; zinc phosphate, 0·0078; bismuth, 0·0078; and ammonium chloride, 0·0156 parts. For large work, the proportions of aluminium and zinc are increased to 1 and 6·25 parts respectively; for light work, the aluminium is omitted and the zinc reduced to 3·5 parts. —W. E. F. P.

Furnace for melting metal for brass castings and the like. C. F. Price, Birmingham. Eng. Pat. 100,849, Jan. 6, 1916. (Appl. No. 215 of 1916.)

The furnace consists of a combined combustion and work-heating chamber arranged immediately above a gas-producing chamber, the latter being jacketed on two sides by flues for preheating the air for combustion and having a series of nostril apertures in the roof for effecting admixture of the producer gas and preheated air. The combustion chamber is divided into a number of compartments, or crucible chambers, any of which may be heated and operated independently; the waste gases are conducted downwards through flues which form jackets to the air channels.—W. E. F. P.

Metal-pickle and method of pickling. L. C. Drefahl, Assignor to The Grasselli Chemical Co., Cleveland, Ohio. U.S. Pat. 1,191,291, July 18, 1916. Date of appl., Feb. 19, 1916.

An acid pickling bath is mixed with approximately 6% of cellulose pulp waste, so as to form a thick foam on the solution.—B. N.

Coating wire with metal; Process of ——. G. L. Meaker, Joliet, Ill. U.S. Pat. 1,191,526, July 18, 1916. Date of appl., June 27, 1913.

A bath of metal, such as spelter, is supported in contact with a bath of a heavier non-adherent metal, such as lead, the latter being kept at an annealing temperature. The article is first passed through the lead to anneal it, then through the surface of contact between the two baths, and finally through the coating bath which is maintained at a materially lower temperature than the annealing bath.—B. N.

Silver; Sterling ——. E. D. Gleason, Assignor to R. H. King, Brooklyn, N.Y. U.S. Pat. 1,191,890, July 18, 1916. Date of appl., Aug. 24, 1911. Renewed Oct. 9, 1915.

The metal contains 92·5% of pure silver, alloyed with cadmium.—B. N.

Articles [*alloys*] *subjected to high temperatures.* J. C. Henderson, Washington, D.C., Assignor to Driver-Harris Wire Co., Harrison, N.J. U.S. Pat. 1,190,652, July 11, 1916. Date of appl., Jan. 4, 1916.

Cast articles subjected to high temperatures in use are made of an iron alloy, practically free from carbon, containing from 5 to 30%, preferably about 12%, of chromium, and from 50 to 90%, preferably about 60%, of another metal of the iron group having nearly the same atomic weight as iron, *e.g.*, nickel; the chromium and the third metal together should amount to at least 60% of the alloy.—A. S.

Volatilising metals; Process of ——. S. I. Clawson, Salt Lake City, Utah. U.S. Pat. 1,192,037, July 25, 1916. Date of appl., Oct. 28, 1912.

Powdered ore is subjected to an oxidising roast in presence of an excess of sulphur so as to form sulphates. A halogen salt is then added and the ore heated and rabbled with slight admission of air, to form volatile halogen compounds, which are collected in a suitable receiver.—W. R. S.

Garnet-works; Utilising the waste-products of ——. J. Davenport, Brighton, Mass. U.S. Pat. 1,192,394, July 25, 1916. Date of appl., Jan. 27, 1915.

Garnet dust is mixed with sufficient carbon powder to reduce the constituents other than alumina, and enough silica to form ferrosilicon with the iron in the mineral. The mixture is heated electrically to the fusion-point of alumina until reduction is complete. The temperature is then gradually decreased to allow the alumina to crystallise and the ferrosilicon to collect in nodules. —W. R. S.

Alkali metals; [Electrolytic] process of producing ——. H. Labhardt, Mannheim, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,191.799, July 18, 1916. Date of appl., Dec. 14, 1914.

See Eng. Pat. 17,763 of 1914; this J., 1915, 967.

XI.—ELECTRO-CHEMISTRY.

Asbestos: Improvement of the insulating properties of ——. T. Schopper. Gummi-Zeit., 1915, **29**, 1197; **30**, 243. Chem.-Zeit., 1916, **40**, Rep., 239, 279.

Commercial asbestos contaminated with iron compounds may be purified by treatment with a 2% aqueous solution of oxalic acid for 48 hours, followed by washing with water; the strength of the asbestos is not affected. A band of asbestos, 20 mm. wide, showed at 14 different places an electrical resistance of 600—700 ohms; after treatment as described, the resistance increased to 1,500,000 ohms. An alternative method consists in heating the asbestos for 20—24 hours in a current of hydrogen or carbon monoxide at 390°—400° C., and then washing with very dilute hydrochloric or sulphuric acid and afterwards with water.—A. S.

Patents.

Electrolytic apparatus. Siemens und Halske A.-G., Berlin. Eng. Pat. 100.739, June 8, 1916. Under Int. Conv., June 24, 1915. (Appl. No. 8111 of 1916.)

The wires forming the electrodes are connected with and are hung freely from the same conductor, and are weighted at their lower ends with a single piece, or with individual spherical, cylindrical, or other weighting pieces; or the wires may be weighted at both ends and hung over the conductor or an insulator.—B. N.

Electrolytic cell. J. M. Goldman, St. Louis, Mo. U.S. Pat. 1.191,300, July 18, 1916. Date of appl., Oct. 4, 1915.

Electrodes, of opposite polarity, are arranged alternately, one above the other, at distances apart which become gradually greater towards the top of the cell, whilst the relative superficial area of each electrode lengthwise, becomes smaller. —B. N.

Furnace: Electric ——. S. H. Fleming, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,192.050, July 25, 1916. Date of appl., Jan. 7, 1914.

The cover of the furnace is provided with a central opening for a vertical electrode, and with feed openings for the charge surrounding the electrode. The interior of the furnace is divided into an upper and lower chamber by a transverse partition with sloping surfaces which support the charge. The partition is provided with a number of openings near the walls of the furnace, to permit the passage of the charge downwards and the gaseous products upwards. It is provided also with a central opening for the electrode in line with the one in the cover, and by means of a second electrode co-operating with the first, the material is heated in the lower chamber and finally withdrawn at the bottom. Air, preheated in a surrounding channel, is admitted to the upper chamber to burn the gaseous products, and the waste gas withdrawn from the top.—B. N.

Galvanic batteries; Regenerating the waste products of ——. W. Hickmann, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,192.061, July 25, 1916. Date of appl., May 10, 1911.

The spent electrolyte and depolarising mass of a galvanic cell of the Leclanché type, is regenerated by separating the electrolyte components from the whole mass by lixiviation with dilute hydrochloric acid. The remaining portion is treated with dilute acid, and the manganese salt thus obtained in solution is oxidised with permanganate.—B. N.

Electrolytic cells; Replenishing ——. W. S. Smith, Grosse Ile, Mich., Assignor to Pennsylvania Salt Manufacturing Co., Philadelphia. U.S. Pat. 1.191.356, July 18, 1916. Date of appl., June 3, 1915.

See Eng. Pat. 15,761 of 1915; this J., 1916, 608.

Electrolytic processes; Apparatus for use in and in connection with ——. A. E. Battle, London. U.S. Pat. 1,191.386, July 18, 1916. Date of appl., May 24, 1915.

See Eng. Pat. 14,513 of 1914; this J., 1915, 910.

Process of making carbon articles. U.S. Pat. 1.192,062. *See* VII.

Process for organic synthesis. [*Preparation of tartaric acid.*] U.S. Pat. 1,190,845. *See* XX.

XII.—FATS; OILS; WAXES.

Oil from the kernels of stone-fruits; Process of obtaining ——. K. Alpers. Chem.-Zeit., 1916. **40**, 645—646.

The cracked stones of fruits such as cherries, plums, apricots, etc., are treated with a solution of chloride of calcium or magnesium of about 1·15 sp.gr. The shells sink to the bottom, and the kernels are skimmed off the surface of the liquid, washed, dried, and the oil expressed. Only traces of hydrocyanic acid can be formed by cyanogenetic enzymes, since amygdalin is only sparingly soluble in such salt solutions; but to prevent risk it is advisable to renew the solution frequently. Oil thus prepared from plum-stone kernels had the taste and odour of bitter almonds, but it was rendered nearly odourless by exposure to a current of steam. The same effect was also obtained by heating the oil to 160° C., or by exposing it to the air for 14 days. The distillate from the treatment of 100 grms. of oil with steam contained 4 mgrms. of hydrocyanic acid.—C. A. M.

Canadian vine (*Parthenocissus quinquefolia, Planchon*); *Oil of the fruit of the* ——. S. Fachini and G. Dorta. Annali Chim. Appl., 1916. **5**, 301—304.

The fruits of the *Parthenocissus quinquefolia*, Planchon (*Ampelopsis quinquefolia*, Torrey and Gray) are composed of 10% of skins, 64·8% of pulp, and 25·2% of seeds. The seeds contain 11·8% of a dark yellowish-green oil (*a*), liquid at the ordinary temperature, and the pulp, including skins, contains 3·3% of an olive-green oil (*b*), of the consistence of butter: sp.gr. at 15° C., (*a*) 0·9215; n_D = (*a*) 1·4778, (*b*) 1·4722; saponif. value, (*a*) 189·2—189·6, (*b*) 192·3—193·3; iodine value, (*a*) 141·4—141·6, (*b*) 90·3; non-volatile fatty acids, (*a*) 93·97%, (*b*) 94%; unsaponifiable matter, (*a*) 1·44%, (*b*) 1·67%; iodine value of mixed fatty acids, (*a*) 144·6, (*b*) 94·4—94·6; mean mol. wt. of fatty acids, (*a*) 281·2, (*b*) 278·8; iodine value of liquid acids, (*a*) 148·8—149·2, (*b*) 110·2. In both cases the solid acids (*a* about

3 %, and *b* about 10 %) consist almost entirely of palmitic acid, and the liquid acids of oleic and linolic acids.—A. S.

Glycerol in hardened fats; Determination of ——. W. Normann and E. Hugel. Chem. Umschau, 1916, 23, 45—47. Z. angew. Chem., 1916, **29**, Ref., 371.

The glycerol content of hardened fats was determined by several of the published methods and the results obtained compared with those calculated from the ester values. The results obtained by the bichromate method agreed very well with the calculated values. Willstätter's method (this J., 1912, 997) gave satisfactory results, but the results obtained by the acetin method were 1—1½ % lower than the calculated values.—A. S.

Wool fat; Utilisation of crude —— *in the soap industry.* W. Schrauth. Seifensieder-Zeit., 1916, **43**, 437—438. Z. angew. Chem., 1916, **29**, Ref., 372.

If crude wool fat be saponified and extracted with ether or the like, not only the alcohols (cholesterol, etc.) but also soaps of unsaturated fatty acids are dissolved. To overcome this difficulty, the wool fat is hydrogenised in presence of palladium at a low temperature, or fused with excess of caustic alkali (Varrentrapp's reaction, see this J., 1916, 428) to convert the unsaturated into saturated fatty acids. The hydrogenised product is saponified under pressure, and the alcohols then extracted with ether; their physical properties are not affected by the hydrogenation. From the residue left after extraction with ether, the fatty acids are recovered by distillation with superheated steam under diminished pressure.—A. S.

Calcium and magnesium soaps [; *Solubility of* ——]. W. Fahrion. Chem. Umschau, 1916, **23**, 34—35, 47—48. Z. angew. Chem., 1916, **29**, Ref., 372.

One litre of water at 15° C. is capable of dissolving 90 mgrms. of oleic acid in the form of calcium salt and 224 mgrms. in the form of magnesium salt, but the solubilities vary considerably according to the experimental conditions. The solubility is greater in water containing sodium chloride. The solubility cannot be calculated from the quantity of dissolved lime or magnesia because the soaps are hydrolysed by water, the calcium soap to a greater extent than the magnesium soap. (See also Haupt, this J., 1915, 39.)—A. S.

Pink colour on the surface of fats. Knapp. *See* XIXa.

Comparison of results obtained by colorimetric and gravimetric determinations of cholesterol. Mueller. *See* XX.

Patents.

Catalyser and process of making same and for effecting catalytic reactions therewith. N. Sulzberger, New York. Reissue No. 14,167, July 18, 1916, of U.S. Pat. 1,143,332, June 15, 1915. Date of appl., May 4, 1916.

See this J., 1915, 822. Compounds of more than one metal, precipitated simultaneously, may be reduced to form the catalyst. Thus nickel and palladium may be used together. The use of the products as catalysts, especially for hydrogenating oils, is claimed.

Catalyst for the hydrogenation of unsaturated organic compounds [*oils*]. B. W. van E. Thieme and A. C. Geitel, Gouda, Netherlands. Ger. Pat. 292,894, Dec. 3, 1913. Under Int. Conv., Nov. 8, 1913.

Nickel nitrate or other metallic nitrate is heated with an organic salt of nickel or other metal, or with the product obtained by moderate oxidation of glycerol with nitric acid, followed by neutralisation with nickel carbonate or other metallic carbonate. The catalysts thus prepared have a very pronounced emulsifying power, so that a very simple apparatus may be used for the hydrogenising operation, which can be performed at 140°—150° C.—A. S.

Fatty material; Process of hydrogenating unsaturated ——. J. C. C. Hoehn, Chicago, Ill. U.S. Pat. 1,189,817, July 4, 1916. Date of appl., Mar. 13, 1914.

The unsaturated material, in which is suspended a finely divided catalyst, is exposed in open pans of large superficial area and of substantial depth to the action of hydrogen at a suitable temperature and pressure, while means are provided for withdrawing material from the exposed surface and introducing it into material near the bottom of the same or other pans without causing violent agitation.—C. A. M.

Oil or grease; Lubricating ——. J. H. Mackle, Watervliet, N.Y. U.S. Pat. 1,191,328, July 18, 1916. Date of appl., Oct. 17, 1914.

A mixture of 85 % of cottonseed oil and 15 % of castor oil is heated to drive off volatile impurities, and afterwards decanted from sediment.—J. H. L.

Beeswax and the like; Washing ——. M. S. Salamon, London. Eng. Pat. 100,901, Feb. 21, 1916. (Appl. No. 2563 of 1916.)

Separation of impurities is facilitated and the colour of the product improved by forcing a current of air for a short time through the hot water in which the melted wax is being washed.—C. A. M.

Oil from whale blubber; Process and apparatus for extracting ——. A./S. Myrens Verksted, Christiania. Eng. Pat. 14,227, Oct. 7, 1915. Under Int. Conv., Oct. 10, 1914.

See U.S. Pat. 1,188,922 of 1916; this J., 1916, 898.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Iron-gall inks. XIV. Gravimetric determination of gallic and tannic acids. R. Kempf. Mitt. K. Materialprüf., 1915, **33**, 241—270.

The high and discordant results frequently obtained in the determination of gallic and tannic acids in inks by the ethyl acetate method (this J., 1913, 281; 1914, 306), are due largely to the retention by the extracted tannin of acetic acid produced by hydrolysis of the ethyl acetate. Acetic acid retained by dry tannin cannot be expelled by heating at 100° C. in a vacuum oven, but can be removed by dissolving the tannin in water and evaporating the solution to dryness. It is recommended, therefore, that the residue from the ethyl acetate extract be dissolved in water, the solution evaporated, and the residue dried, these operations being repeated until the weight remains practically constant. By this modified method results agreeing within ±0·5 mgrm. or ± 0·2 % in parallel determinations can be obtained.—A. S.

Approximate determination of colophony in the gum-resins used in the rubber industry. Hutin. *See* XIV.

Patents.

Carbonate of lead [*white lead*]; *Process and apparatus for the production of* ——. G. Bevilacqua, Genoa, Italy. Eng. Pat. 9201, June 22, 1915.

Molten lead is projected through an apertur or apertures against a plane or cylindrical moving surface, either by the action of centrifugal force, capillarity, entrainment, or natural or mechanical pressure, the operation being carried out if necessary in an atmosphere of carbon dioxide or other inert gas. Suitable apparatus for the application of each of these methods is figured and described. The lead flakes thus obtained are introduced through a hopper into the hollow trunnion of a horizontal revolving drum, provided with internal perforated baffle-plates, or partitions, and perforated peripheral plates, which dip, continuously or intermittently, into water contained in the closed chamber in which the drum revolves. Acetic acid vapours, together with the necessary carbon dioxide and oxygen, preheated, are passed or drawn into the drum, where the formation of white lead takes place, the product forming a fine suspension in the water in the chamber. The excess of heated gases and condensable vapour passes into a second cylindrical drum, which is heated by it, and which is caused to revolve with its surface just dipping into a paste of the white lead removed from the first chamber to a floating box in the chamber surrounding the drying drum. As the white lead is taken up by the drum and dried it is removed by scrapers. Condensed acetic acid vapours can be drawn off from the drum, and a final condensation of the exit vapours is effected by means of a condensing worm.—E. W. L.

Lead oxide; Process for carbonating ——. F. H. Sharpe, and The British and Colonial Lead Co., Ltd., Liverpool. Eng. Pat. 9486, June 29, 1915. Addition to Eng. Pat. 17,579, July 24, 1914 (this J., 1915, 92).

Lead oxide suspended in water containing a small quantity of acetic acid, is introduced near the top into a vertical cylindrical vessel, the bottom portion of which tapers down to a comparatively small diameter. Near the bottom carbon dioxide is introduced through one, or preferably more jets in a direction nearly tangential to the wall of the vessel, so as to impart an upward spiral motion to the contents. Each jet is connected through two valves and an intermediate pipe, in which is a non-return valve, with the main gas-pipe encircling the vessel at a higher level, so that any jet can be disconnected separately for inspection and cleaning. For the latter purpose a plug or plunger is provided to each jet. Baffle-plates in the upper portion of the vessel deflect a portion of the gas to the centre. The contents of the vessel are discharged through a cock near the bottom, by means of the gas pressure in the vessel, the gas inlets being meanwhile left open, and a fresh charge is introduced immediately. Any sediment may be removed from the bottom of the vessel through another cock at the lowest level. The pressure in the vessel is regulated by a blow-off or safety valve. The gas passing from the vat may be passed through a second vat, but the complete process takes place in a single vat.
—E. W. L.

Preservative coating composition; Manufacture of a ——. J. Jacobs, Voorburg, Netherlands. Eng. Pat. 16,448, Nov. 22, 1915.

Shell-lime, calcined at a high temperature, and afterwards exposed for a considerable period to the action of air in a covered space, is purified, for instance by sifting, and is then mixed with a heated bituminous binding material, such as asphalt, bitumen, or petroleum pitch, in the proportion of from 2 to 28% of lime to 98 to 72% of bitumen. A diluent, such as toluene, benzene, solvent naphtha, or light tar-oil, and an alcohol or the like are then added. The composition is applied in layers 1—2 mm. thick to iron, wood, metals, cement, or the like.—E. W. L.

Lampblack machine. W. H. Davis, Muncie, Ind. U.S. Pat. 1,191,673, July 18, 1916. Date of appl., Oct. 10, 1914.

Previously-formed carbon flakes are fed from a conveyor into an inlet opening, controlled by a valve, at the upper end of a vertical agitating chamber containing rotary beating mechanism, and the finished carbon black is removed from the lower end of the chamber by means of a conveyor, operated alternately with the opening of the inlet valve.—E. W. L.

Paints; Method of making ——. R. V. Brown, Pullman, Ill., Assignor to The Sherwin-Williams Co., Cleveland, Ohio. U.S. Pat. 1,192,163, July 25, 1916. Date of appl., Oct. 3, 1913.

Lead linoleate or other water-insoluble soap of a drying vegetable oil is mixed with linseed oil with a relatively high acid value, or with another drying vegetable oil, and the mixture incorporated with a pigment distributed in water, with or without the application of heat. The oil replaces the water and incorporates the pigment and linoleate.
—C. A. M.

Drying-rooms, especially for drying varnish, enamel, or the like. A. E. White, London. From Reliance Drying Room Co., Chicago, Ill., U.S.A. Eng. Pat. 100,869, Feb. 9, 1916. (Appl. No. 1930 of 1916.)

The drying-room has double walls and ceiling. Near one side is a partition extending nearly from floor to ceiling, dividing the space into a larger drying-chamber and a smaller heating-chamber containing coils of heating-pipes. Deflecting plates are provided across the angles between ceiling and wall above the heating chamber, and on the opposite side of the drying chamber. A blower, fixed below the floor of the drying-room, discharges air upwards through the heating-chamber. The heated air is deflected downwards towards the opposite side of the drying-room, and from near the floor level is drawn through a duct leading beneath the floor, back to the blower. Provision is made for the regulated admission of fresh air through a side-branch of this duct, and the amount of re-circulated air can also be regulated by means of a damper.—E. W. L.

Plastic compositions; Method of making ——. K. Tarassoff, Moscow, Russia. U.S. Pat. 1,187,869, June 20, 1916. Date of appl., Feb. 8, 1916.

A phenol is condensed with an aldehyde containing the methylene group (*e.g.*, formaldehyde) in presence of a sulpho-acid having emulsifying properties, and of an aqueous solution of a protein.
—E. W. L.

Condensation product and method of preparing same. L. V. Redman, Assignor to Redmanol Chemical Products Co., Chicago, Ill. U.S. Pat. 1,188,014, June 20, 1916. Date of appl., Feb. 24, 1914.

A mixture of a phenolic body and hexamethylene tetramine, in the proportion of considerably more than one phenol group to one methylene group, is heated in the absence of water to about 130° C. to start an anhydrous reaction, which continues when the source of heat is withdrawn, ammonia being liberated, and the temperature rising to about 180° C. As the evolution of ammonia abates, further heat is applied and the temperature kept at about 180° C. until practically all the nitrogen is driven off from the mass. The product consists of phenylene-decasaligenosaligenin. It may be converted into an insoluble, infusible product by cooling below 120° C., and adding sufficient of a substance containing the methylene group to effect such conversion.—E. W. L.

[Varnish.] Composition of matter and process of making same. B. B. Goldsmith, New York. U.S. Pat. 1,188,439, June 27, 1916. Date of appl., Dec. 9, 1914.

THE varnish consists of a solution of a resin formed by heating together a phenol (carbolic acid), and a definite compound of formaldehyde and an amine (*e.g.*, anhydroformaldehyde-aniline). —E. W. L.

Varnish composition and process of making same; Waterproof ——. C. A. Hollenbeck, Elmhurst, and A. C. Horn, New York. U.S. Pat. 1,190,765, July 11, 1916. Date of appl., Dec. 30, 1914.

A HARD resin is melted and heated in order to render it soluble in a varnish vehicle; it is then solidified by cooling, re-melted, and incorporated with a sulphurised drying oil, *e.g.*, Chinese wood oil, and a drier, and thinned to the consistency of a varnish by means of turpentine.—E. W. L.

Paint and process of making same. G. L. Davies and W. E. Windsor-Richards, London. U.S. Pat. 1,192,756, July 25, 1916. Date of appl., Feb. 6, 1913.

SEE Eng. Pat. 3008 of 1912; this J., 1913, 666.

Condensation products from phenols and formaldehyde; Process for making ——. L. Berend, Amöneburg, Germany. U.S. Pat. 1,191,390, July 18, 1916. Date of appl., Dec. 8, 1913.

SEE Eng. Pat. 15,875 of 1914; this J., 1915, 805.

Treatment or preservation of surfaces of metal sheets, bars, rods, wire, castings, etc. Eng. Pat. 11,917. *See* X.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Vulcanisation of rubber; Theory of [cold] ——. F. W. Hinrichsen and E. Kindscher. Mitt. K. Materialprüf., 1915, 33, 407—415.

ACCORDING to Weber (this J., 1894, 11) caoutchouc combines with sulphur chloride to form a series of compounds, of which $C_{10}H_{16}.S_2Cl_2$ (23·62 % S) is the member richest in sulphur. Measured quantities of a solution of purified Para rubber in dry thiophen-free benzene, were treated with quantities of a solution of sulphur chloride in benzene in excess of that corresponding to Weber's formula, and the reaction product was purified as described by Weber. In eight experiments the sulphur content found ranged from 15·58 to 28·37 %. In another series of experiments, quantities of the rubber solution containing 0·5 grm. of rubber were treated with quantities of sulphur chloride solution containing from 0·433 to 1·299 grm. S_2Cl_2, under conditions to exclude the presence of moisture, and after 3—4 weeks, portions of the solutions were withdrawn and analysed. The amount of sulphur chloride fixed by the rubber ranged from 0·2526 to 0·2795 grm., corresponding approximately to the formula $(C_{10}H_{16})_2S_2Cl_2$ (compare Bernstein, this J., 1912, 1087). The higher results obtained in the first series are attributed to adsorption of sulphur chloride or of sulphur liberated therefrom. The yellowish-white addition compound of caoutchouc and sulphur chloride when boiled with alcoholic sodium hydroxide solution is converted into a dark brown substance corresponding to the formula, $C_{20}H_{20}S_2$. In the technical cold vulcanisation process it is considered that adsorption of sulphur chloride by the rubber first takes place, followed by slow chemical combination and by liberation of sulphur from the excess of sulphur chloride. Cold-vulcanised rubber may thus be regarded as an adsorption product of sulphur in a solid or semi-solid solution of the compound, $(C_{10}H_{16})_2S_2Cl_2$, in excess of rubber.—A. S.

Colophony: Approximate determination of —— in the gum-resins used in the rubber industry. Hutin. Caoutchouc et Gutta-Percha, 1916, **13**, 8994—8995.

ROSIN is detected by saponifying 1 grm. of the gum-resin with the smallest possible quantity of caustic soda, diluting the mass with water, and adding the smallest possible excess of copper sulphate solution. In the presence of colophony a green copper resinate soluble in oil of turpentine is obtained. For an approximate determination, the finely pulverised sample is dissolved in 97 to 98 % alcohol, the solution mixed with sand, and the mass evaporated to dryness on the water-bath. The residue is pulverised and mixed with more sand and alcohol and again evaporated. The process is again repeated, and finally the sand is extracted for 4 hours with chloroform in a Soxhlet apparatus. The colophony is dissolved, whilst the gum resin is left. Another method is to treat 1 grm. of the sample with 50 c.c. of 10 % borax solution, which dissolves the gum-resin but not the colophony.—C. A. M.

PATENTS.

Latex; Process for coagulating —— [by wood distillation gases]. E. C. R. Marks, London. From J. F. Baerveldt, jun., Bandjar, Java. Eng. Pat. 11,615, Aug. 11, 1915.

COAGULATION is effected by means of the gases produced by the destructive distillation of wood in retorts, after removal of the tar by known methods. The retorts are heated by means of a portion of the charcoal obtained from a previous distillation.—E. W. L.

Rubber; Process for the recovery of —— from rubbered fabrics. C. de Villers, Neuilly, France Eng. Pat. 10,146, July 12, 1915. Under Int Conv., July 11, 1914.

RUBBER is recovered from fabric impregnated wit vulcanised rubber, such as pneumatic tyre fabric by heating it with boiling tetrachloroethan Solution of the rubber is complete in about 1 hour After removing the fabric, the rubber is recovere from the solution, by adding water and distillin off the solvent with the water; or the solven may be distilled dry, provided care be taken no to overheat the rubber. If desired, the fre sulphur may be removed by a short preliminar treatment of the rubbered fabric with hot tetra chloroethane, the operation being interrupte before the rubber begins to dissolve.—E. W. L.

Rubber; Process of reclaiming ——. H. R. Mur dock, Naugatuck, Conn., Assignor to Rub Regenerating Co. U.S. Pat. 1,189,282, July 1916. Date of appl., Aug. 10, 1915.

FIBROUS, cellular material present in rubber was is disintegrated by heating with a natural organi product containing protein.—E. W. L.

Rubber-waste; Reclaiming ——. H. R. Murdoc Naugatuck, Conn., Assignor to Rubber R generating Co. U.S. Pat. 1,189,721, July 1916. Date of appl., Apr. 6, 1916.

RUBBER waste containing lead sulphide is treat with a reactive material, *e.g.*, zinc sulphate, co taining an acid radicle which will form a ligh coloured, insoluble salt with lead, and a met which will form a light-coloured sulphide wi sulphur.—E. W. L.

Caoutchouc-like substances and process of making them. H. S. A. Holt, Assignor to Badische Anilin u. Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,192,310, July 25, 1916. Date of appl., July 30, 1913.

See Fr. Pat. 459,005 of 1913, and Addition thereto; this J., 1913, 1164. Zinc balls may be used instead of porcelain balls.

XV.—LEATHER; BONE; HORN; GLUE.

Eggs; The denaturing of —— [for tanneries]. J. S. Rogers. J. Amer. Leather Chem. Assoc., 1916, 11, 412—425.

Experiments were confined to the denaturing of egg-yolk preserved by the addition of 20% of salt, as it is believed to be impracticable to denature eggs without removing the shell. Only sound eggs which passed the food standard were used for the preparation of the yolk. 2% of birch tar oil rendered the egg-yolk inedible, and such denatured egg-yolk when used in preparing food rendered the food inedible if at least 7% of denatured egg-yolk was used. Experiments in tanneries showed that such egg-yolk used in the manufacture of leather gives entirely satisfactory results, even in the case of white or delicately coloured leathers.—F. C. T.

Leathers; Wear resistance of sole ——. L. Balderston. J. Amer. Leather Chem. Assoc., 1916, 11, 429—440.

Small samples of sole leather were fixed on the circumference of a wheel revolving in contact with another wheel of the same size. The surface of the second wheel was of roughened steel, and its speed in the ratio 4 : 5 compared with that of the first, giving a slip of 0·15 inch on each sample. The two wheels were drawn together by a spring, the tension of which was adjustable from zero to 100 lb. In one set of experiments the tension was set at 40 lb., and the apparatus run for 50,000 revolutions in 30 hrs. The loss in weight of the samples (after allowing for loss of moisture) varied from 5·8% in the case of chrome leather to 11·5% with hemlock-tanned leather, and 25·8% with a leather substitute.—F. C. T.

Supplies of tanning materials. War Office announcement.

The Secretary of the War Office announces that n Order has been made by the competent military uthority requiring all persons having in their ustody or under their control any stocks or having nade contracts for the supply of any of the ollowing tanning materials, viz.:—Chestnut xtract, oak extract, quebracho extract, hemlock xtract, myrabolams, myrabolam extract, mimosa ark, mimosa extract, gambier, divi-divi, algaroilla, valonia, and sumach—to furnish to the irector of Army Contracts (R.M.S.) at Imperial ouse, London, S.W., particulars of their stocks, heir contracts on the 9th September, and their equirements for the five months September, 1916 o January, 1917. Any person concerned who has ot yet received a form on which to make the equired return should apply at once to the irector of Army Contracts (R.M.S.) at the above ddress.

Patents.

loves; Treatment of leathers and skins used in the manufacture of ——. Soc. Anon. des Gants Alexandre, Paris. Eng. Pat. 100,311, Apr. 12, 1916. Under Int. Conv., Apr. 21, 1915. (Appl. No. 5381 of 1916.)

fter tawing, the leather is floated in a dressing bath prepared from egg-yolk and salt, together with such antiseptic substances as the methyl or ethyl esters of benzoic and salicylic acids. Other substances such as essential oils are also added to the bath. The antiseptics thus incorporated in the leather sterilise perspiration from the hands, thus lengthening the life of the gloves and protecting the hands of the wearer.—F. C. T.

Tanning of hides and skins. E. W. Merry, Sheffield, Assignor to International Pyrotan Co., Ltd., London. U.S. Pat. 1,191,527, July 18, 1916. Date of appl., Jan. 12, 1916.

A tanning solution consists of crystallised alum, 5 to 7 parts, and anhydrous sodium pyrophosphate, 1 part, the amount of alum used being approximately 10%, and the quantity of water in the bath 20—40% of the weight of hide to be tanned. For example a bath may consist of water 27, alum 10, sodium pyrophosphate 1·66, and common salt (a pore-opening agent) 5% of the total weight of hide.—E. W. L.

Leather; Material for use in manufacture of imitation ——. W. O. Stoddard, jun., Madison, N.J., U.S.A., Assignor to The Duratex Co., Newark, N.J. U.S. Pats. (A) 1,190,806 and (B) 1,190,807, July 11, 1916. Dates of appl., Dec. 29, 1914, and Feb. 18, 1915.

(A) The material consists of a fabric coated with nitrated cotton and an oil, *e.g.*, rape oil, with a superimposed baked coating of a japanning composition. (B) A fabric is coated with a composition containing nitrocellulose and leather, with or without an oil, after which a coating of a japanning composition may be baked on.—F.C.T.

Gelatinising substances; Methods for finely dividing ——. Aktienges. für Chemische Produkte vorm. H. Scheidemandel, Berlin, Assignees of L. Askenasy, Karlsruhe, Germany. Eng. Pat. 15,365, Nov. 1, 1915. Under Int. Conv., Oct. 30, 1914.

Hot solutions of gelatin or gelatinising substances are introduced, in drops, into a cooling liquid such as benzene or carbon tetrachloride, whereby a perfect separation of solidified substance into granules is effected. The solution may be atomised before cooling, or driven through filter-cloth covering a centrifugal rotor rotating in the cooling liquid. Oils or fats may be added to the cooling bath or to the solution to ensure better separation with inferior grades of gelatinising substance. (See also Eng. Pat. 100,392 of 1916; this J., 1916, 855.)—F. C. T.

Glue and gelatin; Manufacture of ——. K. Twele, Wladislau, Moravia. Ger. Pat. 293,047, Feb. 19, 1915. Under Int. Conv., Feb. 19, 1914.

Sinews, alum-tawed leather scraps or other leather waste are treated with a solution of sodium chloride, washed, and worked up into glue in the usual way.—A. S.

Casein; Manufacture of horn-like masses from ——. A. Bartels, Harburg, Germany. Eng. Pat. 10,049, July 9, 1915.

An apparatus is described whereby slightly moistened granular casein, either naturally hard or artificially hardened, is first strongly compressed to expel air and subsequently kneaded by forcing through sieve-like obstacles, the kneading being aided by heat. The process is continuous.—F. C. T

Tanning. O. Schmidt, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,191,480, July 18, 1916. Date of appl., Dec. 4, 1913.

See Fr. Pat. 462,635 of 1913; this J., 1914, 326.

Leather substances : Method of manufacturing ——. C. Roessler. Hamburg. Germany. U.S. Pat. 1,192,460, July 26, 1916. Date of appl., Aug. 28, 1913.

SEE Eng. Pat. 19,787 of 1913 ; this J., 1914, 559.

XVI.—SOILS ; FERTILISERS.

Protozoa ; Further observations on the relation of —— to soil bacteria. T. Goodey. Roy. Soc. Proc., 1916, 89, B, 297—314. (See this J., 1915, 438.)

THE immediate object of the investigation was to trace the effect of inoculating protozoa, freed as far as possible from bacteria, into partially sterilised soil. The soil selected was a fibrous loam obtained from stacked turf, and the partial sterilisation was effected by treating it with 2 % of toluene and then heating for 2 hours at 65° C. This treatment removed nearly all the protozoa contained in the soil. To obtain protozoa free from bacteria, a mixed culture obtained from soil was made in a 1 % hay infusion, and then by means of a 220-volt current passed between non-polarisable electrodes, the protozoa were driven into a medium containing no bacteria. In this way the bacterial number was reduced from about 36 million to 300,000 per c.c. of liquid. Amœbæ were also obtained free from bacteria by cultivating a single cyst on agar to which *Bacillus fluorescens non-liquefaciens* was added, and after the organism had developed and multiplied, the bacteria were destroyed by adding 2 % hydrochloric acid, leaving the protozoa uninjured. The number of protozoa was estimated by making cultures in 1 % hay infusion (best for ciliated protozoa), and on agar plates (especially good for amœbæ) ; bacterial counts were made by the gelatin plate method. When large numbers of protozoa, with or without bacteria, were inoculated into the partially sterilised soil, little or no multiplication was observed, and the bacterial counts failed to show any relation between the numbers of protozoa and of bacteria. The residual protozoa of treated soil, also, did not increase in number although the conditions were very favourable for bacterial development. Hence a treated soil, by itself, is an unsuitable medium for the existence of active trophic protozoa. *Per contra*, definite evidence in favour of the Russell-Hutchinson hypothesis that diminution of the number of bacteria is a direct effect of increase in the number of protozoa, was obtained from the experiments in which 5 % of untreated soil was mixed with the partially sterilised soil. The fall in the number of bacteria (after a short initial rise) was accompanied by an increase in the number of protozoa, and an amœba of the *limax* group was found to be especially active in bringing about this effect. The observed increases in the number of protozoa ranged from 600 in one experiment, and from 150 in another, to 30,000 per gram of soil in each case, and it is suggested that for a given soil the number of bacteria does not begin to wane until the number of protozoa has reached a definite figure. Two other kinds of amœbæ, flagellates, and certain large ciliates were found to co-operate in exterminating the bacterial population.—E. H. T.

Phosphates ; Availability of mineral —— for plant nutrition. W. L. Burlison. J. Agric. Res., 1916, 6, 485—514.

POT experiments extending over three years were made with cereals and legumes grown in purified sand with a constant supply of nitrogen and potassium, and manured with varying quantities of different natural phosphates found in America. The crops obtained were weighed and analysed for their content of phosphate. Even in the absence of organic matter, the plants assimilated the phosphate readily and good crops were obtained. The yields tended to be better, the larger the quantity of phosphate used. The amount of phosphate taken up was not the same with each variety of mineral. It was thought that the presence of plant foods, namely, the nitrogen and potassium solution used, and the addition of water, might render the phosphate more soluble, but it was found that when the minerals were shaken daily with the nutrient solution for three months, very little more phosphate was dissolved. The influence of the presence of organic matter was investigated by adding dextrose solution and an infusion from a rich soil with the mineral. The fermenting dextrose proved to be injurious, even when the acidity produced was neutralised by calcium carbonate. When plant residues were used as the organic matter, the result was beneficial. The plants obtained their supply of calcium from the phosphates, as addition of calcium carbonate did not improve the results. The amount of phosphate taken up increased with the degree of fineness of the mineral. No relation was noticed between the citric acid solubility of the mineral and the availability of the phosphate for the plant.—J. H. J.

Manganese ; Action of —— on plant growth. G. Masoni. Staz. Sperim. Agrar. Ital., 1915, 48, 822—838. Bull. Agric. Intell., 1916, 7, 345—346.

ACCORDING to Pugliese, the uncertain results of the action of manganese as a fertiliser are probably connected with the failure of the observers to recognise the existence of a definite optimum ratio between iron and manganese in the soil. Experimenting with the sulphates of manganese, sodium, and iron, in quantities containing equivalent amounts of the sulphate radical, it was found that manganese and sodium sulphates gave equally good results, that the former was more injurious than beneficial, and that any good effects following its use were a consequence of the action of the acid radical and of the substance *qua* soluble salt. Pot experiments were carried out in 1912 with maize, followed by buck wheat, and in the two succeeding years with maize. The following weights (in mgrms. per kilo. of soil) were used : manganese 5—50, sodium 4·16—19·95, SO_4-radical 8·72—104·39, chlorine (as chloride 12·97—64·85, and CO_3-radical 27·45—137·25 The conclusion reached was that manganese compounds exert a favourable influence on plant life, whether used in small or large quantities, but that this effect is not due to the specific action of the manganese, since the corresponding sodium or calcium compounds are equally, and in some cases more beneficial. The varying effect of manganese salts can sometimes be attributed to thei action as salts, particularly if easily soluble, and to the nature of the acid radical.—E. H. T.

Nutrient solution ; A three-salt —— for plants J. W. Shrive. Amer. J. Botany, 1915, 2, 157—160. Bull. Agric. Intell., 1916, 7, 349—350.

THE solution contains monopotassium phosphate calcium nitrate, and magnesium sulphate, an does not readily become turbid. The mixed salt were tested in solutions of constant molecula concentration, but with varying proportion of the ingredients, on wheat and buckwheat The results were very satisfactory and superi to those obtained with the four-salt nutrien solutions of Knop and of Tottingham. Fo wheat the most favourable composition was potassium phosphate 0·0180 m., calcium nitrat 0·0052 m., magnesium sulphate 0·0150 m (m = grm.-molecules per litre); and for buckwheat 0·0144 m., 0·0052 m., 0·0200 m., respectively.
—E. H. T.

New and sensitive indicator for acidimetry and alkalimetry, and for determination of hydrogen ion concentrations between limits of 6 and 8 on the Sörensen scale. Bogert and Scatchard. *See* XXIII.

Patents.

Fertiliser; Preparing concentrated ——. W. H. Ross and A. R. Merz, Washington, D.C. U.S. Pat. 1,191,615, July 18, 1916. Date of appl., Apr. 11, 1916. (Dedicated to the public.)

A fertiliser, having the composition $xKH_2PO_4 + yNH_4H_2PO_4$, is formed by treating one equivalent of phosphate rock with ten equivalents of phosphoric acid, thus forming three equivalents of "calcium mono-phosphate" with an excess of six equivalents of phosphoric acid. Ignited alunite, potassium sulphate or carbonate is added in amount sufficient to precipitate the calcium as sulphate or carbonate, which is then filtered off, and gaseous ammonia is added till the filtrate is neutral to cochineal. As an alternative less phosphoric acid may be used at first, and the excess of acid added just prior to passing the ammonia. The liquid is concentrated, until on cooling the mass becomes solid.—B. N.

Phosphates; Treating ——. C. G. Memminger, Lakeland, Fla., Assignor to Coronet Phosphate Co., New York. U.S. Pat. 1,192,545, July 25, 1916. Date of appl., Dec. 4, 1915.

Raw phosphate material, containing free silica, is heated under oxidising conditions, so as to decompose the contained calcium carbonate and cause the resulting lime to combine with the silica. —F. Sodn.

Fertiliser containing [calcium] cyanamide and calcium phosphate; Manufacture of a ——. M. Zollenkopf, Königsberg. Ger. Pat. 293,258, May 5, 1915.

Calcium carbide is dissolved in molten basic slag, the mass is cooled to a suitable temperature, and subjected to the action of nitrogen under pressure in a closed ball-mill, so that the reaction-mixture is continuously agitated and progressively disintegrated.—A. S.

Manufacture of ammonium phosphate. Ger. Pat. 292,530. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

Sugars; Some numerical relations among the rotatory powers of the compound ——. C. S. Hudson. J. Amer. Chem. Soc., 1916, **38**, 1566—1575.

The molecular rotatory power of sugars of the sucrose group, *i.e.*, those which invertase decomposes into lævulose and an aldose, may be regarded as the algebraic sum of three factors. One factor represents the rotation due to the aldose chain apart from its terminal (lactonic) asymmetric carbon atom, and is equal to the mean of the molecular rotatory powers of the α- and β-forms of the free aldose. The other factors represent respectively the rotation due to this lactonic carbon atom, and that due to the lævulose residue, and both of these are invariable for sugars of this group. From these considerations the author concludes that for sugars hydrolysable by invertase (sucrose, raffinose, gentianose, and stachyose), the molecular rotatory power (specific rotatory power × molecular weight) of the aldose hydrolytic product is less than that of its parent sugar by 2340 for its α-form and 19,300 for its β-form. The data available at present confirm this conclusion, and the author applies the principle of the additive character of optical rotatory power to other groups of polyoses.—J. H. L.

Deterioration of sugar used for making lemonade. Haddon. *See* XIXa.

Patents.

Sugar juice; Process and apparatus for the evaporation of ——. L. Naudet, Chelles, France. U.S. Pat. 1,190,317, July 11, 1916. Date of appl., June 28, 1915.

In a multiple-effect apparatus the inflow of juice to each unit is made to accelerate the flow of juice already in the unit over the heating surface. Each evaporator has combined with it an external supplementary tubular heater, through which juice from the evaporator can circulate, passing through a pipe from the bottom of the evaporator to the bottom of the supplementary vessel and returning from the top of the latter through a second pipe. This circulation is promoted by the injector action of the juice entering the unit (from the preceding one), the supply conduit being connected to the bottom of the supplementary heater.—J. H. L.

Starches; Apparatus for making modified ——. A. W. H. Lenders, Cedar Rapids, Iowa. U.S. Pat. 1,191,324, July 18, 1916. Date of appl., Sept. 17, 1915.

The apparatus comprises means for mixing starch with an acid, and delivering the mixture into a hollow element having a wall perforated with narrow slits through which the material is forced by the rapid rotation of beaters inside the hollow element.—J. H. L.

Starch from amylaceous materials; Process for obtaining ——. K. Peche, Vienna. Ger. Pat. 292,864, Jan. 8, 1914. Under Int. Conv., Jan. 5, 1914. Addition to Ger. Pat. 292,482.

The material is subjected to the action of bacteria such as those described in the chief patent (see page 938), which are capable of decomposing cellulose without attacking the starch.—A. S.

Process for converting cellulose into fermentable carbohydrates. Ger. Pat. 292,482. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Amylase of Aspergillus oryzæ. H. C. Sherman and A. P. Tanberg. J. Amer. Chem. Soc., 1916, **38**, 1638—1645.

The amylase of *Aspergillus oryzæ* exerts its maximum activity, both amyloclastic and saccharogenic, in a very slightly acid medium. "Saccharogenic power" is measured by the amount of maltose formed at 40° C. by the action of the enzyme on an excess of starch for 30 minutes. Acid phosphates accelerate and alkaline phosphates retard the action. Addition of neutral electrolytes, such as sodium and potassium chlorides, to commercial taka-diastase, has no measurable effect on the saccharogenic power, but increases the amyloclastic action. Preparations thirty times as active as taka-diastase were made from the latter by extracting with water, precipitating with ammonium sulphate, dialysing, and precipitating fractionally with alcohol. Such preparations are not so active as purified pancreatic amylase (see this J., 1911, 973); they have higher amyloclastic but lower saccharogenic power than the most active preparations of malt amylase yet described. The high ratio of amyloclastic to saccharogenic power, which is characteristic of commercial taka-diastase, is shown in at least equal degree by

purified preparations. The purest specimens obtained by the authors gave protein reactions and contained about 11 % of nitrogen and 2 % of ash.
—J. H. L.

Citric acid by fermentation. J. A. Martin. Amer. J. Pharm., 1916, **88**, 337—355.

The author studied the production of citric acid in sugar solutions by a mould probably identical with the *Citromyces tollensianus* of Wehmer (see this J., 1910, 37), this having been found to produce much larger quantities than other moulds investigated. A 10 % dextrose solution containing nutrient salts was inoculated with spores of the mould and maintained at 20° C. in presence of air. Growth was noticeable after 4 days, and the liquid later became covered with a thin, velvety, green layer. The production of citric acid commenced after about 5 days, and reached its maximum in 24 days, when it amounted to 20 % of the sugar originally present. The citric acid remained in the uppermost layers of liquid, and for this reason as well as to ensure free access of air the experiments were conducted in shallow vessels. By adding calcium carbonate from time to time, to neutralise the acid, and extending the duration of the experiments to 60 days, it was found possible to increase the yield to 43 % of the weight of sugar employed. The production of citric acid by this means requires a neutral or slightly acid medium containing suitable salts and not more than 10 % of sugar. As the process is one of oxidation, free access of air is necessary. The temperature should be carefully regulated, but light has no influence. The author suggests that the process might be used industrially after further study. The cultures would, however, be very liable to invasion by other moulds, most of which grow more rapidly than the one employed in these experiments.—J. H. L.

Wine containing free sulphuric acid. W. I. Baragiola and O. Schuppli. Z. anal. Chem., 1916, **55**, 369—377.

An Alsatian white wine (1889 vintage) examined by the authors contained about 0·1% of free sulphuric acid.—W. P. S.

Alcohol; Determination of very small quantities of water in —— by means of the critical solution temperature. V. Rodt. Mitt. K. Materialprüf., 1915, **33**, 426—433.

The method devised by Crismer (this J., 1904, 451; 1907, 32) has been re-investigated and proved to be capable of giving extremely accurate results. A suitable petroleum oil giving sharp indications without artificial cooling may be prepared by mixing transformer oil with commercial paraffin oil. For standardising the oil, perfectly anhydrous alcohol must be prepared. About 2 litres of 99% alcohol is placed in a large flask with 300 grms. of quicklime and the flask is suspended in a water-bath which can be quickly removed. The alcohol is gently boiled for some days under a reflux condenser protected by a phosphorus pentoxide guard-tube. The condenser is then reversed and arranged to deliver the distillate into a wide, corked burette, also guarded with moisture-absorption tubes. Successive portions of alcohol are distilled over into the burette and tested with the petroleum until a constant minimum value is attained. For the test, all the apparatus must be dried in an oven at 150° C. and every precaution taken against access of atmospheric moisture. An Erlenmeyer flask of about 50 c.c. capacity, fitted with rubber stopper, is accurately tared, a few drops of water are introduced rapidly from a pipette and the weight noted, then 15—25 c.c. of alcohol is drawn from the distillation burette and the flask is weighed again, so that the gravimetric composition of the aqueous alcohol is accurately known. The rubber stopper is replaced by another, also dried in the oven, having two holes, through one of which passes a standardised thermometer, reading to 0·2° C., and through the other a short glass rod. The glass rod is withdrawn, the point of a burette being inserted through the hole, and a measured volume of petroleum is run in, calculated from its sp.gr. to amount to 48/52 by weight of the alcohol employed; the measurement should be accurate to 0·1 c.c. The rod is replaced, the contents of the flask are warmed with gentle rotation until the liquid is perfectly clear, and rotation is continued while cooling until a sudden sharp clouding of the solution appears. The critical temperature may be noted with an accuracy of 0·2° C., corresponding to 0·01 % of water in the alcohol. A standardisation curve is plotted for a given petroleum oil which may be used subsequently for rapid and simple estimations of water in strong spirits; the rise of critical temperature is almost a straight line function of the percentage of water within the limits of 0—2·5 %.—J. F. B.

Effect of feeding on the composition of milk and butter. Dried yeast and decorticated cottonseed meal. Cranfield and Taylor. *See* XIXa.

Patents.

Diastatic product; Process in making ——. J. Takamine. New York. U.S. Pat. 1,192,584, July 25, 1916. Date of appl., July 1, 1912.

The fungus Koji, which contains diastase, is grown on a medium free from alkalinity and moistened with solutions of sodium chloride and an antiseptic. Preparations rich in diastase and having an abnormal resistance to antiseptics are thus obtained.—J. H. J.

Cellulose; Process for converting —— into fermentable carbohydrates. K. Peche, Vienna. Ger. Pat. 292,482, Nov. 23, 1913. Under Int. Conv., Nov. 20, 1913.

Cellulosic material is subjected to the action of bacteria capable of decomposing cellulose, and the resulting mucilage is converted into fermentable carbohydrates by the action of steam under pressure, alkalis, acids, or enzymes such as cytase. Suitable bacteria can be isolated from putrefying radishes; or *Micrococcus cytophagus* or *M. melanocyclus* may be used.—A. S.

Bread-improver and process of making same. U.S. Pat. 1,190,827. *See* XIXa.

XIXa.—FOODS.

Milk and butter: Effect of feeding on the composition of ——. Dried yeast and decorticated cottonseed meal. H. T. Cranfield and M. G. D. Taylor. Analyst, 1916, **41**, 240—245.

Dried yeast was found to be an excellent food for dairy cows as regards the quality of the milk and butter. There was no appreciable difference between the butters obtained from cows fed on dried yeast and cottonseed meal rations, respectively, the only variation in the composition of the butter fat being noticed in the case of the Polenské values, where the dried yeast feeding gave the higher figures. The dried yeast ration slightly increased the yield of milk and the fat content of the milk, the average percentage of fat being 3·77 for the dry yeast feeding and 3·72 for the cottonseed meal ration. (See also this J., 1915, 1108.)
—W. P. S.

Milk ; Acidity of fermented ——. A. Chouttinène. Pharmzevtizeski J., 1916, 110. J. Pharm. Chim., 1916, **14**, 109—112.

The acidity of fermented milk being due to the presence of lactic acid, dissolved carbon dioxide, acid phosphates, casein compounds, and products resulting from hydrolysis of the proteins, the acidity value varies according to the conditions under which it is determined. Titration with potassium hydroxide solution, using phenolphthalein as indicator, yields the lowest but most concordant results, provided that the titrations are always made under the same conditions. Calcium hydroxide and barium hydroxide solutions yield higher figures, but with these the former sometimes yields lower, sometimes higher, results than does the latter.—W. P. S.

Fats ; Pink colour on the surface of ——. A. W. Knapp. Chem. News, 1916, **114**, 73.

Margarine fats when exposed to the air of the laboratory frequently become pink. This is due to the presence of an azo dyestuff, probably dimethylaminoazobenzene, or "Butter Yellow," which is very sensitive to acid and alkaline vapours. To detect such azo dyestuffs in butter or margarine, the filtered fat is allowed to solidify in a small beaker, which is then placed in a crystallising dish at the bottom of which is filter paper saturated with strong hydrochloric acid. The dish is covered and left for two hours, and if an azo dyestuff be present a pink coloration gradually diffusing from the surface of the fat will then be seen. The rate of the diffusion of the acid vapours may be measured by the growth of the red layer. In the case of a butter fat containing 0·01 % of the azo dyestuff, the pink layer had penetrated $\frac{1}{16}$ in. in one day, ½ in. in 2 days, and 2 in. in 49 days.—C. A. M.

Casein ; Influence of alkali and alkaline-earth salts upon the rate of solution of —— *by sodium hydroxide.* T. B. Robertson and K. Miyake. J. Biol. Chem., 1916, **25**, 351—361.

The relation between the time and the amount of casein dissolving in sodium hydroxide solutions is expressed by the equation $x=Kt^m$, where x is the number of grams of casein dissolved, t is the time, and K and m are constants depending on the concentration of the alkaline solution and the total mass of casein present in the mixture. This relation holds good even in presence of alkali or alkaline-earth chlorides, though the rate of solution is decreased to an extent depending on the concentration of the salt employed. The alkaline-earth chlorides in $N/200$-concentration retard the rate of solution to approximately the same extent as 100 times this concentration of an alkali chloride. Whilst the value of K decreases, that of m increases with increasing concentration of the salts. The product Km, designated the coefficient of penetration, decreases with increasing concentrations of NaCl, KCl, $CaCl_2$, $SrCl_2$, or $BaCl_2$ between the limits of concentration employed, the acceleration of the decrease being positive in the first two cases, and the negative in the latter. Lithium chloride increases the value of Km, but with a negative acceleration, so that, with concentrations higher than $N/3$, a decrease is observed.—G. F. M.

Cacao products ; Determination of fat in ——. W. Lange. Arb. Kaiserl. Gesund., 1915, **50**, 149. Chem.-Zeit., 1916, **40**, Rep., 246.

When the Soxhlet apparatus is used, complete extraction of fat from cocoa powder, etc., requires up to 25 hours, and notable quantities of alkaloids and other substances are also dissolved. By the following method extraction can be effected in ½—¾ hour. A wide-necked flask of 250 c.c. capacity is used, fitted with a rubber stopper which carries a tube leading to a water-pump and a filter-tube, 3·5—4 cm. diam. and 8 cm. long. A Witt's filter-plate, with openings of ¾—1 mm. diam., is fitted inside the filter-tube and carries a layer of asbestos 3—4 cm. thick. Water is drawn through the layer of asbestos with the aid of the pump until particles of asbestos no longer pass through, and 5—10 grms. of cocoa powder or of grated chocolate is then introduced, levelled with a glass rod, and covered with 10—15 c.c. of ether, the tube being then closed by a watch-glass. When the ether begins to drain through, suction is applied cautiously. The operation is repeated, using 7—10 c.c. of ether each time, until a quantity of about 100 c.c. has been used. The flask is then replaced by a fresh one, and the extraction continued until a further 50 c.c. of ether has been used. The residue obtained by evaporating the ether extract is dried in a steam-oven until of constant weight. The amount of fat found in nine samples of cocoa ranged from 50·9 % (Venezuela, Caracas) to 57·3 % (Kamerun).—A. S.

Benzoic acid [in foods] ; Modification of the so-called Mohler's reaction for ——. J. Grossfeld. Z. Unters. Nahr. Genussm., 1915, **30**, 271. Chem.-Zeit., 1916, **40**, Rep., 266. (See this J., 1890, 770.)

The benzoic acid is extracted as usual with ether or other solvent, the solution evaporated, the residue heated with 0·1 grm. of potassium nitrate and 1 c.c. of concentrated sulphuric acid for 20 mins. on a boiling water bath, then cooled, treated with 2 c.c. of water, again cooled, treated with excess of ammonia, and mixed with 2 c.c. of a solution of 2 grms. of hydroxylamine hydrochloride in 100 c.c. of water. The red coloration produced if benzoic acid is present develops more quickly if the tube is immersed in hot water and then cooled. Cinnamic acid and benzene give similar colorations, but benzoic acid can be distinguished from salicylic acid by the test.—A. S.

Sugar used for making lemonade ; Deterioration of ——. E. Haddon. Bull. Soc. Chim. de Maurice, 1916, **7**, 12—13. Int. Sugar J., 1916, **18**, 383.

Instances of deterioration of lemonade due to fermentation, in Mauritius, were traced to the presence of the organism *Bac. levaniformans* (Greig Smith and Steel, this J., 1902, 1381) in the sugar used. The organism was isolated by adding 1 grm. of the sugar to 25 c.c. of a solution containing 5 grms. of potassium chloride, 2 grms. of sodium phosphate, and 2 grms. of ammonium nitrate per litre, heating in a boiling water-bath for 20 mins., and then keeping in a dark room for 3 days at 27°—30° C., after which a sub-culture in a tube of gelatin was made. It is recommended that the syrup used for making lemonade be sterilised in an autoclave at 120° C., and that all containing vessels also be sterilised.—A. S.

Non-protein nitrogenous constituents of feeding stuffs. H. S. Grindley and H. C. Eckstein. J. Amer. Chem. Soc., 1916, **38**, 1425—1431. (See also Hart and Bentley, this J., 1915, 1161.)

A cold-water extract of the feeding stuff was treated with colloidal ferric hydroxide to precipitate the proteins, and after filtering, the different forms of nitrogen compounds in the filtrate were determined ; the acid-amide nitrogen was determined as ammonia after hydrolysis with 20% hydrochloric acid, and the amino-acid nitrogen by Van Slyke's nitrous acid method (this J., 1911, 771, 1135). The results obtained are shown in the following table :—

Nitrogenous constituents of protein-free solution expressed as percentages of total nitrogen of feeding-stuff.

	Total nitrogen.	Free ammonia nitrogen.	Humin nitrogen.	Free amino-acid nitrogen.	Free and combined acid-amide nitrogen.	Combined amino-acid nitrogen.	Residual soluble nitrogen (by diff.).
	%	%	%	%	%	%	%
Alfalfa hay	17·55	1·11	1·44	5·04	3·35	3·13	3·48
Timothy hay	15·43	1·47	2·68	4·83	2·64	1·17	2·64
Blood meal	1·87	0·17	0·05	0·57	0·48	0·50	0·10
Corn (maize)	5·65	0·68	0·30	2·17	1·06	0·54	0·90
Clover hay	14·22	1·98	1·78	4·37	1·29	0·24	4·56

The results show that the greater part of the nitrogen of the soluble non-protein nitrogenous constituents of feeding stuffs exists in forms that result from the decomposition of proteins by hydrolysis, and hence only a small part, if any, of these non-protein constituents can interfere with the application of the Van Slyke method to the estimation of the free and combined amino-acids and amides of feeding stuffs (see this J., 1915, 848; 1916, 65).—A. S.

Denaturing of eggs [*for tanneries*]. Rogers. *See* XV.

Patents.

Bread-improver and process of making the same. R. W. Wahl, Chicago, Ill. U.S. Pat. 1,190,827. July 11, 1916. Date of appl., Jan. 21, 1916.

A concentrated yeast-food for use in making bread, and containing salts of lactic acid and lactic bacteria, is prepared by growing lactic bacteria in a mash, neutralising the lactic acid by means of a base as it is produced, separating the liquid from the exhausted solid material, and concentrating.—J. H. L.

Beverage extracts [*coffee substitutes*]*; Manufacture of* ——. J. L. Kellogg, Battle Creek, Mich., U.S.A. Eng. Pat. 17,255, Dec. 8, 1915.

Extracts containing the soluble constituents of roasted and ground algaroba (carob) bean and those of roasted and ground amylaceous materials such as wheat or soya beans, are concentrated and caramelised.—J. H. L.

Beverage; Non-alcoholic concentrated —— *and process for its manufacture.* H. Laessig, Berlin. U.S. Pat. 1,191,440, July 18, 1916. Date of appl., Aug. 6, 1914.

Milk serum containing lactic acid is mixed with material containing cane sugar under such conditions that the sugar is inverted. The proportion of lactic acid to sugar is about 4 : 100. The product is stable on exposure to air, and on addition of water forms a non-alcoholic beverage.—J. H. J.

Cream; Process of making artificial ——. H. C. Beckman and G. E. Dyck, Assignors to National Synthetic Products Co., Chicago, Ill. U.S. Pat. 1,190,369, July 11, 1916. Date of appl., Sept. 19, 1912.

A mixture of an oleaginous base with a milk base, to which casein may be added, is pasteurised and emulsified. A binding agent such as starch may be added, or the product may be subjected to the action of oxygen or ozone.—J. H. L.

Fodder; Process for making ——. R. R. Renshaw, Ames, Iowa. U.S. Pat. 1,190,953, July 11, 1916. Date of appl., Sept. 2, 1914.

Cellulosic materials rich in pentosans are heated under pressure with an inorganic acid, so as to hydrolyse the pentosans without materially affecting the cellulose. The pentoses thus produced may be removed, or after the acid has been neutralised the resulting mass may be dried. —J. H. L.

Ensilage; Towers or buildings for the fermentation and storage of ——, *or for the storage of grain.* W. Thompson, Wexford, Ireland. Eng. Pat. 11,041, July 30, 1915.

XIXb.—WATER PURIFICATION; SANITATION.

Water; Influence of algæ in sand filters used in the purification of ——. F. Diénert and L. Gizolme. Comptes rend., 1916, 163, 127—130.

The reduction of the alkalinity of a water, during its passage through an open sand filter, owing to the action of the algæ (see Gizolme, this J., 1915, 1068), is a direct measure of the purifying power of the filter. For instance, when the alkalinity has been reduced by about 4 mgrms. of calcium carbonate per litre, *B. coli* disappear from the water and the total number of organisms present is reduced by about 85%.—W. P. S.

Oscillaria prolifica; Chemical composition of ——. B. B. Turner. J. Amer. Chem. Soc., 1916, 38, 1402—1417.

Oscillaria prolifica (*Cyanophyceæ*), a blue-grass alga causing much trouble with water supplies, when air-dried contains 9·7% of moisture, 6·4% of ash, and 46·25% of protein, the remainder consisting chiefly of carbohydrates. The alga does not contain saponin in appreciable quantities but contains a glucoside or polysaccharide having physical properties similar to those of saponin, together with a pectin-like carbohydrate hydrolysed very slowly by boiling 5% sulphuric acid and yielding first a non-reducing dextrorotatory substance which on further hydrolysis gives a reducing sugar. The alga contains a chlorophyll-like substance and a blue substance, algocyan, soluble in water and in glycerol with an intense red fluorescence, but no crystalline substance except a small amount of the magnesium salt of an organic acid. A new form of extraction apparatus suitable for continuous extraction of large quantities of material with volatile solvents, and a modification of the Kjeldahl method of nitrogen determination enabling analyses to be made on as little material as 5 to 10 mgrms., are described.—T. C.

Ultra-violet radiation; Mode of action of —— *in producing sterilization.* W. E. Burge. J. Franklin Inst., 1916, 182, 261—265.

Fluid cultures of liquefying bacilli were exposed to the action of ultra-violet rays until all the bacilli were killed. The dead bacilli were washed with salt solution, and ground with sand and dilute alcohol, 10 c.c. of the extract was added to a tube of gelatin medium, and 10 c.c. of a living culture was added to another tube of gelatin. Six species of bacilli were examined in this way, and in each case practically as much liquefaction of the gelatin was produced by the extract of the dead bacilli as by the living culture. This indicates that the sterilising action of ultra-violet rays is not due to the destruction of intracellular enzymes.—J. H. J

Disinfecting power of disinfectants in relation t their concentration. J. P. Gregersen. Zentr Bakt., 1915, 1., 77, 168. Chem.-Zeit., 1916 40, Rep., 259.

Using the garnet method of Krönig and Paul, the time required to kill a given kind of bacterium wa determined, and the reciprocal of the value thu obtained was taken as a measure of the disinfecting power of the antiseptic in question, under th

given conditions of concentration, temperature, and kind of bacterium. By this method the disinfecting power of hydrochloric acid, mercuric chloride, iodine in potassium iodide, and formaldehyde, in aqueous solutions, was found to be directly proportional to the concentration, whilst that of phenol, thymol, and chloral hydrate was proportional to the fourth power of the concentration.
—A. S.

Solubility of calcium and magnesium soaps. Fahrion. *See* XII.

Chemical composition of Oscillaria prolifica. Turner. *See* XX.

Patents.

Water: Purification of ——. F. and F. P. Candy, London. Eng. Pat. 10,705, July 23, 1915.

The water is chlorinated in the usual manner and after standing for a half hour, is passed through a layer, about 18 ins. deep, of washed lignite, broken into granules $\frac{1}{4}$—$\frac{1}{2}$ in. size. A suitable rate of flow is about 150 galls. per sq. ft. per hr., but the rate may be adjusted according to the depth of the lignite, and *vice versa*. The lignite is supported on a layer of sand, over a layer of graded gravel or pebbles, resting on a perforated floor. The lignite becomes inefficient after about a year's use, but may be revivified by soaking in commercial hydrochloric acid for 12—24 hours.—J. H. J.

Filters; Feed water ——. H. B. Watson and T. B. Billetop, Newcastle-on-Tyne. Eng. Pat. 10,940, July 28, 1915.

In filters in which filter cartridges are used within an outer casing, the filtering area of the cartridges is increased without increasing the over-all dimensions by corrugating them longitudinally. The frames are also strengthened by inserting into them a strip of metal bent into a zig-zag form. The outer cylindrical casing is divided into compartments by partitions parallel to the axis.—W. H. C.

Feed water; Treatment of —— *for preventing corrosion and incrustation in steam generators and the like.* H. Laraque, Sheffield. Eng. Pat. 100,830, May 9, 1916. (Appl. No. 6613 of 1916.)

A composition of tannin, aluminium sulphate, and barytes, in proportions corresponding to the amount of impurities present, is added to the water.—W. H. C.

Water: Purification of ——. H. Kriegsheim, Assignor to The Permutit Co., New York. U.S. Pat. 1,192,075, July 25, 1916. Date of appl., May 16, 1916.

The water, with or without the addition of a salt of aluminium, is treated with a small proportion of sodium silicate and passed through a granular bed of a silicate with an exchangeable base.—J. H. J.

Sterilization of liquids by ultra-violet rays; Apparatus for ——. M. von Recklinghausen, Paris, Assignor to The R.U.V. Co., New York. U.S. Pat. 1,190,609, July 11, 1916. Date of appl., Jan. 15, 1914.

The apparatus consists of a concrete tank through which the liquid to be sterilised flows. A quartz container projects into the tank through an opening in the side, and is connected on the outside with a box containing an ultra-violet ray lamp and accessories. The lamp slides into the quartz container.—J. H. J.

Sewage sludge and like materials; Treatment of ——. E. A. Paterson, Thorold, Ontario, Canada. Eng. Pat. 10,670, July 22, 1915.

The sludge is fed under pressure through a flat nozzle on to a travelling perforated belt, which passes through a drying chamber heated by gas burners or other means. The upper part of the drying chamber is divided into sections by baffle-plates extending from the roof to just above the sludge layer on the belt. In front of each baffle-plate is an outlet, with a damper, leading to the main outlet flue through which the steam and gases given off from the sludge are drawn by a fan. The roof of each section of the drying chamber is lower than that of the preceding one, in order that more heat may be reflected on to the sludge as it gets drier.—J. H. J.

Garbage, sludge, and other like substances: Apparatus for disposition of ——. R. W. Amos, Hackensack, N.J., Assignor to National Purification Co. U.S. Pat. 1,188,382, June 27, 1916. Date of appl., Feb. 15, 1912.

The garbage is heated in a retort and the vapours given off are led by a pipe to a condensing chamber forming the lower compartment of a separating box from which the condensed alcoholic liquid produced may be drawn off. The box is divided by a perforated plate into the condensing chamber and a filter chamber filled with a filtering medium for the lighter ammoniacal vapours; the pipe leading away the vapour from the filter chamber passes through and serves to heat a combined evaporating and crystallising apparatus.—J. H. J.

Destructor-furnace. J. Primrose, Assignor to The Destructor Co., New York. U.S. Pat. 1,190,458, July 11, 1916. Date of appl., Sept. 4, 1914.

The furnace has a trough grate, with its side plates suspended along their upper edges from the walls of the furnace, and with a flat bottom supported on the side plates. The front of the grate is secured to the front wall of the furnace, and the back has a sliding support on the back wall. The grate has a central ridge on which an angle iron slides, for removing the clinker. Air is supplied above the grate through perforations in the top of the ridge.—J. H. J.

Disinfection: Process of ——. Schweizerisches Serum u. Impfinstitut, Bern, Switzerland. Eng. Pat. 9637, July 1, 1915. Under Int. Conv., July 13, 1914.

A mixture of 300 grms. each of dehydrated copper sulphate, finely powdered potassium chlorate, and pulverised iron is placed in a tub and covered with a litre of water and a litre of formalin. The heat of hydration of the copper sulphate is sufficient to decompose the potassium chlorate, and the additional heat thus produced vaporises the formalin. The iron combines with the liberated oxygen. Manganese dioxide may be added if desired.—J. H. J.

Formaldehyde gas; Method of generating ——. H. Anhaltzer, Pittsburgh, Pa. U.S. Pat. 1,191,647, July 18, 1916. Date of appl., June 12, 1914.

A mixture of equal parts of paraformaldehyde and potassium or sodium persulphate is treated with a solution of sodium peroxide.—J. H. J.

Insecticides [*; Waterproof* ——]. International Color and Chemical Co., Assignees of A. S. Ramage, Detroit, Mich., U.S.A. Eng. Pat. 100,302, Mar. 13, 1916. (Appl. No. 3734 of 1916.) Under Int. Conv., Apr. 16, 1915.

A spraying composition for foliage which when dry is practically waterproof is obtained, for example, by adding 10% by weight (calculated to dry arsenate) of a soluble (tallow) soap to a suspension of lead arsenate in water and then adding lead acetate or nitrate solution so as to obtain a precipitate of an insoluble lead soap distributed over the arsenate. Such a spraying composition possesses excellent adhering and weathering qualities, has no corrosive effect upon the foliage, and requires only about one-half the usual number of sprayings to ensure protection. Spraying compositions containing Paris green may be prepared similarly, precipitating in this case a copper soap, the products being strongly water-repellent.—F. W. A.

Clarifying waste waters; Apparatus for ——. R. Schilling, Schöneberg, Germany. U.S. Pat. 1,192,569, July 25, 1916. Date of appl., Mar. 5, 1912.

SEE Eng. Pat. 2741 of 1912; this J., 1912, 699.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Poison oak; The poisonous principle of ——. J. B. McNair. J. Amer. Chem. Soc., 1916, **38**, 1417—1421.

POISON oak (*Rhus diversiloba*) and poison ivy (*Rhus toxicodendron*) differ very slightly botanically and the poisonous constituents are very similar in pharmacological action, solubility, and other properties. On extracting chips of the limbs of the former plant with gasoline and subsequently removing the solvent, a black, poisonous residue was obtained which after hydrolysis with dilute sulphuric acid did not yield fisetin, gallic acid, or rhamnose, the substances obtained by Syme (this J., 1905, 951) by the hydrolysis of the black poisonous residue obtained by the ether extraction of the leaves and flowers of *Rhus toxicodendron*. Doubt is therefore thrown on the conclusion attributed to Syme that the poison of *Rhus toxicodendron* is a glucoside of fisetin, gallic acid, and rhamnose.—T. C.

Poison ivy; The poisonous principle of ——. S. F. Acree. J. Amer. Chem. Soc., 1916, **38**, 1421—1425. (See also preceding abstract.)

MCNAIR's reasoning that the limbs of *Rhus diversiloba* (poison oak) might be expected to contain the same toxic constituent as the leaves of *Rhus toxicodendron* (poison ivy) is contrary to well-established evidence that the chemical constituents of different species may vary widely whilst the botanical differences may be only slight, and that the constituents of the leaves of a given species are generally not identical with those found in the limbs of the same plant. The poisonous tar obtained by Syme from *Rhus toxicodendron* was most probably a mixture of toxic and non-toxic constituents, and Syme took into account the fact that the gallic acid, fisetin, and rhamnose which he obtained from the hydrolysis of the poisonous tar might be derived from some constituent of the tar other than the toxic constituent itself.—T. C.

Euthamia Caroliniana; Volatile oil of ——. G. A. Russell. J. Amer. Chem. Soc., 1916, 38, 1398—1402.

DISTILLATION of 83 kilos of *Euthamia Caroliniana* (L.) *Greene*, gathered in Florida, just previous to flowering, yielded 576 grms. of a pale yellow oil having a pleasant aromatic odour. After storing for 15 months the oil possessed the following constants: sp.gr. = 0·8587 at 23° C., $n_D = 1·4805$, $a_D = -10°48'$ at 23° C.; it consisted mainly of dipentene with a trace of pinene and possibly a small amount of limonene, together with about 10% of an unidentified lævo-rotatory compound or compounds of high density. The oil contained 5·35% of free and 1·66% of combined alcohols, a small amount of aldehydes, but no free acids or phenols. It is readily soluble in 6 vols. and in excess of 90% alcohol and in 9 vols. of 70% alcohol with slight cloudiness.—T. C.

d-Pinene hydrochloride and hydrobromide. d-Camphene. D. E. Tsakalotos and B. Papaconstantinou. J. Pharm. Chim., 1916, **14**, 97—103.

d-PINENE hydrochloride, prepared from *d*-pinene separated from Grecian oil of turpentine (see this J., 1915, 237), had $[a]_D^{17} = +33·19°$, m.pt. 127·1° C., b.pt. 207° C. at 750 mm., and a molecular weight of 172 (theory, 172·5). The dextro-rotatory power of the substance is thus established, although other observers have stated that it is inactive. The hydrobromide had $[a]_D^{21} = +31·31$, m.pt. 80° C., and a molecular weight of 214·4 (theory, 217); it decomposed when boiled. *d*-Camphene was prepared by treating *d*-pinene hydrochloride with potassium phenoxide, distilling the product, and collecting the portion passing over between 145 and 170° C. This portion was washed with sodium hydroxide solution, and re-distilled. It had $[a]_D^{18} = -84·05°$, m.pt. 42·7° C., b.pt. 157·6° C. (745 mm.), and a molecular weight of 137·5 (theory, 136·1).—W. P. S.

Salvarsan and neo-salvarsan: Excretion and secretion of ——. J. Webster. Analyst, 1916, **41**, 231—237.

SALVARSAN and neo-salvarsan are excreted fairly rapidly at first, but the amount *per diem* falls after the second day, until at the end of a week the quantity excreted is comparatively small. Arsenic may, however, be found in the urine at the end of three weeks or even longer after the dose has been given. In cases following death after the injection of these substances, relatively large amounts of arsenic are found in the liver, kidneys, and spleen, and small amounts in the muscles and blood. Arsenic is entirely, or almost entirely, absent from the brain and nervous system. Beneficial results have been obtained from the ingestion by a syphilitic child of milk from the mother who had undergone treatment by salvarsan. In several cases the milk was examined and found to be free, or practically free, from arsenic: this fact points strongly to the presence of antibodies in the milk serum and not to the actual presence of salvarsan. The method of analysis used consisted in oxidising the organic matter with nitric and sulphuric acids, then reducing with potassium metabisulphite, and determining the arsenic in the "electrolytic Marsh" apparatus, using platinum electrodes.
—W. P. S.

Vitamines; Chemical nature of the ——. *I. Antineuritic properties of the hydroxypyridines.* R. R. Williams. J. Biol. Chem., 1916, **25**, 437—445.

As indications are forthcoming that the natural "vitamines" are pyridine derivatives, the curative action of a number of synthetic substances of this type was tested on polyneuritic pigeons. Only in the case of a-hydroxy- and 2.4.6- and 2.3.4-trihydroxypyridines was any evidence of curative power obtained. The erratic nature of the results obtained with these three substances suggests that their physiological action may be influenced by keto-enol tautomerism, and attempts were made to study the individual action of the dynamic isomers. a-Hydroxypyridine was obtained in needles and as granular crystals, but neither form as tested by K. Meyer's bromine method was enolic. A solution in sodium hydroxide, however, rapidly absorbed bromine in excess of that required by the soda, and was probably 50—60% enol. Owing to the difficulty of definitely isolating the isomerides or determining the proportions present in a mixture, the biological results were not conclusive, but the granular crystalline form was certainly inactive, and aqueous solutions of the needle variety after some days lose their curative action. Caustic soda solutions were also active, but whether this is due to the enol form is uncertain, since the keto form was also present in such solutions.—G. F. M.

Guanidine sulphate; Preparation of ——. P. A. Levene and J. K. Senior. J. Biol. Chem., 1916, **25**, 623—624.

Guanidine sulphate may be prepared by the hydrolysis of dicyanodiamide (100 grms.) with 75% sulphuric acid (200 c.c.). After the spontaneous evolution of gas has subsided, the mixture is heated for 5 mins. and allowed to cool. When the product begins to solidify, 1500 c.c. of 95% alcohol is added and the crystals of ammonium sulphate filtered off. The filtrate, after concentration to 300 c.c., is neutralised with barium carbonate, and the liquid, after filtration of the barium salts, and exact neutralisation with sulphuric acid, is further concentrated to a thick oil, which on pouring into 1000 c.c. of alcohol slowly solidifies to a crystalline mass of nearly pure guanidine sulphate (about 125 grms.).—G. F. M.

Vicine and divicine. P. A. Levene and J. K. Senior. J. Biol. Chem., 1916, **25**, 607—622.

The position of the two amino-groups in divicine was ascertained by its oxidation, on the one hand, to guanidine, thereby demonstrating the presence of a 2-amino group, and by comparison of its transformation products with those of the 2.5- and of the 4.5-diamino bases. Its constitution is definitely established as 2·5-diamino-4.6-dioxypyrimidine. Vicine is shown to be a monomolecular nucleoside, containing one *d*-glucose and one pyrimidine residue in the molecule, but the point of attachment is still undetermined.—G. F. M.

Cholesterol: Comparison of the results obtained by the colorimetric and gravimetric determinations of ——. J. H. Mueller. J. Biol. Chem., 1916, **25**, 549—560.

When applied to solutions of pure cholesterol, Autenrieth and Funk's colorimetric method (Münch. Med. Woch.; 1913, **60**, 1243) and the digitonin method of Windaus (Z. physiol. Chem., 1910, **65**, 110) give accurate results. The discrepancies which have been recorded between determinations of cholesterol in blood by these two methods are traced on the one hand to incomplete extraction of the dried blood, and recourse must be had to hot alcohol or alcohol and ether, as ether extraction alone, even when prolonged, is incomplete. On the other hand colorimetric analyses of blood give high results, as they represent cholesterol plus some closely-related substance or substances of the nature of oxidation products. For this reason the digitonin method is to be regarded as giving more nearly correct results.—G. F. M.

Acetone; Determination of —— in presence of ethyl alcohol. J. Rakshit. Analyst, 1916, **41**, 245—246.

A portion of the sample, containing about 0·05 grm. of acetone, is placed in a 750 c.c. flask, 300 c.c. of freshly-prepared lime-water is added, the flask is closed loosely with a rubber stopper, and its contents heated to 35° C.; 5 c.c. of $N/5$ iodine solution is then added, drop by drop, and after shaking for 5 mins., a second 5 c.c. is added, and so on until 40 c.c. in all has been introduced. After 10 mins., starch solution is added, the mixture cooled, acidified with 15 c.c. of $N/1$ sulphuric acid, and the excess of iodine titrated with $N/10$ thiosulphate solution. The number of c.c. of $N/5$ iodine solution used is multiplied by 0·00193 to obtain the quantity of acetone in the portion of the sample taken. If, during the addition of the iodine, the colour persists after thorough agitation, more lime-water should be added. About 0·8 c.c. of $N/5$ iodine is absorbed by 1 c.c. of ethyl alcohol. When the sample contains only about 1 part of acetone and 100 parts of ethyl alcohol, the results are not very trustworthy, but in samples containing 1 part of acetone and 10 parts of ethyl alcohol the results are accurate and concordant.—W. P. S.

Methyl alcohol; Decomposition of —— by means of heated copper. C. Mannich and W. Geilmann. Ber., 1916, **49**, 585.

On passing methyl alcohol over heated copper, formaldehyde and hydrogen are produced (Sabatier and Senderens, this J., 1903, 577). The yield of hydrogen is greater than would correspond to the amount of formaldehyde, due partly to the decomposition of the latter into carbon monoxide and hydrogen and partly to its condensation to give methyl formate.—F. W. A.

Formaldehyde; Contamination of —— by copper. H. Kunz-Krause. Apoth.-Zeit., 1916, **31**, 66. Chem.-Zeit., 1916, **40**, Rep., 266.

When a copper spiral is used in the preparation of formaldehyde, contamination with copper readily occurs, owing to formation of volatile copper formate from formic acid produced by oxidation of the aldehyde. Copper, if present, may be removed by means of pieces of bright iron, the aldehyde being first shaken with calcium carbonate and filtered if it has an acid reaction. The presence of copper in formaldehyde may be detected by adding a few drops of pyridine, when a greenish-blue coloration is produced.—A. S.

Citric acid by fermentation. Martin. *See* XVIII.

Patents.

Therapeutically active substances from Corpus Luteum; Method of manufacturing two ——. O. Imray, London. From Soc. of Chem. Industry, Basle, Switzerland. Eng. Pat. 10,877, July 27, 1915.

By successive extraction with various solvents of the *Corpora lutea* taken from freshly killed animals, an alcoholic solution of two therapeutically active substances is obtained which can be fairly easily separated and purified by reason of their different solubilities in water and ether. One substance is a lecithin-albumin, easily soluble in water or 40% alcohol and insoluble in ether. It is used as 0·1% aqueous solution and has the property of inducing menstruation. The other substance belongs to the lipoid class, has a deep red brown colour, and is easily soluble in ether and difficultly soluble in alcohol. It is used in solution in olive oil and has the property of suppressing menstruation. The former, water-soluble, substance can also be obtained in a similar manner from young *Corpora lutea*. Both substances can be administered by subcutaneous injection and the former in tablet form also. Analyses and suggested empirical formulæ are given for both substances.—B. V. S.

Hog-cholera antitoxin; Process of filtering —— with the aid of chemicals. Process for producing a sterile hog-cholera antitoxin. J. Reichel, Philadelphia, and H. Werner, Glen Olden, Assignors to H. K. Mulford Co., Philadelphia, Pa. U.S. Pats. (A) 1,192,559 and (B) 1,192,560, July 25, 1916. Dates of appl., (A) Dec. 15, 1915, and (B) Mar. 10, 1916.

(A) Hog-cholera antitoxin (1 litre) is treated with sodium citrate (75 grms.) and calcium chloride (25 grms.). The precipitate formed carries down the insoluble inert impurities of the antitoxin, and thus assists filtration. (B) The hog-cholera antitoxin is freed from all solid particles and the accompanying organisms in a suitable centrifugal machine, and the clear liquor is filtered first through a layer of moist infusorial earth and then through a Berkefeld candle.—B. V. S.

Calcium acetylsalicylate: Manufacture of ——. J. A. Wülting, Berlin. Eng. Pat. 100,343, Jan. 18, 1916. (Appl. No. 827 of 1916.) Under Int. Conv., Apr. 29, 1915.

Equivalent proportions of acetylsalicylic acid and calcium hydroxide are mixed intimately in the dry state, the mixture is moistened with a small amount of an aliphatic alcohol, ester, or ketone, and the mass is triturated until completely soluble in water; the solvent is removed, and the calcium acetylsalicylate dried, disintegrated, and extracted with small amounts of ether until neutral. Commercial methylethylketone, ethyl alcohol, and ethyl acetate have been found to be suitable solvents.—F. W. A.

Organic synthesis; Process for ——. [Preparation of tartaric acid.] L. H. Baekeland, Yonkers, N.Y., and A. H. Peter, New York. U.S. Pat. 1,190,815, July 11, 1916. Date of appl., July 10, 1912.

A chloride solution is electrolysed so as to produce chlorine and an amalgam, and the chlorine is mixed with steam and led over carbon at about 300° C. to produce hydrochloric acid and carbon monoxide and dioxide. The hydrochloric acid and the amalgam are used in later stages of the process. The mixture of carbon monoxide and dioxide may be passed over carbon heated to redness to reduce the dioxide to monoxide, and the latter then converted into formate by passing it over alkali hydroxide at 180°—220° C.; or formate may be produced by saturating water with the carbon dioxide and reducing the latter by means of an amalgam in presence of acid. The formate is heated to 360°—440° C. under pressure to convert it into oxalate, the oxalate is reduced to glyoxalate by amalgam in presence of acid, and the glyoxalate is reduced electrolytically in alkaline solution in the cathode chamber of a cell containing a soluble chloride in the anode chamber, whereby racemic and mesotartrates are formed and precipitated. After separating the tartrates, the residual chloride solution may be evaporated, yielding steam for use in the process. The process thus forms a cycle of reactions by which carbon is caused to combine with the oxygen and hydrogen of decomposed water, with formation of tartaric acid as final product.—A. S.

Chlorinating; Process and apparatus for ——. B. T. Brooks, H. Essex, and D. F. Smith, Assignors to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,191,916, July 18, 1916. Date of appl., Dec. 8, 1915.

Gasoline fractions or other organic liquids are chlorinated by placing them in an opaque container, the upper end of which is illuminated by a source of actinic light, and passing chlorine into the lower end of the container, the liquid being moved progressively from the bottom of the container into the illuminated region by a stirrer. —F. W. A.

4-Hydroxypiperidine; Preparation of N- and C-homologues of ——. B. Emmert, Würzburg. Ger. Pat. 292,871, Mar. 5, 1915. Addition to Ger. Pat. 292,456 (this J., 1916, 868).

By reducing the N- or C-homologues of 4-hydroxypyridine (γ-pyridone) as described in the chief patent, the corresponding homologues of 4-hydroxypiperidine are produced.—A. S.

Phenylpropiolic acid compounds containing arsenic. E. Fischer, Berlin, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,191,580, July 18, 1916. Date of appl., Nov. 2, 1915.

See Eng. Pat. 295 of 1915; this J., 1915, 1072.

4.4′-Di[hydr]oxy-3.3′-diaminoarsenobenzene: Mixtures of alkali salts of —— and process of making same. B. Reuter and K. Streitwolf, Assignors to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,191,997, July 25, 1916. Date of appl., Dec. 29, 1914.

See Eng. Pat. 24,152 of 1914; this J., 1915, 1165.

Ball mills [for grinding bacteria and bacterial products]. Eng. Pat. 100,719. *See* I.

Preparation of phthaleins and their halogen derivatives containing selenium. Ger. Pat. 291,883. *See* IV.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Pyrogallol and amidol; Production of —— in Australia. Board of Trade J., Aug. 31, 1916.

As a result of extensive experiments, the Government Laboratory attached to the State Railway Department in Victoria is now producing pyrogallol and amidol in commercial quantities at a cost less than half the present market rates.

Red prussiate for blue print paper. U.S. Dept. Agric., Bureau of Chem. Bull. Paper-making, 1916, 253—254.

Potassium ferricyanide is one of the principal components of the coating used for sensitising paper for photographic blue print reproductions. It is prepared by the oxidation of potassium ferrocyanide by chlorine gas, but at the present time the pure crystallised red prussiate is extremely scarce. Experiments at the Bureau of Chemistry have shown that it is not necessary to employ the pure salt, but that the crude oxidised solution, containing a small amount of potassium chloride, gives perfectly satisfactory blue print papers, provided the liquid be used soon after it is prepared. A convenient charge, yielding 1 lb. of red prussiate in solution, is prepared by dissolving 1⅓ lb. of potassium ferrocyanide in 2½ quarts of water. After the oxidation is complete, the excess of chlorine must be removed, preferably by forcing or aspirating a current of air through the liquid until no odour remains.—J. F. B.

Patents.

Blemished moving-picture films; Process for restoring ——. F. W. Hochstetter, New York, Assignor to P. M. Pierson, Scarboro'-on-the-Hudson, N.Y. U.S. Pat. 1,192,424, July 25, 1916. Date of appl., June 20, 1913.

The film is coated with an oily substance which softens the emulsion surface, and the oil is then removed by a rubbing and buffing process which cleans the film and closes up scratches in its surface.—B. V. S.

Colour photography. P. D. Brewster, East Orange, N.J. U.S. Pat. 1,191,911, July 25, 1916. Date of appl., Feb. 11, 1913.

See Fr. Pat. 468,297 of 1914; this J., 1914, 986.

XXII.—EXPLOSIVES; MATCHES.

Sodium, potassium, and ammonium nitrates, potassium chlorate, and mercury fulminate]; Hygroscopic properties of ——. G. B. Taylor and W. C. Cope. U.S. Bureau of Mines. Met. and Chem. Eng., 1916, 15, 140—143.

As the result of experiments made in connection with the study of detonators (blasting caps), the hygroscopic properties of mixtures of mercury fulminate and potassium chlorate were found to be almost entirely due to the latter constituent. With commercial detonators the absorption of moisture was constant for detonators of the same diameter and independent of the chlorate content and weight of the charge. Fulminate-chlorate detonator composition does not absorb atmospheric moisture at all until the air is almost saturated, *i.e.*, about 97% between 0° and 35° C. The hygroscopic properties of the salts investigated were found to be a function of the humidity of the air and the vapour pressures of the corresponding saturated solutions, the latter values being capable of calculation when the moisture absorptions of the salts are known. The maintenance of constant conditions of humidity is the most important factor in determining the relative moisture absorptions of salts, for which purpose exposure on watch-glasses over water in ordinary desiccators is wholly unsatisfactory.—W. E. F. P.

Patents.

Match-splints; Composition for imparting flaming and non-glowing properties to ——. Treated match-splints and process of producing same. W. G. Wey, Oswego, N.Y., Assignor to The Diamond Match Co., Chicago, Ill. U.S. Pats. 1,191,544 and 1,191,545, July 18, 1916. Dates of appl., Nov. 7, 1912, and Sept. 22, 1915.

The splints are impregnated for a considerable part of their length with molten paraffin wax containing a solution of an inorganic phosphorus compound in an oil which is miscible with paraffin wax. The wax acts as a flame carrier and the phosphorus compound prevents glowing when the flame is extinguished.—W. F. F.

XXIII.—ANALYSIS.

Calorimeter; An adiabatic ——. F. Daniels. J. Amer. Chem. Soc., 1916, 38, 1473—1480.

An adiabatic calorimeter is described, which obviates the necessity of the cooling correction. The inner can, containing the thermometer and the source of heat, is filled with water, and is set on glass supports in a slightly larger vessel, and the whole is closed tightly by means of a ground-in brass cover. This arrangement is supported on glass rods in a large double-walled copper vessel which is filled with water and provided with a stirrer. Immersed in the water of the inner calorimeter and this outer water jacket are the junctions of a thermocouple so that temperature differences of 0·01° C. can be immediately detected by means of a mirror galvanometer. In use the radiation or conduction from the calorimeter proper is prevented by maintaining the outer water jacket at precisely the same temperature by hand manipulation of an electric heating circuit the terminals of which are connected with the inner wall of the outer vessel and the outer wall of the inner vessel respectively, so that the current actually traverses the water jacket, and the lag attendant on the use of resistance spirals is obviated. An automatic control by means of a selenium cell and a relay is also described which for a slow rise of temperature in the calorimeter will keep the determination adiabatic to within 0·02—0·03° C. without attention.—G. F. M.

Indicator for acidimetry and alkalimetry, and for the determination of hydrogen ion concentrations between the limits of 6 and 8 on the Sörensen scale; New and sensitive ——. M. T. Bogert and G. Scatchard. J. Amer. Chem. Soc., 1916, 38, 1606—1615.

A dinitrobenzoyleneurea is described, the monosodium salt of which forms a very sensitive indicator, changing from colourless to greenish-yellow between p_{H} 6 and 8. It is easily prepared by converting anthranilic acid into its uramino-acid by the action of potassium cyanate, condensing the product to benzoyleneurea by means of sodium hydroxide, and nitrating. It resembles *p*-nitrophenol more closely than any other well-known indicator. It is affected only slightly by neutral salts, and not at all by chloroform or toluene. Proteins (egg-albumin) have no more influence on it than on *p*-nitrophenol. Its colour fades only slightly in a week, and is not changed by nitrous acid. It can be used in cold or boiling solutions, and gives a sharp end-point with ammonia and hydrochloric acid, but cannot be used to titrate carbonates. It should prove superior to rosolic acid for the preparation of neutral ammonium citrate solutions for soil analyses.—J. H. L.

Ferric oxide; Use of —— as standard in the volumetric estimation of iron in hydrochloric acid solution. I. Brandt. Chem.-Zeit., 1916, 40, 605—607, 630—633.

Ferric oxide is obtained in a state of great purity as follows: iron, free from cobalt and practically free from phosphorus, is dissolved in not too great an excess of hydrochloric acid, and the solution is diluted to a maximum strength of 10 grms. of iron per litre, heated to boiling, and then treated with hydrogen sulphide until cold. After filtering, the liquid is concentrated by evaporating in large porcelain dishes and again filtered. The ferrous chloride solution is oxidised with nitric acid of sp. gr. 1·4 (45 c.c. to 100 grms. iron), evaporated to dryness, twice evaporated to dryness with hydrochloric acid, the residue dissolved in dilute hydrochloric acid, and treated with 200 c.c. of concentrated acid. When quite cold, this solution is extracted with ether in a separating funnel of 1 litre capacity (*i.e.*, for 100 grms. iron), care being taken to cool with running water at first. After being well shaken the aqueous liquid is run off from the green ethereal solution, and when the extraction has been repeated a second and, if necessary, a third time, the ether extracts, filtered through a dry paper, are united and the solvent distilled off. The residual ferric chloride solution is then heated in a covered spouted beaker or in a covered dish, until the pleasant-smelling fumes have been (practically) expelled; the syrupy residue, which crystallises on cooling and which contains both ferric and ferrous salt, is dissolved in dilute hydrochloric acid, filtered, diluted, and then reduced with sulphur dioxide. The reduction can be hastened by adding about 2 grms. of iodine, and in this case heat need not be applied. The excess of acid is removed with ammonia, or better with ammonium carbonate, the liquid is diluted to about 3 litres with hot distilled water, and the iron precipitated as ferrous oxalate with ammonium oxalate. The precipitate is washed repeatedly with hot water, first by decantation, then on the filter, dried, and powdered in an agate mortar; it is decomposed by heating it in a silica dish, gently at first and then more strongly, until a constant weight is obtained. During the ignition, the mass is stirred constantly with a quartz rod or with a thick silver wire. If a platinum vessel be used, traces of that metal are found in the oxide; a large porcelain crucible, however, can be employed. Larger quantities of iron, *e.g.*, 200 grms., can be converted with equal facility. If commercial ferric oxide or chloride be used instead of the metal, the extraction with ether is performed on the initial solution in hydrochloric acid, followed by reduction and treatment with hydrogen sulphide; in this case the filtrate from the hydrogen sulphide precipitate can be precipitated with ammonium oxalate forthwith, but the hydrogen sulphide must be completely removed previously, preferably by boiling in a current of carbon dioxide. Made in this way, ferric oxide dissolves readily in hydrochloric acid; it is very pure and even if some phosphorus be present in the metal used, at the most only $\frac{1}{200}$ of it is found in the finished product; volumetric determinations with permanganate gave results in complete accord with those obtained by the author's prevous method of preparing the oxide through the nitrate, and by comparison with iron wire of which the iron content was found gravimetrically. The Verein Deutscher Chemiker has recommended the adoption of pure iron oxide, obtained as above, for use in preparing volumetric standards.—E. H. T.

Gold: Iodometric determination of ——. L. Vanino and F. Hartwagner. Z. anal. Chem., 1916, **55**, 377—388.

A MODIFICATION of Peterson's method (this J., 1899, 176) is described, the gold chloride ($AuCl_3.HCl$) being treated with a mixture of potassium iodide and iodate and the liberated iodine then titrated with thiosulphate solution. The reactions proceed according to the equations:— $6(AuCl_3.HCl) + 18KI = 6AuI + 12I + 18KCl + 6HCl$; $6HCl + 5KI + KIO_3 = 6I + 6KCl + 3H_2O$; and $18I + 18Na_2S_2O_3 = 18NaI + 9Na_2S_4O_6$. Three molecules of thiosulphate correspond, therefore, with 1 atom of gold (see also Gooch and Morley, this J., 1900, 72). Provided that the salt contains no free acid, the method yields fairly accurate results; with quantities of gold of 2 to 10 mgrms., the error varies from —0·9 to + 4·5%. The method may also be applied to the salt $AuCl_3,2H_2O$; the quantity of iodine liberated from potassium iodide by this salt is a measure of the gold content; the difference between this quantity of iodine and that liberated when a mixture of iodide and iodate is added gives the amount, if any, of hydrochloric acid present.—W. P. S.

Vanadium; Separation of —— *from phosphoric and arsenic acids, and from uranium.* W. A. Turner. Amer. J. Sci., 1916, **42**, 109—110.

VANADIUM can be separated quantitatively from phosphoric and arsenic acids by means of the "cupferron" method (this J., 1916, 558), but in these cases the precipitates must be washed very thoroughly. Di-sodium hydrogen phosphate, or the corresponding arsenate, was mixed with a weighed quantity of standardised ammonium vanadate solution, and a 6% solution of cupferron used as precipitant.

When ammonium vanadate and uranyl nitrate solutions are mixed, yellow uranyl vanadate is precipitated; hence the separation of vanadium and uranium had to be performed in presence of acid (10 c.c. of sulphuric acid per 100 c.c. of solution), and the precipitate was washed with sulphuric acid containing 1·5 grms. of cupferron per litre. A more complete separation was effected by replacing the washed precipitate, with the filter, in the original beaker, dissolving the vanadium precipitate in ammonia, nearly neutralising with acid, and cooling to 20° C. After dilution and acidification, the vanadium was re-precipitated by adding a little more cupferron. The uranium in the filtrate was determined by precipitation with ammonia in presence of ammonium chloride. In this way it was found that the whole of the uranium used was recovered, but the vanadium found was nearly 3% greater than the quantity taken.
—E. H. T.

Tellurium and arsenic, and iron, thallium, zirconium, and titanium; Qualitative separation and detection of ——. P. E. Browning, G. S. Simpson, and L. E. Porter. Amer. J. Sci., 1916, **42**, 106—108.

THE solution containing tellurium and arsenic in presence of dilute hydrochloric acid, is treated with sodium sulphite and potassium iodide to precipitate the tellurium (Noyes and Bray, J. Amer. Chem. Soc., 1907, **29**, 137). The filtrate is boiled to remove sulphur dioxide, treated with hydrogen peroxide to decompose the iodide, and then boiled to remove iodine. Thereupon the liquid is made alkaline with caustic soda, and more peroxide added to convert the arsenic into arsenate. After acidifying, the arsenate is precipitated by addition of ammonia and magnesium chloride mixture. The filtrate from the arsenic precipitate may be tested for molybdenum by treatment with potassium thiocyanate and zinc in hydrochloric acid solution.

To separate iron, thallium, zirconium, and titanium, the precipitated hydroxides are dissolved in a minimum amount of sulphuric acid, and hydrogen peroxide is added: a red coloration indicates titanium. After rendering slightly alkaline with caustic soda, adding sodium phosphate, and then acidifying with sulphuric acid containing hydrogen peroxide (to keep the titanium oxidised), zirconium is precipitated as phosphate ($ZrOHPO_4$). The filtrate from this precipitate is then treated with caustic soda, whereby iron and thallium are removed, and the liquid is again filtered. The filtrate is acidified with sulphuric acid, and the titanium then precipitated as phosphate ($TiOHPO_4$) by adding sodium sulphite and a little more sodium phosphate. The mixed iron and thallium hydroxides or phosphates are dissolved in sulphuric acid, sodium sulphite is added, followed by potassium iodide, which precipitates thallous iodide; the filtrate from the latter is boiled to remove sulphur dioxide, treated with hydrogen peroxide to remove iodine and to oxidise the iron, and the latter is then identified with potassium thiocyanate.
—E. H. T.

Valuation and efficiency of gas oils. Downing. *See* IIA.

Differentiation of natural asphalts from industrial pitches. Hutin. *See* IIA.

Determination of the permeability to heat of textile fabrics. Bauer. *See* V.

Test for grease-proof properties of imitation parchment and "pergamyn" papers. Bartsch. *See* V

Precipitation of magnesium salts by ammonium carbonate. Fichter and Osterwalder. *See* VII

Determination of small quantities of sulphide sulphur. Drushel and Elston. *See* VII.

Determination of glycerol in hardened fats. Normann and Hugel. *See* XII.

Iron-gall inks. Gravimetric determination of galli and tannic acids. Kempf. *See* XIII.

Approximate determination of colophony in the gum resins used in the rubber industry. Hutin *See* XIV.

Determination of very small quantities of water i alcohol by means of the critical solution tempera ture. Rodt. *See* XVIII.

Determination of fat in cacao products. Lang *See* XIXA.

Modification of the so-called Mohler's reaction f benzoic acid [in foods]. Grossfeld. *See* XIX

Comparison of results obtained by colorimetric a gravimetric determinations of cholesterol. Muelle *See* XX.

Determination of acetone in presence of ethyl alcoh Rakshit. *See* XX.

Trade Report.

Prohibited imports. Board of Trade J., Aug. 31, 1916.

The following further rulings and decisions have been arrived at by the Department of Import Restrictions:—

Not prohibited: Cement for leather belting; chalk; synthetic rubies (from South Africa).

Prohibited: Artificial leather (made of cotton); compounds of brandy; compounds of rum; fruit pectin.

Prohibited imports. Royal Proclamation, Aug. 18, 1916.

The importation of chestnut extract and of glass (window, plate, sheet, and table ware) into the United Kingdom is prohibited as from and after Aug. 21, 1916.

Notification of accidents and poisoning under the Factory and Workshop Acts, 1901 *to* 1916. Home Office Notice, August, 1916.

On and after the 4th September, 1916, it will no longer be necessary for the occupier to notify any accident to the certifying surgeon (s. 8 of the Police, Factories, etc. (Miscellaneous Provisions) Act, 1916). Accidents must, however, be notified as before, on Form 43, to the District Inspector of Factories and entered in the General Register. The certifying surgeon may be required by the inspector to investigate and report upon certain accidents, and for this purpose will have the same powers as in the past. The paragraph of the abstract as to "Notice to Certifying Surgeons" is therefore obsolete, and will be omitted in the next revision. The Accident Notice (Form 43) has been revised accordingly, and the amended form will be placed on sale at once.

Notice of every case of lead, phosphorus, arsenical, or mercurial poisoning, or anthrax, occurring in a factory or workshop, must still be sent to the certifying surgeon as well as to the inspector, and this requirement now applies also to cases of toxic jaundice, that is, jaundice due to tetrachlorethane or nitro- or amido-derivatives of benzene or other poisonous substance.

German contraband of war. Board of Trade J., Aug. 24, 1916.

An Ordinance, dated 22nd July, declares the following absolute contraband: Powder and explosives of all kinds, smoke-producing and illuminating articles, incendiary matter, implements for fighting with gas, and materials which can be used for their manufacture, including:—Nitric acid and nitrates of all kinds; ammonia, ammonia liquor, ammonium chloride, ammonium salts; sulphur, sulphur dioxide, sulphuric acid, fuming sulphuric acid (oleum), carbon bisulphide; acetic acid, acetates; acetic ether, formic ether, sulphuric ether; acetone; ethyl and methyl alcohol (spirit), for example, sulphite spirit; urea; resinous products, camphor and turpentine (oil and spirit); calcium carbide; cyanamide; sodium cyanide; phosphorus and its compounds; chlorates and perchlorates of sodium, barium, and calcium; chlorine, chlorhydrin; bromine; phosgene (carbonyl chloride); stannic chloride; mercury; pitch; tar, including wood-tar, wood-tar oil; benzol, toluol, xylol, solvent naphtha, phenol (carbolic acid), cresol, naphthalene, and their mixtures and derivatives; aniline and its derivatives; glycerin; manganese dioxide; arsenic and its compounds. Photographic articles. Coal and coke. Flax, hemp, jute, vegetable fibres and yarns made therefrom. Wool, raw, combings or cardings; wool waste, flocks of wool and wool combings; carded and combed woollen yarn; animal hair of all kinds, as well as flocks, combings and yarns made of animal hair. Raw cotton, linters, cotton waste, cotton yarns, cotton goods and other cotton products capable of being used in the manufacture of explosives. Gold, silver, coined and in bars, paper money, and all negotiable commercial documents and marketable securities. Rubber tyres for motor vehicles, as well as all articles and materials used specially in manufacturing or repairing rubber tyres. Rubber (including crude rubber, waste rubber, reclaimed rubber, rubber solution, rubber cement, or any other preparation containing rubber), balata and guttapercha, as well as the following kinds of rubber—viz., Borneo, Guayule, Jelutong, Palembang, and all other materials containing rubber; besides articles which are made in whole or in part of rubber. Mineral oils (including shale oils, petroleum, benzine, naphtha, gasoline). Lubricants. Tanning material of all kinds, including quebracho wood and the extracts used in tanning. The following ores—Tungsten ores (wolframite and scheelite), molybdenite, manganese ore, nickel ore, chrome ore, zinc ore, lead ore, hæmatite iron ore, pyrites (crude and calcined), copper ores. Aluminium, aluminium salts, calcined alumina, bauxite. Antimony, together with the sulphides and oxides of antimony. Felspar. The following metals—Tungsten, molybdenum, vanadium, nickel, selenium, cobalt, hæmatite pig iron, manganese and its alloys, copper and its alloys, tin, lead. Alloys of iron (ferro compounds), including tungsten, manganese, vanadium, and chrome iron.

The following, coming under the designation of conditional contraband, shall be considered as contraband of war: Foodstuffs. Forage and all kinds of feeding stuffs for animals; oil seeds, nuts, and kernels; animal, fish, and vegetable oils and fats, excluding those suitable as lubricants, and not including volatile oils. Fuel, exclusive of coals, coke and mineral oils. Cement.

The following cannot be declared contraband of war:—Raw silk. Resin, shellac, hops. Horns, bones and ivory. Natural and artificial fertilisers. Earths, lime, chalk, stones including marble, bricks, slates, and roofing tiles. Porcelain and glass. Paper and the materials prepared for its manufacture. Soap, colours, including the materials exclusively used for their manufacture, and varnish. Chloride of lime, soda, caustic soda, sulphate of soda in cakes, copper sulphate.

Books Received.

Coal mine fatalities in the United States, 1915. Compiled by A. H. Fay. List of permissible explosives, lamps, and motors tested prior to Jan. 1, 1916. U.S. Bureau of Mines. 80 pages. Price 10 cents.*

Inflammability of Illinois coal dusts. By J. K. Clement and L. A. Scholl, jun. U.S. Bureau of Mines. Bull. 102. 74 pages. Price 15 cents.*

Instruments for recording carbon dioxide in flue gases. By J. F. Barkley and S. B. Flagg. U.S. Bureau of Mines. Bull. 91. 60 pages. Price 10 cents.*

Analysis of natural gas and illuminating gas by fractional distillation at low temperatures and pressures. By G. A. Burrell, F. M. Seibert, and I. W. Robertson. U.S. Bureau of Mines. Techn. Paper No. 104, 1915. 41 pages, 9 × 6 in. Price 5 cents.*

A description of the analysis of gaseous mixtures by liquefaction by means of liquid air, followed by fractional distillation in a vacuum (see this J. 1914, 808 ; 1915, 17, 267, 411, 540, 895).

PREPARATION OF PURE IRON AND IRON-CARBON ALLOYS. By J. R. CAIN, E. SCHRAMM, and H. E. CLEAVES. U.S. Bureau of Standards. Scientific Paper No. 266. 25 pages. Price 10 cents.*

SEE this J., 1916, 470.

STANDARD TEST-SPECIMENS OF ZINC-BRONZE (CU 88, SN 10, ZN 2). PART I. PREPARATION OF SPECIFICATIONS. By C. P. KARR. PART II. MICROSTRUCTURE. By H. S. RAWDON. U.S. Bureau of Standards. Technologic Paper No. 59. 67 pages. Price 25 cents.*

SEE this J., 1914, 1012 ; 1915, 1057, 1255.

RULES AND REGULATIONS FOR METAL MINES. By W. R. INGALLS, J. DOUGLAS, J. R. FINLAY, J. P. CHANNING, and J. H. HAMMOND. U.S. Bureau of Mines, Bull. 75. 296 pages, 9×6 in. Price 35 cents.*

IN 1906 a Committee was appointed by the American Mining Congress to draft a law governing quarrying and metalliferous mining which could be recommended to the several States for adoption, in the hope that it would tend to lower the number of accidents occurring in mines. This Bulletin contains a draft and synopsis of the proposed law, a digest of State metal mine inspection laws, chapters on mining inspection systems, and data regarding fatal and non-fatal mine accidents.

REPORT OF THE SELBY SMELTER COMMISSION. By J. A. HOLMES, E. C. FRANKLIN, and R. A. GOULD. U.S. Bureau of Mines, Bulletin 98, 528 pages. 9×6 in. Price $1.25.

THE Commission was appointed, as a result of litigation between the Selby Smelting and Lead Co. and the citizens of Solano County, California, to consider whether the company was violating the terms of a Court injunction. This Bulletin contains the report of the Commission and also papers on the effect of smelter smoke on vegetation and on animal life. The Bulletin is illustrated by 55 plates and diagrams.

MANUFACTURE AND USES OF ALLOY STEELS. By H. D. HIBBARD. U.S. Bureau of Mines, Bull. 100. 77 pages, 9×6 in. Price 10 cents.*

A BRIEF description is given of the various alloy steels and their uses, with a bibliography of the literature relating to each.

PROHIBITIONS OF EXPORT IN FORCE IN THE UNITED KINGDOM AND IN CERTAIN ALLIED AND NEUTRAL COUNTRIES. Supplement to the "Board of Trade Journal." Aug. 17, 1916, containing complete lists of articles which according to the latest information received by the Board of Trade, are prohibited to be exported from the United Kingdom and certain foreign countries, *viz.*: Denmark, France (and Algeria), Greece, Italy, Japan, Netherlands, Norway, Portugal, Roumania, Russia, Spain, Sweden, and Switzerland. Price 3d.

ANNUAL REPORT ON THE MINERAL PRODUCTION OF CANADA IN 1914. By J. McLEISH. Canada Dept. of Mines, Report No. 381. 362 pages, 9¾×6½ in. (See this J., 1915, 363.)*

INVESTIGATION OF A REPORTED DISCOVERY OF PHOSPHATE IN ALBERTA. By H. S. DE SCHMID. Canada Dept. of Mines, Bull. No. 12. 38 pages, 9¾×6½ in.*

SAMPLES of phosphate from belts in the Banff District, Alberta, contained on the average 20% P_2O_5, the highest being 27·63%. Two of the outcrops are conveniently situated for transportation purposes. The mineral is not suitable for treatment by the sulphuric acid process, but one of the "thermic" processes might be utilised for its conversion into superphosphate.

REPORT OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH FOR THE YEAR 1915-16. [Cd. 8336.] Wyman & Sons, Fetter Lane, E.C. 56 pages. Price 3d.

DESCRIPTION OF THE LABORATORIES OF THE MINES BRANCH OF THE DEPARTMENT OF MINES, OTTAWA. Canada Dept. of Mines, Bulletin No. 13. 51 pages and 60 plates, 9¾×6½ in.*

PETROLEUM AND NATURAL GAS RESOURCES OF CANADA. VOL. II. DESCRIPTION OF OCCURRENCES. By F. G. CLAPP and others. Canada Dept. of Mines, Mines Branch, Rept. No. 291. 404 pages. 9¾×6½ in.*

CONTAINS detailed descriptions of the Canadian oil and gas fields, illustrated by 71 photographs and drawings and six maps. Statistics of the production of petroleum and natural gas are appended (see this J., 1916, 200).

UNITED STATES MINING STATUTES ANNOTATED. By J. W. THOMPSON. U.S. Bureau of Mines, Bulletin 94 (Law Serial 4). 1772 pages. 9⅛×5⅞ in. Part I. Sections and Statutes relating to metalliferous and coal mining. Part II. Miscellaneous mining subjects. Price $2.50.

ABSTRACTS OF CURRENT DECISIONS ON MINES AND MINING. October, 1914, to April, 1915. By J. W. THOMPSON. U.S. Bureau of Mines, Bulletin 101 (Law Serial 5). 138 pages 9⅛×5⅞ in. Price 15 cents.

TWENTY-SIXTH ANNUAL REPORT OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION, FOR THE YEAR 1913. State University Press, Lexington, Ky. 624 pages, 9×6 in.

IN addition to the Report on the year's work of the Station, this volume contains Bulletins Nos. 169 to 177 of the Experiment Station, including reports on the woody plants of Kentucky, concentrated commercial feeding stuffs, the sulphur content of typical Kentucky soils, commercial fertilisers, and mineral waters.

A BIBLIOGRAPHY OF THE CHEMISTRY OF GAS MANUFACTURE. By W F. RITTMAN and M. C. WHITAKER. U.S. Bureau of Mines, Tech. Paper 120. 29 pages, 9×6 in. Price 5 cents.*

GASOLINE MINE LOCOMOTIVES IN RELATION TO SAFETY AND HEALTH. By O. P. HOOD and R. H. KUDLICH. With a chapter on methods of analysing exhaust gases, by G. A. BURRELL. U.S. Dept. of Mines, Bull. 74. 83 pages, 9×6 in. Price 15 cents.*

SHOT-FIRING IN COAL MINES BY ELECTRICITY CONTROLLED FROM OUTSIDE. By H. H. CLARK, N.Y. BERTH, and C. M. MEANS. U.S. Bureau of Mines, Tech. Paper 108. 36 pages. Price 5 cents.*

MINE VENTILATION STOPPINGS, WITH ESPECIAL REFERENCE TO COAL MINES IN ILLINOIS. By R. Y. WILLIAMS. U.S. Bureau of Mines, Bull. 99. 30 pages. 9×6 in. Price 10 cents.*

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* A certain number of these publications can be obtained free on application to the respective Government Departments.

In the case of the U.S. Government publications, when this supply is exhausted, copies can be obtained at the prices mentioned from the Superintendent of Documents, D.C., U.S.A.

Journal of the Society of Chemical Industry.

No. 18, Vol. XXXV. SEPTEMBER 30, 1916. No. 18, Vol. XXXV.

British Association.

SOME ASPECTS OF THE FUTURE OF THE SYNTHETIC CHEMICAL INDUSTRY OF GREAT BRITAIN.

Address delivered at the British Association (Section B), Newcastle Meeting, 1916.

BY FRANCIS H. CARR.

Since the outbreak of war we have read and listened to much concerning the question how to assist the development of British chemical industry, and nearly all that we have read and heard as to the need of co-operation in both research and industry, and their systematic organisation in matters financial, manufacturing, and educational, has met with our approval. Over and over again we have been urged to take resolute action—as, indeed, we were, also, from time to time before the war. Already, not a few of us are getting very weary of these discussions and are determined to replace them by immediate action.

What has been said of the British chemical industry in general applies with special force to the synthetic chemical branch, with which I propose to deal. As I wish to refrain, if possible, from the repetition referred to, will you please excuse me from attempting to give any complete survey of the future prospects of this branch and allow me to deal with the educational aspect of the matter, which, after all, may be the one of which you are weariest? It must be because I am not an educationalist that I am bold enough to come before men who are so qualified, and make fresh and heterodox proposals for which a teacher of chemistry might incur severe chastisement at your hands. However, if one may proceed, let it be assumed that we understand approximately the present position of the synthetic chemical industry, and how we have been led during the war to manufacture many dyes and medicinal chemicals in addition to those which were previously made here. Of many of these substances the demand (generally created by Germans) had by that time, and in most cases long previously, become an imperative need. It is equally understood that his great need and the enormous increase in prices resulting therefrom have temporarily opened he way to the manufacture of many dyes and nedicinal and photographical chemicals not hitherto made here. Probably we are agreed, also, as to the need of taking steps to protect the ndustry from destruction by foreign competition during the early years after the war, and as to that of establishing it ultimately without dependence upon any form of protective measures—for, in the ong run, scientific efficiency must determine which nation shall retain an industry. What, hen, are the conditions required to make the ynthetic chemical branch of the industry flourish nd expand in Great Britain?

The manufacture of synthetic chemicals is, erhaps, peculiar among manufactures in one espect. A very great diversity of operations inolving expert knowledge has to be carried out in he preparation of any one compound, and, with ut few exceptions, the demand for any one such ubstance is so small that, for economic reasons, s manufacture cannot be carried on continuously l the year round. The diversity of functions required of workers and organisation must therefore be still further extended by the making now of one compound, now of quite a different one. In addition to being various, the operations, as already indicated, are often difficult, requiring skill and experience, lack of which on the part of the workman may entail heavy losses.

We are generally agreed, no doubt, that this diversity makes co-operation between manufacturers a fundamental necessity, so that intermediate products required for several manufactures may be made economically, and therefore on the largest possible scale, and without unnecessary overlapping. But I wish to focus attention upon the type of men required to carry on and direct such manufactures, and to point out that if our educational provisions for supplying suitable men were less haphazard it would be greatly to the advantage of chemical manufacture in Great Britain. At the same time, it must be admitted that the prospects of those embarking on a chemical career are not as alluring as they might or ought to be.

The works chemist is not a greatly envied man as is, say, a medical practitioner, a barrister-at-law, or a civil engineer, yet he should have at least as lengthy an education as any of these. The industry needs more men of ability, character, and courage, and to get them we must improve the position both as regards scientific recognition and remuneration. The latter should be liberal enough, not only to attract men of first-rate ability to the industry, but to retain them on its technical side. It is anomalous that a man's earning capacity should generally be considered distinctly greater in commercial than in technical occupations: the anomaly unfortunately exists, and is responsible for a good many deliberate desertions of the technical for the commercial side of a business. A more general adoption of systems of partial payment by results would not only benefit both employer and employed, but would have far-reaching effects upon the whole industry by stimulating men to greater effort and inducing them to remain at their technical work. Scientifically trained people would do well when accepting engagements to stipulate for some scheme of participation in the fruitfulness of their work. Such schemes have worked well for both parties in the chemical industry on the Continent, and have been a material factor in its progress.

Let it be granted, then, that the chemical industry is in need of specially trained workers—a position which, after all, is true of many industries. By what process ought they to be prepared? In the college, in the factory, or in both? Most of us will agree that it must be by the last-mentioned combination—that neither college nor factory can alone complete the training; but as to the details of the functions to be performed by the two there is greater room for difference of opinion.

At this stage we need to discriminate between two classes of workers, namely (1) technical and scientifically trained departmental managers, and (2) expert operatives. The first class consists of resourceful well-trained chemists actually directing on the spot operatives of the second class. They must be men prepared to give directions when a reaction takes a different course from that expected; men with some engineering as well as chemical training; men who can carefully harvest from daily observations all those deductions which, in sum total, become invaluable knowledge. Such accumulative experience of practical detail is the secret of success, leading yields higher and higher, making the labour cost of the product less and less, and resulting at times in important discoveries. This power of controlling complicated and delicate processes, not merely conscientiously but with intelligence and initiative, of observing closely and of appreciating what in the mass of observed details is of practical as well as of scientific importance, demands qualities of mind and of interest which are different from, though not incompatible with, those of the research chemist in the narrower sense. The industrial chemist may have the research instinct and will not need to starve it, but his hunger after new knowledge for its own sake must not prevent his giving interest and enthusiasm to saving on the cost of materials, labour, and fuel; and such work demands not merely a type of ability as specialised as that of the research chemist, but above all a type of training which our educational system appears most conspicuously to lack. I regard it as fundamental to the solution of the problem before us. For it is in synthetic chemical manufacture above all other branches of chemical manufacture that men of this kind are indispensable, and it is to lack of educational provision for their development and encouragement more than to anything else that I am disposed to attribute our failure in that field.

One needs to apologise, I suppose, for dealing at greater length with this well-worn topic of education, yet I feel compelled to do so by reason of the great need of some means for more quickly and effectively supplementing university education in these respects so as to fit men for the pursuit of industrial chemistry. As we have heard so often, the university graduate, including the B.Sc.Tech., has even less knowledge of how to contrive to apply his knowledge than the manufacturer has of how to utilise it: the result being that the chemist in his caged laboratory is held by his employer at arm's length from manufacturing operations, and his lack of self-confidence still further increases the difficulty of putting his knowledge into practice. The working foreman's rule-of-thumb knowledge—to which great respect is due—is commonly regarded by the manager as a bulwark not to be shaken by any theoretical considerations, however plausibly they may be put forward by the chemist; and experience often justifies this attitude because, although the chemist knows, he does not know that he knows, and he therefore lacks confidence in applying his knowledge. The first failure is regarded as proof of mistake instead of the first stepping-stone to success, which indeed it often is. The trained chemist, without understanding the practical application of knowledge, is in a dilemma in industry—he must either gain knowledge by risking mistakes or remain in insignificance in his laboratory. That is the difficulty; the question is, can we evolve a practical scheme for removing it? The orthodox educationalist view is, I believe, that after the stage of graduation, training can best be carried out either in the research laboratory or in the industrial establishment. My own view is that neither of these places at present affords the proper training required. The shortcomings of the research laboratory for this purpose have been already indicated, and it is self-evident that competitive industrial concerns will not facilitate the training of men either by affording them the necessary leisure or by enabling them to pass from one works to another. It is notorious that in fear of such men passing on secrets (some real, others imaginary) to competing firms, employers put many difficulties in the way of such training as the works might afford, and sometimes metaphorically keep their chemists locked up in the laboratory.

In addition to a sound and thorough fundamental knowledge of chemistry, physics, and engineering, and a little of many other things, the works chemist requires the knowledge of applying knowledge. He needs to understand the business of applying chemistry to manufacture, just as the engineer does the application of physics to the same end. At present we ignore the study of the history of industrial processes, the economics of chemistry, the accountancy of chemistry, and the applied mathematics, mechanics, and engineering of chemistry; yet all of these are subjects capable of being taught to great advantage and for the most part in the laboratory in much the same way as electrical and mechanical engineering are taught. The scheme which I desire to propose applies exclusively to students who have creditably passed through a full college curriculum. It involves the formation of one or more technological colleges of a new type. Such a college would itself be nothing less than a manufacturing concern, having a complete and well regulated course extending over, say, two years, the students of which would spend a considerable portion of their time in actually manufacturing, under the direction of experienced technical men, those inorganic and organic compounds which are required in relatively small quantities by educational and research institutions throughout the Empire. For supplies of these substances we have, to our no small discredit, been dependent almost entirely upon German enterprise, and even, in many instances, on that of one particular German firm. With such productions the ordinary manufacturer will not be troubled, since the demand is so small and irregular as to render them insufficiently remunerative.

The college would need a large permanent staff who would conduct it on lines of strict and complete business organisation and discipline. The hours of attendance would be not less than eight per day and the holidays short. To enforce the regulations, power of dismissal would be given to those in control, and no student would be abl to proceed from one stage in his course to anothe without having qualified in the earlier one.

Structurally, the college would be composed o the lecture rooms, chemical, physical, and engineering laboratories, drawing office, and, in addition a series of well-equipped manufacturing laboratories, with store-rooms, joiners' and fitters' shops and so forth, and, lastly, but by no means of leas importance, a power plant generating steam, gas and electricity under such conditions that th efficiency is daily computed and under contro The steam, gas, water, and electricity supplied t each section should be recorded on meters, for th fundamental requirements must be that the studen should learn to approach chemical operation quantitatively from the point of view of the valu of raw materials, the yield of product, the heat an power absorbed, and time and labour expended.

To assist the student in getting the true commercial perspective he would, in the beginnin attend a course of instruction in accountancy an costing as exemplified in the system adopte throughout the college.

Having said so much of the general idea of m scheme I wish, before entering into other detail to explain that the object in view is not to teac the method of manufacture of a particular produ or kind of product. Although this may be do successfully in the case of certain industries, a for example, brewing and tanning, it is clear impossible for the chemical industry in genera but the care and exercise of resource required the manufacture of a selection of chemicals on th small manufacturing scale of from 5 to 1000 kil are typical of most manufactures, and instructio on these lines could, I claim, be made of immen value, though, of course, the whole of a manufacturer's knowledge can, by no conceivable means, be given in an institution.

In his progress through the laboratories the student would spend some time during the first year in an analytical department, in which the intermediate and finished products are submitted to examination for purity. It would be the function of the permanent staff of this department to set such a standard of perfection in manufacture as should uphold the reputation of the college with the institutions using its products, and, incidentally in many cases, supplying it with students. Much of the care expended in the works would be determined by the efficiency of this department, and the fact that the reputation of the college would depend on the judgment of those institutions and colleges to which the products are supplied would act effectively in maintaining a standard of excellence of work.

During the first year the student would attend courses of instruction in physical and electrochemistry, applied mathematics, construction and design, chemical engineering, machine drawing, etc.; he would also receive practical instruction in the repair shop and power-house, as well as in the use of special machinery and plant. He would take his turn at stoking, engine driving, making steam-joints, lead-burning, and so forth.

Passing into the works laboratory, first-year students would be set in small groups to manufacture at first simple inorganic compounds, and would be given an opportunity of watching the operations of advanced students. These manufacturing operations would need to be conducted under strict discipline as regards both time spent and quantitative results, and although from its nature the work would not be on the full scale of ordinary technical procedure, it would be carried out on a sufficiently large scale to require manufacturing apparatus as distinguished from that of the laboratory. During the first and second year, students gradually would become familiar with the construction and use of autoclaves, large reaction vessels, vacuum pans, gas compressors, furnaces, centrifuges, filter-presses, and so forth, and would acquire experience in handling difficult and dangerous substances, in utilising catalysts, etc. He would also have experience in designing pecial pieces of plant for particular technical processes. In the second year, courses of lectures would include various engineering aspects, among hem steam raising and power production, every tudent spending several weeks in the department oncerned with the supply of steam and power o the institution, and in a laboratory in which uel, water, and flue gases, etc., are analysed.

Courses of instruction in special manufactures, uch as sulphuric acid and alkali, would probably nd their place in the curriculum; arrangements might be made for students destined for particular ndustries to attend special courses of instruction iven by men actually engaged in the industries n question—a proceeding which has already been dopted in the evening classes of some of our echnical colleges.

Further, it would be an invaluable adjunct to uch a college if arrangements could be made for udents to attend courses of practical instruction actual works. By careful arrangement this ight be done with such slight interference to the usiness of the firms concerned during only a short eriod in each year that the opposition to the oposal would be satisfactorily met. Above all, is essential that the staff of the college should nsist mainly of men of ripened works experience not, be it understood, men (however able) who ve merely spent a period in the research or analytical department of a works. Such men have usually been regarded by our educational authorities as men with works experience, when in point of fact they have little more real claim to a knowledge of chemical manufacture than has the average practising analyst.

As regards the nature of the substances manufactured, the first-year students would be occupied partly in making from raw material simple inorganic substances; for instance, potassium bichromate and permanganate, metallic arsenic and tellurium, hydrogen peroxide, hydriodic acid and ammonium persulphate, and partly in isolating and purifying tar products, sugars, and natural vegetable products, such as theobromine and caffeine.

In the second and succeeding years—for it may be safely assumed that many students would remain longer than two years, and it should prove possible to pay them small salaries to do so—the students would be occupied in carrying out synthetic organic processes on the large scale; they would be enabled to follow each other's processes, being present to watch critical stages and so enlarging their experience.

The compounds manufactured would, in general, be those which, while not in common use, are required for exceptional purposes, chiefly by colleges and research laboratories. In order that the scale may be a large one it would be necessary to make of many substances much bigger quantities than are likely to be required; these might remain in storage for many years, and only gradually would a complete list of the substances in demand be accumulated.

One claim for this scheme is, that besides affording a really practical training, it would maintain and impart by means of actual manufacture and sales a standard of industrial efficiency almost impossible of attainment without this incentive. It would also have the further practical value of supplying many chemicals for which we have hitherto been dependent upon Germany. Nor need we fear that such a scheme would give serious offence in commercial quarters, for the monetary value of business in the manufacture of fine chemicals of this type is of no great account, and it would not be difficult to avoid jealousies by confining the manufacture to those substances which manufacturers of fine chemicals do not wish to produce.

If a manufacturer should complain that he is subjected to unfair competition through the production of a certain chemical by an endowed and privileged institution the reply is simple: let him produce a supply of the substance of adequate purity, and it may be assumed that the college of my conception would leave it to him.

Incidentally, the college would prove of great advantage to research workers, who would have here facilities for procuring the compounds with which their investigation commences, instead of spending a lot of their valuable time in repeating tedious preparations on a small scale. This single benefit, increasing as it would the effectiveness of research workers, would react favourably on the industry as a whole.

It may be objected that by the time a student has graduated he has no means to continue his education for two more years, making the course, say, five years in all. If we consider the number of medical students who find the means for a course of usually greater length the difficulty does not appear insuperable. It may be met to some extent by the suggestion that no student in this college should proceed to his second year unless he merits promotion by his attendance and progress in the first year; it might then be possible to remit the fees in the second year, or even to give a small remuneration. The sales of the chemist's products would, perhaps, assist partly in enabling this to be done, but endowment by the Government as well as by the Association of British Chemical Manufacturers should do so more materially.

Chemical manufacturers commonly pay salaries to members of their staff who are trying to teach themselves what might be more quickly taught in the institution I have sketched, but still more must be spent for this purpose if our industry is to progress, and it would be far more economical to do so in the manner here proposed. No doubt can exist that contributions from employers through the Association of Chemical Manufacturers might afford a substantial and adequate endowment, but for the cost of the buildings and equipment surely we might justly look to the Government, for it is recognised in the highest quarters that our educational organisation must be directed to practical ends of this very nature.

Dealing next with the training of the expert operative, we recognise that his chief training ground is now the factory, and must remain so for the present. Unfortunately, the lack of an established apprenticeship system in the chemical trade renders this training very uncertain and at times valueless, and efforts are needed to improve it. Much may be done by utilising the research and analytical laboratories of a works for the purpose of training selected boys from primary and secondary schools. To secure the success of such a method attendance at evening classes should be a condition of engagement in these laboratories, and the fees ought to be paid by the employer. This plan has many limitations, for not only may it be disadvantageous to the work of the laboratories to pass youths forward in this way, but the amount of attention which can be given to them is insufficient, and the number so trained does not meet the requirements of a growing industry. Our secondary schools, excellent though many of them are, fail lamentably to produce youths suitable for industrial careers. Too little latitude is granted by the Board of Education to permit of youths in a particular district being trained for industries belonging thereto, nor is there sufficient differentiation at the age of about thirteen in the training given to boys of quite different aptitudes. It would not be difficult in large towns to arrange that one or other institution should frame its course somewhat on the line of the old Mechanics' Institute, whose discontinuance has proved such a real loss—selecting the boys who are to attend it from all the other secondary schools of the district. The selection would be comparable to that which at present is made in the case of students proceeding to the commercial course in some secondary schools. Physics, mechanics, chemistry, mathematics, machine construction, and mechanical drawing should figure on the time-table, and the full course would extend to four years.

In addition to this modification of our secondary schools one cannot plead too often or too much for the Government of this country immediately to adopt compulsory continuation of the education of those brought up in our primary schools; at least eight hours per week should be so spent until eighteen years of age, the hours which people of this age can be employed in factories being limited to forty per week, and the secondary schools, already referred to, supplying the necessary classes. But this is not the proper occasion for discussing in detail the large question of general primary and secondary education. It suffices here to call attention to the fact that chemical manufacture among many other industries would be greatly benefited by the reforms referred to.

No mention has been made of the educational provision for training research workers, because it is felt that our universities are capable of turning out all that we require. Of their capacity in this respect as well as of the competency of British students we may rest well assured. Of greater moment is it that manufacturers should understand the commercial value of pure research, and that they should, both by co-operating with the universities and by providing their own laboratories, render it possible for these researchers to carry on their investigations.

To look upon research as a business proposition has been distasteful to many of that great band of devotees to science who have been attracted thereto by the love of research and the quest of knowledge for its own sake, but I am sure it would be healthful if this attitude on the part of scientific men were somewhat modified so that matters of practical importance might, without prejudice to scientific reputation, frequently form the subject of research in academic laboratories and of theses for degrees.

The commercial exploitation of the results of researches is a matter calling for careful attention in this country in the domain of medicinal chemistry. This matter presents considerable difficulty, partly because the medical fraternity are very conservative and unwilling to adopt new remedies, but mainly because of the difficulty in getting drugs tested and getting official recognition of their utility. In Germany the demand for such new remedies has been created by medical men rewarded for their services, a system happily impossible in this country and one which may do damage to the health of the unfortunate consumers. To overcome these difficulties it is suggested that institutions, universities, and hospitals should co-operate in performing physiological and chemical tests of likely substances, and that some body such, for instance, as the Medical Research Committee should, on examination and confirmation of the evidence thus afforded, authoritatively express opinion on the usefulness of new drugs, which opinion, properly vouched for in this way, would no doubt be accepted by the medical practitioners. This is particularly difficult under the present system by which good and bad remedies alike become known to them by the advertisements of interested firms.

In conclusion, let me reiterate in a very few words what I have endeavoured to express at greater length in this paper, namely, that the future of synthetic chemical manufacture as well as of other branches of the industry in this country can only be secured by greater progress in organisation and by co-operation among the various firms engaged in it. That, in addition, there must be an important development in our system of technical education so as to increase the efficiency of labour and its scientific management. For this purpose I have put forward with all modesty certain practical suggestions.

Finally, let us not wander like the Lost Tribes of Israel in the Desert, crying aloud to the Government to act as our Providence, but let us continue to work out our own salvation, and trust th Government to give the assistance we need whe we ask for it.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

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I.—GENERAL; PLANT; MACHINERY.

Heat transmission through boiler tubes. H. Kreisinger and J. F. Barkley. Tech. Paper 114, U.S. Bureau of Mines. 36 pages.

The following deductions are drawn from a large number of measurements of the temperature of the inside and outside of the tubes of a boiler. The temperature of the boiler tube is very little affected by the temperature of the hot gases, and does not differ from that of the boiler water by more than 10°—20° C. The boiler tubes can easily transmit to the water all the heat which they receive from the hot gases, and providing the boiler and tubes are free from scale, oil, or deposit, it is impossible to overheat the tubes, however fast the boiler is worked. The passage of the heat from the hot gases to the tube takes up the most time, and an increase in the rate of working a boiler can only be effected by devices which increase the rate of transmission of heat from the hot gases to the boiler tubes. In steam pipes conveying saturated steam, the temperature of the outside of the pipe is practically identical with that of the steam.

—W. H. C.

Saturated vapours [steam]; Relation between the temperature and pressure of ——. Kubierschky. Z. angew. Chem., 1916, **29**, 305—307.

The relationship between the temperature and the pressure of saturated steam is very closely expressed by the equation $\log p = \frac{5 \cdot 1(t-100)}{t+230}$, where p is the pressure in atmospheres. Expressing the pressure in kilos. per square cm., the equation becomes $\log p = \frac{5 \cdot 1(t-99 \cdot 1)}{t+230}$, and in mm. of mercury, $\log p = \frac{5 \cdot 1(t-100)}{t+230} + 2 \cdot 881$, or $\log p = \frac{8(t+19)}{t+230}$ For temperatures between 35° and 300° C. the calculated pressures in no case differ from the observed pressures by more than 1%, and in most cases by very much less, and the above equations are therefore to be preferred to those of van't Hoff or van der Waals.—G. F. M.

Patents.

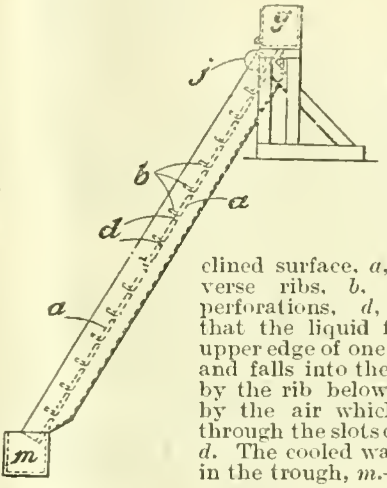
Solids from liquids: Apparatus for the separation of ——. W. Russell, London. Eng. Pat. 11,666, Aug. 12, 1915.

The pulp is fed as a thin film on to a slightly inclined table so that the solid particles remain on the table (to be removed by a scraper) and the liquid drains off. Several circular tables having an inclination of less than 1 in 100 may be mounted one above the other on a central rotating shaft.—W. H. C.

Water from air or steam and the like; Means for separating ——. J. E. Mortimer, London. Eng. Pat. 13,599, Sept. 24, 1915.

Annular ribs having lips on the side facing the current are disposed transversely in the conduit hrough which the air or steam flows, to arrest the particles of water thrown to the side by a helical baffle in the conduit, and convey them out of the path of the air or steam.—W. H. C.

Cooling liquids; Apparatus for ——. S. Bates, Prudhoe-on-Tyne. Eng. Pat. 15,931, Nov. 11, 1915.



The liquid is fed from the trough, *g*, on to the rotary distributor, *j*, and falls on to the upper transverse gutter of the inclined cooler. The latter is formed by the inclined surface, *a*, having transverse ribs, *b*, and slots or perforations, *d*, so arranged that the liquid flows over the upper edge of one transverse rib, and falls into the gutter formed by the rib below, being cooled by the air which is drawn in through the slots or perforations, *d*. The cooled water is collected in the trough, *m*.—W. H. C.

Filtering media of filtering apparatus; Means for cleansing the —— *wherein air is introduced with the cleansing liquid.* J. Wilson, London. Eng. Pat. 16,901, Dec. 1, 1915.

Perforated hoods of inverted V-shape are fitted over the inlet pipes for the cleansing liquid to form separating chambers, the washing liquid escaping through the lower and the air through the upper perforations, and thence passing upwards through the filtering medium.—W. H. C.

Filter. Filtration of liquids. Filter. E. G. Acheson, Assignor to Acheson Corporation, New York. U.S. Pats. (a) 1,193,333, (b) 1,193,334, and (c) 1,193,335, Aug. 1, 1916. Dates of appl., (a) and (b) Mar. 3, 1916, (c) June 5, 1916.

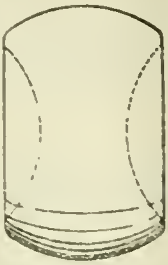
(a). A filter element of porous ceramic material is made of arched form continuous with a surrounding thicker annular portion. The arched portion is completely contained between the upper and lower planes of the annular portion and forms a partition within an enclosing casing. (b). A filtering medium for liquids is formed by stirring or kneading clay with a deflocculating agent and then moulding and baking it. (c). A filtering element is formed of a surface layer of the material described in (b) with a backing of relatively permeable material.

—W. F. F.

Filtering-frame for filter-presses. W. Guerrero, Madrid. U.S. Pat. 1,193,779, Aug. 8, 1916. Date of appl., Mar. 17, 1915.

A rectangular frame is provided with sockets along two opposite inner edges. A double grate within the frame consists of parallel members with transverse connecting portions; the latter alone engage with the sockets, and the other members are substantially flush with the opposite faces of the frame.—W. F. F.

Grinding mill; Comminuting body for ——. R. C. Newhouse, Milwaukee, Wis., U.S.A. Eng. Pat. 101,035. Mar. 3. 1916. (Appl. No. 3211 of 1916.



The grinding bodies have the form shown in the figure, the generating radii of all the curved surfaces being approximately equal. —W. H. C.

Kiln. J. N. Silva, Pueblo, Colo. U.S. Pat. 1,192,946.Aug.1,1916. Date of appl.,Aug.28,1915.

A number of kilns are arranged in a group connected with air feeding and waste gas exhaust tunnels, which surround each kiln and are connected at one end with the air feed and at the other with the exhaust tunnel. Connection with either or both of the tunnels can be established or cut off by suitable valves.—W. H. C.

Dry-kiln. J. F. Oldfield, Bel Air, Md. U.S. Pat. 1,193,596,Aug.8,1916. Date of appl.,Oct.16,1912.

A kiln of rectangular section with sloping roof is provided with double side walls and the space between them is divided by vertical partitions into flues, each having an opening in the roof. The flues also communicate with the drying chamber by openings of which the height increases from one end of the kiln to the other, and heating means are provided between the floor and a track which is situated above the flue openings.—W. F. F.

Drying apparatus. F. W. Adlof, New Brighton, Pa. U.S. Pat. 1,194,118, Aug. 8, 1916. Date of appl., Mar. 1, 1916.

The apparatus consists of three vertical concentric tubes between the inner and intermediate of which two parallel helical flanges are provided. The inner tube opens at the bottom into a furnace, the hot gases from which pass up the tube and then down through one of the helical passages and also the outer annular space. The material to be dried passes downwards through the other helical passage.—W. F. F.

Vacuum-evaporator; Continuously operating ——. J. do A. Castro, Sao Paulo, Brazil. U.S. Pat. 1,193,359.Aug.1.1916. Date of appl.,Dec.17,1915.

The liquid is caused to flow down a series of superposed inclined trays arranged within a chamber connected with a vacuum pump, and the heating medium is caused to pass below each tray in an upward direction from tray to tray. Scrapers are provided to remove the material from the upper surface of the trays and the dried product is removed from the bottom of the chamber by a hollow conveyor which also acts as a cooler. —W. H. C.

Centrifugal extractor. A. E. W. Jahn, New York, Assignor to Troy Laundry Machinery Co., Ltd. U.S. Pat. 1,193,697, Aug. 8, 1916. Date of appl., Aug. 4, 1914.

A basket mounted on a vertical rotating shaft is surrounded by a casing and provided with a ball-bearing between its upper rim and the wall of the casing which permits a limited vibration of the basket.—W. F. F.

Boiler. W. L. R. Emmet, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,191,157. Aug. 8. 1916. Date of appl., Dec. 12, 1912. Renewed Dec. 3, 1915.

A number of vertical heating tubes open at their upper ends into the base of a common vapour chamber and are closed at their lower ends. Each tube is provided with a central core of non-conducting material with a small axial opening which communicates at the top with the vapour chamber and at the bottom with the narrow annular space between the tube and core; the upper end of the axial opening is enlarged to form a cup to which the liquid to be vaporised is fed by gravity. The core may be enclosed by a metal envelope.—W. F. F.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Gases from [coal] mine fires: Explosibility of ——. G. A. Burrell and G. G. Oberfell. U.S. Bureau of Mines, 1915. Tech. Paper 134. (29 pages.)

From the results of analyses of samples of the gases from fire-areas in various mines, and a comparison of mine-fire combustion processes with those in gas producers, gas retorts, and boiler furnaces, it is concluded that, in addition to the methane naturally emitted by coal in "gaseous" mines, the carbon monoxide, methane, and hydrogen produced by the action of heat on coal are largely responsible for explosions which occur when ventilation is stopped during a mine fire. Methane is the most dangerous as regards low limit of explosibility; while carbon monoxide and hydrogen are especially dangerous because of their wide explosive ranges. The proportions of hydrogen, carbon monoxide, and paraffin hydrocarbons (mainly methane) produced by the destructive distillation of coal between 339° and 1100° C. may vary between 0 and 73, 2 and 16, and 2·5 and 71%, respectively. At low temperatures the proportions of hydrogen and carbon monoxide formed are lower than that of methane, the latter thus forming the principal source of danger in low-temperature mine fires. In the case of a mine fire which has been burning for some time, it is probable that when the oxygen of the air has been so depleted that products of distillation appear the embers will have cooled to a point where the low-temperature products are given off in largest quantity. Carbon monoxide formed by the action of hot carbon on carbon dioxide is a highly important agent in some mine-fire explosions: but water-gas produced by the action of steam on ho carbon probably plays a relatively unimportan rôle.—W. E. F. P.

Water in coal; Some properties of ——. H. C Porter and O. C. Ralston. U.S. Bureau of Mines Technical Paper 113. 30 pages.

There is no ready means of separating the fre water (" moisture ") and inherent or " combined ' water in coal, as some of the latter is remove even when the coal is dried over sulphuric aci or phosphorus pentoxide. Calcium chloride i unsuitable as a desiccant for coal as the aqueou tension of the dihydrate is too high. Differen kinds of coal in an air-dried condition contai widely different proportions of water and, conversely, equal percentages of water in various coal produce very different vapour pressures. This i due to the inherent water in coal having a subnormal vapour pressure and indicates the presenc of variable proportions of colloidal matter in coa When coal is wetted, a rise in temperature occu which depends on the nature of the dry coal and o the proportion of water in it, the increase in temperature being highest with perfectly dry coal The fineness of the samples does not affect th results. Determinations of the specific heat dried and undried coals showed that the inhere water in coal has a molecular heat lower than th normal. The authors conclude :—(a) That it is impossible to dry coal thoroughly in an atmosphere which is not absolutely dry ; (b) that the extremely hygroscopic character of dry coal may lead to serious errors if it is overlooked ; (c) that large changes occur in the humidity of coal exposed to the atmosphere ; (d) that the free water adhering to broken coal varies according to the size of the particles and to the nature of the coal ; and (e) that the rate at which coals can be dried depends on the origin of the sample, the mature Appalachian coals drying more rapidly than the more hygroscopic younger coals of the Middle West and West of the United States.—A. B. S.

Coals : Graphic studies of ultimate analyses of ——. O. C. Ralston. Tech. Paper 93, U.S. Bureau of Mines. 41 pages.

By a modification of the ordinary system of trilinear co-ordinates the author has plotted the results of a large number of coal analyses calculated on a basis of pure coal, that is, the carbon, hydrogen and oxygen made equal to 100 %. The resulting diagram shows that the various grades of coal of the generally accepted classification fall into definite fields on the diagram. By connecting the points of coals of equal calorific value and also those having equal volatile matter, a series of curves, called " isocals " and " isovols " is obtained which show that there is an undoubted relation between the ultimate analysis and each of the above qualities, and a combination diagram of isocals and isovols crossing each other, shows the possibility of predicting the ultimate analysis from the calorific value and volatile matter and *vice versa*. No relationship could be established between the moisture, ash, sulphur, and nitrogen and the properties of the coal.—W. H. C.

Coke-ovens ; Recovery of by-products from —— in the United States.

According to a report issued by the U.S. Geological Survey the value of the by-products recovered from coke-ovens in 1915 was nearly $30,000,000, as compared with $17,500,000 in 1914. The greatest increase was in benzol products, the value of which increased from less than $1,000,000 in 1914 to more than $7,760,000 in 1915. The quantity of coal carbonised in by-product recovery coke-ovens in 1915 was 19,500,000 short tons. The amounts and value of the products are shown in the following table :—

Products.	Quantity.	Value.
Tar obtained and sold, gallons ……	138,414,601	$3,568,384
Ammonia obtained and sold :		
Sulphate, lb. ……	199,900,487	5,648,958
Liquor, galls. ……	10,626,612	1,240,473
Anhydrous, lb. ……	30,002,196	2,978,044
Gas produced, million cb. ft. ……	213,667,614	—
Surplus gas sold or used :		
Illuminating, million cb. ft. ……	17,196,426	3,083,311
Domestic fuel, million cb. ft. …	27,590,624	3,158,129
Industrial fuel, million cb. ft. .	39,568,864	2,383,459
Benzol products :		
Crude light oil, galls. ……	13,082,678	4,304,281
Secondary light oil, galls. ……	182,039	28,731
Benzol, galls. ……	2,516,483	1,428,323
Toluol, galls. ……	623,506	1,529,803
Solvent naphtha, galls. ……	196,151	46,233
Naphthalene, lb. ……	465,865	46,959
Other products* ……	—	379,491
		29,824,579
Coke, short tons ……	14,072,895	48,558,325
		78,382,904

* Includes breeze, retort carbon, domestic coke, and coke dust, and aniline oil.

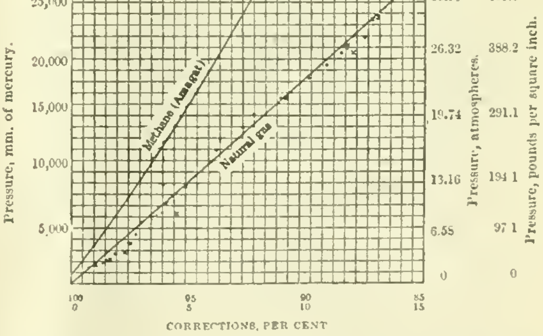
The increase in by-product coking has been very great since the beginning of 1916, and production is far in excess of the 1915 figures.

Carburetted water-gas manufacture ; Decomposition of hydrocarbons and the influence of hydrogen in ——. M. C. Whitaker and E. H. Leslie. J. Ind. Eng. Chem., 1916, 8, 593—601, 681—695.

The decomposition of a vaporised paraffin hydrocarbon oil (sp.gr. 0·8, b.pt. 150—265° C.) at atmospheric pressure and at temperatures of 621°, 723°, and 825° C. respectively, was studied, using the electrically-heated furnace described previously (Whitaker and Alexander, this J., 1915, 705), and the effect of varying the oil feed and of adding hydrogen at different concentrations (approximating $1H_2$: 2 oil gas and $2H_2$: 1 oil gas respectively) was investigated. The experimental results are given chiefly in the form of curves. When oil is cracked in an atmosphere of hydrogen, the absorption of hydrogen is greater the higher the concentration of the latter, the higher the temperature, and the lower the rate of oil feed. There is no marked difference in the amount of tar formed in presence or in absence of added hydrogen below 723° C. At 825° C. less tar is formed when hydrogen is added. The proportion of tar increases with decrease of temperature and with increasing rate of oil feed, particularly at the lower temperatures. Below 723° C. the tar formed consists largely of unchanged or partially changed oil. The proportion of the carbon of the oil which appears as hydrocarbons in the gas is largely increased by addition of hydrogen. The volume of illuminants produced per unit volume of oil increases, in general, with the temperature. About one-third by volume of the illuminants in the gas consists of propylene and higher olefines. The formation of ethane is not large at any temperature, but the formation of methane is greater the higher the temperature. A decomposition temperature of about 825° C. appears most desirable provided too great opportunity for extensive secondary and tertiary changes is not given. It is suggested that in commercial practice the best results would probably be obtained by cracking the oil in an apparatus designed and operated primarily for the production of gas, and then carburetting the gas in a second apparatus with the tar formed in the first.—A. S.

Natural gas at high pressures ; Compressibility of ——. G. A. Burrell and I. W. Robertson. U.S. Bureau of Mines, 1916. Techn. Paper 131. Petroleum Technology 31. [6 pages.]

In comparing the compressibility of natural gas (Pittsburgh) with that of an ideal gas (methane) at different pressures, the results shown in the accompanying chart were obtained. The practical value of the results is apparent since, in commerce, natural gas is frequently measured at pressures up to 40 atmospheres.—W. E. F. P.



Sabatier's catalytic actions. [Hydrogenation of ethylene.] U. Grassi. Nuovo Cim., 1916, [vi], 11, i, 147—163. J. Chem. Soc., 1916, 110, ii., 425.

THE author has investigated the hydrogenation of ethylene in presence of recently reduced copper at various temperatures between 150° and 300° C. The catalyst at first exhibits variable activity, but gives constant and reproducible results after it has been subjected for several hours to the action of a circulating mixture of ethylene and hydrogen at 250° C. The thermostat and thermoregulator were charged with dense automobile oil, which exhibits sufficient mobility at temperatures above 50° C. to admit of uniform distribution of the temperature. The mean values of the initial velocities of the hydrogenation at different temperatures are as follows: 150° C., 0·25; 200°, 1·10; 250°, 1·19; and 275° C., 1·21. The velocities of the reaction are found to be rigorously proportional to the concentrations of the hydrogen and ethylene, and the conclusion is drawn that the reaction is of the type of absorption reactions. The anomalous values of the temperature coefficient of the reaction, which should be about 2, but is low at 150°—200° C., and lower still at higher temperatures, are explainable according to Trautz's theory of the influence of temperature on the velocity of reaction (J. Chem. Soc., 1910, 98, ii, 24; 1912, 102, ii, 746). This theory leads to the result that the temperature at which the maximal velocity of a reaction is reached becomes lower as the heat of formation from the elements of the system diminishes; in the present case the heats of formation of ethane and ethylene are −23,300 and —14,600 cals. respectively, and the maximal velocity is attained or approached at 275° C.

Kerosene shale as a gas and power producer. E. V. Espenhahn. Soc. Chem. Ind. of Victoria. June, 1916. J. Gas Lighting, 1916, 135, 398—400.

TESTS under working conditions have shown that the kerosene shale (torbanite) of New South Wales yields a large quantity of gas of high illuminating value, the author quoting instances of 15,399 and 17,160 cb. ft. per ton, of an illuminating power of 46·35 and 43·62 candles respectively. The coke has a high percentage of ash and is useless for ordinary firing purposes. A high yield of tar is obtained but it is not in a form to permit its economical use as a heating or power agent without further treatment. The author gives results of experiments carried out by himself and Seeger in Bunte's laboratory with a view of ascertaining conditions for the production of a gas of a gross calorific value of 520 to 560 B.Th.U. per cb. ft. By simple distillation at 700° and 1000° C., only low yields of gas were obtained. Cracking the volatile products at 800° C. resulted in a large increase of permanent gases and in the conversion of hydrocarbons condensed as tar into aromatic compounds, with formation of some free carbon. At higher temperatures the volatile products suffered further decomposition and at 1000° C. the gas increased by 50% but at the cost of the calorific value, which decreased by 40%. Still higher yields of gas were obtained and the production of tar reduced to a minimum by cracking the volatile products in presence of steam, but it was difficult to regulate the steam under laboratory conditions so as to ensure uniform results. In two tests in which cracking was effected at 1000° C., the yields of gas were 40,800 cb. ft. of gross calorific value 582 B.Th.U. per cb. ft. and 45,600 cb. ft. of 532 B.Th.U. per cb. ft. at 60° F. and 30 ins., the yields of tar being 2·9 and 1·2% respectively. It would not be difficult to regulate the steam on a works scale and the prospects of adapting the process for the manufacture of illuminating gas appear favourable, the author giving a description of his method for carbonisation of such shale. The crushed shale passes through vertical retorts and the residue is withdrawn at intervals into bunkers from which it is fed into a producer of revolving grate type with air-blast. The producer gas after meeting preheated secondary air passes through heating flues (forming the superheater) which are maintained at any desired temperature. Part of the producer gases pass to the heating flues of the vertical retorts, heating the lower section up to 700° to 850° C. The sensible heat of the remainder is taken up in the regenerator for preheating the secondary air. Steam is admitted into the retorts below the hottest zone, whilst the permanent gases on leaving the retorts are separated from the oils, condensed at lower temperature, and treated for recovery of ammonium sulphate. The oil is fed along with steam into the superheater where fixation into permanent gases takes place. The permanent gases formed in the first instance are passed with oil into the superheater or may be used for carburetting the mixed oil- and water-gas. All grades of mineral are not suitable for this process as in the case of a first-class shale the fixed carbon would probably not suffice to maintain a combustion zone. Scotch shales contain a high percentage of ash and probably would be unsuitable for gaseous firing, without considering the economic value of the mineral as an oil producer.—J. E. C.

Petroleum production of the world in 1915. U.S. Geol. Survey.

THE total quantity of crude petroleum entering the world's markets in 1915 amounted to 426,892,673 barrels, or 7% more than the 1914 production. The bulk of the increase in 1915 came from the United States and Mexico, though Russia, Argentina, and Japan recorded significant gains. The distribution of this production is shown in the following table:—

Country.	Quantity, 1915.	
	Brls. of 42 g's.	Metric tons.
United States	*281,104,104	37,480,547
Russia	68,548,062	9,353,077
Mexico	32,910,508	4,388,068
†Dutch East Indies	12,386,808	1,710,415
Roumania	12,029,913	1,673,145
India	‡7,400,000	986,667
Galicia	4,158,899	578,388
Japan and Formosa	3,118,464	415,785
Peru	2,487,251	331,633
Germany	995,764	‡140,000
Trinidad	‡750,000	100,000
Argentina	516,120	75,900
Egypt	221,768	29,569
Canada	215,464	28,729
Italy	39,548	‡5,500
Other	‡10,000	1,333
Totals	426,892,673	57,298,786

*Marketed production. †Includes British Borneo. ‡Estimated.

Petroleum; Emulsified or cut ——. C. K. Francis. J. Ind. Eng. Chem., 1916, 8, 682—684.

A SAMPLE of emulsified petroleum from the Cushing field, Oklahoma, yielded 1·6% of sediment when treated for 10 min. in a centrifuge at 1450 revs. per min.; the sediment contained only a very small proportion of solid matter. When a portion of the oil was filtered, and the residue washed with gasoline, the final residue amounted to 0·51% and comprised 0·28% of non-volatile mineral matter and 0·23% of organic and volatile substances. The mineral matter consisted of sand, 2·69; gypsum, 13·35; calcium chloride, 7·60; magnesium chloride, 0·91; and sodium chloride

75·45 %; the quantity of salts was more than sufficient to saturate the water present in the oil. The presence of the chlorides explains the corrosive action of such emulsified oils on the stills, etc., in the refinery; this action is so severe that some pipe lines refuse to accept emulsified oils. The treatment adopted in Oklahoma consists in introducing the oil below the surface of water warmed to 80°—125° F. (27°—52° C.) in a tank. The slight expansion causes the breaking of the oil film, and the aqueous liquid subsequently soon separates from the oil in the stock tank.—A. S.

Petroleum; Distillation [*cracking*] *of* ——. Selinsky. J. Russ. Phys.-Chim. Obschtestwa, 1915, **9**. Chem.-Zeit., 1916, **40**, Rep., 285.

The carbonaceous deposit which is formed in considerable quantities when petroleum is cracked in iron retorts contains about 70 % of carbon and 30 % of iron. When decomposed with hydrochloric acid it yields a mixture of combustible gases containing 85 % of hydrogen, 12 % of methane, and 2·2 % of olefines. The best yields of benzene and toluene are obtained when petroleum is cracked in tubes filled with alumina and titanium oxide, which act as catalysts.—A. S.

Propane-butane fraction from natural gas condensate; Thermal decomposition of the ——. J. E. Zanetti. J. Ind. Eng. Chem., 1916, **8**, 674—678.

The propane-butane fraction which condenses along with the pentanes in the recovery of gasoline from "wet" natural gas, and forms what is called the "wild gasoline," is usually allowed to escape during the "ripening" process, but is sometimes condensed in steel cylinders and sold as "liquid gas," "gasol," etc. In some places after the first gasoline fraction has been separated, the gas is compressed further, and the propane-butane fraction condensed together with ethane for use as an illuminant and for welding with oxygen. The author's experiments were made with a product sold as "liquid gas" in steel cylinders under 100 lb. pressure; it consisted of propane with about 3 % of butane. The gas was passed at atmospheric pressure and at a rate of 0·45 cb. ft. per hour through a quartz tube, 30 in. long, ¾ in. diam., heated in an electric furnace; tar-fog was separated from the reaction products by an electrical method. It was found that up to 750° C. no aromatic compounds (tar-fog) were formed, the decomposition products consisting of unsaturated hydrocarbons (ethylene, butylene, etc.) and hydrogen; the percentage of hydrogen increased continuously with rising temperature, whilst the percentage of unsaturated hydrocarbons increased to a maximum (about 38·5 %) at 750° C. and then decreased. The results were practically the same in the presence of copper gauze, but with nickel gauze or iron gauze, the formation of aromatic hydrocarbons was inhibited and decomposition into hydrogen and free carbon promoted. Benzene, toluene, and naphthalene were identified in the tar, of which about 10 c.c. was formed per cb. ft. of gas.—A. S.

Thermolised paraffin base oil; Viscosity of a ——. G. Egloff and R. J. Moore. Met. and Chem. Eng., 1916, **15**, 192—193.

A paraffin base oil was cracked at varying temperatures at constant and varying rates of flow with the following results:—

Table I.

Viscosities of a paraffin base oil cracked at varying temperatures and constant rate of oil flow of 16 galls. per hour.

Temperature, °C.	500°	550°	600°	650°	700°
Viscosity, Engler deg.	1·104	1·151	1·245	1·094	1·055

Table II.

Effect of rate of flow on the viscosity of a cracked paraffin base oil at constant temperature of 600° C.

Rate, galls. per hour	12	16	22	30	36
Viscosity, Engler deg.	1·330	1·245	0·906	1·151	1·161

—W. H. C.

Boiling points and critical temperatures of homologous compounds [*paraffins and isoparaffins*]. S. Young. Scient. Proc. Roy. Dublin Soc., 1916, **15**, 93—98.

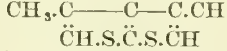
The rise of boiling point in a homologous series, due to the introduction of a CH_2 group, may be regarded as a function of the absolute temperature, and is closely expressed by the equation

$$\Delta = \frac{144{\cdot}86}{T^{0{\cdot}01485\sqrt{T}}},$$

where Δ is the difference between the absolute boiling point T of a member of the series and its next higher homologue. Applied to the series of normal and isoparaffins this formula gives much more accurate results even for the lower members than the earlier equations of Ramage or Ferguson; of the whole series from CH_4 to $C_{19}H_{40}$ for example only ethane shows a difference greater than 2° C. from the observed boiling point, whilst in 13 cases the difference is less than 1° C. As regards the relation between the absolute critical temperatures and boiling points, the ratio T_c/T_b diminishes in a homologous series with rise of molecular weight, and the ratio for iso-compounds is greater than for normal.—G. F. M.

n-Octane; Action of sulphur on —— *under pressure.* W. Friedmann. Ber., 1916, **49**, 1344—1352.

On heating with sulphur in a sealed tube at 280° C., *n*-octane (b.pt. 124·5°—125° C.) gives small yields of diethylthiophene (b.pt. 179°—180° C.) and dimethylthiophthene (m.pt. 116°—117° C.; m.pt. of picrate, 127°—128° C.):



$$\begin{array}{c} CH_3.C\text{——}C\text{—}C.CH_3 \\ \ddot{C}H.S.\ddot{C}.S.\ddot{C}H \end{array}$$

Carefully fractionated *n*-octane heated at 280° C. in a sealed tube gives a series of fractions boiling from 118° to 127° C., and it is considered that the formation of an *iso*-butane precedes and explains the production of the above sulphur compounds. —F. W. A.

Patents.

Washing coal and other minerals; Method and apparatus for ——. P. Habets, Montegnee, and A. France, Liège, Belgium. Eng. Pat. 15,689, June 30, 1914. Under Int. Conv., July 26, 1913.

The apparatus described in Eng. Pats. 22,655 of 1912 and 17,011 and 17,012 of 1913 (this J., 1914, 471) is provided with a flooded elevator or conveyor for removing the heavier materials without loss of water. The hydrostatic pressure in the receiver and the water currents between the receiver and the main trough are controlled by regulating flaps and adjustable vertical passages between the vessels.—W. H. C.

Peat; Preparation of —— *for fuel, or for destructive distillation and carbonisation.* E. A. Paterson, Thorold, Ontario. Eng. Pats. 12,003, Aug. 19, 1915, and 2530, Feb. 19, 1916.

Superfluous water is removed, the material is disintegrated, neutralised if necessary by addition of an alkaline substance, mixed with alkali silicate solution, with or without the addition of solutions of boric acid and calcium chloride, moulded into bricks or the like, and dried.—J. E. C.

Fuel made from anthracite coal refuse, and process of making same. A. Schmidt, Philadelphia, Pa. U.S. Pat. 1,192,942, Aug. 1, 1916. Date of appl., Sept. 2, 1909.

Anthracite coal-waste is mixed with a calcareous binder, which is rendered porous by incorporating with lampblack and its included air.—J. E. C.

Coke; Apparatus for discharging and quenching ——. S. N. Wellington, London. Eng. Pat. 16,108, Nov. 15, 1915.

Mechanical rams take up the weight of the bottom doors of the retorts, and the doors are then disengaged and lowered, allowing the mass of coke to descend gradually into receptacles below. Water is sprayed on the outside of the receptacles and the coke is quenched without actual contact with the water. The apparatus runs on rails and is taken to the screening plant, the elevation of the ram delivering the coke on to the screens.—J. E. C.

Coke ovens; Recuperative ——. A. Roberts, Evanston, Ill. U.S. Pat. 1,193,066, Aug. 1, 1916. Date of appl., Dec. 1, 1914. Renewed May 8, 1916.

Recuperators are situated between the heating flues of two adjacent retorts and are constructed as independent elements capable of being removed without disturbance of the retorts and allowing independent expansion, adjustment, etc. (See following abstract.)—J. E. C.

Recuperator wall. A. Roberts, Evanston, Ill. U.S. Pat. 1,193,069, Aug. 1, 1916. Date of appl., Jan. 3, 1916.

A recuperator wall is built up of blocks laid in courses, each block being recessed to provide a meshwork of interconnected vertical and horizontal passages.—J. E. C.

Coke oven; Regenerative ——. A. Roberts, Evanston, Ill. U.S. Pat. 1,193,067, Aug. 1, 1916. Date of appl., Feb. 23, 1915. Renewed May 8, 1916.

A pair of regenerators extends lengthwise beneath the central portion of the ovens. Between these and the oven is situated an air supply passage connected to the regenerators. Tunnels also running lengthwise are connected to the regenerators. The air passages and the tunnels are intermediary chambers between the regenerators and the heating flues.—J. E. C.

Coke ovens; Expansion control for ——. A. Roberts, Evanston, Ill. U.S. Pat. 1,193,068, Aug. 1, 1916. Date of appl., Aug. 5, 1915.

The heating walls are held in position by struts acting against their upper and lower extremities so as to allow independent expansion and contraction of the heating walls of individual ovens.—J. E. C.

Furnace with vertical retorts and gas producers beneath the retorts. Bunzlauer Werke Lengersdorff und Co., Bunzlau. Ger. Pat. 293,061, Jan. 5, 1915.

A recuperator is provided alongside each retort or group of retorts to furnish preheated air for burning the producer gas. The producer chamber is inclined, the charging opening being on the retort side, so that the hot coke can be discharged directly from the retort into the producer, whilst the outlet for ashes from the producer is on the recuperator side.—A. S.

Gas; Manufacture of ——. Anglo-Mexican Petroleum Products Co., and R. P. Brousson, London. Eng. Pat. 6873, May 7, 1915.

Coal is mixed with bitumen of a hard, brittle, and refractory nature obtained by the distillation of petroleum at high temperatures. From 5 to 7½% of bitumen may be used, and the mixture is treated in retorts as in gas manufacture.—J. E. C.

Blast-furnace gases; Dry process and apparatus for purifying ——. Dortmunder Bruckenbau C. H. Jucho, and F. Häring, Dortmund, Germany. Eng. Pat. 17,081, Dec. 1, 1915.

The gas is passed through a filter formed of several layers of iron borings or turnings compressed in a heated condition into a frame. The filter is rotatably mounted in the gas main, so that whilst one portion is in position in the main, another portion is without the gas main and can be cleaned.—W. H. C.

Peat; Treatment [dewatering] of wet-carbonised ——. T. Rigby, Dumfries, Scotland, Assignor to Wetcarbonizing, Ltd., London. U.S. Pat. 1,193,924, Aug. 8, 1916. Date of appl., July 11, 1914.

See Eng. Pat. 17,773 of 1913; this J., 1914, 1003.

Fuel [; Smokeless ——]. H Clarke, London, and J. A. Campbell, Ilford. U.S. Pat. 1,193,763, Aug. 8, 1916. Date of appl., Aug. 4, 1911. Renewed Jan. 24, 1916.

See Fr. Pat. 436,918 of 1911; this J., 1912, 481.

Coke-oven; Regenerative ——. N. Schuster, London. U.S. Pat. 1,193,830, Aug. 8, 1916. Date of appl., Dec. 21, 1914.

See Eng. Pat. 29,517 of 1913; this J., 1914, 410.

Gas retorts; Settings of ——. H. A. Carpenter, Sewickley, Pa., and Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 101,116, June 8, 1915. (Appl. No. 4128 of 1916.)

See U.S. Pats. 1,150,807 and 1,150,808 of 1915; this J., 1915, 948.

Gas producer. S. Glover, St. Helens, and J. West, Southport. U.S. Pat. 1,194,730, Aug. 15, 1916. Date of appl., Nov. 9, 1915.

See Eng. Pat. 5315 of 1915; this J., 1916, 297.

Petroleum hydrocarbons; Method for converting higher-boiling —— *into lower-boiling hydrocarbons.* G. W. Gray, Houston, Tex. U.S. Pats. 1,193,540 and 1,193,541, Aug. 8, 1916. Date of appl., Jan. 23, 1913.

See Eng. Pats. 17,838 and 17,839 of 1913; this J., 1914, 1044.

Petroleum and shale oils; Process of treating ——. H. W. Knottenbelt, Brussels. U.S. Pat. 1,194,033, Aug. 8, 1916. Date of appl., Jan. 13, 1910.

See Fr. Pat. 411,780 of 1910; this J., 1910, 933.

Hydrocarbons; Process of cracking ——. W. A. Hall, New York. U.S. Pat. 1,194,289, Aug. 8, 1916. Date of appl., Mar. 21, 1916.

See Eng. Pat. 1594 of 1915; this J., 1916, 626.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Wood oils suitable for ore flotation. Palmer and others. *See* X.

Patents.

Wood alcohol and calcium acetate; Method and apparatus for obtaining —— *from acetate liquor.* C. L. Campbell, Assignor to E. B. Badger and Sons Co., Boston, Mass. U.S. Pat. 1,192,087, Aug. 1, 1916. Date of appl., Jan. 3, 1912.

The liquor derived from the distillation of wood is freed from tar, neutralised with lime, and passed continuously through a still. Alcohol is removed from one part of the apparatus, and the liquor removed from another part is decanted from impurities, heated, and concentrated. The steam produced in the latter operation is returned to the still to supply heat for distillation.—W. F. F.

Heating; Method of ——. H. L. Doherty, New York. U.S. Pat. 1,194,151, Aug. 8, 1916. Date of appl., Jan. 9, 1912.

A MIXTURE of combustible gases and combustion products is passed at high temperature through a bed of fuel, whereby the combustion products and fuel interact to produce additional combustible gas. The mixture is passed in a stream through a heating chamber and air is added in successive portions. Partly burnt and completely burnt gases are withdrawn at different points, mixed, and passed through a fuel bed and then into the heating chamber. The residue of completely burnt gases not previously withdrawn is passed through a recuperator to heat the air for combustion.—W. F. F.

Electric lamps; Manufacture of incandescence ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 11,544, Aug. 10, 1915.

"GETTERS" such as the halogen compounds specified in Eng. Pat. 15,621 of 1910, are applied directly to the heated metallic filament by painting or spraying them while suspended or dissolved in a non-aqueous liquid. The coating may be protected during subsequent manipulation by the addition of another coating of a solution of nitrocellulose in amyl acetate with or without wood alcohol and ether. The "getter" may consist of sodium chloride, or a single coating may be employed consisting of finely powdered double fluoride of sodium and iron made into a paste with a non-aqueous liquid and mixed with a solution of nitrocellulose.—W. F. F.

Preparation of peat for fuel, or for destructive distillation and carbonisation. Eng. Pats. 12,003 of 1915 and 2530 of 1916. *See* IIA.

III.—TAR AND TAR PRODUCTS.

Synthetic phenol plant; Mechanical engineering of a ——. F. Pope. Met. and Chem. Eng., 1916, **15**, 185—192.

THE benzol is stored in an iron tank contained in a building which can be heated in winter, and is pumped into the measuring tanks. The acid is also stored in tanks in a similar building. The charges of benzol and sulphuric acid are weighed in tanks and run into the sulphonating kettles which are of cast iron and provided with agitators of the propeller type, steam jackets, and thermometers, and connected with reflux coils of ample capacity. The sulphonated benzol is run into the liming tubs, which are of yellow pine or iron, provided with stirrers and leaden cooling coils. The lime mixing tanks are situated above the liming tubs and have agitators, perforated lime trays, and hot and cold water and steam supply pipes. The mixture is pumped from the liming tubs into filter-presses of the frame and plate type with side filling and arranged for complete washing with hot or cold water. The solution is treated with soda ash in wooden or iron tanks provided with agitators, and the calcium carbonate is separated by filter-presses. The weak soda liquors are concentrated in double or triple effect evaporators, which should have free and easy liquor circulation to prevent scale formation and be provided with efficient save-alls. The strong liquor is pumped into a store tank having a steam heating coil and passes thence to a rotary drum dryer. The salt is then transferred by conveyors to large storage bins of iron. The cast iron fusion kettles are provided with powerful agitators, and heated, preferably, by oil burners. The fused product is ladled out and dumped directly into a dissolving trough through which water is circulated. The sodium phenoxide solution is decomposed with weak acid in iron or lead-lined tanks. The waste soda liquor is run to the sewer through a decanter tank to save phenol, and the crude phenol is run to the store tanks. The crude phenol is distilled by indirect steam in a vacuum still having a fractionating column and a dephlegmator, and connected by a silver or silver-plated pipe with a tubular condenser having silver tubes. The distilled phenol is received in enamelled receivers, and all pipes and connections that come into contact with the finished phenol must be of silver or be silver-plated. A complete plant to produce 10,000 lb. of phenol per day, with brick and steel buildings and power plant complete, is about $200,000. A plant for 20,000 lb. per day cost about $250,000.—W. H. C.

β-Methylnaphthalene; Action of sulphur on —— under pressure. W. Friedmann. Ber., 1916, **49**, 1352—1355.

CONTINUATION of the research on the action of sulphur on α-methylnaphthalene (this J., 1916, 350) has shown that products free from sulphur or containing sulphur are obtained respectively according to whether the sealed tube is opened every 12 hours or allowed to remain sealed throughout the heating; by heating to 320° C. for 72 hours without opening the tube, a substance $C_{22}H_{14}S_2$ (m.pt. 332° C.) was isolated. β-Methylnaphthalene gives under the same experimental conditions isomeric β-compounds, but an isomeric picene could not be obtained; after extraction of the melt with alcohol and benzene, a product $C_{22}H_{14}S_2$ (m.pt. 350° C.), similar in appearance to picene and isomeric with the product of m.pt. 332° C. from α-methylnaphthalene was obtained, and from the benzene extract a cyclic sulphur compound, $C_{22}H_{14}S$ (m.pt. 167° C.) was isolated. —F. W. A.

Distillation [cracking] of petroleum. Selinsky. *See* IIA.

Thermal decomposition of the propane-butane fraction from natural gas condensate. Zanetti. *See* IIA.

PATENTS.

Tar and similar substances; Distillation of ——. A. Leinveber, Chemnitz. Ger. Pat. 292,992, May 23, 1915.

IN the process of distilling tar or the like by forcing it through heated tubes under high pressure and then discharging it through a spraying device into a vaporising chamber, the tar is diluted with lower-boiling hydrocarbons before introducing it into the heated tubes.—A. S.

Pitch; Method of preventing caking of disintegrated ——. J. Alexander, Altona. Ger. Pat. 293,267, Oct. 23, 1915.

THE particles of pitch are coated with an oily substance which is non-volatile at temperatures to which the pitch will be exposed and which improves the binding power of the pitch or the calorific value of the briquettes prepared therefrom. Suitable substances are petroleum, naphthalene, and oil-gas tar.—A. S.

IV.—COLOURING MATTERS AND DYES.

Azo-compounds; Relation between the chemical constitution and colour of ——. A. C. Sircar Chem. Soc. Trans., 1916, **109**, 757—776.

From a study of the colour of a number of azophenols, azonaphthols, and some new azo-*a*-anthrols, the preparation of which is described in detail, it is found that the longer the chain of alternate double and single bonds in that part of the molecule containing the auxochrome which proceeds from the auxochrome to the azo-linking by the longest possible route, the deeper is the colour. Thus benzeneazophenol with three double and two single bonds is yellow, whereas benzeneazo-*a*-naphthol with five double and four single bonds is orange-red, and benzeneazo-*a*-anthrol with seven double and six single bonds reddish-violet. The theory was further tested by the preparation of a number of benzeneazotetrahydro-*a*-naphthols, in which the chain of double and single bonds is the same as in the azophenols. These substances were all yellow and gave dyeings almost identical with those given by the corresponding azophenols. Similarly the benzeneazoanthranols, having their longest possible conjugated chain similar to the azo-*a*-naphthols, gave dyeings of much lighter shades than the azoanthrols. A spectroscopic examination of these dyestuffs also showed that as the length of the conjugate chain is increased, the head of the absorption band is gradually shifted towards the red end of the spectrum. —G. F. M.

Xanthone derivatives and xanthone colouring matters. S. Dhar. Chem. Soc. Trans., 1916, **109**, 744—750.

The preparation and properties of mono-, di-, tetra-, and hexabromoxanthones, and *a*- and *β*-dinitroxanthones, are described. Some anilino-derivatives of the bromoxanthones possessing dyeing properties have been prepared, for example, dianilinodibromoxanthone, $C_{12}H_4O_2Br_2(NHC_6H_5)_2$ was obtained as a bluish-black precipitate by boiling the tetrabromo-compound with aniline and a trace of copper powder. It gives blue shades on chrome-mordanted wool. Hexa-anilinoxanthone, similarly prepared from hexabromoxanthone, gives deep blue shades on chrome-mordanted wool, whilst phenyliminodinitroxanthone, $C_{13}H_6O(NO_2)_2:NC_6H_5$, from *a*-dinitroxanthone and aniline dyes pale violet shades on tannin-mordanted cotton. Some azo-compounds were obtained from *β*-nitroaminoxanthone and *β*-naphthol, phenol, and 1.5-dihydroxynaphthalene, but their dyeing properties were of no special interest. Attempts to prepare vat dyes by the condensation of bromo- and amino-derivatives were not successful.—G. F. M.

Sulphurylindoxyl; Action of halogen compounds on ——. *Heterocyclic sulphones. IV.* M. Claass. Ber., 1916, **49**, 1408—1415. (Compare this J., 1916, 529.)

Sulphurylindoxyl possesses weak basic in addition to acid properties; the hydrochloride and the ammonium salt have been isolated. With benzoyl chloride sulphurylindoxylphenylketone (m.pt. 124°—125° C.) is obtained; acetyl chloride and ethyl chlorocarbonate act similarly, but ethylphenylurea chloride leads to the formation of di-sulphurylindoxyl-ketone (m.pt. 247° C.). Isato-sulphurylindoxyl (m.pt. 171°—172° C.) is obtained by the action of isatin chloride; this compound dissolves in cold caustic soda giving a solution of a deep blue colour similar to indigo in shade and strength; its hydrosulphite vat is colourless, but the dyestuff is regenerated by exposure to air; it is very sensitive to acids.—F. W. A.

Dyeing values of some [natural Indian] dyestuffs. Srivastava. *See* VI.

Patents.

Dye or stain. W. Somerville, Auburn, Victoria, Australia. U.S. Pat. 1,193,838, Aug. 8, 1916. Date of appl., Dec. 15, 1915.

A dye or stain is obtained by treating the resin of the grass tree (*Xanthorrhœa*) with a solution of an alkali and concentrating the mixture to the required consistency; it may be used in conjunction with mordants.—F. W. A.

Phthaleine dyes; Manufacture of ——. H. Imrie, London. From J. R. Geigy A.-G., Basle, Switzerland. Eng. Pat. 16,725, Nov. 26, 1915.

See Ger. Pat. 290,508 of 1915; this J., 1916, 532.

Phthalein dye and process of making the same. H. Hagenbach, Assignor to J. R. Geigy, Basel, Switzerland. U.S. Pat. 1,194,380, Aug. 15, 1916. Date of appl., Nov. 17, 1915.

See Ger. Pat. 290,508 of 1915; this J., 1916, 532.

Disazo dyestuffs and process of making the same. R. Schüle, Frankfort, Germany, Assignor to Cassella Color Co. U.S. Pat. 1,193,829, Aug. 8, 1916. Date of appl., Oct. 8, 1914.

See Eng. Pat. 28,925 of 1913; this J., 1915, 899.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Sulphite-cellulose waste lyes; Treatment and utilisation of ——. J. König. Z. Unters. Nahr. Genussm., 1916, **31**, 171—176. Z. angew. Chem., 1916, **29**, Ref., 379.

To render sulphite-cellulose waste liquor suitable for feeding to cattle, it is neutralised with lime, oxidised by allowing it to trickle over galvanised wire gauze, again neutralised by passing it over limestone, and then allowed to trickle over a bed of porous brick coated with manganese peroxide. The purified liquor is concentrated to a thin syrup by indirect heating with steam, the syrup is mixed with dry feeding stuffs (bran, malt coombs, dried brewers' grains, etc.), and the mixture dried until the water-content is reduced to 10—12%. —A. S.

Extraction of rosin from wood. Experiments using a petroleum solvent. Palmer and Boehmer. *See* XIII.

Decomposition of cellulose in soils. McBeth. *See* XVI.

Patents.

Fibrous materials; Method of treating ——. E. D. Jefferson, Boston, Mass. U.S. Pat. 1,192,903, Aug. 1, 1916. Date of appl., Jan. 13, 1915.

Fibrous material is placed in a closed vessel containing an alkaline liquor, the air is expelled by steam, and the material, the various parts of which are retained in the same relative position, is alternately and repeatedly immersed in the boiling liquid and withdrawn into the atmosphere of steam above it.—J. F. B.

Cellulose acetate; Use of amyl acetate for solutions containing ——. L. J. Riley, London. Eng. Pat. 15,428, Nov. 2, 1915.

Cellulose acetate which is insoluble in amyl acetate is dissolved in a solvent and amyl acetate is added to the solution in proportion determined by previous experiment. *Example*:—Cellulose acetate, 8 parts, is dissolved in 40 parts by weight of acetone and 42 parts of amyl acetate added. —J. F. B.

Cellulosic compositions. H. S. Mork, Brookline and G. J. Esselen, jun., Swampscott, Mass., Assignors to Chemical Products Co., Boston. U.S. Pat. 1,193,178, Aug. 1, 1916. Date of appl., Apr. 29, 1916.

The composition contains a cellulose ester (*e.g.*, acetate), triphenyl phosphate, and phenyl salicylate.—J. F. B.

Paper pulp; Method and means for testing ——. M. Riegler, Unterkochen. Assignor to L. Schopper, Leipzig, Germany. U.S. Pat. 1,193.613, Aug. 8, 1916. Date of appl., Sept. 8, 1913.

The apparatus consists of a hopper with a perforated bottom and a container with sloping walls attached underneath the hopper. Several outlets are provided in the container at different heights, each delivering water to separate collecting vessels. The quality of the pulp, as shown by the rate of draining, is indicated by the relative quantities of water collected in the several vessels.—J. F. B.

Fibrous caps for bottles and other containers; Manufacture of ——. A. Westlake, New York. Eng. Pat. 16,148, Nov. 16, 1915.

See U.S. Pat. 1,160,478 of 1915; this J., 1915, 1244. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 2604 of 1867 and 17,883 of 1899.)

Celluloid; Product resembling —— *and process for producing the same.* L. Lederer, Sulzbach, Germany. U.S. Pat. 1,195.040, Aug. 15, 1916. Date of appl., May 2, 1907. Renewed July 1, 1916.

See Fr. Pat. 377,010 of 1907; this J., 1907, 1027.

Method of refining wool grease. Method of treating [bleaching] wool grease. U.S. Pats. 1,194,013—1,194,015. *See* XII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Dyeing values of some [natural Indian] dyestuffs. II. J. P. Srivastava. Agric. J. India (Indian Scient. Congress, Special Number), 1916, 53—64.

The dyeing values of eight further indigenous dye materials (compare this J., 1915, 606) have been examined. Kachnar (*Bauhinia racemosa*) bark is available in quantity for dyeing dull red shades on cotton; faster dyeings are obtained on alumina or tin mordant. Peepul (*Ficus religiosa*) gives good pink shades on alumina-mordanted cotton. Sanderswood (*Pterocarpus santalinus*) dyes unmordanted wool and fast red shades are obtained with cotton on tin and alumina mordants; the dye is insoluble in water, but freely soluble in alcohol, ether, and acetic acid. Roli or Kamela powder (*Mallotus philippinensis*) gives in an alkaline bath a shade similar to Chrysophenine on alumina-mordanted silk. Akhrot (*Juglans regia*) bark yields a valuable brown dye, the shade of which on wool can readily be modified to khaki; the deepest shade is obtained by dyeing with 3% of acetic acid in the dye-bath, but is not fast to light; fairly full shades are obtained on chrome-oxalic acid mordant or by the after-chroming process, the dyeings being of excellent fastness to light and to milling. Kathal (*Artocarpus integrifolia*) wood yields a dye which gives fast yellow dyeings on alumina-mordanted cotton. Barberry (*Raswat*) bark, roots, and stem contain a large amount of a good yellow dye for silk; dull shades are obtained on alumina-mordanted cotton. *Rhus cotinus* wood yields a dye similar to young Fustic; orange shades are obtained on alumina-mordanted cotton and redder shades on tin-mordanted cotton, but the dyeings are not fast to alkali or soap. —F. W. A.

Patents.

Dyeing and other treatment of fibrous materials; Method of ——. J. R. and H. G. Dyson, Huddersfield. Eng. Pat. 12,010, Aug. 20, 1915.

The fibrous materials are placed on a tightly fitting removable perforated false bottom in the vat round a central tube up which steam draws the liquor from the bottom of the vat; the liquor impinges against an adjustable spreader and is distributed over the materials until dyeing is complete; the steam is then shut off, the spreader screwed down so as to form a tight joint with the top of the central tube, and air or steam and air is blown into the upper part of the vat and passes through the material, acting as an oxidising agent, and also extracting the surplus dye liquor; the materials may then be washed, the whole process being completed without removing the lid of the vat. The same apparatus may be adapted for dyeing by the cold process by combining with it a pump for exhausting the dye-liquor from the vat. —F. W. A.

Dyeing, scouring, and washing wool and other fibrous materials; Machines for ——. J. and R. Whitaker, Dewsbury. Eng. Pat. 101,060, Mar. 17, 1916. (Appl. No. 3959 of 1916.)

In a machine for dyeing, scouring, and washing wool, etc., consisting of a fixed outer vat fitted with a movable inner chamber with a perforated false bottom, steam and heated air under pressure are delivered alternately and uniformly beneath the false bottom, the liquor is drawn off through a bottom outlet pipe and forced by means of a pump into the top of the machine (above the normal level of the liquor) through a side-perforated horizontal pipe across the inner chamber, and the movable inner chamber is arranged for a side-tip discharge. —F. W. A.

Weighting silk; Metal-chloride bath for ——. P. Schmid and K. Gross, Basel, Switzerland. U.S Pat. 1,193,429, Aug. 1, 1916. Date of appl., Oct. 7, 1915.

See Ger. Pat. 291,009 of 1915; this J., 1916, 596.

Dyeing bath for silk; Foam or froth ——. P. Schmid and K. Gross, Basel, Switzerland. U.S. Pat. 1,193,430, Aug. 1, 1916. Date of appl., Oct. 7, 1915.

See Eng. Pat. 100,336 of 1916; this J., 1916, 630.

Dyestuffs [on the fibre]; Compounds for use in the production of ——. F. Kunert, Offenbach, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1.193,566, Aug. 8, 1916. Date of appl., Apr. 23, 1915.

See Eng. Pat. 6663 of 1915; this J., 1916, 204.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitrosylsulphuric acid (nitrosulphonic acid): Tautomerism of ——. J. Biehringer and W. Borsum. Ber., 1916, 49, 1402—1406.

From a survey of the literature referring to the constitution to be attributed to HSO_5N, the authors conclude the substance is to be regarded as possessing the two formulæ: $HO.SO_2.NO_2$ and $HO.SO_2.O.NO$, being tautomeric. In support of this conclusion it has been found that this compound yields with dimethylaniline a mixture of *p*-nitro- and *p*-nitrosodimethylaniline; the yield of the nitroso-compound decreased with rise of temperature, whereas the yield of nitro-compound increased : it was shown that this increase is not due merely to oxidation of the nitroso-compound, but is caused by tautomeric change of the nitrosylsulphuric acid to nitrosulphonic acid.—F. W. A.

Formic acid : Determination of —— in pure solutions and in urine, together with a new method for the titration of calomel. O. Riesser. Z. physiol. Chem., 1915, **96**, 355—366. J. Chem. Soc., 1916, **110**, ii., 455.

THE solution (30 c.c.) containing the formic acid (10—20 mgrms.) is heated with a considerable excess of a solution containing 200 grms. of mercuric chloride, 300 grms. of sodium acetate, and 80 grms. of sodium chloride per litre for six hours on the water-bath. The mixture is then cooled and, without filtering from the precipitated calomel, treated with 10 c.c. of 25 % hydrochloric acid, then excess of concentrated aqueous potassium iodide (4 grms. of potassium iodide for every 10 c.c. of the above mercuric chloride solution added to the formic acid solution), followed by an excess of *N*/10-iodine solution. The calomel is thereby quantitatively reconverted into mercuric chloride according to the equation

$$2HgCl + I_2 + 2HCl = 2HgCl_2 + 2HI.$$

The clear solution is now titrated with *N*/10-thiosulphate solution, employing starch as indicator in the usual way. The number of c.c. of *N*/10-iodine solution required to transform the calomel into mercuric chloride multiplied by 0·0023 represents the amount of formic acid in grams present in the volume of the solution taken for the analysis. In the absence of sodium chloride or a corresponding salt, the formic acid reduces a portion of the mercuric chloride to metallic mercury, whereby gross error in the estimation of the formic acid may be entailed ; close adherence to the above conditions is therefore necessary.

Soda and alkaline water ; Natural —— from East Mongolia. T. Suzuki. J. Chem. Ind., Tokyo, 1916, **19**, 631—641.

THE water of Lake Tafusu (96 sq. km. area) was found to contain Na_2CO_3 1·31, NaCl 2·27, and Na_2SO_4 0·68 %. A surface deposit due to evaporation of a shallow lake in the Poli valley during the dry winter season contained Na_2CO_3 12·01, NaCl 1·45, and Na_2SO_4 0·75 %.—W. R. S.

Calcium acid carbonate ; Composition and solubility of ——. A. Cavazzi. Gaz. Chim. Ital., 1916, **46**, II., 122—135.

EXPERIMENTAL proof is given that the salt formed by the action of excess of carbon dioxide on lime water, or by the action of water containing carbonic acid on normal calcium carbonate, is actually the bicarbonate, $Ca(HCO_3)_2$. The maximum quantity of calcium carbonate dissolved by prolonged agitation (not less than 10 hours) in 1 litre of water saturated with carbon dioxide and kept in contact with carbon dioxide at atmospheric pressure is 1·56 grms. $CaCO_3$ at 0° C. and 1·1752 grms. at 15° C. By passing a strong current of carbon dioxide into lime water saturated at 15° C., an unstable supersaturated solution of calcium bicarbonate containing 2·29 grms. $CaCO_3$ per litre can be obtained.—A. S.

Nitrous oxide, air, and water vapour in mixtures of these constituents ; Determination of ——. G. A. Burrell and G. W. Jones. J. Ind. Eng. Chem., 1916, **8**, 735.

THE apparatus used is the same as that described previously (this J., 1915, 895). The gas is introduced at atmospheric pressure and after cooling by means of liquid air for 10 mins., the air is withdrawn by means of a Topler pump and measured ; at the temperature of liquid air the vapour pressure of nitrous oxide is negligible. The bulb containing the liquefied gas is next immersed in a mixture of solid carbon dioxide and acetone (—78° C.) and after 10 mins. the nitrous oxide is pumped off and measured ; the vapour pressure of water is inappreciable at this temperature. The bulb is now removed from the cooling mixture and the amount of water vapour determined from its partial pressure by means of the attached manometer.—A. S.

Iodine and starch iodide in aqueous media ; Action of light upon ——. H. Bordier. Comptes rend., 1916, **163**, 205—206.

AQUEOUS solutions of iodine and of starch iodide contain these substances in a colloidal form, and if a very dilute solution of iodine (18 mgrms. per litre) or starch iodide be exposed to light for some hours, the yellow or blue colour disappears and the liquid becomes acid. The decolorised iodine solution does not react with starch, and the decolorised starch iodide becomes blue on the addition of a little iodine. These phenomena are explicable on the assumption that the ionising action of violet and ultraviolet rays causes the electrically charged colloidal particles to lose their charges, thereby causing them to acquire chemical properties which they did not possess in colloidal solution. They then react with the hydrogen of the water to form hydriodic acid. The yellow glass used for bottles in which substances are preserved from the action of light, was found to be quite transparent to the rays which decompose starch iodide.—E. H. T.

Investigation of the "chromate" method for separating the alkaline earths. Vickery. *See* XXIII.

PATENTS.

Oxalic acid ; Process for the production of ——. C. T. Thorssell and H. L. R. Lundén, Gotheuburg, Sweden. Eng. Pat. 11,487, Aug. 9, 1915.

IN the production of oxalic acid from sodium oxalate containing sodium carbonate and hydroxide, the material is first treated with a solution containing sodium bisulphate and sulphuric acid to obtain acid sodium oxalate and normal sodium sulphate. The acid oxalate is then washed with water and treated with sulphuric acid to produce oxalic acid and a solution containing sodium bisulphate and sulphuric acid, which solution is used for treating a fresh portion of original material after the latter has received a preliminary treatment with either the wash water of the acid sodium oxalate or the mother-liquor from the crystallisation of the sodium sulphate produced in the process.—W. E. F. P.

Acids [nitric and hydrochloric] ; Process of making mineral ——. H. Howard, Brookline, Mass. U.S. Pat. 1,193,552, Aug. 8, 1916. Date of appl., July 13, 1914.

IN the manufacture of nitric and hydrochloric acids from sodium nitrate and chloride, adjustment between the respective furnaces (of which the hydrochloric acid furnace has a greater capacity than the nitric acid furnace) is effected by mixing the sodium bisulphate obtained in the nitric acid process with an excess of sodium chloride and sufficient sulphuric acid to produce normal sodium sulphate, and heating the mixture in the hydrochloric acid furnace.—W. E. F. P.

Acetic acid ; Production of concentrated from dilute ——. Harburger Chem. Werke Schön und Co., Harburg. Ger. Pat. 292,959, Jan. 6, 1915.

THE dilute acid is treated with sufficient potassium acetate to form double compounds of potassium acetate and acetic acid which separate from the solution. These are removed and the acetic acid recovered in a concentrated condition by distillation. The potassium acetate may be partially replaced by other salts, especially those capable of acting as dehydrating agents, *e.g.*, calcium chloride.—A. S.

Alumina and soda from bauxite residues; Obtaining ——. J. H. Ramsay and F. R. Lowe, Low Fell, Durham. Eng. Pat. 9705, July 3, 1915.

Bauxite residues from which the greater part of the alumina has been extracted, contain up to 25% Al_2O_3 as double silicate with soda. By treating the residues with wet or dry carbon dioxide the alumina and soda are rendered soluble.—W. E. F. P.

Copper sulphate and other dry hydrated salts; Manufacture of ——. T. Pedder, Widnes. Eng. Pat. 11,298, Aug. 5, 1915.

The crystals to be dried are maintained at a suitable temperature in a current of air and kept in motion by a worm conveyor or similar means, so as continually to expose fresh surfaces.—B. V. S.

Zinc chloride; Manufacturing ——. W. H. Biggs, Mumbles, Glamorgan. Eng. Pat. 11,031, July 29, 1915.

Zinc oxide—obtained by roasting or calcining blende or other zinc ore—is intimately mixed with common salt or other chloride, the mixture heated to about 700° C. in a closed vessel, and the vapour of zinc chloride condensed.—W. E. F. P.

Ammonia; Production of ——. C. T. Thorssell, Gothenburg, Sweden. Eng. Pat. 11,186, Aug. 9, 1915.

In the production of ammonia by heating barium cyanide with water in an autoclave, the residue obtained (containing barium formate) is treated with sodium carbonate to produce barium carbonate and a solution of sodium formate. The latter is evaporated *in vacuo* to obtain a salt from which sodium oxalate may be subsequently produced; while the former is heated with coal and nitrogen to regenerate barium cyanide.—W. E. F. P.

Ammonia; Method of oxidising ——. *Process and apparatus for oxidising ammonia. Catalyser apparatus for oxidising ammonia. Platinum catalyser. Catalyser for oxidising ammonia.* W. S. Landis, Niagara Falls, N.Y., Assignor to F. S. Washburn, Nashville, Tenn. U.S. Pats. (A) 1,193,796, (B) 1,193,797, (C) 1,193,798, (D) 1,193,799, and (E) 1,193,800, Aug. 8, 1916. Dates of appl. (A) and (B), Feb. 20, 1915; (C), (D) and (E), Jan. 27, 1916. (A) Renewed June 15, 1916.

(A) and (B). Ammonia is mixed with air in suitable proportion and passed through a catalytic mass maintained at a uniform temperature above 500° C.; a cooling appliance is arranged so as to prevent the mixture of gases being heated before it reaches the catalyst. (C) The catalyst is powdered and contains embedded in it an iridium-free platinum wire heated by a controlled electric current. (D) and (E). The catalyst is composed of uniform, fine, iridium-free platinum wire in the form of a grid or gauze and heated by a controlled electric current.—B. V. S.

Carbides; Production of ——. Alby United Carbide Factories, Ltd., London, and K. Hylland, Odda, Norway. Eng. Pat. 14,486, Oct. 13, 1915. Under Int. Conv., Oct. 31, 1914.

Claim is made for an intermediate product (in the manufacture of calcium carbide) obtained by coking a mixture of lime or limestone and caking coal at above 700° C. The product has powerful reacting properties and no tendency to crumble or powder.—W. E. F. P.

Table salt from rock salt; Process for making ——. Gewerkschaft "Einigkeit I." Ehmen, Germany. Eng. Pat. 18,125, Dec. 29, 1915. Under Int. Conv., Jan. 22, 1915.

A non-caking and non-hygroscopic table salt is prepared by moistening powdered rock salt with a saturated solution of pure sodium chloride and drying the product.—W. E. F. P.

Sodium percarbonate; Manufacture of ——. Henkel und Co., Düsseldorf, Germany. Eng. Pat. 100,097, Apr. 8, 1916. (Appl. No. 5185 of 1916.) Under Int. Conv., Aug. 18, 1915.

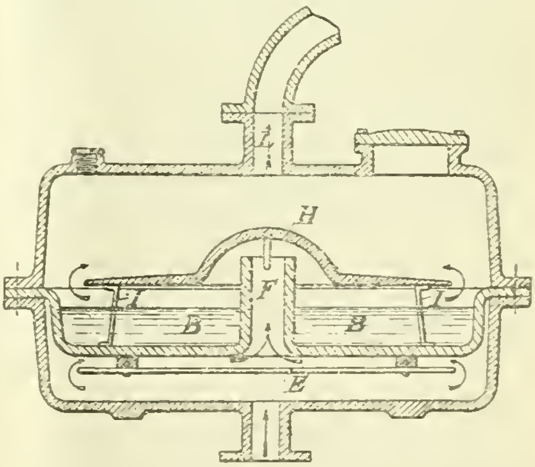
"Sodium percarbonate, $2Na_2CO_3,3H_2O_2$," is obtained by treating sodium carbonate with an aqueous solution of hydrogen peroxide in the proportion of not less than 3 mols. of the latter to 2 mols. of the former; the process is conducted at about 0° C. and the product dried in a vacuum. The specified quantities of sodium carbonate and hydrogen peroxide may be partly or entirely produced from suitable reaction components in aqueous solution, *e.g.*, from sodium bicarbonate and a mixture of sodium peroxide and sulphuric acid respectively.—W. E. F. P.

Chromium-containing [base-exchanging] silicates; Process of producing ——. *Process of base exchange. [Purification of water.]* A. Kolb, Charlottenburg-Westend, Germany. Assignor to The Permutit Co., New York. U.S. Pats. (A) 1,193,794 and (B) 1,193,795, Aug. 8, 1916. Date of appl., Mar. 28, 1916.

(A) A solution, which may be alkaline, containing chromium, is precipitated with an alkaline solution of silica, and the precipitate washed, pressed, and dried. (B) The liquid, *e.g.*, water, to be treated or purified, is passed through a bed of hard granular material which contains chromium, alkali, silica, and water, and may also contain a catalyst.
—B. V. S.

Sulphur dioxide and nitrogen; Manufacture of a mixture of ——, *and apparatus therefor.* L. Descamps, Chateauroux, France. Eng. Pat. 100,939, Jan. 21, 1916. (Appl. No. 1010 of 1916.) Under Int. Conv., July 18, 1915.

Dry, preheated air is completely deprived of oxygen by contact with a large surface of molten sulphur. In the apparatus employed (see fig.),



dry air entering at the opening, D, is preheated by passing successively below and above the baffle-plate, E, and through the pipe, F, and is then deflected on to the surface of the molten sulphur, B, by the circular cap, H, supported on the tripod,

I. The mixture of sulphur dioxide, nitrogen, and sulphur vapour thus produced is conducted through the exit, L, to an apparatus for condensing sulphur vapour. The mixture of sulphur dioxide and nitrogen is suitable for use in the manufacture of hydrosulphites.—W. E. F. P.

Carbon bisulphide; Manufacture of ——. A. Walter, Ardsley, N.Y. U.S. Pat. 1,193,210, Aug. 1, 1916. Date of appl., Sept. 23, 1913; renewed Jan. 6, 1916.

HYDROGEN sulphide, "evolved in a retort containing highly heated carbon and fed with sulphur," is passed through a retort containing highly heated carbon to produce carbon bisulphide.—W. E. F. P.

Javel water [hypochlorite solution]; Solid product intended for use in the preparation of ——. F. A. Bonnaud, Suresnes, France. Eng. Pat. 11,567, Aug. 10, 1915. Under Int. Conv., Jan. 14, 1915.

SEE Fr. Pat. 477,691 of 1915; this J., 1916, 601.

Process of recovering water-soluble potassium salts from felspathic rocks or their derivatives in the manufacture of Portland cement. U.S. Pat. 1,194,344. *See* IX.

VIII.—GLASS; CERAMICS.

Clay wares; Casting of ——. T. G. McDougal. U.S. Bureau of Mines. Technical Paper 126, 26 pages.

THE chief difficulties in casting pottery arise from variations in the composition of the slip used, improper preparation of the slip, poor selection of the clays, and an improper condition of the moulds. The casting properties of a clay are due to the proportion of colloidal clay present, and it is usually necessary to diminish the amount of gel in the clay so as to reduce the plasticity of the slip and make the cast clay open enough to permit a free passage of the water from the slip to the mould. When the ware is of simple design, the proportions of ball and china clays should be reduced to a minimum, using instead scrap ware which has been heated in the drying room so that the gel in it is "set" and rendered innocuous. When raw clays must be used, the colloidal content can be controlled by adding certain soluble salts such as sodium carbonate or sodium silicate. On adding a small quantity of a concentrated solution of sodium carbonate to a clay slip and stirring thoroughly, the slip becomes very thin, but on continued addition of the solution the slip begins to thicken again and may become very viscous. Very small amounts of sodium carbonate are required, the maximum thinning effect in a porcelain body slip being attained with 0·8 grm. per litre of slip. The proportion required depends on the concentration of the sodium carbonate in the water present in the slip and not on the amount of clay present. Sodium silicate behaves similarly, but the approach to a maximum effect is more gradual, the minimum viscosity being obtained with a concentration of 1·6 grms. of silicate of 40° B. (sp.gr. 1·375) containing 41·6% of dry sodium silicate, per litre of slip. In commercial practice, mixtures of carbonate and silicate are used, as the former does not give the necessary bonding power to the slip. The most suitable proportions are determined by tests in a simple flow viscometer. If too large a proportion of soluble salts is present, the slip will cast rapidly at first but will soon stop, and a thick piece of ware cannot be made. Mixtures of two clays (such as Georgia kaolin and English china clay) do not give viscosities intermediate between the figures for each clay separately. Georgia kaolin thickens the china clay and Florida kaolin renders it thinner, possibly on account of the variations in salts present in each. In making thick ware it was found impossible to use china clay alone, and the addition of English ball clay proved better than that of Tennessee ball clay for the purpose. Increasing the temperature of the slip has the same effect as adding more salts.

The author recommends that the clays should first be mixed with the amount of water required for the whole of the materials, the salts being added first and then the clays. The felspar, flint, and any other non-plastic ingredients are only added when the clays have been made into a uniform slip, as if all the ingredients are added together, a much larger proportion of water will be needed, and this causes difficulties. Care should be taken that variations in the moisture content of the materials are allowed for, as it is important to keep the composition accurate within very narrow limits. The mixing must be very thorough; it may be performed satisfactorily in a blunger. The weight per pint of the casting slip should be kept constant and the temperature should not vary greatly. If scrap body is used it must be dried thoroughly first, as moist scrap introduces serious variations in the moisture content of the slip. The effect of drying the clay is to render the silicate inactive, and also to "set" some of the natural gel in the clay. Drying may also cause a partial removal of some of the soluble salts. These variations must be counteracted by adjusting the amount of salts added to the scrap clay. When no variations occur in the ingredients of the slip and in its weight per pint, viscometer readings afford an effective check on its general properties. The moulds used should be made of thick plaster; 200 to 300 pieces should be obtained from a mould before it is worn out. After fifty pieces have been made, the inside of the mould should be scraped so as to remove any saline deposit on it, and after each piece is withdrawn the mould should be wiped with a cloth. Excessively dry moulds are not satisfactory. The dried ware must be cleaned so as to remove any scum formed by the soluble salts in the slip, or the burned ware will have slightly glossy patches on it. Blisters may be due to the same cause.—A. B. S.

Refractory firebricks; Practical methods for testing ——. C. E. Nesbitt and M. L. Bell. Amer. Soc. for Testing Materials, June, 1916. Met. and Chem. Eng., 1916, **15**, 205—212.

TESTS should be made on bricks taken at random and not on specially prepared test pieces. They must be conducted at temperatures bearing some relationship to those in commercial furnaces, *e.g.*, the upper part of a blast furnace is about 260° C., whilst 1350° C. is above the melting point of cast iron, and is in other ways a suitable temperature at which to make tests. The following tests have been developed mainly with reference to bricks to be used in iron and steel plants, but may be modified so as to be applicable to almost any conditions of service. *Impact test.* Before testing the brick is heated to 260° C. in 1 hour and kept at that temperature for 3 hours. A steel ball, 2½ in. diameter, weighing 2·31 lb., is dropped on the end of the brick from a height of 2 in., 4 in., and so on, until the brick shows a fracture radiating 1 in. or more from the point of contact. The ball falls between two vertical and parallel angle irons, so that it may travel freely with not more than ¼ in. clearance. The ends of the bricks are ground parallel and at right angles to the angle irons. The brick is supported on a steel block 6½ in. by 15 in. by 12 in. *Abrasion test.* The brick is heated slowly to 1350° C., and kept at that temperature for 3 hours, and one end is then pressed under a constant pressure of 10 lb. per sq. in. for exactly 5 minutes against a vertical carborundum wheel, 18 in. diameter with 2 in. face, grit 16, grade J, revolving at a surface speed of 1640 ft. per min. The depth of the cut is regarded as a measure of the abrasion. Some bricks give different results when both ends are tested. *Spalling test.* The brick is dried thoroughly, weighed, and placed in the doorway or wall of a furnace so that one end is exposed for one hour to a temperature of 1350° C., this end being flush with the wall. The brick is then plunged to a depth of 1 in. in 2 galls. of water for 3 minutes. After heating and cooling in this way ten times, the bricks are dried at 100° C. for at least 5 hours, all particles which can be easily broken off with the fingers are removed, and the bricks are re-weighed. The percentage loss in the weight of the brick is regarded as a measure of the spalling. This test is only applicable to fireclay bricks. *Slagging test.* The use of kaolin rings to confine the slag was unsatisfactory, and it was found necessary to drill a circular cavity, 2½ in. diam. and ½ in. deep at the sides, in the brick, the cutting edges of the drill enclosing an angle of 150°. The brick is heated to 1350° C., 35 grms. of slag ground to pass a 10-mesh sieve is placed in the cavity, and the heating is continued for 2 hours. The brick is allowed to cool, and is then sawn through the centre of the drilled cavity by means of a carborundum wheel, ⅛ in. thick, grit 16. The area penetrated by the slag is measured with a planimeter. *Compression test.* The brick is heated slowly at 1350° C., and is then maintained at that temperature for 3 hours; it is removed from the furnace, and a 2½ in. steel ball forced into it by means of a weighted lever of the second order consisting of a 4 in. I-beam 10 ft. long; the brick is placed 6 in. from the fulcrum, and a spherical depression in the beam marks the location of the ball. The lever alone applies a pressure of 850 lb. on the ball, and sand is run into a bucket at the end of the lever at the rate of 25 lb. per second so as to produce a total load of 1600 lb. on the ball. After 5 mins. the pressure is released, the brick removed and allowed to cool. The depth of the impression is measured with a micrometer gauge when the brick is cold. *Expansion, contraction, and fusibility* are determined by the usual methods. *Apparent specific gravity* is determined by weighing and measuring the brick, and not by suspension in water. It depends partly on the percentage of moisture in the material used for making the bricks, and on the pressure employed in shaping them. Power-pressing up to 1500 lb. per sq. in. improves the quality of fireclay bricks.—A. B. S.

Sulphur-yellow sharp-fire colours for hard porcelain. T. Hertwig. Sprechsaal, 1916, **49**, 120. Z. angew. Chem., 1916, **29**, Ref., 378.

Commercial cerium phosphate when melted with basic fluxes gives yellow to greenish-yellow colours suitable for hard porcelain. Mixtures containing potash or lead oxide are characterised by pure sulphur-yellow tints; frits prepared from mixtures of the composition $2KNO_3 + SnO + CePO_4$ and $PbO + SnO + CePO_4$ are free from any tinge of green. By addition of other metallic oxides orange tints can be obtained.—A. S.

Patents.

Vitreous bodies; Methods of making ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 15,695, Nov. 6, 1915.

Vitreous rods, tubes, and other articles of extended shape are made of two ingredients in such a manner that the composition of the article varies gradually from one end to the other. The two ingredients (such as quartz and borosilicate glass of low expansion) are placed side by side in a trough fitted with a diagonal partition which is arranged so that taken transversely the two ingredients are in the desired proportions. The partition is then removed and the material is stirred transversely to the length of the trough so as to produce a mixture which is homogeneous on a transverse section but retains its predetermined longitudinal variation in composition. To form a tube the mixture is then transferred to a mould containing a core, by tilting the trough on its long axis without disturbing the composition of the mixture. The material is sintered by heating it electrically to 1300—1400° C. for 1½ mins. The invention is specially applicable to the joining of two materials, such as silica and glass, which have different coefficients of expansion, and for making gas-tight seals in silica containers. Such a seal is made by fusing the silica-end of a rod of the material on to the end of a silica tube and working the molten material so as to close the tube. A metallic conductor may be embedded in the fused glassy end of the seal.—A. B. S.

Glass furnace. M. K. Holmes, Assignor to Hemingray Glass Co., Muncie, Ind. U.S. Pat. 1,193,788, Aug. 8, 1916. Date of appl., June 8, 1914.

At the delivery end of the furnace the floor is raised above the level of the main bed but is below the normal level of molten glass. On this raised portion are platforms with their upper faces above the normal glass level and separated laterally so as to form a channel in line with an outlet opening in the end wall of the furnace, which opening is covered by a flow block having a discharge opening in its bottom.—A. B. S.

Leer [for annealing glass]. J. Rau, Indianapolis, Ind. U.S. Pat. 1,195,987, Aug. 15, 1916. Date of appl., Feb. 12, 1916.

A longitudinal heating chamber has a false floor with openings at intervals, and a perforated conveyor to carry the glass-ware. Hot gases enter at the front of the chamber and are drawn off at the back and also through the openings in the conveyor and floor, into a longitudinal flue beneath. —A. B. S.

Mica; Process of splitting ——. H. R. Edgecomb, Edgewood Park, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,191,155, Aug. 8, 1916. Date of appl., July 21, 1912.

Mica blocks are split by heating them and subsequently applying a stream of liquid to the edges, the blocks being bent before or after the application of the liquid.—A. B. S.

Clay articles; Manufacture of ——. J. C. Quinin. Assignor to The Acme Furnace Equipment Co., New York. U.S. Pat. 1,193,922, Aug. 8, 1916. Date of appl., June 15, 1911.

Clay articles are burned by forcing air through a bed of fuel into the kiln and simultaneously withdrawing the flue gases through the chimney, the forced and induced draughts being adjusted to the conditions desired.—A. B. S.

IX.—BUILDING MATERIALS.

Plaster; Chemical examination of ——. A. Cavazzi. Annali Chim. Appl., 1916, **6**, 18—26. (See this J., 1913, 828.)

Sodium chloride in crude gypsum may be determined by Mohr's method applied directly to the aqueous extract. In the case of plaster of Paris,

it is necessary to treat the solution first with carbon dioxide at the ordinary temperature to convert free lime into bicarbonate and decompose any sulphide present: after boiling to decompose the bicarbonate and expel hydrogen sulphide, and concentrating, Mohr's method may be applied. To determine sodium sulphate in crude gypsum, an aqueous extract of the finely powdered mineral is treated hot with excess of barium hydroxide solution, the precipitate of barium sulphate and magnesium hydroxide filtered off, and the solution treated with carbon dioxide to convert into bicarbonates the hydroxides of calcium, barium, and sodium present in the solution. The bicarbonates are then decomposed by boiling, the calcium and barium carbonates filtered off, and the sodium carbonate, equivalent to the sodium sulphate originally present, is titrated with hydrochloric acid. Magnesium sulphate is determined by precipitating the magnesium as magnesium ammonium phosphate after removing the calcium as oxalate. Carbonic acid is determined by the method described previously (this J., 1915, 1206). Free lime in plaster is determined by titration of the aqueous extract with hydrochloric acid; if sulphide is present, as indicated by a brown colour or precipitate on adding silver nitrate, it must be oxidised to sulphate by boiling with a small quantity of hydrogen peroxide before titrating.
—A. S.

Flooring; Composition [Sorel cement] ——. R. R. Shively. J. Ind. Eng. Chem., 1916, 8, 679—682.

Considerable difficulty has been experienced in the use of Sorel cement in the United States, and has been sometimes attributed to the sudden changes of temperature encountered. The results of the author's investigation show, however, that the principal causes of failure are the use of improper mixtures and the lack of care in application. To obtain good results with composition flooring of the Sorel cement type, control of both the chemical composition and the manipulation of the mixture is necessary. The composition must be modified to suit particular cases, but excellent results have been obtained in practice with a mixture of 40% of magnesia, 20 of clay, 12 of Venetian red, 10 of sawdust, 8 of *terra alba*, and 10% of magnesium chloride. The magnesia and fillers are mixed, incorporated with magnesium chloride solution, and water added to give the proper consistence.—A. S.

Patents.

Building material. [Artificial stone.] K. Ogawa, Tokyo, Japan. Eng. Pat. 13,075, Sept. 13, 1915.

Dolomite is burned at 700—800° C. so as to decompose the magnesium carbonate but not the calcium carbonate present. The product is reduced to a fine powder and is mixed with 15—25% of its weight of cork or sawdust and 50% of magnesium chloride solution (18° B., sp.gr. 1·11), and kneaded into a plastic mass which is then allowed to set into a hard and strong but light body. This body is coated with a facing material composed of burned dolomite powder 100, pigments 5—10, magnesium chloride solution 35 parts, with a suitable quantity of slag wool or asbestos. The material may be made into tiles or used for coating walls, floors, etc.—A. B. S.

Potassium salts; Process of recovering water-soluble —— from felspathic rocks or their derivatives in the manufacture of Portland cement. F. W. Huber and F. F. Reath, Riverside, Cal. U.S. Pat. 1,191,341, Aug. 8, 1916. Date of appl., Jan. 26, 1916.

The rock and a calcareous material are mixed in proportions suitable for forming Portland cement, and the mixture is heated with an insoluble haloid salt (fluoride) of an alkaline-earth metal to about 950° C. until the greater part of the potassium has been volatilised. The potassium fluoride is collected, and treated with a solution of the alkaline-earth compound to regenerate the fluoride for re-use in the process and to provide a soluble potassium salt.—A. B. S.

Portland cement; Improving —— by addition of finely ground granite or diorite. E. Longan, Aytona, Spain. Ger. Pat. 293,124, Aug. 4, 1914.

Finely ground granite or diorite which has been heated at about 1000° C. for at least two hours is added to the cement. Concrete of superior quality and resistant to sea water is obtained by using the improved cement as binding agent, with an aggregate composed of pieces of granite or diorite of the same kind as used for adding to the cement and which likewise have been heated at 1000° C.
—A. S.

Heat-insulating material; Manufacture of ——. J. Oettershagen, Berlin. Ger. Pat. 293,221, July 1, 1914.

Blast-furnace flue-dust, from which particles of iron have been removed, is mixed with suitable quantities of aluminium compounds and combustible material, moulded, dried, and baked at a moderate temperature in a kiln by means of waste fire-gases and excess of air. Dust and fragments produced in the process are mixed with clay and a binding agent and made into a mass which can be applied with a brush.—A. S.

Plastic composition for flooring. D. G. Anderson, Glasgow. U.S. Pat. 1,191,926, Aug. 15, 1916. Date of appl., Mar. 23, 1915.

See Eng. Pat. 21,987 of 1914; this J., 1915, 1116.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Vanadium: Electrometric titration of ——. G. L. Kelley and J. B. Conant. J. Amer. Chem. Soc., 1916, 38, 341—351.

Vanadium can be determined readily and accurately by titrating an acid solution containing the vanadium as vanadate with standardised ferrous sulphate solution, the end point being ascertained by a change in the E.M.F. of a suitable cell. The beaker containing the solution to be titrated and a platinum electrode is provided with a stirrer, and the solution communicates by way of a capillary tube with the potassium nitrate solution used to fill a wide-mouth bottle containing a calomel electrode. The changes of potential are detected by means of an ordinary suspension galvanometer. A double knife switch permits both the galvanometer and the main circuit to be put into action in one operation, and a resistance box containing two coils and sliding contacts with resistances of 195 and 5 ohms is so wired that one resistance serves to vary the E.M.F. of a battery of dry cells and the other serves as a potentiometer. During the addition of the ferrous chloride solution the resistance is varied so that the galvanometer needle is kept on the scale. After addition of about three-quarters of the total quantity of ferrous sulphate the needle remains practically at rest until the end point is reached, after which a sudden movement occurs; dilute standard bichromate solution is then added to restore the needle to its former position, and these alternate additions of ferrous sulphate and potassium bichromate may be repeated to ascertain the exact end point. The temperature should be low, preferably 10° C., and the acid concentration at least 30 c.c. of sulphuric acid of sp.gr. 1·4 per 250 c.c. of solution. For oxidising the vanadium to vanadate, satisfactory results were obtained with potassium permanganate and with ammonium persulphate in presence of silver nitrate. The method may be used to determine vanadium in ferro-vanadium and with certain modifications to the analysis of ores. 1 grm. of the alloy is dissolved in dilute sulphuric acid (10 c.c. of acid of sp.gr. 1·4 to 100 c.c. or less of water), a small quantity of nitric acid is added to oxidise the iron and decompose carbides, and then the vanadium is oxidised to vanadate and determined as described.—A. S.

Chromium and vanadium in steel; Determination of —— by electrometric titration. G. L. Kelley and J. B. Conant. J. Ind. Eng. Chem., 1916, **8**, 719—723.

Chromium in steel may be determined by the same method as vanadium (see preceding abstract), oxidation to chromate being effected by means of ammonium persulphate in presence of silver nitrate. To determine both chromium and vanadium, 2—3 grms. of the steel is dissolved in 60—100 c.c. of sulphuric acid of sp.gr. 1·2, the solution evaporated till salts separate, diluted to 60 c.c., oxidised whilst still hot with dilute nitric acid, again evaporated till salts separate, diluted to 200 c.c., heated to 80° C., treated with 5 grms. of sodium phosphate to retain tungstic oxide in solution (Wdowiszewski, this J., 1911, 89), and the vanadium oxidised by titration with permanganate until the first "gray" colour appears. The solution is then cooled to 10°—20° C., more sulphuric acid added, and the vanadium determined (*loc. cit.*). When the titration is finished, the solution is diluted to 300 c.c., heated to boiling, treated with 10 c.c. of a solution containing 2·6 grms. of silver nitrate per litre and 25 c.c. of a solution containing 200 grms. of ammonium persulphate per litre, boiled vigorously for 10 mins., and again for 5 mins. after adding 5 c.c. of hydrochloric acid (1 : 1). After cooling and adding a little more sulphuric acid, the chromium and vanadium are determined together by electrometric titration, and the amount of chromium calculated by difference.—A. S.

Copper in low-grade ores [and slags]; Determination of ——. F. O. Hawley. Eng. and Min. J., 1916, **102**, 307—308.

To 1 grm. of slag, mixed with a little water in a beaker, 5 c.c. of a mixture of sulphuric and nitric acids and water in equal parts is added, followed by 20—25 drops of hydrofluoric acid. After boiling the mixture to expel the nitrous fumes and most of the silicon fluoride, another 10 c.c. of the acid mixture is added, the heating continued for a few minutes, and the solution cooled and diluted with about 70 c.c. of water. The solution is then neutralised with ammonia, of which an excess of 10 c.c. is added, and heated to 60°—65° C., when potassium cyanide solution is slowly added until the liquid is nearly decolorised; at least 75% of the copper should be thus combined with yanide, but an excess of the latter is not desirable. The unfiltered, alkaline solution is then electrolysed, etween a cathode and rotating anodes of platinum, y a current of 0·25 amp. for about 10 mins. ollowed by 0·5 amp. for 40 mins., after which he current is stopped, the beaker of liquid removed nd replaced by one containing water in which he electrodes are quickly rinsed. The electrodes re then immersed in a similar volume of slightly arm water containing 7 c.c. of the nitric and ulphuric acid mixture, and the current reversed o dissolve the deposited copper, which requires nly about 1 min. The current is then reversed gain and the copper re-deposited at 0·6—1·0 amp., this second precipitation requiring 30—40 mins. Finally, the cathodes are removed, rinsed with water and alcohol in succession, and dried and weighed as usual. Copper ore is decomposed by means of nitric acid and potassium chlorate, with hydrochloric acid also, if necessary, after which 8 c.c. of sulphuric acid is added and the liquid evaporated until fumes of sulphur trioxide appear; 3 c.c. of nitric acid and 100 c.c. of water are then added, followed by ammonia and potassium cyanide as stated. 1 grm. of 8% ore requires about 90 and 45 mins. for the complete precipitation of copper from the alkaline and acid solutions respectively. The precipitation of the copper as brass from the alkaline solution is advantageous, the deposit being more dense and smooth than that of copper alone. For this purpose, zinc may be added to the alkaline liquid with the potassium cyanide, a good proportion being 1 part of ZnO to 6 of KCN; whether added or originally present in the ore, zinc is of course not finally deposited with the copper in acid solution. The method is rapid and accurate. The presence in the ore and slag of the added impurities, antimony, arsenic, bismuth, molybdenum, selenium and tellurium, did not affect the results, all of which were in close agreement with those obtained on the pure ore and slag by the above and the iodide and permanganate methods. Under the conditions of assay, the platinum electrodes lost weight at the rate of 0·0001 grm. per 1 to 6 determinations, this being very slightly greater than in ordinary acid electrolysis.—W. E. F. P.

Brass; Electrolytic deposition of ——. A. Hönig. Z. Elektrochem., 1916, **22**, 286—293.

The separation potentials of copper and zinc from complex cyanide solutions were determined for current densities up to 0·01 amp. per sq.cm., and the influence of various additions to the bath, as also the influence of varying concentrations of the CN and OH ions, on the appearance of electrolytically deposited brass, determined. The experiments showed that for the deposition of brass the cathode potential must closely approach that necessary for the deposition of zinc from cyanide solutions. Whilst in potassium-copper cyanide solutions which contain at least 2KCN to 1CuCN, and therefore presumably contain the salt $K_2Cu(CN)_3$, the cathodic copper separation is accompanied by considerable polarisation, it becomes, at least with small current densities, almost reversible in solutions of the salt $KCu(CN)_2$. If increasing quantities of KCN are added to the latter solutions, the polarisation increases largely, long before all the CuCN can be present as $K_2Cu(CN)_3$. Also the presence of $K_2Zn(CN)_4$ in $KCu(CN)_2$ solutions causes strong polarisation of the copper separation, whereby there is brought about, just as in the solution of $K_2Cu(CN)_3$ and $K_2Zn(CN)_4$, a rise in the separation potential of the copper nearly up to that of the zinc, and as a result, electrodeposition of brass from the solution takes place. The separation potential of copper from cyanide solutions can be raised considerably by allowing the solutions to stand and by heating them. It is suggested that this result is due to changes in small quantities of colloidal material. If so, the polarisation of the cathode depends in these cases on continually renewed surface layers (mechanical passivity of the cathode).—T. St.

Nickel; Electrolytic deposition of —— from chloride solutions. II. The exfoliation of the nickel. R. Riedel. Z. Elektrochem., 1916, **22**, 281—286. (See also this J., 1915, 555.)

Nickel deposited electrolytically at the ordinary temperature on smooth nickel sheet cathodes from an electrolyte of nickel chloride solution acidified with acetic acid, peels off after a foundation only a fraction of a mm. thick has been deposited. Fine cracks soon appear at the edges and gradually extend over the whole surface forming a reticulated pattern. Additions such as glycerin, affecting the viscosity of the solution, and others such as amyl alcohol, affecting the surface tension, effected no improvement. Other additions such as pine-wood extract, colloids, etc., were also made without improving the deposit. It would appear that the first-deposited nickel undergoes a volume change a little while after deposition. This would result if a nickel-hydrogen alloy was first deposited and later gave off hydrogen (compare Foerster and Römmler. Z. Elektrochem., 1907, **13**, 567), or if an unstable form of nickel was first deposited, and later changed into the stable form. Oxidising agents and substances capable of forming additive compounds with hydrogen were, however, added to the electrolyte without success. Good, firmly-adhering deposits, on the other hand, were obtained with roughened cathodes. The roughening was produced mechanically with emery and by sand-blasting, and chemically by etching with different acids. A current density of 300 to 400 amps. per sq. m. gave the best deposits; 1000 amps. per sq. m. produced lumpy edges, but the deposit was firm and thick. Good deposits were also obtained from a cold nickel chloride solution by using cathodes on which thin firmly adhering deposits had been made by electrolysis either at a high temperature, or from a cold concentrated solution of equal parts of nickel sulphate and sodium ethylsulphate. It made no difference whether the original electrodes thus treated were rough or smooth, and in one case the preliminary treatment lasted only 5 minutes, giving a deposit only 0·003 mm. thick. The cathodes thus prepared became uncertain in their action if kept for more than a few days.—T. St.

Lead blast-furnaces; Flow of air in ——. A. W. Tournay-Hinde. Eng. Assoc., N.S.W. Eng. and Min. J., 1916, **102**, 392—393.

Experiments made at the Cockle Creek smelter, N.S.W., showed that with the same pressure in the blast-main the rate of smelting was lower with tuyères with conical apertures than with large-diameter tuyères. The air-pressure in the smelting-zone is dependent on the tightness of the charge; the variation in size of the tuyère opening only varies the amount of energy required to force a given volume of air into the furnace. —W. R. S.

Silver; Injurious action of oxygen on fine ——. G. J. Roman. Metall u. Erz, 1916, **13**, 221—225. Z. angew. Chem., 1916, **29**, Ref., 377.

Fine silver permeated by microscopic bubbles containing oxygen will not give satisfactory castings even after repeated re-melting. Treatment with the usual deoxidising agents, subjecting to a vacuum, and melting in an atmosphere of inert gas fail to overcome the difficulty. Satisfactory castings can be obtained after addition of copper, but the alloy produced is unsuitable for many purposes in the fine metal and electrochemical industries. If crystals of electrolytically deposited silver be finely ground, traces of electrolyte may be removed by washing with hot water, and the purified silver when melted will give sound castings.—A. S.

Tungsten; Determination of ——, *and its separation from tin.* E. Dittler and A. von Graffenried. Chem.-Zeit., 1916, **40**, 681—682.

The criticism made against Fieber's method (this J., 1912, 389), that the pulverisation of the analytical sample takes an inordinate amount of time, is held to be unfounded; and this method is recommended strongly not only for ferro-tungsten but also for the determination of tungsten in materials containing tin, arsenic, copper, and molybdenum, provided that the following precautions are observed. The sample for analysis should weigh about 0·2 grm., be ground in a steel mortar, and sifted through the finest gauze. The treatment with bromine should last 21 hours, and water should be rigorously excluded. A second treatment with bromine is seldom necessary. After the sample has been dissolved (with the exception of silica), about 10 c.c. of hydrochloric acid is added, the liquid is evaporated nearly to dryness, and then a few c.c. of concentrated nitric acid and 2—3 c.c. of hydrochloric acid are added. The liquid containing the canary-yellow, crystalline precipitate of tungsten trioxide is left for 2 hours, the precipitate washed by decantation until no iron can be detected in the wash water, filtered off, and ignited at a moderate temperature. The results are accurate to 0·1%. Concentrates rich in tungsten and containing not more than 10% of tin as stannic oxide, are treated similarly, but the tungsten oxide must be separated from admixed stannic oxide by ignition with ammonium chloride. Tin ores containing tungsten are best disintegrated by fusion with sodium peroxide, and the metal determined by the mercurous nitrate method, the precipitation being performed in a neutral solution; the ignition should be done in a porcelain vessel if antimony be present. The results may be somewhat high. A new method of estimating tin in ores which also contain tungsten consists in melting a 1 grm. sample with 6—8 grms. of sodium peroxide in an iron crucible over the full flame of a Teclu burner. The cooled melt is treated with water and the solution made up to 500 c.c., of which 250 c.c. is used for the tungsten determination by the mercury method, and 200 c.c. for the estimation of tin. To the latter end, the solution is treated with a concentrated aqueous solution of 10 grms. of commercial sodium phosphate and acidified, any precipitate (*e.g.*, silica or hydrated manganese peroxide) is filtered off, the liquid is boiled to decompose remaining peroxide, and is then saturated hot with hydrogen sulphide, subsequently diluted with water, and again saturated. After standing, the precipitate is washed with ammonium acetate solution until no more free acid is present, then dried, and the tin determined as oxide or electrolytically. The tungsten is removed in the washing as soluble phosphotungstic acid.—E. H. T.

Radium production in Bohemia. U.S. Comm. Rept., Aug. 17, 1916.

The Bohemian uranium ore mines produced, in 1915, 25,720 lb. of uraninite prepared for smelting, having an average value of 19s. per lb. The Government mine at Joachimsthal produced 2325 lb. of uranium compounds, valued at about £1200. The Government radium factory produced compounds containing 1·75 grms. of radium elements, valued at £40,000.

[Ore] flotation; Wood oils suitable for ——. R. C. Palmer, G. L. Allen, and O. C. Ralston. U.S. Bureau of Mines. Amer. Inst. Min. Eng., Sept., 1916. Eng. and Min. J., 1916, **102**, 311—313.

The results are given of preliminary tests in which commercial wood oil and other products from the distillation of hardwood were employed with typical sulphide ores in acid, alkaline, and neutral solutions. Many of the wood products were found to be as efficient as pine oil in their behaviour towards the minerals tested; and good all-round results were obtained with the crude hardwood tar settled out of pyroligneous acid.

The results are regarded as decidedly encouraging, especially in view of the fact that the products in question are practically waste and immediately available at low prices.—W. E. F. P.

Practical methods for testing refractory firebricks. Nesbitt and Bell. *See* VIII.

Aluminium [electrical] machines. Richter. *See* XI.

PATENTS.

Iron, steel, and other substances not easily reduced to the molten condition ; Melting of ——. F. G. C. Rincker. The Hague, Holland. Eng. Pat. 14,215, Oct. 7, 1915. Under Int. Conv., June 3, 1915.

AN open-hearth furnace is heated on the regenerative system by the combustion of gasified oil. A liquid hydrocarbon is sprayed directly, without admixture with steam, into the upper part of a gas-producing chamber, previously heated by the waste gases from the furnace. The gases formed are led from the lower part of the chamber into a similarly formed superheater chamber, from which they pass to the hearth, where they are burnt with air heated by passage through similar chambers. Any carbon, tar, or the like, remaining in the gas generators and superheaters after the gas formation, are burnt with the aid of fresh air. —T. ST.

Steel and high-phosphorus slag ; Method of producing ——. A. W. Allen and E. G. Lilly, Birmingham, Ala. U.S. Pat. 1,193,496, Aug. 8, 1916. Date of appl., June 18, 1915.

AFTER removing the silicon from pig iron and separating the resulting slag, sufficient lime and iron oxide are added to form a slag in which the bulk of the phosphorus is removed. Part of the metal and slag are withdrawn and replaced by fresh quantities of pig iron and fluxes. The metal is separated from the high-phosphorus slag, and the last of the phosphorus removed by treatment with a slag containing excess of lime.—W. R. S.

Iron of high grade from ordinary cast-iron ; Process of producing ——. L. A. Leonard, New York, and J. P. Larrimer, Brooklyn, N.Y. U.S. Pat. 1,194.756, Aug. 15, 1916. Date of appl., Apr. 6, 1912.

CAST-IRON is "baked," in a closed holder, in the presence of hydrated oxide of iron and silica (with or without phosphorus), to render the metal capable of being acted on by carbon ; and then quenched in a bath containing carbon with or without calcium sulphate and ferric oxide. —W. E. F. P.

Ferromanganese ; Preventing incrustations in metallurgical melting and transporting apparatus for easily oxidisable metals and alloys, especially ——. Ges. f. Elektrostahlanlagen, Siemensstadt, and W. Rodenhauser, Völklingen. Ger. Pat. 293,043, June 25, 1913.

THE parts of the furnace which come in contact vith the molten metal are covered with a layer of owdered carbonaceous material, *e.g.*, coke dust, nd coke dust is also placed in the ladle so that n running in the molten metal it is forced outwards o the walls to form a protective layer.—A. S.

Copper] ores ; Concentration of ——. A. C. Howard, L. A. Wood, and Minerals Separation, Ltd., London. Eng. Pat. 8263, June 3, 1915.

OPPER sulphide ores are powdered and subjected o flotation separation, with aeration, in an aqueous edium containing a mineral-frothing agent, such creosote oil from blast-furnace tar, and a caustic lkali such as sodium hydroxide. The caustic lkali, in the amount of about 1 lb. per ton of ore, added immediately before the frothing operation. —T. ST.

Zinc from ores and other zinc bearing materials ; Electrolytic recovery of ——. *Electrolytic recovery of metals from their solutions, and apparatus therefor.* U. C. Tainton, Johannesburg, Transvaal. Eng. Pats. (A) 11,335, and (B) 11,336, Aug. 5, 1915.

(A) A CONTINUOUS or cyclic process is used for the electrolytic extraction of metallic zinc from ores, sufficient of the latter being added to an acid to form a concentrated solution of a zinc salt, and the neutral solution separated from the residue. An excess of acid (50 to 300 grms. per litre) is added, and the solution is electrolysed, using a current of high density (50 to 1000 ampères per sq. ft.) The solution, now strongly acid, is divided into two parts, one portion being neutralised by a further addition of ore, and then mixed with the second portion so as to give approximately the same acid content as above, and the process is repeated. (B) A series of anodes, alternating with cathodes, are separated by distance frames with porous diaphragms between the adjacent electrodes, the latter being connected in parallel. Means are provided for the escape of evolved oxygen from the anode compartments. Each cathode element is provided with a porous support, upon which a coating, covering, or cake, of finely divided conducting material, such as graphite, is deposited from a solution carrying the material in suspension, or the graphite may be introduced with the solution to be treated. During the electrolysis, the metal-bearing solution is passed through the porous support and the graphite, upon which the metal is deposited. The coating with the precipitated metal is removed, and screened so as to concentrate the portion of the detached material carrying the metal.—B. N.

Zinc ; Recovery of ——. C. H. Fulton, Cleveland, Ohio, Assignor to D. B. Jones, Chicago, Ill. U.S. Pat. 1,193,680, Aug. 8, 1916. Date of appl., Dec. 23, 1915.

THE ore is ground, calcined, mixed with powdered coke and 12—15% of pitch or tar, and pressed into moulds ; the briquettes are heated so as to coke the binding material without reducing the zinc oxide, and then subjected to distillation. The weight of added coke powder is such that the weight of the briquettes after distillation will not be less than 40—50% of their original weight. —W. R. S.

Separating metals ; Process of ——. A. H. Sherwood, Oroville, Cal. U.S. Pat. 1,192,915, Aug. 1, 1916. Date of appl., Sept. 24, 1913.

THE material is treated with nitric acid to remove base metals and silver, and the residue of gold and platinum metals amalgamated in presence of a solution of cobalt nitrate. The resulting gold amalgam is parted with nitric acid.—W. R. S.

Gold ; Method of extracting ——. A. W. Smith, Cleveland, Ohio. U.S. Pat. 1,193,197, Aug. 1, 1916. Date of appl., Aug. 15, 1911.

THE ore is ground with a solution of cyanide and an oxyhalogen compound such as a bromate, enough lime being added to maintain an alkaline reaction. The mixture is then agitated with air. —W. R. S.

[Electric arc furnace] for reducing ores and fusing other materials. C. B. Hillhouse, New York. U.S. Pat. 1,193,783, Aug. 8, 1916. Date of appl., Nov. 25, 1912.

THE finely divided ore, etc., is blown under pressure axially into an electric arc furnace with a vertical axis, the material falling upon a surface heated by the arc.—W. R. S.

Aluminium : Composition for welding and soldering articles of ——. R. L. Weatherford, Fort Worth, Tex. U.S. Pat. 1,194,101, Aug. 8, 1916. Date of appl., May. 22, 1916.

A COMPOSITION for welding and soldering aluminium articles, consists of aluminium 1, lead 1, block tin 2, zinc 2, commercial bismuth 1, and antimony 1 part.—W. R. S.

Soldering compound. F. E. J. Litot, Wilkinsburg, Pa. U.S. Pat. 1,194,648, Aug. 15, 1916. Date of appl., Mar. 22, 1915.

THE solder, composed mainly of zinc, contains (a) not more than 1% of phosphorus, (b) not more than 5% of phosphor-tin, or (c) not more than 2% of phosphor-tin.—W. E. F. P.

Metals [cadmium, etc.] ; Process for separating ——. R. H. Stevens, Salt Lake City, Utah, Assignor to United States Smelting, Refining and Mining Co., Portland, Me. U.S. Pat. 1,194,438, Aug. 15, 1916. Date of appl., Nov. 20, 1912.

ROASTED ore containing cadmium, bismuth, copper, lead, tellurium, arsenic, etc., is treated with sulphuric acid and the solution electrolysed, first at low voltage to separate bismuth and copper, and then at higher voltage to obtain a deposit rich in cadmium. After being fluxed with sodium hydroxide and carbon to separate tellurium, the cadmium deposit is cast into ingots and treated by electrolysis to obtain pure cadmium (cathode) and a cadmium-containing residue (anode). The latter is then melted and cast into ingots which are subsequently re-electrolysed in a cadmium electrolyte to obtain pure cadmium and an anodic residue rich in bismuth.—W. E. F. P.

Radium [carnotite] ore ; Concentrating ——. H. Schlundt, Columbia, Mo. U.S. Pat. 1,194,669, Aug. 15, 1916. Date of appl., Feb. 21, 1916.

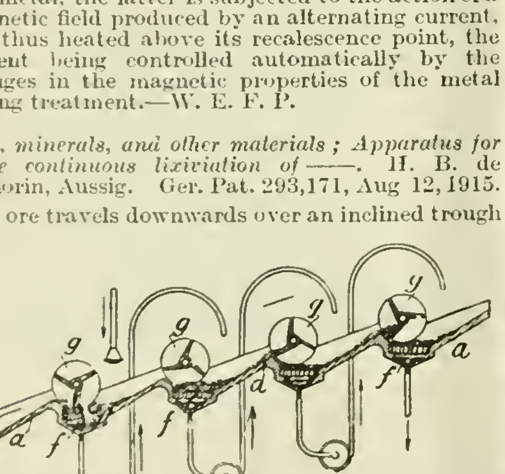
THE ore is treated with hot sulphuric acid, of about 60° B. (sp.gr. 1·71) or stronger, to dissolve radium and barium, and the mixture diluted. The precipitated radium-barium sulphate is separated from the undissolved residue by differential sedimentation.—W. E. F. P.

Metals : Magnetic treatment of ——. F. L. Bishop, Pittsburgh, Pa. U.S. Pat. 1,194,940, Aug. 15, 1916. Date of appl., Jan. 2, 1914.

IN a process for altering the molecular structure of a metal, the latter is subjected to the action of a magnetic field produced by an alternating current, and thus heated above its recalescence point, the current being controlled automatically by the changes in the magnetic properties of the metal during treatment.—W. E. F. P.

Ores, minerals, and other materials ; Apparatus for the continuous lixiviation of ——. H. B. de Florin, Aussig. Ger. Pat. 293,171, Aug 12, 1915.

THE ore travels downwards over an inclined trough or the like, and the lixiviating liquid travels, as a whole, in the opposite direction, but over separate portions of the path flows backwards in the same direction as the ore. Various forms of apparatus may be used. For example, the ore may pass downwards through a series of inclined troughs, *a*, being delivered from one trough to the next by the shafts, *g*, with arms of acid-proof material. The solution flows from each trough through a filter, *f*, and is pumped up into the next higher trough.—A. S.



Platinum and allied metals ; Recovery of —— from low-grade platinum ores. B. Streit, Düsseldorf. Ger. Pat. 293,104, Mar. 26, 1914.

THE finely powdered ore is mixed with magnesium chloride and sodium nitrate, or agglomerated with a solution of the salts, and heated to about 330° C., after which it is treated as usual for the recovery of the platinum.—A. S.

Hydraulic concentrator or classifier. F. F. Wagner, Denver, Colo. U.S. Pat. 1,193,953, Aug. 8, 1916. Date of appl., June 29, 1915.

Coatings for iron and steel metallic articles. C. Mark, Evanston, Ill., U.S.A. Eng. Pat. 11,557, Aug. 10, 1915

SEE U.S. Pat. 1,186,217 of 1916 ; this J., 1916, 849.

Metallic coatings ; Method of applying —— to metallic articles. C. Mark, Evanston, Ill., U.S.A. Eng. Pat. 101,128, Aug. 10, 1915. (Appl. No. 5518 of 1916.)

SEE U.S. Pat. 1,168,664 of 1916 ; this J., 1916, 313.

Nickel ; Recovery of —— from its ores. H. L. Sulman and H. F. K. Picard, Assignors to The Madagascar Minerals Synd., Ltd., London. U.S. Pat. 1,193,734, Aug. 8, 1916. Date of appl., Feb. 18, 1914.

SEE Eng. Pats. 17,131 and 18,769 of 1913 ; this J., 1914, 489.

Sintering metal ; Method and apparatus for ——. R. B. Walling, Newark, N.J., Assignor to General Electric Co. U.S. Pat. 1,194,906, Aug. 15, 1916. Date of appl., Oct. 7, 1912.

SEE Eng. Pat. 14,795 of 1913 ; this J., 1914, 425.

Dry process and apparatus for purifying blast furnace gases. Eng. Pat. 17,081. *See* 11A.

XI.—ELECTRO-CHEMISTRY.

Aluminium [electrical] machines. R. Richter. Z. Elektrochem., 1916, 22, 294—296.

THE use of aluminium, iron, and zinc for conductors has become general in Germany during the war. The layer of oxide which quickly forms on aluminium wire is sufficient insulation for field-magnet windings, for low voltages, and thus allows of space being economised. Aluminium, however cannot be used for commutators. For rotating machines of average size the efficiency with aluminium windings is 0·5 to 2, with zinc 3 to 6 and with iron 8 to 12% less than with copper. The relative costs of a normal alternating-current motor (62 K.W., 750 revs. per min., 50 cycles per sec.) at pre-war metal prices are given as follows :—copper 100·0, aluminium 96·8, zinc 150·7, iron 161·8. The prospects for iron and zinc machines, after the war, are unfavourable, but it is expected that aluminium will be used in preference to copper in many cases for the windings of electrical machines —T. ST.

Patents.

Insulating compositions; Elect. ——. E Söberg and J. Andersen, Lillehammer, Norway. Eng. Pat. 101,067, Apr. 12, 1916. (Appl. No. 5398 of 1916.)

Pulverised magnesium silicate, such as Norwegian talc-potstone (50 %) is mixed with 40 % of resin and 10 % of linseed oil as a binder. The oil is thickened by boiling, the resin added, and the mixture well boiled, the powdered potstone being finally stirred in. An alternative composition is composed of 80 % of talc-potstone powder, 20 % of shellac, and a small quantity of spirit.—B. N.

Anodes; Preventing disintegration of ——. G. D. van Arsdale, New York. U.S. Pat. 1,193,741, Aug. 8, 1916. Date of appl., Aug. 2, 1915.

Graphite anodes, in the electrolysis of copper solutions, are prevented from disintegrating, by electrolysing in the presence at the anode of ferrous sulphate and sulphur dioxide, in amounts sufficient to prevent the evolution of free oxygen. —B. N.

Furnace; Electric arc ——. E. Edwin, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,193,882, Aug. 8, 1916. Date of appl., May 13, 1915.

Several electric arc furnaces are combined, each furnace consisting of a tube forming the reaction chamber, with an electrode insulated from the tube at one end, and a second electrode electrically connected to the tube at the other end. A gas inlet is provided near the insulated electrode, and an outlet near the other end. A polyphase current is employed, with an electrical star connection between the insulated electrodes belonging to a group of furnaces and the corresponding phase of the source of electricity; groups of furnaces are connected in parallel with the source of electricity, and an electrical connection insulated from earth is employed between the other electrodes.—B. N.

Electrolytic apparatus for production of liquor for bleaching and other purposes. A. Holliday, London. U.S. Pat. 1,193,786, Aug. 8, 1916. Date of appl., Dec. 22, 1915.

See Eng. Pat. 1672 of 1915; this J., 1915, 622.

Electrolytic method of purifying sewage. U.S. Pat. 1,194,000. *See* XIXb.

Electrolytic and saponifying process for producing oxamide. U.S. Pat. 1,194,354. *See* XX

XII.—FATS; OILS; WAXES.

Fats; Determination of the melting-point of ——. M. Monhaupt. Chem.-Zeit., 1916, **40**, 676.

The initial melting point of fats is determined by introducing a quantity of the sample sufficient to form a column about 3 to 6 mm. deep, into a capillary tube of 1 to 1·5 mm. diameter, and sealing up one end of the tube. After the fat has solidified, it is melted again at a moderate temperature, and the tube is then allowed to stand on ice. A pointed piece of wire or a needle 25 to 30 mm. in length is placed in the tube so that its point rests on the solidified fat, and the tube attached to a thermometer, which is immersed in a beaker of water. The temperature at which the point penetrates the fat gives the m.pt. Occasional shaking of the tube is necessary to prevent adherence of the needle to the side.—C. A. M.

Beeswax; Hydrocarbons of ——. H. Ryan and T. Dillon. Scient. Proc. Roy. Dublin Soc., 1916, 15, 107—112.

Direct experiments with melissyl alcohol have shown that in Buisine's method of measuring the hydrogen evolved on heating the wax with potash and potash-lime at 250° C. (this J., 1891, 52), 95·9 % of the theoretical quantity of hydrogen is obtained. Synthetical higher tertiary and secondary alcohols do not evolve any hydrogen in the test, so that if esters of such alcohols are present in beeswax the volume of hydrogen evolved would be less than that calculated from the ester value. It is possible that about 1·3 % of the combined alcohols in beeswax may consist of tertiary or secondary alcohols. The so-called hydrocarbons extracted by petroleum spirit from the product of the interaction of the wax with potash-lime contain on the average about 0·8 % of oxygen, and it is suggested that alcohols other than primary alcohols may be present.—C. A. M.

Soap making and glycerol recovery; The Krebitz process of ——. G. A. Wrisley. J. Ind. Eng. Chem., 1916, **8**, 732—733.

The Krebitz process (see Eng. Pats. 4092 and 4092a of 1905 and U.S. Pat. 1,126,787 of 1915; this J., 1906, 188, 434; 1915, 290) has been worked on the large scale with good results at Chicago. From 1200 to 1400 lb. of lime is slaked with 3700—4500 lb. of water, the mass is heated, if necessary, to 70° C., 10,000 lb. of fat and oil is run in, with vigorous agitation, and the mixture is heated with live steam to 90°—92° C. in the course of half an hour. The vessel is covered and after 8—12 hours, the soap is discharged through a trapdoor in the bottom, and ground to the size of fine corn meal. The ground soap is washed four times with water in a hopper-shaped tower of 25,000—30,000 lb. capacity, using altogether about 40,000 lb. of water; the first wash-water contains 10—12 % of glycerol and is treated for the recovery of glycerol, and the later wash waters are used again; about 95 % of the total quantity of glycerol is recovered. After being washed the calcium soap is introduced slowly into a soap kettle containing a boiling solution of sodium carbonate, and when decomposition is practically complete a small amount of caustic soda is added, after which the soap is salted out. The lime sludge which settles to the bottom carries down 9—12 % of soap; it is heated and vigorously agitated with sufficient water to dissolve the soap; after settling and removing the soap solution, the lime sludge can be filter-pressed, and only 1—1·5 % of soap is lost in the press-cake. The soap compares favourably in quality with that made by the usual process; it contains always at least 0·2 %, and sometimes 0·5—0·7 % of lime.—A. S.

Soap powders; Analysis of ——. L. Rosenberg and V. Lenher. J. Ind. Eng. Chem., 1916, **8**, 716—718.

Two grams of the powder is dried in a vacuum oven at 65° C. until of constant weight to determine the moisture. The residue is extracted with light petroleum spirit, the solution evaporated, and the residue of free fatty matter dried at 110° C., and weighed. The residue insoluble in petroleum spirit is extracted with 95 % alcohol which dissolves soap and free alkali; the latter is determined by titration with $N/10$ acid, using phenolphthalein as indicator, and the solution then diluted, boiled to expel alcohol, the soap decomposed with excess of $N/1$ nitric acid, and the fatty acids separated as a cake with the aid of 4 grms. of stearic acid previously heated to 160° C.; by titrating the excess of acid the quantity of alkali combined as soap is obtained. The residue insoluble in alcohol is dissolved in hot water, the solution diluted to

250 c.c., and divided into five portions for the determination of sodium carbonate by titration with acid, sodium chloride by precipitation with silver nitrate, sodium silicate as silica, sodium sulphate by precipitation with barium chloride, and borax by the glycerol or mannitol method. In seven commercial soap powders examined, the following results were obtained: moisture, 18·52—43·38%; fatty anhydride, 16·74—21·63; Na_2O as soap, 2·23—3·58; total soap, 18·97—24·31; Na_2CO_3, 36·30—56·45; $Na_2Si_4O_9$, 0·36—0·99; $NaCl$, 0·31—1·32; unsaponified matter, 0·24—0·87%.—A. S.

Soap solutions: Studies on ——. V. Lenher and M. V. R. Buell. J. Ind. Eng. Chem., 1916, **8**, 701—703.

EXPERIMENTS were made with the Traube stalagmometer (compare Shorter, this J., 1916, 549) on the surface tension of sodium oleate solutions towards air, oil of turpentine, kerosene, benzene, toluene, and cottonseed oil. Towards air the surface tension increased as the concentration of the solution fell from *N*/1 to about *N*/100. In the other cases the surface tension was lower with the concentrated than with the dilute solutions, and the general direction of the curves was the same. In comparative tests the quantity of sodium oleate required to produce stable emulsions at 20° C. with 50 c.c. of water and 50 c.c. of various other substances was as follows:—oil of turpentine, 0·63 grm.; carbon tetrachloride, 0·114 grm.; chloroform, 0·78 grm.; benzene, 0·98 grm.; vaseline (2·5 grms.), 1·52 grms. Other experiments showed that a definite quantity of sodium oleate will emulsify more chloroform or olive oil at a high than at a low temperature, and that weaker solutions of sodium oleate are relatively more effective than more concentrated solutions in emulsifying oil of turpentine. The emulsifying power of sodium oleate solution is impaired only very slightly by the hydrolysis which occurs on keeping. At 100° C. sodium palmitate is more effective than sodium oleate or stearate in emulsifying olive oil.—A. S.

PATENTS.

Wool-grease; Method of refining ——. J. O. Handy and R. M. Isham, Assignors to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pats. (A) 1,194,013 and (B) 1,194,014, Aug. 8, 1916. Date of appl., Apr. 22, 1916.

(A) THE grease is dissolved at the ordinary temperature and pressure in petroleum spirit or other neutral inert solvent, and the solution is treated with ammonia or ammoniacal alcohol. (B) The grease is treated with alcohol to remove part of the free fatty acids, and the neutralisation is completed by dissolving the residue in petroleum spirit and shaking the solution with dry magnesium oxide or other basic oxide or hydroxide, to which fullers' earth may be added as a bleaching agent.—C. A. M.

Wool grease; Method of treating [bleaching] ——. J. O. Handy, Assignor to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pat. 1,194,015, Aug. 8, 1916. Date of appl., Apr. 22, 1916.

THE grease is dissolved in petroleum spirit or other solvent, the solution shaken with fullers' earth, and the solvent distilled and recovered. —C. A. M.

Palm and other nuts; Treatment of ——. P. C. Rushen, London. From F. Krupp A.-G. Grusonwerk, Magdeburg-Buckau, Germany. Eng. Pat. 11,686, Aug. 12, 1915.

Process for reducing matter [garbage, etc.] containing grease or oil. U.S. Pat. 1,193,743. *See* XIXB.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Chrome yellow. I. The system $PbSO_4+K_2CrO_4 \rightleftarrows PbCrO_4+K_2SO_4$. J. Milbauer and K. Kohn. Z. physik. Chem., 1916, **91**, 410—430. J. Chem. Soc., 1916, **110**, ii., 441.

WITH the object of explaining the formation and nature of the variously tinted forms of chrome-yellow prepared on the large scale, the authors have investigated the reaction

$$PbSO_4+K_2CrO_4 \rightleftarrows PbCrO_4+K_2SO_4$$

from the point of view of the phase rule and of chemical equilibrium. It is shown that the reaction proceeds practically completely in the direction from left to right, and at such a rate that it can be readily followed. The velocity in the opposite direction is very small, and can only be detected by the great sensitiveness of the reaction, $CrO_4''+8H^{\cdot}+6I'=Cr^{\cdot\cdot\cdot}+4H_2O+3I_2$. From determinations of the stability, it is shown that the solid phase $PbSO_4$ cannot exist in the presence of K_2CrO_4, K_2SO_4, and $PbCrO_4$, and, further, the existence of double salts is unlikely. The determination of the mass-action curve was rendered very difficult owing to the very small equilibrium constant and the strong adsorption. Adsorption is very marked at lower temperatures and high concentration, and is doubtless of importance in the manufacture of particular shades of chrome-yellow. The equilibrium constant is so small that it follows that the region of existence of lead sulphate practically vanishes from the isothermal diagram. The velocity of the reaction increases with increasing temperature, but here also the adsorption causes the velocity coefficients to appear as functions of the adsorption. It follows as a general result that the manufacture of chrome yellow can be carried out from lead sulphate, and that various shades can be obtained by varying the conditions, temperature, concentration, and time. It also follows that in the manufacture an excess of lead acetate should be used, for this will secure the absence of potassium chromate in the product. This point is essential, since such chromate would rapidly convert the lead sulphate, which is necessary for the particular shade, into lead chromate, and so the shade would be changed. The theory which explains the stability of chrome-yellow by the existence of a lead sulphochromate is unlikely, since the present experiments make the existence of these double salts extremely doubtful.

Manganese in pigments, varnishes, etc.; Colorimetric method for the detection of ——. J. F. Sacher. Farbenzeit., 1915, **20**, 1309. J. Chem. Soc., 1916, **110**, ii., 451.

THE reaction between manganese hydroxide and oxalic acid described previously by the author (this J., 1915, 638) may be used for the detection of manganese in pigments, paints, varnishes, etc. A small quantity of the substance is incinerated, the ash dissolved in water, and the solution filtered; the filtrate is rendered very slightly alkaline, heated gently, then cooled, and 3% oxalic acid is added drop by drop. A red coloration is obtained when just sufficient of the oxalic acid has been added to dissolve the manganese hydroxide. The test will detect as little as 0·05 mgrm. of manganese in 0·1 grm. of substance.

Rosin; Extraction of —— from wood. Experiments using a petroleum solvent. R. C. Palmer and H. R. Boehmer. J. Ind. Eng. Chem., 1916, **8**, 695—701.

EXPERIMENTS were made with long-leaf pine

stumps in an extraction battery of three retorts, each with a capacity of 30—35 lb. of wood. Gasoline boiling almost entirely between 70° and 150° C. was used as solvent. The wood was used in the form of chips averaging $\frac{3}{16}$ in. and $\frac{5}{8}$ in. respectively along the grain, and each lot received four washes, the arrangement being such that the fresh wood was treated with the nearly saturated solvent whilst the nearly spent material came in contact with fresh solvent. The results indicate that practically the whole of the petroleum-soluble rosin in the wood can be extracted in this way from $\frac{3}{16}$ in. chips by four washes of 15 min. each under 30 lb. pressure, the vaporised solvent being returned continuously to the retort during the extraction. Considerably less rosin was extracted from the $\frac{5}{8}$ in. chips. The spent $\frac{3}{16}$ in. chips when treated by the sulphate process gave pulp from which a good grade of No. 2 Kraft paper was made. A rotary type of digester would probably prove best in commercial practice. It is estimated that a plant with a capacity of 200 tons of wood would yield a quantity of spent chips sufficient to furnish the fuel required and in addition raw material for a 20-ton pulp mill.
—A. S.

Pine balsam. F. Henrich. Chem.-Zeit., 1916, **40**, 673—674.

The balsam (208 grms.) obtained in one day from a German pine (*Pinus sylvestris*), was distilled, first with ordinary and then with superheated steam, and yielded 24 to 25% of volatile constituents. The first fraction of 37 grms., when refractionated, yielded as its main constituent a liquid with b.pt. 153·5 to 154·5° C., sp.gr. 0·8591 at 20°/4° C.; and $[\alpha]^{20}_{D} = +20{\cdot}99$. The second fraction of 13 grms., when extracted with ether, dried, and redistilled, yielded fractions boiling at 155° to 157° C. and at 157° to 170° C., the latter having sp.gr. 0·8618 at 20°/4° C., and $[\alpha]^{20}_{D} = +12{\cdot}03$. Pinene was identified both in the first and second fractions. The residue in the distillation flask melted at 90° to 115° C., and after extraction with 70% alcohol at 127° to 130° C. The final residue was identified as abietic acid.
—C. A. M.

Patents.

Coatings for walls and other surfaces. M. C. Church, Grand Rapids, Mich., U.S.A. Eng. Pats. (A) 8429, June 7, 1915, and (B) 100,162, June 7, 1915. (Appl. No. 3735 of 1916.) Under Int. Conv., June 19, 1914.

(A) Finely pulverised uncalcined gypsum is mixed with glue, with or without the addition of whiting or other inert powder. Water is added to the mixture before use; or the preparation may be made into paste, which is subsequently diluted. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 13,154 of 1895.) (B) The coating given with a mixture such as is described in (A) is treated with a solution of alum, which hardens the surface and renders it durable and suitable for painting and varnishing.—C. A. M.

Resinous products and method of producing same. J. P. A. McCoy, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,194,201, Aug. 8, 1916. Date of appl., June 14, 1912.

The product of the interaction of an oil or oily substance with sulphur chloride is mixed with phenol and treated with formaldehyde.—C. A. M.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patent.

Caoutchouc: Manufacture of synthetic ——. A. Heinemann, London. U.S. Pat. 1,194,839, Aug. 15, 1916. Date of appl., Aug. 9, 1913.

See Eng. Pat. 18,506 of 1912; this J., 1913, 1022.

XV.—LEATHER; BONE; HORN; GLUE.

Patent.

Tanning of hides and skins. E. W. Merry, Sheffield. Eng. Pat. 17,350, Dec. 10, 1915.

See U.S. Pat. 1,191,527 of 1916; this J., 1916, 935.

XVI.—SOILS; FERTILISERS.

Calcium oxide in peat soils; Rapid method for determining ——. R. A. Gortner. Soil Sci., 1916, **1**, 505—508. J. Chem. Soc., 1916, **110**, ii., 449.

The peat (5 grms.) is ignited in a quartz dish, the ash digested with *aqua regia*, evaporated to dryness, extracted with dilute acid, filtered, and made up to 500 c.c. Of this solution, 100 c.c. is treated with ammonia to precipitate the iron and aluminium, boiled, and precipitated with 18 c.c. of a saturated solution of ammonium oxalate. After boiling for two minutes, the solution is left for at least three hours, filtered, and the precipitate washed. The precipitate is transferred to a beaker, the filter being washed with hot sulphuric acid, and after adding 10 c.c. of strong sulphuric acid the solution is heated nearly to boiling and titrated with permanganate (1 c.c. = 0·001 grm. CaO). The method is not suitable for mineral soils.

Cellulose in soils; Decomposition of ——. I. G. McBeth. Soil Sci., 1916, **1**, 437—487. J. Chem. Soc., 1916, **110**, i., 592.

Twenty-five species of cellulose-dissolving bacteria were grown on media containing cellulose prepared from lucerne flour, and all were found to dissolve the cellulose as readily as that prepared from filter paper. The organisms develop most readily in air; some growth can, however, be obtained under anærobic conditions. Whilst most of them grow well on ordinary culture media, a few grow only in presence of cellulose. The organisms assimilate nitrogen both in inorganic and organic forms, peptone being the most favourable for the largest number of species, and casein usually the least favourable. With dextrose, lactose, maltose, sucrose, and starch, the amount of acid formed in twelve days at 30° C. is usually between 1 and 2% on Fuller's scale; in mannitol and glycerol solutions the acidity is usually less than 1%, and in some cases no acid is formed at all. Filamentous fungi are of greater importance in the destruction of cellulose in the humid soils in the east of the United States than in the semi-arid soils of Southern California. In the latter soils the rapid destruction of cellulose is probably due to favourable conditions of climate and cultivation rather than to the specially active nature of the soil flora.

Calcium and magnesium compounds; Influence of —— *on plant growth.* F. A. Wyatt. J. Agric. Res., 1916, 6, 589—619.

The investigation consisted in tracing the influence of calcium and magnesium, both in naturally occurring and in artificially prepared compounds upon the growth of wheat, soya beans, alfalfa, and cowpeas, in cultures of sand or of a brown silt loam. The experiments were conducted in earthenware pots and extended over three years. Extraction of the sand with acid did not remove all the calcium and magnesium contained in it, and the plants showed a marked power of absorbing the residual elements, even after the sand had been extracted with fairly concentrated hydrochloric acid for 9—11 days, or on a steam bath for 4 days. A nutrient solution containing potassium sulphate (50 grms. to 2·5 litres), ammonium nitrate (80 grms. to 2½ litres), disodium phosphate (26·1 grms. to 2·5 litres), and ferric chloride (0·4 grm. per litre) was applied at intervals. Dolomite, limestone, magnesite, calcareous soils, and brown silt loam were used as natural sources of the metals, and the artificial compounds employed were the carbonates, chlorides, and sulphates. The crop yields and the ratio of calcium to magnesium in the plants, bore no direct relation to the ratio of the metals when applied as natural carbonates; and widely varying ratios of the metals produced no corresponding differences in the yields. There was a tendency for the plants to absorb relatively more magnesium than calcium, but the absorption of both increased with the amounts applied. A dressing of 40% of dolomite had a favourable effect upon the plants, and all of them grew well in a mixture of 96% dolomite and 4% sand, in 7% magnesite and 93% sand, and in 100% magnesian limestone. It was, however, noted that a high percentage, *e.g.*, 35%, of magnesium caused a certain amount of sickness, manifested by a yellowing of the top leaves: such plants always showed a high magnesium content. Alfalfa was found to absorb more calcium and magnesium than wheat. Pure, artificial magnesium carbonate ($Mg(OH)_2.4MgCO_3$) was toxic when applied in amounts greater than 0·7% to brown silt loam, and in sand 0·35% sufficed to inhibit the growth of all the plants tested. This carbonate gave an immediate alkaline reaction with phenolphthalein, whereas the magnesite and calcareous soils gave it only after standing in water for 8—12 hours. On wheat and soya beans, with a magnesium-calcium ratio of 4 : 5, 0·1% of magnesium applied as artificial carbonate prevented germination or stopped growth, but chloride and sulphate in the same amount were far less harmful: the chloride was less detrimental than the sulphate. On the other hand with 0·01 and 0·001% of magnesium, the carbonate gave the best result and the chloride the worst. In general, the smaller the amount of artificial compound, the better the development of both plant and root. The plant seeds contained more magnesium than calcium, but in the plant itself there was a preponderance of calcium.

—E. H. T.

Dicyanodiamide; Determination of —— in nitrolim (crude calcium cyanamide) by Caro's method. G. Hager and J. Kern. Z. angew. Chem., 1916, **29**, 309—312.

CARO'S method for the determination of dicyanodiamide in nitrolim (this J., 1911, 23) gives low results, particularly when a comparatively high percentage of this substance is present. The source of the error is twofold. In the first place a certain small quantity of dicyanodiamide is always carried down with the silver cyanamide precipitate, even in presence of an excess of ammonia, and secondly, after filtering off this precipitate, some decomposition, resulting in the evolution of ammonia, occurs when the filtrate containing silver dicyanodiamide is boiled with potassium hydroxide in order to reprecipitate the dissolved silver salt. Both of these errors obviously lead to low values for the dicyanodiamide nitrogen in the subsequent Kjeldahl determination, and no method was found whereby they could be obviated.—G. F. M.

Mineral phosphates; Solubility of mineral ——. A. Aita. Annali Chim. Appl., 1916, **6**, 28—44.

EXPERIMENTS on successive extractions of mineral phosphates, raw and calcined, with 2% citric acid solution, gave results similar to those obtained by Robertson (this J., 1914, 9; 1916, 217). The solubility is diminished by addition of calcium salts but increased by addition of ammonium, potassium, sodium, and magnesium salts; the increase is greater with sulphates than with nitrates, and least with chlorides. It is considered that the solubility of so-called basic phosphates of the Wiborgh phosphate type is due to the presence of alkali salts and not to the formation of a tetracalcium-alkali phosphate.—A. S.

PATENTS.

Fertiliser [ammonium metaphosphate]; Process for preparing a concentrated ——. W. H. Ross, A. R. Merz, and J. N. Carothers, Washington, D.C. U.S. Pat. 1,191,077, Aug. 8, 1916. Date of appl., May 20, 1916. (Dedicated to the public.)

PHOSPHATE rock, etc., is decomposed by heat according to the volatilisation method, and the resulting vapour of phosphoric anhydride brought into contact with gaseous ammonia and water vapour. The product is condensed by cooling and collected in the dry state.—W. E. F. P.

Fertiliser [phosphate]; Process of making ——. S. B. Newberry, Sandusky, Ohio, and G. R. Fishburne, Charleston, S.C. U.S. Pat. 1,191,219, Aug. 8, 1916. Date of appl., Mar. 30, 1910.

IN a process for making citrate-soluble phosphate, finely-divided, insoluble phosphate—either alone or mixed with an alkali metal compound—is heated in an inclined, rotary cylinder through which hot furnace gases are passed. In the latter case the heating is carried to fusion or semi-fusion, the product being re-ground for use, and the gases treated with a spray before discharge.—W. E. F. P.

XVII.—SUGARS; STARCHES; GUMS.

Sugar content of beetroots: effect of removing the leaves. O. Munerati, G. Mezzadroli, and T. V. Zapparoli. Staz. Sperim. Agrar. Ital., 1915, **48**, 743. Annali Chim. Appl., 1916, **6**, 46—47.

Two series of tests were made to ascertain the effect of removing the leaves on single beetroots. In one series the root was not removed from the soil between the first and second analysis, whilst in the other a root was pulled up, its weight determined and a sample taken for the sugar determination, after which the root was re-planted and, after some time, again pulled up, weighed, and analysed. In the case of the roots not removed from the soil, those from which the leaves were removed showed a progressively diminishing content of sugar, whilst in those from which the leaves were not removed, the sugar content increased progressively. In the case of the roots which were transplanted, the weight increased continuously in proportion to the development of new foliage; when the leaves were removed the weight either remained constant or diminished. The percentage of sugar progressively diminished in the roots from which the leaves were stripped, whilst in those retaining their foliage, the percentage of sugar showed first a slight reduction, corresponding to the production of new leaves, and then remained almost constant or, in some cases, increased.—A. S.

XVIII.—FERMENTATION INDUSTRIES.

Pomace wines: their composition and detection. J. R. Eoff, jun. J. Ind. Eng. Chem., 1916, 8, 723—726.

Analyses of a number of pomace wines are tabulated, together with analyses of two genuine wines for comparison, and the differences in composition are discussed in so far as they afford means of distinguishing genuine wines from pomace wines. —A. S.

Colorimetric determination of the hydrogen ion concentration of bacteriological culture media. Clark and Lubs. *See* XXIII.

Patents.

Distillery-slop; Manufacture of by-products from ——. A. von Lászloffy, Peoria, Ill. U.S. Pat. 1,193,951, Aug. 8, 1916. Date of appl., Mar. 27, 1911.

The liquid portion separated from distillery-slop is freed from water and treated with a solvent which extracts the lactic acid, succinic acid, fat, and glycerol, the latter being but slightly soluble in the solvent employed. These substances are then separated from one another by utilising the differences in their solubilities in the solvent. —W. P. S.

Wines and the like; Process for maturing, purifying, and sterilising ——. C. Henry, Coze, France. Eng. Pat. 17,400, May 7, 1914.

See Addition of Mar. 16, 1914, to Fr. Pat. 459,141 of 1912; this J., 1916, 64.

XIXa.—FOODS.

lfalfa [lucerne]: Chemical composition of —— as affected by stage of maturity, mechanical losses, and conditions of drying. C. O. Swanson and W. L. Latshaw. J. Ind. Eng. Chem., 1916, 8, 726—729.

Tests were made on alfalfa cut at different times rom the period of budding up to that of seed ormation in order to ascertain the effect of the tage of maturity and conditions of curing (haynaking) on the composition. The crude fibre nd nitrogen-free extract increase and the crude rotein and ash decrease from the bud stage onwards. The total yield of nutrient constituents er acre depends largely on the yield of the crop; n 1914 (moderately dry summer) the yield of utrients was greatest at the bud stage, whilst in 915 (unusually wet summer) it was greatest at he full bloom stage. The leaves contain more han 2½ times as much crude protein as the stems, hilst the stems contain more than 2½ times as uch crude fibre as the leaves; hence the large echanical loss of leaves in harvesting and hayaking adversely affects the composition of the ay. The content of pure protein, determined y Stutzer's method (Bull. 107, U.S. Bureau of hem.), is higher in alfalfa cured in the sun in the pen than in that cured in the shade under cover, nd the difference more than offsets the influence f the loss of leaves.—A. S.

ood value of Great Britain's food supply. W. H. Thompson. Economic Proc. Roy. Dublin Soc., 1916, 2, 168—220.

Synopsis of the food supply for the year 1908, mpiled from various official sources, and its ergy value, is given in the following table. he energy value is represented in kilo-litre lories (the unit being the heat required to raise 1000 res of water from 15° C. to 16° C.). On this scale, ch 1 lb. of protein or carbohydrate is equivalent to 1·85976 units and each 1 lb. of fat to 4·21848 units.

Food.	Quantity.	Energy value.
	Cwts.	K.-L. calories.
Wheat, flour, and meal ..	79,849,028	14,539,234,192
Oatmeal	1,970,994	409,997,469
Rice	1,780,000	324,956,800
Barley	3,000,000	537,520,000
Indian meal	3,000,000	519,120,000
Other farinaceous products	1,302,724	198,590,000
(Total cereals)	(90,902,746)	(16,529,418,461)
Potatoes	87,496,723	3,649,500,490
Onions	2,898,033	54,582,382
Cabbage, sprouts, etc.	3,979,340	57,847,462
Root crops	8,892,765	141,609,565
Peas and beans	5,452,942	612,756,900
Tomatoes, etc.	2,063,837	20,197,498
(Total vegetables)	(110,783,640)	(4,536,494,297)
Beef and veal	21,138,675	2,198,670,333
Mutton and lamb	9,923,868	1,363,406,326
Pig meat	14,650,294	3,908,940,896
Poultry, game, and rabbits	2,998,591	250,653,015
"Offal" and sausages ...	1,753,037	142,510,063
(Total meat)	(50,464,465)	(7,864,180,633)
Milk and cream (802,502,735 gals.)	73,437,765	2,709,671,042
Condensed milk	1,113,082	181,920,648
Butter	5,524,700	2,230,652,872
Cheese	2,780,459	635,057,146
(Total dairy products) ..	(82,856,006)	(5,757,301,708)
Eggs	3,996,490	284,230,391
Lard and margarine	4,266,518	1,824,059,783
Fish	13,284,332	331,774,867
Sugar and molasses	31,903,755	6,462,974,530
Fruit, fresh	22,854,404	597,242,464
Cocoa and chocolate	549,050	142,788,059
Fruit, preserved, and nuts	3,057,879	458,507,190
Olive oil	82,800	37,318,976
Total	415,002,085	44,826,291,359

—W. P. S.

Pentose and the so-called furfuroids. E. Kunz. Biochem. Zeits., 1916, 74, 312—339. J. Chem. Soc., 1916, 110, i., 590.

The chaff investigated contains two kinds of substances which yield furfural, one of which can be readily hydrolysed, whereas the other cannot. An approximate separation of the two can be accomplished by heating for several hours with 2% sulphuric acid. The soluble product formed by this treatment, is arabinose, and the parent-substance must therefore be regarded as a genuine pentosan. The residue is very resistant to the action of dilute acids, and can be best degraded by the action of 1% sulphuric acid under a pressure of 3—4 atmospheres. Under these conditions about 90% of the residue is rendered soluble. Various reactions indicate that the dissolved substance in this case also is arabinose, and the mother substance some kind of a pentosan. The conclusion is drawn that substances described as furfuroids, contrary to what has sometimes been suggested, probably also contain a pentosan complex; there is no evidence, according to the author, that they contain a methylene ether complex.

Treatment and utilisation of sulphite-cellulose waste lyes. König. *See* V.

Patents.

Food for infants and process of making same. E. J. and D. N. Quertier, Fordingbridge, Hants. Eng. Pat. 100,898, Jan. 28, 1916. (Appl. No. 1389 of 1916.)

A mixture of cows' milk, 100 parts, and a quantity of cream sufficient to introduce 30 parts by weight of fat, is dried at 212° F. (100° C.) on a revolving cylinder, and to the resulting powder is added 70 parts by weight of lactose.—W. P. S.

Solids [*milk powder*] *from liquids ; Process for obtaining* ——. I. S. and O. E. Merrell, Assignors to Merrell-Soule Co., Syracuse, N.Y. U.S. Pat. 1,193,173, Aug. 1, 1916. Date of appl., Jan. 18, 1916.

A portion of the water is removed from the milk by evaporation, and the condensed milk so obtained is sprayed into a chamber along with a current of dry air. The particles of milk are kept in suspension in the current of air sufficiently long to ensure that the whole of the water is vaporised. The desiccated milk powder falls to the bottom of the chamber and is removed by a rotary valve. —W. H. C.

Food [*milk*] *product and method of producing the same.* R. W. Crary, Waukesha, and S. R. Barnett, Albany, Assignors to Crary Brokerage Co., Waukesha, Wis. U.S. Pat. 1,193,477, Aug. 1, 1916. Date of appl., Apr. 14, 1916.

Coconut oil, free from fatty acids, is added to concentrated skimmed milk, and the mixture is homogenised.—W. P. S.

Soy-bean products and method of preparation. J. Friedman, Chicago, Ill. U.S. Pat. 1,194,495, Aug. 15, 1916. Date of appl., Dec. 17, 1914.

See Eng. Pat. 121 of 1914 ; this J., 1915, 148.

XIXb.—WATER PURIFICATION ; SANITATION.

Total hardness [*of water*] *; Determination of* —— *by means of potassium palmitate.* M. Tilgner. Chem.-Zeit., 1916, **40**, 675.

In Blacher's method (this J., 1912, 555) the temporary hardness is determined by means of hydrochloric acid and the residual carbon dioxide expelled by a current of air. As it is difficult to ascertain when the expulsion of the carbon dioxide is complete, it is preferable to neutralise the free carbon dioxide with *N*/10 potassium hydroxide solution, with phenolphthalein as indicator, prior to titration with potassium palmitate solution.—C. A. M.

Chlorine in town water supplies ; Detection of free ——. G. A. Le Roy. Comptes rend., 1916, **163**, 226—228. (See this J., 1916, 378.)

Very minute traces of free chlorine can be detected and the amount roughly estimated by the addition of a few drops of a solution of hexamethyltri-*p*-aminotriphenylmethane; a violet coloration, which varies in intensity according to the amount of free chlorine present, is immediately formed. The reagent is prepared by digesting 1 part of the organic compound in about 10 parts of diluted hydrochloric acid (1 : 1), and making up to 100 parts with distilled water. As an opalescence is produced with some waters, it is advisable to add a little formic or acetic acid, to prevent its appearance. The reagent is stable towards water, reacts extremely slowly with nitrites, and is quite unaffected by hydrogen peroxide. With its aid, 3 parts of chlorine in 100 millions can be detected : the limit of the starch-iodide reagent is 1 part in 10 millions. —E. H. T.

Composition and solubility of calcium acid carbonate. Cavazzi. *See* VII.

Patents.

Fluids : Apparatus for the sterilisation of —— *b ultra-violet rays.* M. von Recklinghausen Assignor to The R. U. V. Co., New York U.S. Pat. 1,193,209, Aug. 1, 1916. Date o appl., Mar. 14, 1914.

The liquid is caused to flow over the corrugate walls of a pivoted receptacle which contains mercury vapour lamp. A trap at the bottom o the receptacle retains a portion of the liquid whil the lamp is in operation, and the lamp is partl submerged in this liquid. An electro-magnet i the circuit holds the receptacle in position whe the lamp is in operation but allows the receptacl to tilt and discharge the contents of the trap whe the current is interrupted.—W. P. S.

Grease or oil ; Process for reducing matter [*garbag etc.*] *containing* ——. C. S. Wheelwright, Pr vidence, R.I. U.S. Pat. 1,193,743, Aug. 1916. Date of appl., May 14, 1912.

Garbage, offal, or the like is heated in a suitabl container and the oil which separates is removed the heated material is then freed from rubbis and mixed with hot spent liquid so as to form a pul which is heated and allowed to settle in a tan Oil or grease is drawn off from the tank and th solid material and clear liquid are separated, th former being dried and the latter evaporated. —W. P. S.

Sewage and the like ; [*Electrolytic*] *method of purif ing* ——. D. T. Dobyns and J. K. Elderki jun., Newark, N.J., Assignors to Clark Proce Corporation. U.S. Pat. 1,191,000, Aug. 8, 191 Date of appl., Dec. 22, 1915.

Solids are removed from sewage and the liqui portion is subjected to electrolysis ; the solids a mixed with a substance which, under electrolyt action, will produce a germicide (nascent oxygen and the mixture is also subjected to electrolysi —W. P. S.

Sterilising liquids by means of ultra-violet rays Apparatus for ——. V. Henri, Paris, an A. Helbronner and M. von Recklinghause Suresnes, France, Assignors to The R.U.V. C Inc. U.S. Pat. 1,193,143, Aug. 1, 1916. Da of appl., Feb. 12, 1914.

See Eng. Pat. 14,128 of 1910 ; this J., 1911, 15

Purifying liquids [*sewage, etc.*] *; Process for* — T. W. Barber, London. U.S. Pat. 1,194,93 Aug. 15, 1916. Date of appl., May 11, 1916.

See Eng. Pat. 6735 of 1915 ; this J., 1916, 55

Sewage ; Apparatus for introducing gases in intimate contact with liquid ——. G. W. Mottra Deepcar. U.S. Pat. 1,195,067, Aug. 15, 191 Date of appl., Feb. 17, 1916.

See Eng. Pat. 2421 of 1915 ; this J., 1916, 431.

Process of producing chromium-containing [*bas exchanging*] *silicates. Process of base-exchan* [*Purification of water.*] U.S. Pats. 1,193,7 and 1,193,795. *See* VII.

XX.—ORGANIC PRODUCTS ; MEDICINAL SUBSTANCES ; ESSENTIAL OILS.

Digitalis standardisation. Physiological evaluat of fat-free digitalis and commercial digita G. B. Roth. U.S. Public Health Servi Hygienic Laboratory Bull. No. 102, 1916, 1—

The one-hour frog method (the aim of which to determine the quantity of digitalis which will produce permanent systole of the ventricle, after one hour, when injected into the ventral lymph sac) was investigated. Absorption from the lymph system was variable and depended partly on the temperature at which the animals were maintained during the experiments. At 10° C., the toxicity of certain digitalis glucosides was much less than at 20° C. The use of a suitable biological method and the adoption of a standard of activity by manufacturers are suggested as means whereby greater uniformity may be expected in the activity of commercial preparations of digitalis. By the one-hour frog method a variation of over 250% was found in 13 samples of commercial fat-free digitalis and of 159% in 5 samples of commercial digitalin. There was practically no difference in absorbability of the fat-free tincture and the official (U.S.) tincture from the lymph system of the frog. Certain samples of fat-free digitalis exhibited deterioration after being kept for seven months, and it is suggested that such preparations should bear the date of their manufacture.—W. P. S.

Colchicine: Pure ——. E. Merck. Apoth.-Zeit. Chem. and Drug., 1916, **88**, 946.

Pure colchicine is an almost white, amorphous and inodorous substance which has no sharp melting point. After drying over sulphuric acid, it becomes soft when heated to 142° C. and melts at 147° C. It is soluble in water, alcohol, chloroform, and benzene, and nearly insoluble in ether. From its solution in 3 parts of water, crystals of $C_{22}H_{25}NO_6,1\frac{1}{2}H_2O$ separate on standing. Crystalline compounds of colchicine with chloroform and with ether are also described. The compound with 14—16% of chloroform is being put on the market.

Vanilla extract. J. R. Dean and J. O. Schlotterbeck. J. Ind. Eng. Chem., 1916, **8**, 607—614, 703—709.

The following conclusions have been drawn partly from experimental results and partly from the experiences of manufacturers of vanilla extracts. For the preparation of the extract the beans should be chopped and not ground. The beans can be dried without material loss of flavour in a slow current of air at the ordinary temperature, and the dried beans yield extracts having higher colour values and lead number values (see Winton and Lott, this J., 1910, 1268) han extracts made from undried beans. The colour value of the extract increases slightly and he lead number decreases slightly as the concentration of the alcohol used as solvent is increased up to about 65%. Extracts made with 60% alcohol are superior in flavour to those made with 50% alcohol; when undried beans are used, he effect of the water present upon the alcohol concentration should be taken into account. Extracts of the highest quality can be obtained only by long maceration at the ordinary temperature. Addition of alkali to the alcohol impairs he flavour of the extract, but addition of glycerol ends to give a deeper colour; sugar has no appreciable effect on the colour and should be added to the extract, not to the alcohol. The resins present in the beans are of no value as lavouring agents, but act as fixatives for the lavouring and colouring substances in the extract. The extract should not be left in contact with any metal that is not completely covered with tin. t is improved by ageing, which should extend ver at least one year and be carried out in unoated, porous, wooden vessels at the ordinary emperature.—A. S.

Caffeine, acetanilide, antipyrine, phenacetin, salol, quinine, etc.; Analysis of mixtures of ——. W. O. Emery. J. Assoc. Off. Agric. Chem., 1916, **2**, 59—75.

At the thirty-first Annual Convention of the Association of Official Agricultural Chemists, U.S.A., the following methods proposed by Emery and others were adopted as official. *Caffeine and acetanilide.* If the mixture is in powder form, the caffeine and acetanilide are extracted with chloroform; when dealing with pills or tablets, or when the caffeine is present as citrate, water should be added previous to the extraction with chloroform. In the case of a dilute alcoholic solution of the two substances, a portion of the sample is heated to expel the alcohol, the residual solution then treated with a small quantity of sodium bicarbonate and one drop of acetic anhydride, and extracted with chloroform. Should other alkaloids be present, the solution, after the acetylation, must be acidified with sulphuric acid. The chloroform solution containing the caffeine and acetanilide is evaporated to 10 c.c., 10 c.c. of dilute sulphuric acid (1 : 10) is added, the mixture evaporated to 5 c.c., 10 c.c. of water is added, and the mixture again evaporated to 5 c.c. The acetanilide is thus converted into aniline sulphate and acetic acid, from which the caffeine may be readily separated by means of chloroform. After removal of the caffeine, the acid aqueous solution is heated to expel all chloroform, then treated with 10 c.c. of concentrated hydrochloric acid, and titrated with standardised bromine solution (1 c.c. of which is equivalent to 5—10 mgrms. of acetanilide). *Caffeine and phenacetin.* The same method of separation is employed as in the case of caffeine and acetanilide; after the hydrolysis with sulphuric acid, the caffeine is extracted with chloroform and the phenetidine sulphate remaining in the solution is re-converted into phenacetin by treatment with sodium bicarbonate and acetic anhydride (see Emery, Spencer, and Le Febvre, this J., 1915, 921). *Caffeine and antipyrine.* The method is that described by Emery and Palkin (this J., 1915, 733). *Acetanilide and phenacetin. Phenacetin and salol.* These substances are separated and determined according to the methods proposed by Emery, Spencer, and Le Febvre (this J., 1914, 887; 1915, 921). *Acetanilide and sodium salicylate.* The solution of the two substances is treated with sodium bicarbonate, the acetanilide extracted with chloroform, hydrolysed with sulphuric acid, and the resulting aniline sulphate titrated with bromine solution (see above). The aqueous solution containing the sodium salicylate is then acidified with hydrochloric acid, the salicylic acid extracted with chloroform, and the chloroform solution next extracted with sodium carbonate solution. This aqueous solution is heated nearly to boiling, an excess of $N/5$ iodine solution is added, the mixture heated for 30 minutes, the excess of iodine then destroyed by the addition of thiosulphate solution, the precipitate collected on a filter, washed with water, dried at 100° C., and weighed. The weight of the precipitate multiplied by 0·4658 gives the amount of sodium salicylate. *Caffeine, acetanilide, and quinine sulphate.* The method depends on the fact that quinine bisulphate is insoluble in chloroform, whilst caffeine and acetanilide are readily extracted by this solvent from a sulphuric acid solution. After the caffeine and acetanilide have been thus extracted, the acid aqueous solution is treated with an excess of sodium bicarbonate, the quinine is extracted with chloroform, the chloroform solution evaporated, the residue dissolved in alcohol, and the solution titrated with $N/50$ hydrochloric acid, using methyl red as indicator. Each c.c. of $N/50$ hydrochloric acid is equivalent to 8·86 mgrms. of quinine sulphate. *Caffeine,* *acetanilide, and codeine sulphate.* The method is similar in every way to that prescribed for caffeine, acetanilide, and quinine, except that in the case of codeine the alkaloid may be weighed before titration. *Caffeine, acetanilide, quinine sulphate, and morphine sulphate.* The two alkaloids are separated from the caffeine and acetanilide by extracting the two latter with chloroform from an acid solution: the separation of quinine from morphine depends on the fact that morphine, when treated with an excess of sodium hydroxide, yields a morphinate which is insoluble in chloroform. The acid aqueous solution containing the two alkaloids is treated with 5 c.c. of 10% sodium hydroxide solution, the quinine then extracted with chloroform and titrated after evaporation of the solvent. To the alkaline solution containing the morphine is added 0·5 grm. of ammonium chloride, and the alkaloid is extracted with chloroform containing 10% of alcohol. After the solvent has been evaporated, the residue of morphine is dried, weighed, and then titrated with N/50 sulphuric acid, using methyl red as the indicator; each c.c. of N/50 acid is equivalent to 7·53 mgrms. of morphine sulphate. *Tragacanth.* The method is that proposed by Emery (this J., 1912, 552).—W. P. S.

Eucalyptus Australiana, Sp. Nov. ("Narrow-leaved peppermint") and its essential oil. R. T. Baker and H. G. Smith. J. Roy. Soc. N.S.W., 1915, **49**, 514—525. J. Chem. Soc., 1916, **110**, i., 566.

THIS eucalyptus was originally regarded as a variety of *Eucalyptus amygdalina*, but further study has rendered it desirable to give it specific rank. It flourishes on the ranges of New South Wales and Victoria, in a region which has little agricultural value, and as it yields a large amount of a good oil, it is proposed to establish a permanent industry. The cineol present in the oil can be profitably concentrated by collecting the steam-distillate during the first hour separately. Such a fraction contains more than 70% of cineol, whereas the whole oil averages about 45%. Moreover, this portion is almost colourless, and contains mere traces of aldehydes, so that it is pure enough for pharmaceutical purposes, whilst the yield is as great as that of the whole oil in most of the other eucalypts. The phellandrene portions which collect more particularly in the later distillates appear to contain an alcohol, $C_{10}H_{17}.OH$.

Calycanthus occidentalis; Volatile oil of ——. C. C. Scalione. J. Ind. Eng. Chem., 1916, **8**, 729—731.

THE shrub known as spice bush (*Calycanthus occidentalis, Butneria occidentalis*) grows in northern California and southern Oregon. On distilling with steam the leaves yielded 0·15% and the twigs 0·37% of a greenish-yellow oil, having a bitter taste and camphoraceous odour. The oil is soluble in all proportions in 90% alcohol and in 15—16 vols. of 70% alcohol by volume. It has sp.gr. 0·9295 at 20° C.; optical rotation, +7° 28′; $n_D^{20}=1{\cdot}4713$; acid value, 0·05; saponif. value, 51·3; acetyl value, 33·5. It contains about 60% of cineol, 8% of pinene (*d*-pinene with a small proportion of *l*-pinene), 9% of borneol, and 19% of linalyl acetate, together with small quantities of methyl salicylate, sesquiterpene-alcohols, and camphor.—A. S.

Cinnamomum Oliveri (Bail.) or Brisbane sassafras; Essential oil of ——. G. W. Hargreaves. Chem. Soc. Trans., 1916, **109**, 751—754.

THE bark of *Cinnamomum Oliveri* yields over 2% of volatile oil having sp.gr. 1·030, and $n_D^{23}=1{\cdot}5165$. Its chief constituents are pinene (12—15%), *d*-camphor (18—20%), safrole (25—27%), and eugenyl methyl ether (40—45%). The oil from the leaves contains similar substances in the lower fractions but differs in the higher ones, no safrole or eugenyl methyl ether being present. The terpenes, amounting to about 25%, contain in addition to pinene a substance giving a nitrosite, possibly phellandrene. *d*-Camphor is present to the extent of about 60%, whilst the highest fraction (15%) consists of phenols and other substances.—G. F. M.

Taurine. P. Bergell. Z. physiol. Chem., 1916, **97**, 260—263.

THE sodium salt of β-naphthalene sulphoamino-ethanesulphonic acid (β-naphthalenesulphotaurine) was prepared by the interaction of taurine in dilute sodium hydroxide solution with β-naphthalenesulphochloride dissolved in ether. When these substances have been shaken together for many hours, and the aqueous liquid has been separated and treated with hydrochloric acid, the new compound can be salted out in a crystalline form by means of common salt or sodium sulphate. After boiling with 85% alcohol and re-crystallising, the new taurine derivative is obtained in long crystals of nacreous lustre, m.pt. 217° C. It is soluble in boiling water and in eight times its bulk of water at the ordinary temperature; it is less soluble in alcohol, soluble in carbon tetrachloride, but nearly insoluble in ethyl acetoacetate, acetone, ether, and benzene. The above-mentioned reaction can be utilised to detect taurine in urine, and it may possibly serve to isolate that base from complex mixtures.—E. H. T.

Hydrogen peroxide of crystallisation; Compounds containing ——. H. Stoltzenberg. Ber., 1916, **49**, 1545—1546.

ATTEMPTS to prepare isomorphous substances containing hydrogen peroxide have not been successful; a mixture of isomorphous compounds would be more stable than the individual compounds. Urea-sodium chloride-hydrogen peroxide, $CO(NH_2)_2,NaCl.\frac{1}{2}H_2O_2$, biuret-hydrogen peroxide, $(C_2H_5N_3O_2)_5.H_2O_2$, alloxan-hydrogen peroxide, $(C_4H_2N_2O_4)_{10}.H_2O_2$, and allantoic acid-hydrogen peroxide, $C_4H_8N_4O_4,3H_2O_2$, have been prepared. The amino group appears to play a part in combining with the hydrogen peroxide, as the alkylation or acetylation of urea decreases its ability to form such compounds. Parabanic acid and allantoin do not form hydrogen peroxide addition compounds.—F. W. A.

Salicylates; Manufacture of —— in Great Britain. Chem. and Drug., Aug. 26, 1916.

THE manufacture of salicylic acid and its derivatives is becoming firmly established in Great Britain. There are now about a dozen firms engaged in the manufacture, and notwithstanding difficulties in obtaining engineering plant, the output is already almost sufficient to meet home demands and is rapidly increasing, especially as ample supplies of raw materials are now available. In the opinion of those engaged in the manufacture, some form of protection, if only temporary, will be necessary if the industry is to be permanently established in this country. It is suggested that assistance should be given for at least two years after the war, but opinion is divided as to the form the assistance should take.

Determination of formic acid in pure solutions and in urine, together with a new method for the titration of calomel. Riesser. *See* VII.

PATENTS.

Cephaeline ethyl ether. J. W. Meader, Indianapolis, Ind., U.S.A. Eng. Pat. 11,718, Aug. 13, 1915.

THE ethyl ether of cephaeline, of the probable formula, $C_{28}H_{37}O_3N_2.OC_2H_5$, is prepared by the action of an alkali metal and an ethyl halide on cephaeline. *Example.* 46·6 grms. of cephaeline and 4·6 grms. of sodium are dissolved in 400 c.c. of alcohol and the solution is boiled with 15 grms. of ethyl bromide under a reflux condenser for two hours. The alcohol is distilled off, and the residue dissolved in dilute hydrochloric acid, treated with ammonia, and extracted with ether. The ethereal solution is extracted with dilute caustic soda to remove unchanged cephaeline, and is then evaporated to dryness on the water-bath. Cephaeline ethyl ether is obtained as a varnish-like substance, easily soluble in alcohol, ether, and chloroform. It forms a crystalline hydrochloride (needles) and hydrobromide. The ether and its salts are valuable medicinal products.—F. Sp.

Bromine[-containing] solution. J. Werner, New York. U.S. Pat. 1,183,055, May 16, 1916. Date of appl., July 1, 1913.

A bromine compound free from irritant properties and smell, but possessing the antiseptic and disinfectant properties of free bromine, is made by combining bromine with an acid containing the nucleus of trihydroxybenzoic acid dissolved in glycerin. *Example.* One part of bromine is added to 2½ parts of tannin dissolved in 10 parts of glycerin, and agitated in a closed vessel until all free bromine has disappeared.—F. Sp.

Hog cholera antitoxin; Process of treating ——. J. Reichel, Philadelphia, and H. Werner, Glenolden, Assignors to H. K. Mulford Co., Philadelphia, Pa. U.S. Pat. 1,183,591, May 16, 1916. Date of appl., July 1, 1915.

The antitoxin of hog cholera, in the form of blood of hyperimmunised hogs, is freed from cells, cellular debris, hæmoglobin, fibrin clots, and living and dead germs, without unduly diluting it, by treating it, preferably at the time of bleeding, with a saturated chemical reagent to prevent coagulation, *e.g.*, saturated sodium citrate solution, and with an aldehyde solution, *e.g.*, formaldehyde, to inhibit hæmolysis. One litre of blood requires about 15 c.c. of saturated sodium citrate and 10 c.c. of 1% formaldehyde solution. After standing about 12 hours to allow the cellular elements to shrink and harden, the latter are separated, *e.g.*, by centrifuging, and the serum is filtered through sterilising filters.—F. Sp.

Hexamethylene[tetr]amine and calcium chloride; Chemical compound of —— and process relating to same. E. Samson, Assignor to C. F. Stiefel, New York. U.S. Pat. 1,193,474, Aug. 1, 1916. Date of appl., Mar. 13, 1914.

Calcium chloride and hexamethylenetetramine are dissolved separately in alcohol, and the solutions are mixed and allowed to crystallise. The product s a stable combination of the two substances, free rom water of crystallisation, and capable of being made into tablets for medical use.—F. Sp.

Anæsthetic bodies. L. Thorp, Assignor to Parke, Davis, and Co., Detroit, Mich. U.S. Pat. 1,193,634, Aug. 8, 1916. Date of appl., Apr. 24, 1916.

The mono salts of esters of 1.3-tetra-alkyldiamino--hydroxypropane behave as local anæsthetics, in particular the monohydrochloride of the benzoic ester of 1.3-tetra-ethyldiamino-2-hydroxypropane, colourless crystalline body of m.pt. 130° C., oluble in water and alcohol, very slightly soluble n ether or benzene, and faintly alkaline to litmus. When heated with hydrochloric acid or caustic soda solution, it yields benzoic acid and 1.3-tetrathyldiaminodihydroxypropane. Treated with otassium carbonate solution it gives the oily enzoic ester of 1.3-tetra-ethyldiaminodihydroxy ropane.—F. Sp.

Anæsthetic bodies and method of preparing the same. Anæsthetic bodies. E. A. Wildman, New York, and L. Thorp, Assignors to Parke, Davis, and Co., Detroit, Mich. U.S. Pats. (A) 1,193,649, (B) 1,193,650, and (C) 1,193,651, Aug. 8, 1916. Date of appl., Apr. 17, 1916.

(A) The salts of the aryl esters of γ-dialkylaminopropyl alcohols possess anæsthetic action, but only slight toxicity compared with cocaine. Particular claim is made to γ-diethylaminopropylcinnamate hydrochloride, prepared by treating γ-diethylaminopropyl alcohol dissolved in an inert solvent such as benzene, ether, or acetone, with the equivalent weight of cinnamoyl chloride, and filtering off the precipitate produced. The free base may be prepared by treating the hydrochloride with potassium carbonate solution. It is a colourless oil, readily soluble in alcohol, ether, or benzene, slightly soluble in water, alkaline to litmus, and hydrolysed by hydrochloric acid or caustic soda solution forming cinnamic acid and γ-diethylaminopropyl alcohol. The hydrochloride crystallises from a mixture of alcohol and ether in white needles, melting at 137° C. (B) The salts of the alkamine esters of anisic acid are claimed as local anæsthetics, particularly the hydrochloride of the γ-diethylaminopropyl ester of anisic acid. The free base is a colourless oil, slightly soluble in water, readily soluble in alcohol, ether, or benzene, alkaline to litmus, and hydrolysed by hydrochloric acid or caustic soda solution forming anisic acid and γ-diethylaminopropyl alcohol. The hydrochloride crystallises from a mixture of acetone and ether in white crystals melting at 129° C. (C) The salts of the alkamine esters of *p*-toluic acid are claimed as local anæsthetics, particularly the hydrochloride of the γ-diethylaminopropyl ester of *p*-toluic acid. The free base is a colourless oil, very slightly soluble in water, readily soluble in alcohol, ether, or benzene, alkaline to litmus, and hydrolysed by hydrochloric acid or caustic soda solution forming *p*-toluic acid and γ-diethylaminopropyl alcohol. The hydrochloride crystallises from a mixture of acetone and ether in white crystals.—F. Sp.

Nitrile derivatives (oxamide); Electrolytic and saponifying process for producing ——. J. E. Bucher, Coventry, R.I., Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,194,354, Aug. 15, 1916. Date of appl., Feb. 23, 1915.

Gaseous cyanogen is led under pressure into a bath of concentrated halogen acid, or other catalytic agent, which is stirred continuously and heated to the temperature most favourable to the formation of oxamide.—F. Sp.

Dinitroalkylaminobenzenearsinic acids; Preparation of ——. C. F. Boehringer und Söhne, Mannheim-Waldhof. Ger. Pat. 292,546, Apr. 28, 1915. Addition to Ger. Pat. 285,604.

Mononitroalkylaminobenzenearsinic acids or their 2-halogen derivatives, prepared as described in the chief patent (see Eng. Pat. 29,546 of 1913; this J., 1914, 806), are nitrated with the calculated quantity of nitric acid in presence of concentrated sulphuric acid.—A. S.

Lecithin derivative containing iodine and iron; Preparation of a ——. H. Kruft, Cologne. Ger. Pat. 292,961, Sept. 4, 1913.

A compound of therapeutic value, containing organically combined phosphorus, iron, iodine, and nitrogen, and resembling lecithin in character, is obtained by treating a saturated alcoholic solution of lecithin with alcoholic solutions of ferric chloride and iodine at 60° C.—A. S.

Barbituric acid derivatives ; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,163, Feb. 12, 1915.

Unsymmetrical disubstituted malonic acids of the general formula, $R_1R_2C(COOH)_2$, where R_1 is an alkyl or aryl group, and R_2 is an alicyclic radical or a secondary alkyl group of the isopropyl type, are converted into barbituric acid derivatives by the usual methods, or the second substituent may be introduced into a mono-substituted barbituric acid prepared from the corresponding malonic acid derivative or from barbituric acid, or into one of the intermediate products obtained in the preparation of the barbituric acid derivatives. Barbituric acid derivatives in which the carbon atom in the 5-position is attached to an alkyl or aryl group and to an alicyclic radical or an isopropyl or similar secondary alkyl group are less toxic and have a more powerful hypnotic action than other symmetrical and unsymmetrical disubstituted barbituric acids.—A. S.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Physical measurement of X-rays. Bronson. *See* XXIII.

Patent.

Colour photography and cinematography. F. W. Donisthorpe, Barnes. U.S. Pat. 1,193,879, Aug. 8, 1916. Date of appl., Mar. 26, 1914.

See Eng. Pat. 7368 of 1913 ; this J., 1914, 503.

XXII.—EXPLOSIVES ; MATCHES.

Patents.

Priming or detonating composition. M. R. Swope, New York. U.S. Pat. 1,194,095, Aug. 8, 1916. Date of appl., Feb. 28, 1916.

The composition consists of compressed nitrocellulose or other nitrocarbohydrate, a thiocyanate, and a chlorate or other oxygen conveyor.—C. A. M.

Explosive and method of manufacturing same. G. Spica, Venice, Italy. U.S. Pat. 1,194,561, Aug. 15, 1916. Date of appl., June 4, 1914.

See Fr. Pat. 473,264 of 1914 ; this J., 1915, 576.

Pyrotechnical composition ; Process of making a ——. M. Magnard, New York. Re-issue No. 14,177, Aug. 1, 1916 (Date of appl., May 3, 1916), of U.S. Pat. 759,387, May 10, 1904.

See this J., 1904, 623.

XXIII.—ANALYSIS.

Indicators for the colorimetric determination of hydrogen ion concentration ; Note on the sulphonephthaleins as ——. H. A. Lubs and W. M. Clark. J. Wash. Acad. Sci., 1916, 6, 481—483. (See this J., 1915, 1226.)

Some slight modifications have been made in the methods of preparation of certain of the indicators previously described (*loc. cit.*). Dibromo-*o*-cresolsulphonephthalein, prepared by bromination of *o*-cresolsulphonephthalein in glacial acetic acid, promises to be useful. It changes from yellow to brilliant purple over a range of $p_H = 5{\cdot}2$—$6{\cdot}8$; and a 0·04 % aqueous solution of its monosodium salt is recommended for use. Thymolsulphonephthalein (*loc. cit.*) changes from red to yellow between $p_H = 1{\cdot}2$ and 2·8, and from yellow to blue between $p_H = 8{\cdot}0$ and 9·6.—J. H. L.

Hydrogen ion concentration of bacteriological culture media ; Colorimetric determination of the ——. W. M. Clark and H. A. Lubs. J. Wash. Acad. Sci., 1916, 6, 483—489. (See preceding abstract.)

For the rapid determination of hydrogen ion concentration in vegetable or animal extracts, etc., the authors recommend the series of indicators given in the table, covering a range of $p_H = 1$ to 10 (*i.e.*, from $N/10$ acidity to faint alkalinity). The values of K in the table are the apparent dissociation constants determined by Salm's method (see this J., 1907, 642). In applying these indicators to the determination of hydrogen ion concentration in various vegetable and animal extracts, some deeply coloured, the authors obtained results rarely differing from the correct ones (found electrometrically) by more than $p_H = 0{\cdot}3$, and usually the agreement was much closer than this. With coloured liquids the compensation method of Walpole (Biochem. J., 1910, 5, 207) is very useful, and in some cases dark liquids may be diluted five-fold or more without any serious change in the value of p_H. The confusing effect of turbidity is often more serious than that of colour. This is particularly the case when bromophenol blue and bromocresol purple are used. Both exhibit dichromatism, their solutions being red in thick layers but blue in thin layers (at the proper p_H). It is therefore impossible with such indicators to establish a good comparison between a turbid liquid, which cannot be viewed in any great depth, and a clear standard liquid of the same p_H. The authors obtained fairly good measurements with bromophenol blue, and excellent ones with bromocresol purple, by illuminating with a bank of ordinary electric lights screened by translucent paper coated with an acid solution of phenolsulphonephthalein to absorb the shorter waves. The reactions of most urines fall within the working range of bromocresol blue. Thymol blue, in its acid range (see preceding abstract), should be useful with vinegars and cultures of yeasts and moulds. The most trustworthy indicators of the series are phenol red and cresol red. Over the range of p_H which thymol blue has in common with phenolphthalein and cresolphthalein, the authors found the two-colour indicator more useful than either of the phthaleins ; and generally they prefer two-colour indicators to one-colour indicators for the determination of hydrogen ion concentration.—J. H. L.

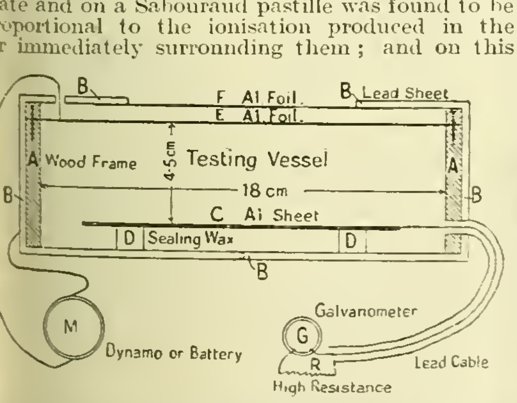
Chemical name of indicator.	Short name.	K as p_H.	Useful range, p_H.
Thymolsulphonephthalein (acid range)	Thymol blue	1·7	1·2—2·8
Tetrabromophenolsulphonephthalein	Bromophenol blue	4·1	2·8—4·6
o-Carboxybenzene-azo-dimethylaniline	Methyl red	5·4	4·4—6·0
o-Carboxybenzene-azo-dipropylaniline	Propyl red	5·1	4·8—6·4
Dibromo-*o*-cresolsulphonephthalein	Bromocresol purple	6·3	5·2—6·8
Dibromothymolsulphonephthalein	Bromothymol blue	7·0	6·0—7·6
Phenolsulphonephthalein .	Phenol red	7·9	6·8—8·4
o-Cresolsulphonephthalein	Cresol red	8·3	7·2—8·8
Thymolsulphonephthalein (alkaline range)	Thymol blue	8·9	8·0—9·6
o-Cresolphthalein	Cresolphthalein	9·4	8·2—9·8

Alkaline earths ; Investigation of the "chromate method" for separating the ——. H. B. Vickery. Proc. Nova Scotian Inst. Sci., 1914—1915, 14, 30—40.

The following procedure is recommended as the result of quantitative investigation :—(1) The filtrate from the precipitation of the iron and zinc groups is boiled to remove hydrogen sulphide, evaporated to 60 c.c., 10 c.c. of ammonia (sp.gr. 0·90), 20 c.c. of ammonium chloride (10 %), and 20 c.c. of ammonium carbonate (25 %) solutions are added at 70° C. and the mixture allowed to stand for several minutes. The precipitation of strontium and calcium is complete in 10 mins. and that of barium very nearly so. If the temperature be much above 70° C. the precipitated carbonates are partly reconverted into chlorides by reaction with ammonium chloride; while below 70° C. calcium and barium are precipitated in more or less gelatinous form. (2) The mixed carbonates are dissolved in 5 c.c. of acetic acid (50 %), the solution diluted to 80 c.c., heated to boiling, 5 c.c. of potassium chromate solution (5 %) slowly added, with constant stirring, and the mixture boiled and filtered. 500 mgrms. of calcium and strontium fail to precipitate under these conditions, whereas 4 mgrms. of barium gives a distinct precipitate; the presence of barium in the latter is confirmed by the flame test. (3) The yellow filtrate is evaporated to 80 c.c., at least 80 c.c. of ammonium chloride (80 c.c. for every 200 mgrms. of calcium present) and 10—15 c.c. of ammonium sulphate (10 %) solutions are added, the liquid boiled and allowed to stand for a few moments. The presence of strontium is indicated by a finely-granular, white precipitate and confirmed by boiling the latter with ammonium carbonate, neutralising the mixture with acetic acid, concentrating the solution to 10—20 c.c., and boiling with a saturated solution of calcium sulphate, when strontium sulphate is reprecipitated. If present to the extent of 100 mgrms., calcium is precipitated by ammonium sulphate as feathery, crystalline calcium sulphate unless a large excess of ammonium chloride is present; but the precipitation of strontium sulphate is inhibited to only a very slight extent by ammonium chloride. Under the above conditions 15 mgrms. of strontium may be readily detected in the presence of large amounts of calcium. (4) The hot filtrate from the ammonium sulphate treatment is made strongly alkaline with ammonia, 20 c.c. of hot ammonium oxalate solution (5 %) is added, and the liquid stirred to precipitate calcium. By the above procedure 1 mgrm. of calcium may be readily detected in the presence of 400 mgrms. of barium and strontium.—W. E. F. P.

X-rays; Physical measurement of ——. H. L. Bronson. Proc. Nova Scotian Inst. Sci., 1914—1915, 14, 17—29.

The action of Roentgen rays on a photographic plate and on a Sabouraud pastille was found to be proportional to the ionisation produced in the air immediately surrounding them; and on this rinciple a simple apparatus was devised for measuring the intensity and hardness of the rays. The apparatus (see fig.) consisted of a leaden case, connected with one terminal of a dynamo, M, and having at the top a large opening closed by a sheet of aluminium foil, F, above which the X-ray tube was mounted at any desired distance. Below F was a second sheet of aluminium foil, E, insulated from the case and connected with the other terminal of the dynamo, the latter being any fairly steady source of potential high enough to produce practical saturation (at least 100 volts). The foil, F, was used to protect E from possible electrostatic action, and both were too thin to produce appreciable absorption of the X-rays. Within the leaden case was an aluminium plate, C, insulated by sealing wax, D, and connected with a galvanometer, G (for measuring the current due to the X-ray ionisation between E and C) by a small, lead-covered cable, the lead cover of which was connected through the high resistance, R, (a pencil line on ground glass) with one terminal of the galvanometer and the lead case, B, of the testing vessel. A milliammeter was used for measuring the current through the tube, but the spark gap was the only means available for measuring the potential; the current varied between 5 and 0·3 milliampères and the spark gap between 8 and 18 cm. Satisfactory results in determining the intensity and hardness of the rays and the times of exposure necessary for producing radiographs of suitable density were obtained by means of this apparatus.—W. E. F. P.



Graphic studies of ultimate analyses of coals. Ralston. *See* IIa.

Determination of formic acid in pure solutions and in urine, together with a new method for the titration of calomel. Riesser. *See* VII.

Determination of nitrous oxide, air, and water vapour in mixtures of these constituents. Burrell and Jones. *See* VII.

Practical methods for testing refractory firebricks. Nesbitt and Bell. *See* VIII.

Chemical examination of plaster. Cavazzi. *See* IX.

Determination of copper in low-grade ores and slags. Hawley. *See* X.

Electrometric determination of vanadium. Determination of chromium and vanadium in steel by electrometric titration. Kelley and Conant. *See* X.

Determination of tungsten and its separation from tin. Dittler and Von Graffenried. *See* X.

Determination of the melting point of fats. Monhaupt. *See* XII.

Analysis of soap powders. Rosenberg and Lenher. *See* XII.

Colorimetric method for the detection of manganese in pigments, varnishes, etc. Sacher. *See* XIII.

Rapid method of estimating calcium oxide in peat soils. Gortner. *See* XVI.

Determination of dicyanodiamide in nitrolim (crude calcium cyanamide) by Caro's method. Hager and Kern. *See* XVI.

Determination of total hardness of water by means of potassium palmitate. Tilgner. *See* XIXb.

Detection of free chlorine in town water supplies. Le Roy. *See* XIXb.

Digitalis standardisation. Physiological evaluation of fat-free digitalis and commercial digitalin. Roth. *See* XX.

Analysis of mixtures of caffeine, acetanilide, antipyrine, phenacetin, salol, quinine, etc. Emery. *See* XX.

PATENTS.

Fluids ; Apparatus for ascertaining the properties of ——. H. Carmichael, Malden, Mass., and W. M. Grosvenor, Ridgewood, N.J., Assignors to Perkins Glue Co. U.S. Pat. 1,192,861, Aug. 1, 1916. Date of appl., July 11, 1914.

THE apparatus consists of a rotatable, cylindrical vessel containing the fluid, in which a cylindrical body is suspended by a wire attached to a support above. The upper face of the cylindrical body has a deep recess, to the bottom of which the wire and an enclosing tube are attached ; and means are provided on the exterior of the tube for measuring the effect produced on the suspended body by the rotation of the fluid in the container.
—W. E. F. P.

Pyrometer. G. F. Machlet, Elizabeth, N.J. U.S. Pat. 1,193,911, Aug. 8, 1916. Date of appl., Aug. 26, 1910 ; renewed Feb. 17, 1916.

THE apparatus consists of a thermo-element partly enclosed by a heat-conducting sheath, the latter having a terminal nipple adapted to withstand high temperatures and being in contact with the thermo-element ; a receptacle containing a heat-absorbing liquid which is directly in contact with and heated by the sheath ; and means for constantly maintaining the liquid at its boiling point while subjected to the heating action of the sheath, so that a standard or normal temperature (much lower than that to which the nipple is actually exposed) is established for the thermo-element, and the sheath protected from injury by heat.
—W. E. F. P.

Method and means for testing paper pulp. U.S. Pat. 1,193,613. *See* V.

Trade Report.

Prohibited exports. Order in Council, Sept. 8, 1916.

THE following headings have been deleted from the list of prohibited exports (see this J., 1916, 620) : (2) Waxes, mineral and vegetable (except carnauba), and composite waxes ; (3) bleaching powder ; brewers' dried yeast ; egg, yolk and liquid, and albumen ; strontium sulphate. The following headings have been added :—(1) Bleaching powder ; iron wire ; iron wire rods ; leather, sole ; (2) strontium sulphate ; waxes, animal, mineral, and vegetable (except carnauba), and composite waxes ; (3) albumen ; gramophone record compositions ; leather, not otherwise prohibited ; egg, yolk and liquid ; yeast.

Export licences.

THE Foreign Office announce that no further export licences or other facilities will be given for the importation of the commodities shown below into the country named until further notice.

Denmark.—Borate of lime, borax, and boron compounds ; sulphur.

Norway.—Borax and boron compounds ; nickel ; pitch.

Sweden.—Antimony ; casein ; rosin ; turpentine.

Netherlands.—Nickel ; pitch ; sulphur ; tar.

Exportation of certain articles from France.

A DECREE of the French Minister of Finance, dated Aug. 23rd, provides that the following articles may be exported or re-exported from France without special authorisation, when consigned to the United Kingdom, the British Dominions, Colonies and Protectorates :—Acetones ; animal wax, rough or worked ; coffee extracts ; menthol (essence of peppermint) ; monazite (ore of cerium, lanthanum, thorium) ; talc, steatite (tailors' chalk, Briançon chalk, etc.).

Books Received.

AGRICULTURE IN INDIA. By J. MACKENNA. Superintendent of Government Printing, Calcutta. 106 pages. Price 4 annas.

THE author gives a succinct account of the efforts which have been made to improve Indian Agriculture, and indicates the main lines on which the Agricultural Departments have been working since their reconstruction in 1905.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF METALS. Vol. IX. Published by the Institute, Buffalo, N.Y., U.S.A.

THIS volume contains a report of the proceedings of the ninth Annual Meeting, held at Atlantic City from Sept. 28th to Oct. 1st, 1915. The majority of the papers have been abstracted in this Journal (1913, 1112 ; 1914, 966 ; 1915, 857, 1015, 1057, 1058, 1097, 1098).

MINERAL RESOURCES OF THE UNITED STATES, 1914. U.S. Geological Survey, Washington. Part I., Metals, 995 pages. Part II., Non-metals, 112 pages.

INDUSTRIAL GASES. By G. MARTIN and others. Crosby, Lockwood & Son, 7, Stationers' Hal Court, London, E.C. 147 pages. Price 7s. 6d.

THIS is the seventh volume of the series of manua of technological chemistry, edited by Dr. Martin The chapter headings and contributors are a follows :—I. The liquefaction of gases, includin the manufacture of oxygen, nitrogen, and hydroge from liquefied gases (J. M. Dickson). II. Industria oxygen (G. Martin). III. Industrial nitroge (G. Martin). IV. Hydrogen (H. S. Redgrove) V. Producer-gas (H. S. Redgrove). VI. Th carbon dioxide industry (H. S. Redgrove). VII Manufacture of nitrous oxide (G. Martin). VIII The ammonia and ammonium salts industr (G. Martin). IX. The manufacture of sulphu dioxide and sulphites (G. Martin). X. Acetylen (F. B. Gatehouse). XI. The illuminating ga industry (E. A. Dancaster). XII. Industria ozone (E. Jobling).

OCCURRENCE OF EXPLOSIVE GASES IN COAL MINES By N. H. DARTON. U.S. Bureau of Mines Bulletin 72. Government Printing Offic Washington. 248 pages. Price 35 cents.*

THIS report gives the results of an investigation started in 1907, of the origin of inflammable gase in coal and the conditions under which the occur. The fields examined were in the norther anthracite basin of Pennsylvania and in the souther part of the bituminous coal field of Illinois.

ECONOMIC METHODS OF UTILISING WESTER LIGNITES. By E. J. BABCOCK. U.S. Bureau Mines, Bulletin 89. Government Printing Offic Washington. 73 pages. Price 15 cents.*

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* A certain number of these publications can be obtained fr on application to the respective Government Departments.

In the case of the U.S. Government publications, when this su ply is exhausted, copies can be obtained at the prices mentione from the Superintendent of Documents, Washington, D.C., U.S.

Journal of the Society of Chemical Industry.

No. 19, Vol. XXXV. OCTOBER 16, 1916. No. 19, Vol. XXXV.

Official Notice.

DEFENCE OF THE REALM REGULATIONS.

An Order-in-Council. dated 7th September, 'urther amends the "Defence of the Realm (Con- solidation) Regulations, 1914." The following unendments in the Regulations are ordered :—

SECTION 1.) REQUIREMENT OF DISCLOSURE OF PARTICULARS OF INVENTIONS, PROCESSES OF MANUFACTURE, ETC., RELATING TO WAR MATERIAL.

After regulation 8c the following regulation hall be inserted :—

"8cc. It shall be lawful for the Admiralty or rmy Council or Minister of Munitions. with a iew to the more efficient or increased production f war material, to require any person to com- unicate to a person nominated for that purpose y the Admiralty, Army Council, or Minister of Iunitions all such particulars as may be in his ossession of any invention, or process or method f manufacture, or of any article manufactured or roposed to be manufactured, and to furnish rawings, models, or plans thereof. and to explain nd demonstrate the same to such person. in all r any of its uses and workings ; and if any person ils or neglects to comply with any such require- ent he shall be guilty of an offence against these gulations ; and if the requirement is addressed a company, every director, manager, or officer the company who fails or neglects to comply ith such requirement shall also be guilty of an fence against these regulations.

"If any person, except as authorised by the dmiralty or Army Council or Minister of Muni- ons, discloses or makes use of any information tained in consequence of any requirement made der this regulation or communicated to him the person by whom it was so obtained, he shall guilty of an offence against these regulations.

"No communication of an invention made in nsequence of any requirement under this gulation, or the use thereof by any person thorised under this regulation to use it, shall ejudice any right of the inventor or owner ereof subsequently to apply for or obtain a tent for the invention."

Edinburgh Section.

eeting held at Edinburgh, on Wednesday, May 17th, 1916.

PROF. JAMES WALKER IN THE CHAIR.

ME ASPECTS OF THE SYNTHESIS OF CAOUTCHOUC.

BY B. D. W. LUFF, F.I.C.

The synthesis of caoutchouc was recorded long ore any very definite ideas were formulated to its constitution. Pure caoutchouc is a drocarbon having the empirical formula C_5H_8 ; molecular weight, however, cannot be ascer- ned by means at present available, owing to the t that it is a colloid. Moreover, the number of nple derivatives which may be obtained is extremely limited and these, being chiefly amorphous and almost impossible to obtain in a pure condition, afford very little insight into the nature of the parent substance. The most readily prepared is the bromide, $C_5H_8Br_2$, a white amorphous solid formed by treating caoutchouc with bromine in chloroform solution ; it is. however, almost impossible to obtain a specimen which approximates sufficiently closely to the empirical formula, to be considered as pure. Perhaps the most interesting derivative is the diozonide, which can be prepared by passing ozone into a chloroform solution of caoutchouc ; on evaporation a vitreous solid is obtained, melting at 50° C. Harries (Ber., 1905, **38**, p. 1195) found that this had a molecular weight corresponding to the formula $C_{10}H_{16}O_6$. On hydrolysis this yields equimolecular proportions of lævulinic aldehyde and lævulinic aldehyde peroxide, the latter subsequently breaking up into lævulinic acid and hydrogen peroxide. Hydrochloric acid and oxides of nitrogen also combine with caoutchouc forming compounds which are more or less ill-defined and need not be discussed here.

More interesting results. however. are obtained on submitting caoutchouc to destructive distillation. As far back as 1833 a patent was granted to Barnard for the invention of "a solvent not hitherto used in the arts" which was obtained by distilling rubber from an iron retort ; this oil could be used to dissolve caoutchouc itself, resins, fatty bodies, etc., and, moreover, could be used as an illuminant. The work was subsequently taken up on more scientific lines by various investigators, including Dalton, Liebig, Himly, A. Bouchardat, and Gregory, their results being embodied in various publications issued between 1835 and 1840, but in all cases their efforts were more or less disjointed.

The most systematic attempt to isolate and examine the various products present in the crude distillate was made by Greville Williams in 1860. He obtained (1) a liquid boiling at 37° C. to which he gave the name "Isoprene"—the molecular formula of this body was found to be C_5H_8 ; (2) a large proportion of a hydrocarbon boiling at 170°—173° C., which was identical with a body previously obtained by Himly, and called caoutchine—the molecular formula of this was $C_{10}H_{16}$, and it may be noted that it has since been proved to be dipentene ; (3) a fraction boiling above 300° to which he gave the name "Heveene."

Some years later, in 1879, Gustave Bouchardat, son of A. Bouchardat, undertook a detailed investigation of isoprene, in the course of which he examined the action of hydrochloric acid ; he noted that an addition product was formed but under certain conditions the action of the acid resulted in the formation of a solid mass, not containing chlorine, but having in fact the same percentage composition as the isoprene itself. In describing this body he says "it possesses the elasticity and other properties of rubber itself. It is insoluble in alcohol swells up in ether and also in carbon bisulphide in which it dissolves after the fashion of natural rubber." Moreover, he noted that on distillation it yielded the same hydrocarbons as in the case of the natural product.

This, then, was an important step in the synthesis of caoutchouc ; in fact, in order to make this complete, all that was necessary was to prepare isoprene, a comparatively simple hydrocarbon, from elementary materials ; at that time the only source of isoprene was rubber itself.

Although Bouchardat regarded the product he had obtained as identical with natural rubber, yet the fact that it was elastic and behaved in a similar manner towards solvents did not suffice to establish definitely the relationship existing between them.

Bouchardat's results received confirmation in 1882 at the hands of Tilden (Chem. News, 1882, **46,** 120) who observed the polymerisation of isoprene when treated with nitrosyl chloride, a reagent which he had used in connection with work on terpenes. In discussing isoprene he remarked that one of the chief characteristics of this body was its conversion into true caoutchouc or indiarubber when brought into contact with certain chemical reagents; he pointed out that this was of great practical interest as, if isoprene could be obtained from some other and more accessible source, the synthetical production of rubber could be accomplished. Two years later Tilden succeeded in obtaining isoprene by passing the vapours of turpentine through a hot tube, the yield, however, being very small in proportion to the amount taken; nevertheless the solution of the problem at any rate from a commercial point of view appeared to be in sight as the initial material was fairly abundant and the cost not excessive.

The outcome of the work of these two investigators was that the caoutchouc molecule was shown to be formed by the union of a number of molecules of isoprene, *i.e.*, it was a polymer of this body, and moreover this union or polymerisation could be brought about by treating the isoprene with suitable reagents.

To them must be given the major share of the credit for laying the foundation of the numerous processes since suggested for preparing synthetic rubber. The importance of their observations will be apparent when we consider that this method of polymerising a simple hydrocarbon is at present the only one by which the complex rubber molecule may be said to have been reproduced. Their work affords a very good illustration of the value of making careful note of changes occurring during a reaction; what organic chemist has not at some time or another succeeded in obtaining, instead of the crystalline solid he had hoped for, an uninviting plastic mass which was promptly discarded as of no consequence? However, Bouchardat and Tilden had in their favour the knowledge that the isoprene which they used had been obtained from rubber itself, so that the identity of their product with this body would the more readily suggest itself.

Subsequently Wallach (Annalen, 1887, **238,** 88) observed that isoprene underwent polymerisation on exposure to light with production of a rubber-like mass. Tilden (Chem. News, 1892, **65,** 265) also drew attention to this phenomenon and at the same time recorded the fact that the material obtained in this manner could be vulcanised with sulphur in the usual way, this pointing to a close relationship existing between the synthetic and the natural material.

Some idea of the quantitative nature of the polymerisation may be gathered from the statement by Weber (this Journal, 1891, **13,** 11) to the effect that from 300 grms. of isoprene, after a period of 9 months, 211 grms. of caoutchouc was obtained.

The synthesis of isoprene and as a corollary that of caoutchouc was accomplished by Euler in 1897 (Ber., 1897, **30,** 1989) and his work together with that of Ipatiew (J. prakt. Chem., 1897, **55,** 4) established the constitution of this body, showing it to be β-methyldivinyl, $CH_2:C(CH_3).CH:CH_2$. This supported the view entertained by Tilden some time previously.

The auto-polymerisation of isoprene was confirmed later by Pickles (Trans. Chem. Soc., 1910, **97,** 1085); in this case the change was not complete after upwards of three years. The product possessed a certain amount of elasticity but was not equal to Para rubber, resembling rather that obtained from immature trees; the comparison, it may be noted, was based on unvulcanised samples. Pickles, furthermore, prepared derivatives with the aid of bromine and oxides of nitrogen, in each case obtaining bodies apparently identical with those resulting from the employment of natural rubber.

The nature of the polymerisation of the simple isoprene molecule to the caoutchouc complex was also discussed by this worker, whose views are as nearly as possible in accordance with observed facts. The union of the C_5H_8 groups is held to be a chemical one, caoutchouc being represented by a chain of an indefinite number of these units connected at the ends to form a ring. This conception, which is perhaps the simplest of the many put forward, has been contested by Harries and others, but in the meantime may be accepted as it does not involve the assumption of molecular aggregation of an unnecessarily vague character.

With the synthesis of isoprene in 1897, the problem of the synthetic production of caoutchouc, at least from an academic point of view, could be regarded as solved. For some time, however, no serious attempt was made to put it on a satisfactory commercial basis.

One of the first methods which attracted attention was that suggested by Heinemann in 1907, which consisted in passing a mixture of acetylene, ethylene, and methyl chloride through a hot tube when isoprene should result.

$$C_2H_4+C_2H_2+CH_3Cl=CH_2:C(CH_3).CH:CH_2+HCl.$$

This reaction, however plausible it might seem, did not appear to take place as desired, with the result that the method was abandoned; it is interesting, however, as being the first instance in which an industrial concern had endeavoured to make the synthesis a commercial success.

Another type of process which at this time received treatment at the hands of a number of workers was that in which, following the lines indicated by Tilden, turpentine was submitted to "cracking" processes. This line of work, which at first sight seemed fairly promising, was ultimately abandoned as supplies of the initial material were becoming somewhat limited and the tendency was for prices to rise; in any case, the yield of isoprene was never satisfactory.

In 1909, owing no doubt to the rapid rise in the price of rubber, the problem was attacked in a systematic manner in this country by a group of chemists which included among others Perkin, Fernbach, Weizmann, and Matthews; in Germany, too, the Bayer and the Badische Companies had taken the matter up and from this time onward an enormous number of processes have been outlined which, at any rate, may be said to be alive with possibilities.

To give anything like a detailed account of these would be outside the scope of this paper, but it will suffice to give types illustrative of the varied ways by which the desired end may be attained. It must be clearly understood, however, that the instances quoted are merely by way of illustration and in no way to be considered as likely to lead to better results than could be obtained in the case of most other methods.

In 1884 Tilden suggested that not only isoprene but its homologues should be capable of polymerisation in a similar manner. This was indeed found to be the case, as subsequent investigators showed that many unsaturated hydrocarbons containing conjugated double bonds exhibited this property, the products thus formed varying from resinous masses to rubber-like bodies. Chief among them may be mentioned butadiene (or erythrene), $CH_2:CH.CH:CH_2$, and dimethyl butadiene, $CH_2:C(CH_3).C(CH_3):CH_2$. It is no surprising then to find these compounds forming the basis of methods for obtaining synthetic caoutchoucs.

In considering the materials available as the starting points for suggested syntheses, it would be as well to confine our attention to those of which the supply is fairly abundant. Among these coal tar at once suggests itself, and indeed a process has been worked out starting from *p*-cresol. This is first reduced by the Sabatier method, the product oxidised to β-methyladipic acid, and by elimination of the carboxyl groups, together with two atoms of hydrogen, isoprene is obtained. In a similar manner, starting with phenol, butadiene can be prepared; the number of stages necessary to complete the reaction, however, renders the process of little value.

The low-boiling fractions obtained in petroleum distillation have also been suggested as the starting points for obtaining isoprene. The normal and iso-pentanes which are present are converted into dihalogen derivatives and from these two molecules of HCl eliminated. The chief difficulty in processes of this type is in arriving at the desired dihalogenide and many methods have been suggested with a view to surmounting this obstacle.

From starch isoprene may be prepared in a variety of ways; most noteworthy is the method described by Perkin (this Journal, 1912, 621) which consists in bringing about fermentation in such a manner that amyl alcohols are produced in much greater proportion than is usually the case; these are converted into dichloro-derivatives and two molecules of HCl split off by means of soda-lime, isoprene being thus produced. Butadiene can be prepared in a similar manner from butyl alcohol.

From starch again ethyl alcohol may be obtained, and according to Ostromyslenski (this Journal, 1916, 69) if this is passed along with a little air over heated copper gauze a proportion of the alcohol is oxidised to acetaldehyde; the mixture of aldehyde and alcohol is then passed over heated alumina whereupon water is eliminated and butadiene produced.

$$CH_3.CHO + CH_3.CH_2OH \rightarrow CH_2 : CH.CH : CH_2 + 2H_2O.$$

This process is certainly suggestive and appeals to one by its very simplicity, but the success; will naturally depend on the yield of butadiene as a general rule pyrogenetic reactions of this type do not take place in one direction only. It is worthy of note that Ostromyslenski (*loc. cit.*) has quite recently published a series of papers dealing with new methods for preparing these hydrocarbons; these are remarkable if for nothing else than the exhaustive consideration which he has given to the subject, as an instance of which may be cited one paper in which he describes no less than 29 new methods for preparing butadiene.

Cellulose has also been suggested as raw material for preparing isoprene; a method has recently been worked out for obtaining lævulinic acid in considerable quantity by submitting sawdust to the hydrolytic action of dilute acids under pressure. With the aid of phosphorus trisulphide the acid so obtained is converted into methylthiophene and by passing this over heated copper along with a stream of hydrogen, isoprene is formed, H_2S being eliminated.

These instances then may be taken as typical of the many processes put forward as being likely to lead to the commercial preparation of isoprene and other closely related bodies.

The production of the necessary unsaturated hydrocarbon is however merely the first stage in the synthesis of caoutchouc, the next step being to bring about polymerisation by some means.

At the outset it was generally recognised that agents hitherto employed in experiments on a laboratory scale did not give at all satisfactory yields of rubber and the need for a more efficient method was evident. One of the most promising was that proposed by Harries in 1910 (this Journal, 1910, 502) which consisted in heating isoprene in a sealed tube with glacial acetic acid; subsequently the same worker announced that better results could be obtained by the use of sodium, the polymerisation to caoutchouc taking place almost quantitatively in the cold. Curiously enough this same agent had already been patented in this country by Matthews and Strange, the former having made the discovery in 1910; the patent however had not been disclosed, so that evidently it was an instance of different investigators arriving at the same result independently of each other. Harries prepared and described two series of rubbers resulting from the polymerisation of butadiene, isoprene, etc., on the one hand with sodium as the condensing agent, and on the other hand using acetic acid. The products obtained by the use of sodium, although resembling rubber in so far as their physical properties were concerned, did not behave similarly when submitted to chemical treatment. The acetic acid products presented a closer analogy from a chemical standpoint but were inferior physically.

It is interesting to note in passing that Greville Williams in 1860 distilled his isoprene over sodium, but most probably the two bodies would not be left in contact for any considerable time, at any rate not long enough for any appreciable polymerisation to take place.

Without venturing to give any definite opinion as to the future developments in connection with the many processes hitherto evolved for producing synthetic rubber, the present position may be put briefly as follows:—

There is no doubt that caoutchouc-like bodies have been prepared by means similar to those outlined above; as to whether these can be regarded as true caoutchouc is a matter of doubt. It will be understood that on account of the colloidal nature of this body the question cannot be settled by determining such physical characteristics as would serve to identify a crystalline solid such as camphor. In the case of a body such as the latter the specific properties which render it of interest can be directly attributed to a well defined molecular structure, the reproduction of which by whatever means ensures possession of these properties. In the case of caoutchouc, however, this cannot be brought about with certainty. Indeed, many of the proposed methods do not purport to give a product chemically identical with the natural material. In the case of the polymerisation of butadiene (C_4H_6), it is manifestly impossible to obtain a body having an empirical formula C_5H_8, although physically the resulting mass is perhaps the most satisfactory of any obtained up to the present.

Harries (this Journal, 1912, p. 733) holds the view that caoutchouc obtained from isoprene with the aid of acetic acid is identical with that occurring in nature, basing this assertion on a study of the ozonides. That derived from the synthetic material is said to give on hydrolysis lævulinic acid and lævulinic aldehyde only, the reaction proceeding with the same velocity as in the case of the natural derivative. On the other hand Steimmig (this Journal, 1914, p. 268) dissents from this opinion, the results of his experiments on the hydrolysis leading him to the conclusion that there is present, in addition, a body produced by the asymmetric polymerisation of isoprene. Harries however maintains his original attitude and attributes Steimmig's results to the use of impure isoprene.

The synthetic caoutchouc obtained by polymerising isoprene in the presence of sodium, however, is not identical with the natural product as neither lævulinic acid nor lævulinic aldehyde is formed on submitting the ozonide to hydrolysis.

It might be urged that the chemical characteristics are of relatively little importance if the material fulfils all the needs of the manufacturer, and this is undoubtedly the correct view to take. Up to the present, however, the quantities of synthetic rubber produced have been so small as not to admit of a comparison being made with the natural material on anything like a satisfactory scale. The rubber manufacturer knows too well that a substance which might truthfully be called a "tough elastic mass" or "caoutchouc-like body" need not necessarily be as good in every way as the product of the plantations in the East.

A glance through one or two specifications to which various rubber articles must conform would quickly convince the reader that a product destined to replace caoutchouc for all purposes must possess properties of a very varied character.

Even if a synthetic body were obtained which could be said to compare favourably with the natural article, the price would obviously become a determining factor in the chance of success: it is here that an industrial process would encounter almost insuperable difficulties. At the time when chemists began to turn their attention towards synthetic rubber the price of this commodity was abnormally high, reaching as much as 12s. 6d. per lb. in 1910. Since then, however, there has been a steady fall, reaching as low as 2s. 4d. per lb. in 1915. This is accounted for by the plantations coming into bearing, the products thereof occupying a very prominent place in the world's markets. The recent growth of the plantation industry, and the very different conditions which a synthetic product has now to face compared with those obtaining in quite recent years, can be seen at a glance from the following tables:—

Plantations—area under rubber.

	Ceylon.	Malaya.
1901	2,500 acres	nil
1912	230,000 ,,	621,621 acres

Tons of plantation rubber exported.

	Ceylon.	Malaya.
1904	35 tons	nil
1912	6,697 ,,	18,956 tons

World's supply of plantation rubber.

1912	28,500 tons
1915	98,000 ,,

The rapid strides which have been made in the cultivation of rubber will thus be evident, and as there is every prospect of the yields increasing for some time to come this is bound to react on the price, and it is generally assumed that unless a synthetic product can be put on the market at about 1s. 3d. per lb. there is little hope of the natural material being superseded.

As chemists, perhaps, it would be gratifying to know that another triumph had been won in the industrial field, but whatever the outcome may be, it is well to remember that the chief factor militating against success is the result of scientific energy expended in other directions, that is to say, in raising the product of the plantation to the highest pitch of perfection.

SOME NOTES ON THE RAW MATERIALS USED BY THE RUBBER MANUFACTURER.

BY B. D. PORRITT, M.SC., F.I.C.

The many varied applications which have been found for rubber in the arts may be attributed in the first place to the remarkable alteration in its physical properties which occurs when this substance is mixed with sulphur and heated, and secondly to the further modifications which can be effected by the incorporation of various mineral and organic substances. The first process is known as "vulcanisation" and the second as "compounding."

Were it not for the discovery and development of these processes the rubber industry would never have reached its present importance, and, instead of uses innumerable, the technical application of rubber would probably have been limited to the manufacture of waterproof garments and similar goods.

First of all, rubber itself, and the changes it undergoes when treated with sulphur and vulcanising agents, may be considered, and subsequently some of the other ingredients which are added by the manufacturer in order further to modify the physical and other properties of his products will be dealt with briefly.

Raw rubber is often far from a clean substance when it reaches the manufacturer, and usually requires washing and drying prior to use. The moisture and impurities removed by this process have been known on occasion to amount to as much as 60% for some dirty varieties of wild African rubber, but the average for the supplies of uncultivated raw material would be nearer half this figure.

Owing to the rapid development of the plantation industry many inferior types of wild rubber have dropped out of the market, and in place of the almost endless variety available some eight years ago, the manufacturer of to-day is mainly concerned with the various grades of wild Para and cultivated *Hevea* rubber, for which the combined washing and drying losses are about 20% and 1% respectively.

This change in the supply of the primary raw material obviously represents a very important simplification for the rubber manufacturer, both from the point of view of purchasing and uniformity of factory running.

Even after washing and drying, good quality rubber is not a chemically pure substance, since it still contains, besides caoutchouc, a small quantity of resin, some nitrogenous and other organic substances, together with a small amount of mineral matter. For instance, an average sample of plantation sheet, after washing and air drying for four weeks, will contain about 94·5% of caoutchouc, the difference being made up by about 0·25% of moisture, 0·25% of ash, 2·5% of resins, and about 2·5% insoluble nitrogenous and other organic impurities.

In addition to the variations which exist in the amounts of the non-caoutchouc constituents present, it is found that the caoutchouc in different rubbers is itself not always identical in physical properties, and in dealing with different varieties of rubber considerable variation will be found in the resistance to oxidation, the temperature of softening, the viscosity of solutions, and the amount of mechanical working required in preparing the material for factory use. Such variations must be attributed to the fact that caoutchouc is a colloid.

Exposure to light, mechanical working, heating etc., considerably modify the properties of raw rubber without any corresponding chemical change being detectable,* and, owing to the inapplicability of any of the usual tests which serve as criteria of purity for crystalline organic compounds, it is impossible to determine whether chemically purified caoutchouc is a simple substance or a mixture. It is interesting to notice in this connection that almost every worker in this field has experienced difficulty in preparing purified material free from oxygen, and that Caspari,[*] by means of petroleum ether, has separated the caoutchouc from wild and cultivated *Hevea* into two varieties, differing in their physical properties and behaviour towards solvents.

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* Harries, Annalen, 1911, **383**, 157.

Those unfamiliar with the rubber industry might be inclined to ask why the manufacturer is satisfied generally merely to remove the gross mechanical impurities without further chemical purification. The removal of the resins and nitrogenous constituents representing the chief impurities would, however, be an exceedingly difficult operation on the technical scale, and would in addition result in an inferior product. The former constituent is found to enhance greatly the resistance of the caoutchouc to oxidation, to which under certain conditions it is somewhat prone,[†] and moreover appears to play a considerable part in the process of vulcanisation, litharge in its absence being inoperative as an accelerator. It has for some time been known that the nitrogenous constituents also facilitate vulcanisation, but these substances have recently attracted increased attention as a result of some investigations carried out by the Laboratory of the Agricultural Department of the Federated Malay States,[‡] which would indicate that the variation in the rate of vulcanisation, which constitutes the chief defect of the plantation rubber, is probably to be attributed to irregular changes which take place in these proteid constituents in consequence of variations in the process of separating and drying the coagulum from the latex. The fact, however, remains that rubber, and plantation rubber in particular, cannot be regarded as fulfilling at present one of the essentials of an ideal raw material in that it is not uniform in quality. Variation in vulcanisation properties, which is the chief defect, will inevitably result in variations in strength under the conditions of uniform treatment necessary during the manufacture of rubber goods on a large scale, when it is evidently impracticable to modify the conditions of vulcanisation to suit each individual consignment of rubber. Technical experience would indicate, moreover, that the cultivated product is somewhat inferior to Para rubber for the preparation of solutions, and also in its resistance to the repeated application of stresses such as are experienced by articles such as catapult cord. Investigations which have as object the production of a uniform plantation product are beset with both scientific and geographical difficulties, due to the complexity of the problems involved and the wide separation of the producer and consumer. Recent publications, however, manifest substantial progress towards this goal. They testify, moreover, that those responsible for the future of one of our youngest and most successful commercial enterprises, which in the course of a few years has made the British Empire the largest rubber producer in the world, are fully alive to the necessity for continuous progress and the need for scientific research.[§]

At the same time co-ordination between the several agencies responsible for research in this field, with the elimination of jealousy and overlapping, is evidently desirable if rapid progress is to be made in the production of the uniform plantation product so important in the interests of the consumer.

The remarkable changes which are effected in the properties of rubber by the addition of sulphur and heating can now be considered.

If two mixtures, the one containing about 95% of rubber and 5% of sulphur, the other 65% and 35% respectively, are heated in steam, the former for about 2½—3 hours at 50 lb. pressure and the latter for a considerably longer period at a higher pressure, striking changes will be found to have taken place in their physical qualities, and they will besides present a marked contrast in appearance. The sample with the low sulphur content on comparison with the untreated material will be found to be little altered in appearance, but enormously improved in strength and resilience.

Further, it will have become insoluble at ordinary temperatures in the usual solvents for rubber, and a proportion of the added sulphur will be found to have become firmly combined with the caoutchouc. The second sample will have been transformed into a hard, jet black material, totally different in its properties from the original yellow plastic mixture of rubber and sulphur.

These examples illustrate the two distinct branches of rubber manufacture—"soft rubber" and "hard rubber." The latter is known also as "vulcanite" or "ebonite," and the process by which these changes are effected is termed "vulcanisation" or "curing." The formation of "hard rubber" can be explained by the assumption that an addition compound $(C_5H_8S)_x$ is formed by the unsaturated caoutchouc and the sulphur. This empirical formula corresponds to a combined sulphur content of 32%, which is in accordance with observed facts. Whether other molecular changes accompany this reaction it is impossible to determine in the absence of information regarding the molecular weights and constitutions of the initial and final products.

The nature of "soft cured" rubber is less readily explained, and in spite of a considerable amount of research work during recent years, it is still a subject of discussion.

Satisfactory vulcanisation may be effected by the combination of from 1·5 to 4·5% of sulphur, depending on the nature of the other ingredients present; these figures do not correspond with the formation of any definite caoutchouc-sulphur compound, though it cannot be assumed that the sulphur has combined uniformly, and possibly there may be present varying quantities of a definite caoutchouc-sulphur compound or compounds dissolved in unchanged caoutchouc. If vulcanised rubber consists of such a mixture its resolution into the several constituents has not as yet been effected. It would seem probable that, in addition to the combination of sulphur, some polymerisation change may take place in the caoutchouc with the formation of a substance of higher molecular aggregation insoluble in solvents.

The polymerising action of sodium on isoprene and butadiene is interesting in this connection; but it is noteworthy that vulcanised rubber "depolymerised" during the process of "reclaiming" does not become soluble once more in solvents.

The remarkable effect produced by this small addition of sulphur was discovered by Goodyear in 1839. It is therefore surprising to find that, in 1916, sulphur is still almost exclusively employed for the purpose of vulcanisation.

No satisfactory explanation has as yet been advanced to account for this property, possessed apparently by sulphur alone of the elements, or for the fact that this action can be accelerated by the presence of litharge and basic substances, and that, in the absence of litharge, a certain amount of pressure seems necessary for the action to take place satisfactorily.

At various times compounds, such as hypochlorites, iodine, and polysulphides, have been proposed as vulcanising agents, but have found at the most only limited technical application.

According to the latest suggestion of this kind a large number of aromatic nitro-compounds are efficient substitutes for sulphur in the process of vulcanisation.*

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[*] Caspari, this J., 1913, 104.
[†] Peachey, this J., 1912, 1103.
[‡] Eaton and Grantham, this J., 1915, 898.
[§] For contrary opinion see H. E. Armstrong, this J., 1916, 501.

It has been found that dinitrobenzene, one of the substances named, is quite inoperative as a vulcanising agent,† and simultaneous work in this laboratory ‡ employing pure 1-methyl-2.4.6-trinitrobenzene confirms the foregoing observation; this latter substance acts neither as a vulcaniser nor an accelerator, but rather as an oxidising agent, the rubber being markedly deteriorated on heating when appreciable quantities of the nitro-compound are admixed.

Apart from sulphur one substance only, and that a sulphur compound, has found general application for the purpose of vulcanisation, the use of sulphur monochloride at ordinary temperatures for this purpose having been patented by Parkes in 1846. The vulcanisation of rubber may, therefore, be effected by one of two general methods—the "hot cure" process, in which sulphur and heat are the agents, and the "cold cure" process just mentioned.

There are three modifications of the former method in general use.

(1) The "steam heat" process can be used for textile and other goods on which the rubber coating is comparatively thin, the material being suitably protected from the deposition of moisture and subjected to the action of steam under pressure. The tendency of the uncombined sulphur to effloresce or "bloom up" on the surface renders this process inapplicable when brightly coloured goods are desired. A modification of this method has been described recently in which the heating is carried out in an indifferent gas under pressure.§

(2) The "dry heat" process also employed for lightly rubbered articles, especially shoes, differs from the previous instance in vulcanisation being effected at ordinary pressure in large hot-air chambers heated by steam pipes. The presence of litharge in addition to sulphur is essential to the success of this process and, owing to the consequent formation of lead sulphide, articles vulcanised in this way are always black. The open heating, however, results in the volatilisation of the greater part of the free sulphur, so that a permanent dead black finish is secured.

(3) The "press cure" process is employed for heavy articles, such as buffers and motor tyres, which are vulcanised in moulds placed in heated hydraulic presses.

The "cold cure" process is rapid and results in a material possessing a soft velvety finish. It permits the production of brilliantly pigmented articles which will not "bloom" but which are generally somewhat deficient in permanence. This method, which is suitable only for lightly coated goods, can be carried out either by dipping in a dilute solution of sulphur chloride in carbon bisulphide or by exposure to the vapour in a large chamber. Whichever method is used, an after-treatment with ammonia must follow to neutralise any acid formed by the action of moisture on the excess sulphur chloride.

Incorrect vulcanisation probably is responsible for as much trouble in the factory as is caused by inferior or defective raw materials. Not only will it result in defective physical qualities, but the material will be liable to oxidise or "perish" in the course of a few weeks, if the treatment has been unduly severe.

The conditions and duration of heating to ensure satisfactory vulcanisation will depend upon the nature of the ingredients and the proportion of each in the mixing. It is therefore of the utmost importance that the rubber manufacturer should employ uniform raw materials, and should submit all factory mixings to careful physical tests in the laboratory in order to determine the correct conditions of vulcanisation, judged by strength and durability, before undertaking the manufacture of goods for sale.

The many other fillers employed by manufacturers, apart from rubber and sulphur, remain for brief consideration. These sometimes are spoken of as "drugs" in the trade. This metaphor is very appropriate since they are materials which, while valuable in skilled hands, may become deleterious when misapplied. It has been said,* "If it had never occurred to any one to mix extraneous substances with rubber, it is safe to say that the industry as we know it would be inconceivable; rubber manufacture would have expanded perhaps in volume, but hardly in scope, beyond its boundaries of pre-vulcanisation times. In unvulcanised rubber we have one material, in soft cured rubber a second, and in ebonite a third; but by admitting compounding ingredients we gain innumerable new materials. Moreover, the lowering of prices thus achieved has done much to widen the market for rubber goods."

In making such additions, the manufacturer may have any of the following objects in view:—(1) Mechanical properties, such as stiffness, toughness, etc. (2) Chemical or physical properties, for example, indifference to acids and dielectric resistance. (3) Colour. (4) Duration of vulcanisation. (5) Cost. These "compounding" ingredients may be divided into two classes, organic substances such as reclaimed rubber, rubber substitute, and bitumen; and mineral compounds, for example, zinc oxide, barytes, and whiting.

It is unnecessary to consider exhaustively the merits and defects of the many different fillers employed by rubber manufacturers, and it will suffice to refer to some of the more important. It might be mentioned in passing, however, that compounds of copper appear to exert a highly prejudicial influence on the durability of rubber goods, and must be avoided carefully for this reason.† A "pure" vulcanised rubber, on account of its extensibility and softness, would be unsuitable for many purposes involving abrasion or compression. It is therefore necessary to incorporate a suitable proportion of mineral matter when rubber is needed for mechanical uses, and zinc oxide and magnesia are the fillers generally favoured by manufacturers for this purpose. The conditions to be satisfied by an eraser are in direct contrast to the foregoing requirements, and, instead of being tough and resistant to abrasion, the material must be flexible and friable. These qualities can be secured by the employment of a large proportion of "white rubber substitute," prepared by acting on rape oil with sulphur monochloride. This, when the goods are dark in colour, can be replaced by a "brown substitute" resulting from the action of sulphur on vegetable oil at a high temperature.

The choice of pigments for the production of coloured articles depends to a considerable extent on the method of vulcanisation selected.

When vulcanisation by heat is necessary the number of pigments which are at the same time cheap and permanent is somewhat limited, the ones generally used being antimony sulphide, yellow arsenic sulphide, zinc chromate, green oxide of chromium, ultramarine, and lamp-black. The cold cure process permits a selection being made from a much wider range of colours, including many brilliant permanent dyes and lake pigments.

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* Ostromyslenski, this J., 1916, 59.
† Stevens, Le Caoutchouc et la Gutta Percha, 1916, 8880.
‡ The author in conjunction with Mr. W. G. Martin.
§ India Rubber World, 1916, 883.

* Caspari, "India Rubber Laboratory Practice," p. 87.
† Thomson and Lewis, this J., 1891, 712.
Dewar, this J., 1891, 71.

The question of accelerators for the hot vulcanisation process may now be considered. These are important for three reasons. In the first place, their use ensures a larger output from the vulcanising plant, or permits the employment of lower temperatures; secondly, they provide a means whereby the correct vulcanisation conditions of two different mixings used in conjunction may be made identical, as, for example, the tube and cover of a hose, and finally by their use the addition of sulphur may be somewhat reduced with a view to minimising "blooming." Litharge is the most effective of these substances, but lime, magnesia, and certain basic organic compounds[*] possess the same property in a lesser degree, and can be employed when colour or other considerations render the use of litharge inadmissible.

The production of satisfactory rubber goods at moderate prices for the many purposes which do not require high mechanical strength has been greatly assisted by the discovery and development of the acid and alkali processes for reclaiming waste rubber. By means of reduction to a fine state of division and chemical treatment followed by washing, it is found possible to remove the textile impurities generally present in rubber waste. The cleaned material can subsequently be restored to a plastic condition by heating in steam under pressure, and the product may after drying be employed either partially or wholly to replace rubber in mixings, which can be vulcanised in the usual manner.

It is noteworthy that up to the present all the various processes having as their object the removal of combined sulphur and the regeneration of the caoutchouc in a soluble form have met with no success, since the combined sulphur appears to be retained tenaciously. Reclaimed rubber, therefore, prepared from vulcanised waste, will be insoluble in rubber solvents, and will contain unchanged the greater proportion of the original fillers, since the methods of preparation have as object merely the restoration of plasticity.

This necessarily superficial sketch of the materials used by the rubber manufacturer would be incomplete without reference to the large amounts of textiles which are used in conjunction with rubber in such articles as motor and cycle tyres, hose, waterproofs, and the like. Such fabrics, usually cotton, must possess the requisite strength, be unaffected by vulcanisation, and be free from any dressing likely to affect the durability of the rubber.

From what has gone before it will be clear that the successful manufacture of rubber goods depends on the observance of three conditions, namely, uniform supplies, suitable mixings, and correct vulcanisation. Failure on the part of the manufacturer to comply with any of these essentials is certain to result sooner or later in serious trouble, which may be either immediate or appear after the goods have been distributed to the consumer.

An efficient chemical and physical laboratory must therefore be regarded as an essential in a rubber works. The preparation of suitable mixings and the physical testing necessary to ascertain the correct conditions of vulcanisation will demand a special section in the department equipped with a miniature factory milling and vulcanising plant, together with all the necessary testing machines for rubber and textiles.

The chemical uniformity of the supplies of raw materials and the investigation of problems in the factory requiring scientific assistance may be left for attention to the chemical section of the works laboratory.

It will remain nevertheless for the research chemist to raise the manufacture of rubber from a somewhat empirical operation, however well controlled it may be by physical and chemical tests, to one which is based on scientific principles. The problems presented by colloid chemistry are difficult of solution and the progress is slow; but until the constitution of rubber and the mechanism of the vulcanisation process are more clearly understood the rubber industry cannot be said to be on a sound scientific basis.

Communication.

THE DETERIORATION OF LEATHER USED IN GAS METERS.

BY M. C. LAMB.

In the early part of 1913 the author was consulted by the South Metropolitan Gas Company, and at their request commenced a somewhat elaborate and lengthy investigation with the view to elucidate the cause or causes which were responsible for the rapid deterioration of the leather employed in the construction of gas meters.

The author now places on record the results of this investigation, so far as it has progressed, as a contribution to the general discussion on the important subject of "The Life of Gas Meters"; a preliminary report of a Joint Committee appointed by the Institution of Gas Engineers and the Society of British Gas Industries has recently been published (see this J., 1916, 821).

As is well known to gas engineers there has, of recent years, been a gradually increasing tendency on the part of gas meters to require repairing on account of either partial or complete breakdown of the mechanism of the diaphragm used as a measuring instrument for the amount of gas passing, thus interfering with the correct recording of the quantity of gas consumed.

The major portion of the complaints were apparently traceable to the leather used, either in the form of a complete diaphragm, or perhaps more generally used to form the connecting bellows of two diaphragms made of tin plate, the leather having apparently undergone some form of deterioration, thereby losing its necessary property of providing a gas-tight medium.

Meter leather requirements.—The hitherto recognised requirements of the meter manufacturer, as understood by those three or four firms of leather manufacturers specialising in the manufacture of "Meter leathers," may be summarised as follows:—

(1) The leather, with one exception, that general usage has demanded has been the so-called "Persian" sheepskin, a native-tanned East India sheepskin. The selection of this particular class of skin was no doubt due to the fact that this leather, on account of its close texture and compact fibre structure, was less liable to porosity, and hence was considered more suitable for the purpose than domestic sheepskins, which possess a more open texture and porous character, and are naturally greasy.

(2) The leather, when dressed, must be supple, be free from excessive natural fat, and free from stretch; it is a necessary stipulation that the skins should be specially selected for freedom from holes.

(3) The substance of the leather is to a great extent determined by the size of the diaphragm upon which it is intended to be used—thin substance skins, *e.g.*, 0·4 to 0·5 mm. for 5-light meters, to from 1·0 to 1·5 mm. for the larger sizes.

(4) In the majority of cases the meter manufacturer stipulates that the grain of the leather should be removed by buffing, the object of this

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[*] Ditmar, Le Caoutchouc et la Gutta-Percha, 1915, p. 8681.

apparently being to make it softer and to increase its power of absorbing the oil and graphite mixture used as a finishing dressing; the buffing produces a surface which is capable of retaining a greater proportion of the dressing than is the case when the grain has not been so removed.

(5) The exception mentioned above (1), so far as the author is aware, only refers to one particular meter manufacturer in Great Britain, and is therefore in the nature of an individual experiment. The leather used is a split sheepskin of British tannage, known as a skiver, *i.e.*, the grain side of a sheepskin; it is of thin substance, has little tensile strength, and is liable, unless extreme care is taken in the selection, to be entirely unsuitable on account of its tendency to possess natural perforations known as "pinholes," due to the natural growth of the skin. It has been stated to be satisfactory in use, but in the author's opinion it is not suitable for general adoption on account of its somewhat irregular physical character and its low tensile strength, though the latter factor does not play so important a part as one might anticipate without a full knowledge of the internal working of the meter leather when in use, and its method of attachment. The fact of its employment is interesting, however, as showing that, with the one exception, every British meter manufacturer has adhered to the use of the E.I. sheepskin, and though this was not considered satisfactory, particularly during recent years, apparently no other kind of leather has been tested with the object of finding a better substitute, or the experiments have resulted in failure.

General investigation of causes of deterioration.—The investigations of the author were in the first place directed to the leathers employed and their condition after being in use for varying periods, as ascertained by examining the leather and diaphragms removed from a very considerable number of meters of many makes, returned to the repair shop of the South Metropolitan Gas Company.

This examination revealed the fact that in almost every instance the perforation of the meter leather was in the majority of cases examined in a line drawn parallel to the periphery of the metallic diaphragm to which the leather was attached, the extent of the perforation varying from ¼ inch to, in a great many cases, five or six inches. The leather, on examination after having been freed from the remains of the graphite and oil dressing, whilst being sound and unaffected in the centre of the leather strip, was hard and perished where it had come in direct contact with either the metallic band fastening the leather to the diaphragm, or with the diaphragm itself. In every case examined, the leather where it had perished and become hard was also discoloured, and was in the majority of cases practically black. In one or two instances a narrow strip of leather had been placed in direct contact with the metal diaphragm, and under the meter leather, to act as a cushion when the meter leather was fixed by hemp cord or string; this strip of leather, which was protected from direct contact with the gas, had, in every case examined, become completely perished.

Subsequent analytical investigations showed that at the points mentioned the deterioration of the leather had undoubtedly been caused by iron, which had converted the tannin into a tannate of iron; this, by continuous oxidation and reduction, made the leather hard and caused it to disintegrate and perish. The amount of iron found was in some examples as great as 0·3% (Fe).

Methods of attachment of diaphragms.—Attention was next paid to the various methods of attaching the leather to the diaphragms as adopted by the various makers. These consisted of either (a) attachment by means of steel bands, most commonly covered to protect the band, either with linen tape or leather, or (b) attachment with several coils of hemp cord drawn tightly round the edge of the metal diaphragm, a cushion being made of a thin strip of leather as stated above, to produce a tight joint.

In the few cases examined where the metal band was covered with leather, it was found that the leather in contact with the metal band had also entirely perished and become black and brittle.

The author ascertained that some manufacturers, with a view to the production of a tight joint, used various adhesives to embed the leather when the band was tightened up, so as to close up and make gas-tight any small crevices or openings that might otherwise result. A number of these were examined, *e.g.*, flour paste, mixtures of resin and tallow, paraffin wax and tallow, and buck tallow. A sample of flour paste examined was found to contain an appreciable percentage of alum. Such a mixture must be unhesitatingly condemned, as owing to the free sulphuric acid liberated it dissolves the metallic band and thereby hastens the deterioration of the leather by transference of the resulting iron salt to the leather.

A mixture of ordinary tallow having, as is usual, a high "acid value," due to the condition of rancidity, must also be condemned for the purpose. Mixtures containing resin are also unsuitable.

The most suitable materials for the purpose, in the opinion of the author, if it is considered necessary to embed the leather in this way, are either paraffin wax, rendered sufficiently plastic by mixing with a small quantity of vaseline, or pure buck tallow, which must not possess a high acid value.

One of the earliest changes made in the repair shop of the South Metropolitan Gas Co., and which has since been retained after some three years' experience, was the substitution of an aluminium band for the steel band attachment. The employment of an embedding agent has been discontinued, as being unnecessary when the fitting was carefully performed.

It is of the utmost importance that the leather should be quite dry before it is fixed to the meter, and the stock of leather should be stored in a dry atmosphere; otherwise the moisture in the leather will quickly cause pitting of the tinned surface of the metal diaphragm at the points of contact with the leather, with consequent exposure of the iron surface.

Oil used in dressing.—Samples of the oil used by the meter manufacturers for mixing with graphite to produce a leather dressing were examined. Almond oil has long been employed for this purpose and has peculiarly suitable properties.

The oil used for the manufacture of the dressing should be a non-volatile, non-drying oil, and must remain liquid at low temperatures; it must also be an oil which does not become rancid and has a low "acid value."

Almond oil possesses all these properties. Other suitable oils fulfilling the necessary qualifications are peach kernel oil and apricot kernel oil; these are often used to adulterate almond oil, being cheaper, but for the purpose under review they are just as suitable.

Sulphonated oils are quite unsuitable either for use in the making of the graphite dressing or in the treatment of the leather.

It has been stated that manufacturers of meters in the United States do not employ any oil dressing in the leathers used. The advantage of the dressing as a protective covering against any injurious chemical impurities of the gas is obvious if reasonable care is taken that the oil used is the most suitable obtainable. The graphite acts as a filling agent, closing up the interstices of the fibres, and tends to produce a more perfect gas-tight medium. The use of petroleum jelly (vaseline) to replace almond oil has not been adopted. but it appears to the author to possess advantages that render it particularly suitable.

Experiments with meter liquids.—Several samples of the liquid condensate from a number of gas meters were examined. A number of samples were found to contain small amounts of ammonia and ammonium salts, compounds of cyanogen, and a fairly high percentage of inorganic non-volatile salts was found, and salts of iron and tin were present in comparatively large amounts. To ascertain the effect of the condensates on meter leathers, samples of different leathers were immersed in samples of liquids removed from meters in which the original leathers had been adversely affected. The results obtained were of a negative character; in every case the condensate had no appreciable effect when used as above, though the experiments were prolonged over six months.

An interesting experiment, which threw some light on the causes of deterioration, consisted of binding strips of leather round pieces of the metallic band used for attaching the meter leather to the diaphragm. and immersing these in meter liquids. The leather in every case, whether the steel band was protected or not with linen strips, was deteriorated and rendered brittle; the deterioration at those parts in contact with the metal was most pronounced, but also extended but to a lesser degree to those portions which were not in direct contact.

This experiment confirms to an appreciable extent the deduction formed on examination of a large number of leathers that had been removed from meters and which had probably perished, as mentioned above, owing to the corrosive action of the acid and ammonia constituents of the gas on the metal band.

New leathers for gas meters.—Experiments were made with several leathers of different tannage to those ordinarily employed as mentioned above. Leathers of vegetable tannage are particularly susceptible to deterioration by the action of acid fumes and of alkaline gases; leathers tanned with mineral tannage agents are not so injuriously affected. In the light of this fact meter leathers were prepared of chrome tannage, also alum tannage, and semi-chrome tannage, which latter consisted of a vegetable tanned East India (Persian) sheepskin from which the greater portion of the original vegetable tannage had been removed by treatment with weak alkaline salts, and replaced by retanning with basic chromium sulphate or chloride.

Leathers of these three different tannages were placed in meters, and to obtain a result as quickly as possible several meters were fixed in various parts of the South Metropolitan Gas Works where they were continuously in service; some few meters fitted with the experimental leathers were also placed on the ordinary circuit. At varying periods some of the meters were disconnected and the contents examined.

Alum tanned leather.—The alum tanned leather underwent considerable deterioration, and after a short period became hard and possessed the appearance of being undertanned, probably owing to the action of the ammoniacal gases. Previous experiments, made by immersing the leather for a lengthy period in meter liquids, had indicated the unsuitability of the leather, the meter liquid being found to possess a solvent action upon the tannage.

Chrome tanned leather.—On the other hand it was found that the sample of chrome tanned leather was quite unaffected, remaining soft and supple and apparently in as good a condition as when first enclosed in the meter.

Semi-chrome leather.—The behaviour of a well-chromed semi-chrome leather, so far as could be ascertained by the somewhat severe tests to which the samples of leather were subjected, was equally encouraging as the fully chrome tanned leather. Samples removed from the test meters after two years' trial showed no signs of deterioration whatever.

Samples of both the chrome and semi-chrome leathers were analysed before and after the experiment. The results of the chemical tests showed practically no change in the leather, as given below:—

	Chrome leather.		Semi-chrome leather.	
	Before.	After.	Before.	After.
	per cent.	per cent.	per cent.	per cent.
Mineral ash	5·7	5·9	3·25	3·3
Chromic oxide ..	3·0	3·0	2·1	2·15

The following tensile strength tests were made:—

Chrome leather.		Semi-chrome leather.	
Mean of 4 tests of strips ½ inch wide by 2 inches long.			
Before treatment.	After.	Before.	After.
21·4	20·7	21·0	21·5

A careful comparative microscopical examination of sections of each of the leathers showed that the samples had undergone no deterioration of the leather fibres.

In view of the fact that the experiments had shown, so far as could be ascertained in the limited time over which the tests had been made, that the semi-chrome East India tanned leather was undoubtedly superior to the ordinary East India (Persian) in general use, it was decided to adopt this leather provisionally for general repair work and in the manufacture of meters constructed by the South Metropolitan Gas Company.

The following specification was eventually adopted with a view to obtaining from various contractors a leather that contained a sufficient chrome content to ensure that the leather had been properly retanned with the basic chromic salt, and having in view the most suitable treatment for the purpose of providing a leather that the experiments indicated to be the most promising.

Specification for the supply of leather intended for use in gas meters.

Semi-chrome East India ("Persian") Sheep.

Material.

1. The skins are to be dressed from a good quality East Indian tanned "Persian" sheepskin of naturally "dry" tannage.

2. The goods to be selected of as near as possible the requisite substance in the crust condition, in order to avoid the necessity of materially reducing the substance by shaving all over the skin.

3. The goods to be reasonably free from grain defects and "tick" and from flaying defects; the the skins to be free from holes.

Dressing.

1. The skins to be prepared by lightly stripping with borax, washing, and retanning with basic chromium sulphate or basic chromium chloride in sufficient quantity to give the required chromium content given below (2).

2. The leather to contain 2·0% to 2·5% of chromic oxide on the dry weight of finished leather.

3. The leather to be neutralised after retanning.

4. The fat-liquoring to be done with neatsfoot oil and neutral soda soap, using an amount

equivalent to 3% oil and 2% soap on the dry finished leather.

5. The leather to be staked, fluffed, and lightly buffed on the grain side, except when expressly stipulated that buffing is not to be done.

6. The goods to be soft full supple leather, and free from any inclination to hardness.

One of the advantages in favour of the adoption of this leather was that it could be supplied by any firm of leather dressers ordinarily engaged in the dressing and finishing of East India tannages.

Subsequent experience has inclined towards the adoption of real chrome leather made from a domestic or New Zealand lamb skin, for use upon the smaller size meters, but retaining the semi-chrome tanned East India sheep for larger size meters. Real chrome leather in the majority of cases was found to be too soft and inclined to bagginess when employed upon large size meters, a defect which is conducive to incorrect registration. Semi-chrome E.I. sheep of 1 to 2 mm. thickness possesses, when properly dressed, the right amount of suppleness without any inclination to be so soft as to be liable to sag when used as the bellows of the meter.

The specification which has been provisionally adopted for real chrome lamb leather is as follows :—

Chrome Leather.

Material.

1. The skins to be tanned from a domestic lamb skin or New Zealand pickled lamb pelt of good quality, of 6 to 8 square feet area.

2. The goods to be specially selected for freedom from cockle, and be reasonably free from butcher cuts, holes, and other defects.

3. The skins to be selected of as near as possible the required substance in order to avoid the necessity of shaving.

Tannage and Dressing.

1. The goods to be tanned by the chrome process, and to contain a minimum of 3% chromic oxide, calculated on the dry (degreased) finished leather.

2. The goods after tanning to be neutralised and afterwards fat-liquored with a minimum of 2% neatsfoot oil and 1% soda soap on the dry finished leather weight.

3. No glycerine or other substance of a hygroscopic nature to be applied to the goods.

4. The goods to be staked, strained, and fluffed on the flesh side, and delivered in the original undyed blue colour.

5. The skins to be supple, fully tanned, well nourished leather, and to be free from any tendency to hardness.

It is extremely satisfactory to report that since the adoption of the semi-chrome leather for use upon all meters of the South Metropolitan Gas Company, which change was made on the author's suggestion as far back as July 1913, not one meter fitted with these leathers has been received by the repair shop for renewal of the leather, and in all the numerous cases which have been examined, including the original experiment and tests made on meters in continuous service, no deterioration of the leather has been observable.

Whilst the author does not claim that the substitution of the two leathers above referred to is the final answer to the question under discussion, the practical result shows that the adoption is at any rate one step in the right direction.

The resistance of chrome leather (and of leather semi-chromed to such a degree that it possesses practically the whole of the essential properties of the full chrome product) to the action of small traces of acid, and of alkaline gases, was thoroughly investigated by the author some years ago,[*] in continuation of the investigations of the special Society of Arts Committee on the Deterioration of Leathers for Bookbinding, published in 1901.

It is also now a well known fact that the life of chrome tanned belting leathers used for the transmission of power in chemical and other works, where they are subjected to various chemical gases, is much greater than is the case with ordinary vegetable tanned leather, and also longer than is the case of the majority of cotton and other fibre belts.

In the recent report,[†] made by Dr. Lessing to the Joint Committee representing the Society of British Gas Industries and the Institution of Gas Engineers, reference has been made to the investigations of the Society of Arts Committee on the Deterioration of Bookbinding Leathers, referred to above.

Dr. Lessing gives details of analyses of 21 samples of leathers used for diaphragms in which the percentage of acid (in terms of sulphuric acid) varied from 0·54% to 1·37% in leathers that had not been used. These results are entirely contradictory to the author's experience.

As above referred to, the ordinary meter leathers are made from sheepskins tanned in East India, chiefly by native tanners in a comparatively small way of business. The term "Persian" applied to these goods does not indicate the source of origin, and is only a trade description that originated many years ago, when an importer having discovered these goods in India was desirous of eliminating competition for their purchase, and in order to mislead his trade rivals called them Persian sheepskins, which resulted in keeping the source of supply secret for some time; the original route for East Indian shipping was by way of the Persian Gulf.

No mineral acid is used by the native tanner in the manufacture of these goods, and in a lengthy experience of these goods the author has not known a single case where the leather has been found to contain sulphuric or other mineral acid in the original condition as imported.

The author can also vouch for the fact that the three principal leather manufacturers specialising in the manufacture of leather for meter diaphragms do not use sulphuric acid in the dressing of these particular goods. The use of sulphuric acid for clearing and improving the ground colour of East Indian and other tannages preparatory to dyeing bright and fancy shades of colour, was quite common before the investigation of the Society of Arts Committee, and resulted in the rapid deterioration of these leathers when used for bookbinding; this practice has now ceased upon these leathers, following the report in question. It has never been common in the case of meter leathers.

With reference to the statement made in Dr. Lessing's report that the presence of decomposition products of leather was found in the non-volatile residues obtained from meter liquids, from which he infers that there has been solvent action of the gas and meter liquids upon the leather diaphragm, the author would point out that some small amount of leather substance is invariably present in all meter liquids. This does not necessarily originate by reason of any solvent action of the gases or the meter liquid, but is often due to the fact that the leather on account of its having been subjected to mechanical attrition on both sides on an emery wheel, has a fine velvety nap surface, and if not carefully brushed before being cut up, introduces a quantity of leather dust into the meter which subsequently finds its way into the meter liquid. The samples of meter liquids examined by the author have had, as above stated, little solvent action upon pieces of leather that have been immersed in them for long periods.

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[*] J. Soc. Dyers and Col., 1908, **24**, 160; this J., 1908, 820.

[†] See this J., 1916, 824.

The above results of the investigation are not considered by the author to be final, but, as stated in the opening paragraph, to be a contribution to the discussion on the subject. Further experimental work is in progress, and the author hopes to be able to communicate any interesting results dealing with this important industrial problem, in due course.

The author desires to take this opportunity of expressing his thanks to the Chairman of the South Metropolitan Gas Company (Dr. Carpenter) for granting him permission to publish the results of his investigations.

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London, S.E.

British Association.

Section B.—Newcastle-on-Tyne, 1916.

ADDRESS TO THE CHEMICAL SECTION.

BY PROFESSOR G. G. HENDERSON, D.SC., LL.D., F.R.S.,

President of the Section.

(Abstract.)

The period which has elapsed since 1885 has witnessed remarkable progress in every branch of pure and applied chemistry. Whilst the study of the compounds of carbon has been pursued with unflagging energy and success, it has no longer so largely monopolised the activities of investigators. Interest in the other elements, which had been to some extent neglected on account of the fascinations of carbon, has been revived with the happiest results.

The more purely scientific side of our science can claim no monopoly in progress, for applied chemistry, in every department, has likewise advanced with giant strides, mainly of course through the application of the results of scientific research to industrial purposes. Many of the more striking results in the field of modern chemical industry have been obtained by taking advantage of the powers we now possess to carry out operations economically both at very high and at very low temperatures, and by the employment on the manufacturing scale of electrolytic and catalytic methods of production. Thanks largely to the invention of the dynamo, the technologist is now able to utilise electrical energy both for the production of high temperatures in the different types of electric furnace and for electrolytic processes of the most varied description. Among the operations carried out with the help of the electric furnace may be mentioned the manufacture of graphite, silicon, and phosphorus; of chromium and other metals; of carbides, silicides, and nitrides; and the smelting and refining of iron and steel. Calcium carbide claims a prominent place in the list, in the first place because of the ease with which it yields acetylene, which is not only used as an illuminant, and, in the oxy-acetylene burner, as a means of producing a temperature so high that the cutting and welding of steel is now a comparatively simple matter, but also promises to serve as the starting-point for the industrial synthesis of acetaldehyde and many other valuable organic compounds. Moreover, calcium carbide is readily converted in the electric furnace into calcium cyanamide, which is employed as an efficient fertiliser in place of sodium nitrate or ammonium sulphate, and as a source of ammonia and of alkali cyanides. Among the silicides carborundum is increasingly used as an abrasive and a refractory material, and calcium silicide, which is now a commercial product, forms a constituent of some blasting explosives. The Serpek process for the preparation of alumina and ammonia, by the formation of aluminium nitride from bauxite in the electric furnace and its subsequent decomposition by caustic soda, should also be mentioned. Further, the electric furnace has made possible the manufacture of silica apparatus of all kinds, both for the laboratory and the works, and of alundum ware, also used for operations at high temperature. Finally, the first step in the manufacture of nitric acid and of nitrites from air, now in operation on a very large scale, is the combustion of nitrogen in the electric arc.

In other industrial operations the high temperature which is necessary is obtained by the help of the oxy-hydrogen or the oxy-acetylene flame, the former being used, amongst other purposes, in a small but I believe profitable industry, the manufacture of synthetic rubies, sapphires, and spinels. Also, within a comparatively recent period, advantage has been taken of the characteristic properties of aluminium, now obtainable at a moderate price, in the various operations classed under the heading alumino-thermy, the most important being the reduction of refractory metallic oxides, although, of course, thermite is useful for the production of high temperatures locally.

The modern methods of liquefying gases, which have been developed within the period under review, have rendered possible research work of absorbing interest on the effect of very low temperatures on the properties and chemical activity of many substances, and have been applied, for instance, in separating from one another the members of the argon family, and in obtaining ozone in a state of practical purity. Moreover, industrial applications of these methods are not lacking, amongst which I may mention the separation of nitrogen and oxygen from air, and of hydrogen from water-gas—processes which have helped to make these elements available for economic use on the large scale.

Electrolytic methods are now extensively employed in the manufacture of both inorganic and organic substances, and older processes are being displaced by these modern rivals in steadily increasing number. It is sufficient to refer to the preparation of sodium, magnesium, calcium, and aluminium, by electrolysis of fused compounds of these metals; the refining of iron, copper, silver, and gold; the extraction of gold and nickel from solution; the recovery of tin from waste tin-plate; the preparation of caustic alkalis (and simultaneously of chlorine), of hypochlorites, chlorates, and perchlorates, of hydrosulphites, of permanganates and ferricyanides, of persulphates and percarbonates; the regeneration of chromic acid from chromium salts; the preparation of hydrogen and oxygen. As regards organic compounds, we find chiefly in use electrolytic methods of reduction, which are specially effective in the case of many nitro-compounds, and of oxidation, as for instance the conversion of anthracene into anthraquinone. At the same time a number of other compounds, for example iodoform, are also prepared electrolytically.

Within recent years there have been great advances in the application of catalytic methods to industrial purposes. Some processes of this class have, of course, been in use for a considerable time, for example the Deacon chlorine process and the contact method for the manufacture of sulphuric acid, whilst the preparation of phthalic anhydride (largely used in the synthesis of indigo and other dyestuffs), by the oxidation of naphthalene with sulphuric acid with the assistance of mercuric sulphate as catalyst, is no novelty. More recent are the contact methods of obtaining ammonia by the direct combination of nitrogen and hydrogen, and of oxidising ammonia to nitric acid—both of which are said to be in operation on a very large scale in Germany. The catalytic action of metals, particularly nickel and copper, is utilised in processes of hydrogenation—for example, the hardening of fats, and of dehydrogenation, as in the preparation of acetaldehyde from alcohol, and such metallic oxides as alumina and thoria can be used for processes of dehydration —*e.g.*, the preparation of ethylene or of ether from alcohol. Other catalysts employed in industrial processes are titanous chloride in electrolytic reductions and cerous sulphate in electrolytic oxidations of carbon compounds, gelatin in the preparation of hydrazine from ammonia, sodium in the synthesis of rubber, etc.

Other advances in manufacturing chemistry include the preparation of a number of the rarer elements and their compounds, which were hardly known thirty years ago, but which now find commercial applications. Included in this category are titanium, vanadium, tungsten, and tantalum, now used in metallurgy or for electric-lamp filaments; thoria and ceria in the form of mantles for incandescent lamps; pyrophoric alloys of cerium and other metals; zirconia, which appears to be a most valuable refractory material; and compounds of radium and of mesothorium, for medical use as well as for research. Hydrogen, together with oxygen and nitrogen, are in demand for synthetic purposes, and the first also for lighter-than-air craft. Ozone is considerably used for sterilising water and as an oxidising agent, for example in the preparation of vanillin from isoeugenol, and hydrogen peroxide, now obtainable very pure in concentrated solution, and the peroxides of a number of the metals are also utilised in many different ways. The per-acids—perboric, percarbonic, and persulphuric—or their salts are employed for oxidising and bleaching purposes, and sodium hydrosulphite is much in demand as a reducing agent—*e.g.*, in dyeing with indigo. Hydroxylamine and hydrazine are used in considerable quantity, and the manufacture of cyanides by one or other of the modern methods has become quite an important industry, mainly owing to the use of the alkali salts in the cyanide process of gold extraction. Those remarkable compounds the metallic carbonyls have been investigated, and nickel carbonyl is employed on the commercial scale in the extraction of the metal. Fine chemicals for analysis and research are now supplied, as a matter of course, in a state of purity rarely attained a quarter of a century ago.

In the organic chemical industry similar continued progress is to be noted. Accessions are constantly being made to the already enormous list of synthetic dyes, not only by the addition of new members to existing groups, but also by the discovery of entirely new classes of tinctorial compounds; natural indigo seems doomed to share the fate of alizarin from madder, and to be ousted by synthetic indigo, of which, moreover, a number of useful derivatives are also made. Synthetic drugs of all kinds—antipyrine and phenacetin, sulphonal and veronal, novocain and β-eucaine, salol and aspirin, piperazine and adrenaline, atoxyl and salvarsan—are produced in large quantities, as also are many synthetic perfumes and flavouring materials, such as ionone, heliotropine, and vanillin. Cellulose in the form of artificial silk is much used as a new textile material, synthetic camphor is on the market, synthetic rubber is said to be produced in considerable quantity; and the manufacture of materials for photographic work and of organic compounds for research purposes is no small part of the industry. However, it would serve no useful purpose to extend this catalogue, which might be done almost indefinitely.

British chemists are entitled to regard with satisfaction the part which they have taken in the development of scientific chemistry during the last three decades, as in the past, but with respect to the progress of industrial chemistry it must be regretfully admitted that, except in isolated cases, we have failed to keep pace with our competitors. Consider a single example. Although there still remain in South America considerable deposits of sodium nitrate which can be worked at a profit, it is clear that sooner or later other sources of nitric acid must be made available. The synthetic production of nitric acid from the air is now a commercial success; several different processes are in operation abroad, and Germany is reported to be quite independent of outside supplies. Electrical energy, upon the cost of which the success of the process largely depends, can be produced in this country at least as cheaply as in Germany, and yet we have done nothing in the matter, unless we count as something the appointment of a committee to consider possibilities. This case is only too typical of many others. A number of different causes have contributed to bring about this state of affairs, and the responsibility for it is assigned by some to the Government, by others to the chemical manufacturers, and by still others to the professors of chemistry. I think, however, it will be generally admitted that the root of the matter is to be found in the general ignorance of and indifference to the methods and results of scientific work which characterises the people of this country.

I believe that a brighter day is dawning, and that, if only we rise to the occasion *now*, chemistry in this country will attain the position of importance which is its due. The Government has taken a most significant step in advance by appointing an Advisory Council for Scientific and Industrial Research and providing it with funds (see this J., 1915, 783; 1916, 424, 912).

The adoption by the Government of the recommendations made by a Sub-Committee of the Advisory Committee to the Board of Trade on Commercial Intelligence (see this J., 1916, 279) would go far to establish British chemical industry on a secure basis, and would undoubtedly lead to the expansion of already existing branches and the establishment of new ones. Meanwhile, the Australian Government has set an example which might be followed with great advantage, and their admirable scheme (this J., 1916, 440) is more comprehensive and more generous than that of our Government, but it could be rivalled without much difficulty. We already possess an important asset in the National Physical Laboratory, and there now exists the Advisory Council with its extensive powers and duties. What is lacking in our scheme, so far as chemistry is concerned, could be made good, firstly, by providing the Advisory Council with much larger funds, and, secondly, by the establishment of a National Chemical Laboratory—an institute for research in pure and applied chemistry—or by assisting the development of research departments in our universities and technical colleges (as is now being done in America), or, better still, by moving in both directions.

It has been suggested by Dr. Forster that the State could render assistance to chemical industry in another way, namely, by the formation of a Chemical Intelligence Department of the Board of Trade, which should be concerned with technical, commercial, and educational questions bearing upon the industry (see this J., 1915, 763, 1173). This proposal, which has been widely discussed and on the whole very favourably received by chemists, has much to recommend it. The principal objections which have been raised are based upon the fear that the proposed Department, however energetic and enterprising it might be at the start, would soon be so helplessly gagged and bound down by departmental red tape as to become of little or no service. This danger, however, could be obviated to a great extent by the institution of a strong Advisory Committee, representative of and elected by the Societies concerned with the different branches of chemistry, which would keep closely in touch with the Chemical Intelligence Department on the one hand and with the industry on the other, and which would act as adviser of the permanent scientific staff of the Department. There is, I fear, little chance of seeing Dr. Forster's proposal carried into effect unless all the Societies concerned move actively and unitedly in the matter; they must do the pioneer work and must submit a definite scheme to the Government, if the desired result is to be attained. In the not improbable contingency that the Board of Trade will decline to take action, I trust that the scheme for the establishment of an Information Bureau—on lines similar to but somewhat less wide-reaching than those which I have just indicated—which has been under the careful consideration of the Council of the Society of Chemical Industry, will be vigorously prosecuted. Difficulties, chiefly financial, stand in the way, but these are not insuperable, especially if the sympathy and support of the Government can be enlisted.

Unless the conditions and methods which have ruled in the past are greatly altered it is hardly possible to hope that the future prospects of our chemical industry will be bright; it is essential that the representatives of the industry should organise themselves in their own interest and co-operate in fighting the common enemy. More than ever is this the case when, as we are informed, three different groups of German producers of dyes, drugs, and fine chemicals, who own seven large factories, have formed a combination with a capital of more than £11,000,000, and with other assets of very great value in the shape of scientific, technical, and financial efficiency. Hence it is eminently satisfactory to be able to record the active progress of a movement, orginated by the Chemical Society, which has culminated in the formation of an Association of British Chemical Manufacturers (see this J., 1916, 561). The main objects of the Association are to promote co-operation between British chemical manufacturers; to act as a medium for placing before the Government and Government officials the views of manufacturers upon matters affecting the chemical industry; to develop technical organisation and promote industrial research; to keep in touch with the progress of chemical knowledge and to facilitate the development of new British industries and the extension of existing ones; and to encourage the sympathetic association of British manufacturers with the various universities and technical colleges.

Needless to say, the progress of this important movement will be assisted by everyone who is interested, either directly or indirectly, in the welfare of our chemical industry, and, moreover, the support of the scientific societies will not be lacking, for, as the result of a conference convened by the President and Council of the Royal Society, a Conjoint Board of Scientific Societies has been constituted, for the furtherance of the following objects:—Promoting the co-operation of those interested in pure or applied science; supplying a means whereby scientific opinion may find effective expression on matters relating to science, industry, and education; taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; and discussing scientific questions in which international co-operation seems advisable.

In an Address given to the Society of Chemical Industry last year (this J., 1915, 717), I indicated another way in which chemical manufacturers can help themselves and at the same time promote the interests of chemistry in this country. In the United States of America individual manufacturers, or associations of manufacturers, have shown themselves ready to take up the scheme originated by the late Professor Duncan for the institution of industrial research scholarships tenable at the universities or technical colleges, and the results obtained after ten years' experience of the working of this practical method of promoting co-operation between science and industry have more than justified the anticipations of its originator. The scheme is worthy of adoption on many grounds, of which the chief are that it provides definite subjects for technical research to young chemists qualified for such work, that it usually leads to positions in factories for chemists who have proved their capacity through the work done while holding scholarships, and that it reacts for good on the profession generally, by bringing about that more intimate intercourse between teachers and manufacturers which is so much to be desired.

In this connection the recent foundation of the Willard Gibbs Chair of research in pure chemistry at the University of Pittsburgh is extremely significant, for it shows that even in such a purely industrial community as Pittsburgh it is recognised that the most pressing need of the day is the endowment of chemical research and the creation of research professorships. Mr. A. P. Fleming, who recently made a tour of inspection of research laboratories in the United States, points to the amount of work done by individual firms and the increased provision now being made for research in universities and technical institutions. He reports that at the present time there are upwards of fifty corporations having research laboratories, costing annually from £20,000 to £100,000 for maintenance, and states that "some of the most striking features of the research work in America are the lavish manner in which the laboratories have been planned, which in many cases enables large scale operations to be carried out in order to determine the best possible methods of manufacturing any commodity developed or discovered in the laboratories; the increasing attention given in the research laboratories to pure science investigation, this being, in my opinion, the most important phase of industrial research; and the absorption of men who have proven their capacity for industrial research in such places as the Mellon Institute, the Bureau of Standards, etc., by the various industries in which they have taken scientific interest." It is evidently the view of American manufacturers that industrial research can be made to pay for itself, and that to equip and maintain research laboratories is an excellent investment.

It cannot be too often reiterated that no branch of chemical industry can afford to stand still, for there is no finality in manufacturing processes; all are capable of improvement, and for this, as well as for the discovery and the application of new processes, the services of the trained chemist are essential. Hence the training of chemists for industrial work is a matter of supreme importance. Perhaps it is too much to expect that practice in research will be made an indispensable qualification for the ordinary degree; failing this, and indeed in every case, promising students should be encouraged, by the award of research scholarships, to continue their studies for a period of at least two years after taking the B.Sc. degree, and to devote that time to research work which would qualify for a higher degree. In this connection an excellent object-lesson is at hand, for the output of research work from the Scottish Universities has very greatly increased since the scheme of the

Carnegie Trust for the institution of research scholarships has come into operation. Thanks to these scholarships, numbers of capable young graduates, who otherwise for the most part would have had to seek paid employment as soon as their degree courses were completed, have been enabled to devote two or more years to research work.

On the whole, there is not much fault to be found with the training for chemists supplied by the universities and technical colleges, but there is still room for improvements which could and would be carried out if it were not that the scientific departments of these institutions are as a rule hampered by lack of funds. Hence no opportunity should be lost of impressing upon the Government the necessity for increasing the grants to the scientific departments of our higher teaching institutions, and for the provision of research scholarships. It is much to be desired also that wealthy men in this country should take an example from America and acquire more generally the habit of devoting some part of their means to the endowment of higher education. The private donations for science and education made in the United States during the last forty-three years amount to the magnificent sum of £117,000,000, and recently the average annual benefactions for educational purposes total nearly £6,000,000. Of course there are few, if any, of the universities and colleges in this country which are not deeply indebted to the foresight and generosity of private benefactors, but the lavish scale on which funds are provided in America leads to a certain feeling of admiring envy.

After all, the chief difficulty which confronts those who are eager for progress in educational matters is that so many of our most famous schools are still conducted on mediæval lines, in the sense that the "education" administered is almost wholly classical. Consequently, "though science enters into every part of modern life, and scientific method is necessary for success in all undertakings, the affairs of the country are in the hands of legislators who not only have little or no acquaintance with the fundamental facts and principles signified by these aspects of knowledge, but also do not understand how such matters can be used to strengthen and develop the State. Our administrative officials are also mostly under the same disabilities, on account of their want of a scientific training. They are educated at schools where science can receive little encouragement, and they do not take up scientific subjects in the examinations for the Civil Service, because marks can be much more easily obtained by attention to Latin and Greek; and the result of it all is that science is usually treated with indifference, often with contempt, and rarely with intelligent appreciation by the statesmen and members of the public services whose decisions and acts largely determine the country's welfare. The defects of a system which places the chief power of an organisation which needs understanding of science in every department in the hands of people who have not received any training in scientific subjects or methods are obvious."* The remedy is also obvious.

Here, again, the prospects are now brighter than ever before, because the warnings and appeals of men of science have at last, and after many years, begun to bear fruit, or perhaps it would be more correct to say the lessons of the war have begun to make an impression on the powers that be. Within the last few weeks it has been intimated that the Government, giving ear to what has been uttered, incessantly and almost *ad nauseam*, with regard to British neglect of science, propose to appoint a committee to inquire into the position of science in our national system of education, especially in universities and secondary schools. The duty of the committee will be to advise the authorities how to promote the advancement of pure science, and also the interests of trade, industries, and professions dependent on the application of science, bearing in mind the needs of what is described as a liberal education. It is stated that the committee will include scientific men in whom the country will have confidence, some of those who appreciate the application of science to commerce and industry, and some who are able from general experience to correlate scientific teaching with education as a whole. I am sure that we may look forward with confidence to the recommendations of such a committee, and we shall hope, for the sake of our country, that their recommendations will be adopted and put in force with the least possible delay.

Institute of Metals.

September, 1916.

THE DEVELOPMENT OF THE SPELTER INDUSTRY.

BY E. A. SMITH.

(Abstract.)

Historical. In 1830 the total production of spelter in Europe was less than 5000 tons; in 1840 it was a little more than 17,000 tons; and in 1870 it had grown to 128,289 tons (Germany 55,741, Belgium 45,715, Great Britain 15,000 tons). The annual production in the United States was at this time 4500 tons. The enormous increase in the rate of production and in the demand for zinc during the past fifty years is shown in the following table:—

Year.	European production.	American production.	World's production.	World's consumption.
	In long tons, 2240 lb.			
1870	128,000	4,500	133,000	..
1880	207,000	21,000	228,000	230,000
1890	—	—	343,000	345,000
1900	310,000	58,000	368,000	474,000
1910	557,000	247,000	801,000	820,000
1913	663,000	315,000	982,000	997,000

The most important smelting centres contributing to the world's supply of zinc are Silesia, Westphalia, and Belgium, on the Continent, Swansea, in England, Illinois, Kansas, and New Jersey in the United States. Japan appears to produce about enough to supply her own demands.

The status of the world's zinc industry, prior to the war, is well shown in the following tables, which give the figures for the production and consumption of spelter in all the principal countries for ten years ending 1913, and also the average price in the London market.

The spelter convention. Before the war spelter reduction plants were in excess of the world's requirements, and the output was therefore controlled by a Spelter Convention to maintain the price. Out of the total world's production of zinc of 957,000 long tons in 1912, nearly one-third (315,000 tons) was controlled by the German Syndicate (associated German and Belgium makers), and nearly 571,000 tons by the International Syndicate (British and certain Belgian and French producers). *Ores of zinc.* Formerly calamine was the most important ore but at the present time zinc blende is the chief source of the metal. There is little doubt however that the zinc

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* "Nature," Feb. 10, 1916.

TABLE I.

Production of Speller (in metric tons).

Countries.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
Germany	191,060	197,181	205,023	208,707	216,876	220,080	227,747	250,393	271,064	283,113
Belgium	139,982	145,592	152,461	154,492	165,019	167,100	172,578	195,092	200,198	197,703
Holland..................	13,099	13,767	14,650	14,990	17,257	19,548	20,975	22,733	23,932	24,323
Great Britain	46,216	50,927	52,587	55,595	54,473	59,350	63,078	66,956	57,231	59,146
France and Spain	49,082	50,369	53,786	55,733	55,819	56,118	59,141	61,221	72,161	71,023
Austria and Italy	9,248	9,357	10,780	11,359	12,761	12,638	13,305	16,876	19,604	21,707
Russia	10,606	7,642	9,610	9,738	8,839	7,945	8,631	9,936	8,763	7,610
Norway	..	..	..	..	..	..	..	6,680	8,128	9,287
Production in Europe	459,293	474,800	498,897	510,614	531,044	542,779	565,455	632,887	661,081	673,912
,, ,, United States of America	165,850	183,245	202,092	226,838	189,941	240,446	250,627	267,472	314,512	320,283
,, ,, Australia....	290	650	1,026	996	1,087	..	508	1,727	2,296	3,724
Total .... about	625,400	658,700	702,000	738,400	722,100	783,200	816,600	902,100	977,900	997,900
Yearly average price ....£	22 11 10	25 7 7	27 1 5	23 16 9	20 3 6	22 3 0	23 0 0	25 3 2	26 3 4	22 14 3

TABLE II.

Consumption of Speller (in metric tons).

Countries.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
United States	157,100	179,000	200,000	227,900	188,300	246,900	244,500	251,600	312,900	313,300
Germany	151,600	162,700	179,300	174,400	180,200	188,100	184,500	219,300	225,800	232,000
Great Britain	129,100	136,000	140,500	140,700	138,500	155,500	177,800	175,700	185,200	194,600
France	67,200	59,700	63,400	69,600	77,900	66,900	56,300	82,000	82,000	81,000
Belgium	52,000	49,100	51,000	55,000	68,000	64,600	76,500	73,700	77,200	76,400
Austria-Hungary	25,300	26,200	28,300	30,300	32,600	32,800	33,800	43,500	46,800	40,400
Russia	23,500	26,000	17,000	17,600	17,800	18,400	24,900	28,900	27,900	33,300
Italy	5,100	5,600	6,200	7,100	8,400	8,200	8,100	10,100	10,700	10,900
Spain	4,000	4,700	4,700	4,800	5,000	4,500	4,200	4,800	4,700	5,900
Netherlands (estimated) ..	3,700	3,800	3,800	3,800	3,800	4,000	4,000	4,000	4,000	4,000
Other countries (estimated)	10,700	11,000	11,000	12,000	10,000	9,000	12,400	17,800	19,700	20,900
Total	629,300	663,800	705,200	743,200	730,500	798,900	827,000	911,400	996,900	1,012,700

of the future will be derived largely from concentrates obtained from low grade and complex ores, by gravity, magnetic, flotation, etc., methods of separation. At the present time the chief sources of the world's supply of zinc ores, including concentrates, are the United States, Australia, Germany, Italy, Spain, Algeria, and Tunis. Zinc ores also occur abundantly in China, and increasing quantities are exported by Japan. The total output of dressed zinc ore for the United Kingdom (chiefly Cumberland and Northumberland) is about 17,500 long tons per annum. In 1913, 11,260 tons was exported to Belgium and 1960 tons to France. In the same year the total imports of zinc ore by British smelters amounted to approximately 65,000 long tons, derived mainly from Australia, Italy, Algeria, Germany, Spain, and France. The most important sources of zinc ore in the British Empire are the deposits at Broken Hill. Owing to the shortage of the supply of domestic ores, European smelters have imported for some years considerable quantities of zinc ore from Sardinia, Algeria, Australia, and, in recent years, in increasing amount, from America. The ore is shipped in bulk to Antwerp and Swansea, generally in the calcined or roasted state. The ores are bought on different formulæ, of which the following is a type :—$V = 0{\cdot}0095\ P\ (T - 8) - R$, where V is the value in £ per ton, P the price of spelter (good ordinary brands) in London, T the percentage of zinc in the ore, R the returning charge (*i.e.* cost of smelting per ton), but the value is affected adversely by the presence of impurities, such as lead (which should not exceed 3%), iron and manganese (which should not exceed 10%), and fluorspar.

The following approximate figures, making a total of nearly 900,000 tons, of the European zinc ore trade in 1913 are available : Zinc ore imported into : Germany 308,000, Austro-Hungary 50,000, Belgium 300,000, France 173,000, England 65,000 long tons.

Metallurgy of zinc. Practically all the zinc of commerce is produced by distillation of the oxide with carbon. Calamine ores are calcined in simple shaft furnaces or in reverberatory furnaces. Crushed zinc blende is best roasted in mechanically raked furnaces such as the Zellweger and Merton furnaces, and in muffle furnaces, such as the Hegeler furnace (when the blende is burnt for sulphuric acid manufacture), though double-hearth hand-raked reverberatory furnaces are still in use in Europe. The retorts are best made by hydraulic machines, but hand-made retorts are still largely used. American clays are inferior to European, and do not allow of such high temperatures being employed. Progress in the metallurgy of zinc in recent years has been confined mainly to changes directed towards higher extraction results and the reduction of labour. Thus all modern furnaces are gas-fired, and are mostly worked on the regenerative system.

In direct-fired furnaces the coal consumption is about 2 tons or more per ton of ore smelted, while in modern gas-fired Belgian furnaces the consumption of coal for fuel is about 1·3 ton per ton of ore smelted. For Rhenish gas-fired furnaces the average is about 1·1 to 1·2 ton. With a view to the reduction of the cost of labour, mechanical appliances for charging and cleaning the retorts have been introduced in several European works, and more recently in American works, but they have not met with general favour. The ore charged into the retorts generally contains about 45 to 50% of zinc. The weight of the charge varies with the size of the retorts, the Belgian retorts in the United States taking about 60 lb., plus a small quantity of by-products, exclusive of reduction material, while for Rhenish retorts in Europe it is from 75 to 90 lb. The plant at Port Pirie, Australia, comprises 10 gas-fired furnaces, each containing 2 tiers of Rhenish retorts back to back, with three rows of 24 retorts in each tier, *i.e.*, a total of 1440 retorts. The charge consists of 10,000 lb. of washed concentrate, 3000 lb. of coke, and 1500 lb. of coal, and the retorts are heated slowly to 1325°—1350° C. With ordinary ores the residue left contains as a rule from 4 to 8% Zn, and a good deal of unburnt coal. This, after screening, and mixing with about 20% of fresh coal, is in some works used as a fuel for boilers. With leady ores, practically all the lead and silver remain in the residues. In such cases these are ground and concentrated and sold to lead smelters. The amount of lead admissible in the distillation process is usually considered to be limited to about 10%, but with care, and the selection of suitable retort materials, it is possible to treat successfully ores containing from 14 to even 20% Pb. In modern German and Belgian practice a 90% yield of spelter is constantly reached with roasted blende carrying 50% Zn; in the Western States of America the yield from a 40% ore is stated to be about 75 to 80%; the yield in this country is usually about 85%. Complex zinc-bearing ores are concentrated by mechanical dressing, electrostatic, magnetic, and flotation processes. The last-named process produces slimes, the metallurgical treatment of which is the greatest problem of zinc smelters at the present time. The loss of zinc in roasting is particularly large, and, in smelting, lead tends to distil over with the zinc. This lead may however be kept back by passing the zinc vapours through charcoal or burnt fireclay filters. When slimes and fine ore are briquetted with bituminous coal and pitch, the filtration which takes place through the pores of the briquettes causes the lead to remain in the carbonaceous residue, this then being suitable for lead smelting. Briquetting has the further advantages of allowing larger charges to be worked, and making the charging and discharging operations more rapid and cleanly. Another successful method of dealing with complex ores is to reduce them in reverberatory furnaces, or in a current of air, whereby the zinc is again immediately oxidised by the carbon dioxide formed, and by the air. The gaseous products carrying the zinc oxide are passed through a cooling tower to a series of woollen bags wherein the oxide is retained. Complex ores are also smelted in electric furnaces, and this process may possibly be advantageously substituted for the retort process where fuel is dear and hydro-electric power easily available. The reduction of carbon dioxide is more incomplete however than in retorts, with the result that a larger amount of fume (blue powder) containing 8 to 10% of zinc oxide, is formed. In the Côte and Pierron process blende is smelted without preliminary treatment. The furnace is circular, with sides and bottom lined with graphite, the top being a low dome of fire-brick. A carbon electrode, which can be raised or lowered, passes through an opening in the centre of the top, whilst the other electrode, a cone of graphite, projects from the hearth. The charge consisting of a mixture of blende, iron, and lime is introduced through the roof into the hot furnace, and the first reaction of iron on lead sulphide is effected at a relatively low temperature. The resulting lead is tapped. The temperature is then raised to induce decomposition of the zinc sulphide by the iron. The zinc distils over, and is condensed in the condenser, the carbon in which is kept at a red heat, to diminish, as far as possible, the formation of zinc fume. Finally, iron sulphide and the slag are run out. Electric zinc smelting has now passed the mere experimental stage and become a commercial process, but investigations are still proceeding. Complex ores are also successfully treated for the production of chloride or sulphate, with subsequent leaching. The sulphate may be used for the manufacture of lithopone, or treated eletrolytically for the production of the metal. The chloride is treated electrolytically and the chlorine utilised for the manufacture of bleaching powder. *Industrial applications of zinc.* The galvanised iron industry probably accounts for about 60% of the world's consumption of spelter, while the manufacture of brass probably utilises another 20 or even 25%, the remainder being used for conversion into sheets and for minor uses. Hot galvanising is now being largely replaced by sherardising and by electrolytic deposition. Zinc exhibits its greatest degree of ductility and malleability between 100° C. and 150° C., between which temperatures it is rolled into sheets. In the manufacture of rolled zinc the usual practice is to cast the metal into thin plates, nor ingots, which while still hot are rapidly passed through the rolls until the desired thickness is attained. Lead is stated not to interfere with the rolling qualities when below 1·25%, but any increase above this is injurious. Cadmium is injurious if above 0·25%, whilst arsenic and antimony are harmful from 0·02% upwards, arsenic in particular having a hardening effect. As little as 0·01% Sn has a bad effect. Copper below 0·08% has no effect, nor iron below 0·12%. Zinc intended for the manufacture of brass which has to undergo severe mechanical treatment, as in the manufacture of cartridge cases, should be of good grade and contain not more than 0·1% Pb and 0·05% Fe. The highest grades of zinc are generally prepared by the employment of pure ores, and by redistillation of ordinary spelter, but some are prepared by electrolysis.

The following analyses of brands of virgin spelter may be taken as typical :—

Brand.	Lead. per cent.	Iron. per cent.	Cadmium. per cent.	Tin. per cent.
Upper Bank (English)	2·55	0·15	0·09	0·05
V.M.G. (Belgium)	0·66	0·26	nil	0·03
Vieille Montagne (Belgium)	2·00	0·04	0·07	nil
Freiberg (Saxony)	1·03	0·04	0·02	0·07
Lazyhutte (Upper Silesia)	1·12	0·02	0·017	nil
Lipine electrolytic (Upper Silesia)	0·06	0·01	0·005	0·02

The impurities are often removed by liquating the metal in large reverberatory furnaces, with sloping hearth, holding from 20 to 30 tons of metal. Amongst the newer zinc alloys are those of aluminium-zinc containing 10 to 20% Zn, with the addition of a little copper, these alloys being largely used for light castings in the automobile industry. *Future of the zinc industry.* Owing to the shortage of spelter brought about by the war, the selling price of the metal has appreciated in England to more than five times its pre-war figure. Very great efforts are being made in the United States to take advantage of the present conditions, and the total capacity of the American plants in process of erection, and completed, will be brought to about 650,000 tons per annum, or just double the output of 1913. The ore reserves in America are large and will no doubt keep the smelting works satisfactorily supplied with ore. In Germany the supply of ore from Silesia, Hungary, Carinthia, and Tyrol will probably be insufficient, but although the importation of ore from Australia is stopped, large quantities of concentrates have been obtained from China, and this source will no doubt be developed. For some time the total output of Germany and Belgium will probably be only sufficient to satisfy home consumption. Although there will be American competition to contend with, the present would appear to be a very favourable opportunity to expand the spelter industry of this country, and steps are being taken to erect new smelting plants both in this country and in Australia. Special inducements are being held out to English smelters, and a scheme has been drawn up, and is under consideration, providing not only for preferential treatment of the Empire's zinc ores, but also alloting a fair share of the raw material to France and Belgium.—T. St.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

Patents.

Grinding machine or apparatus [*for oil-cake, etc.*]. G. R. Schueler, Hull. Eng. Pat. 12,015, Aug. 20, 1915.

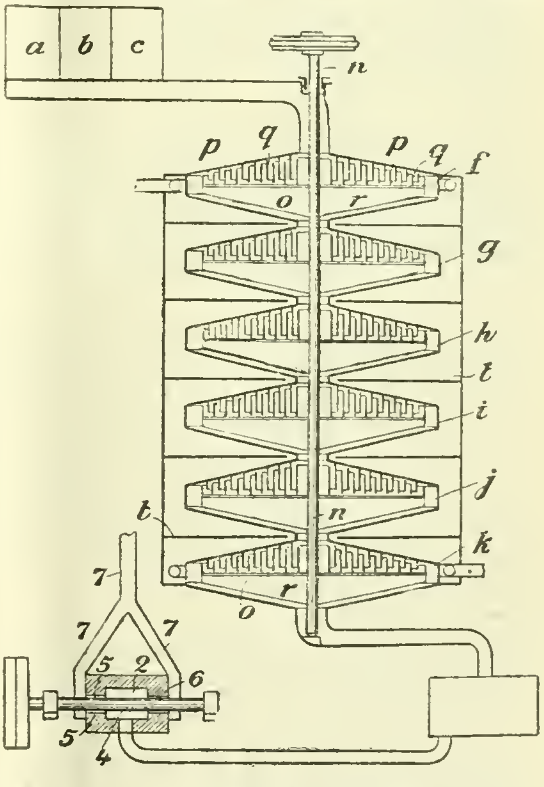
In a grinding machine suitable for oilcake, a vertical cylinder is provided with a series of blades projecting inwards to an adjustable distance, while a concentric rotating shaft is provided with a series of lateral holes arranged spirally, in which blades similarly adjustable are fixed. The material is fed in at the top and withdrawn at the bottom through lateral openings which are controlled by moving covering plates towards or away from them.—W. F. F.

Grinding-mill. J. W. Cover, Tacoma, Wash. U.S. Pat. 1,194,717, Aug. 15, 1916. Date of appl., Nov. 16, 1915.

A cylindrical framework is mounted to rotate on a horizontal axis and contains a series of cylindrical pockets just within the outer surface and supported by the end plates, each pocket containing a number of grinding bars which roll upon one another as the frame rotates. The drum rotates with its lower part in a receptacle containing the material to be ground, and the material is taken up by scoops on the drum formed by short circumferential and radial plates, one scoop being provided for each pocket and arranged so as to deliver the material into the grinding pockets as they rise. The circumferential openings between the scoops are provided with screens. The material delivered from the grinding pockets falls on to short radial plates and thence on to a screen in the centre of the apparatus. The screened material is delivered to a shoot extending through an axial opening.—W. F. F.

Mixing and homogenizing apparatus. J. Gry, Odder, Denmark. Eng. Pat. 100,077, Feb. 14, 1916. Under Int. Conv., Nov. 25, 1915. (Appl. No. 2193 of 1916.)

The constituents of the mixture are supplied in adjustable proportions by separate pumps, *a, b, c,* to a series of flat, superposed, circular compartments, *f, g, h, i, j, k.* Each compartment contains a horizontal disc, *o,* having projecting teeth, *p,* on its upper surface and spiral guides, *r,* on its lower surface. All the discs are mounted on a vertical rotating shaft, *n,* the teeth, *p,* moving between obliquely inclined teeth, *q,* depending from the top of the compartment. The mixture thus passes into each compartment at the centre, outwards through the moving teeth, and then inwards between the spiral guides to the next compartment. A cooling medium passes upwards through the casing and is guided by baffles, *t.* The mixture passes to the homogenizing chamber, 2, provided with outlets, 5, 6, which are adjustable by an axial movement of the slightly conical rotating shaft, 4. The homogenized mixture is delivered to the outlet, 7.—W. F. F.



Kiln; Continuous ——. F. D. Shaw, Chicago, Ill., Assignor to Shaw Kiln Co., Atlanta, Ga. U.S. Pat. 1,194,556, Aug. 15, 1916. Date of appl., Dec. 19, 1910.

The kiln comprises a central chamber having a combustion chamber on each side, and a common arched roof enclosing a space which extends over the combustion chambers and communicates with the central chamber. A moving carriage may be carried horizontally through a preheating chamber and above the central chamber close to the common roof.—W. F. F.

Filter. C. D. Burchenal, New York. U.S. Pat. 1,194,949, Aug. 15, 1916. Date of appl., Mar. 10, 1916.

A FILTER comprises parallel plates with ribs on both faces forming cells, with filtering media between them. A supply passage opens into all the cells, and valve-controlled outlet passages communicate with both faces of each plate.—W. F. F.

Filter. R. L. y Guijarro, Habana, Cuba. U.S. Pat. 1,195,000, Aug. 15, 1916. Date of appl., Nov. 5, 1915.

A ROTATING filtering drum is mounted horizontally in a tank the lower part of which is concentric with the drum. The interior of the drum communicates with the hollow perforated central shaft, and a vacuum is maintained within it. Radial vanes are provided to direct the filtered liquid to the central shaft. A conveyor having scraping members partly surrounds the drum and conveys solid material along an inclined trough to a discharge shoot. A baffle plate is provided having one edge in contact with the drum to prevent rotation of the liquid to be filtered.—W. F. F.

Drying-kiln. C. Harley, Ludington, Mich., Assignor to L. G. Merritt, Lockport, N.Y. U.S. Pat. 1,194,734, Aug. 15, 1916. Date of appl., Aug. 28, 1915.

A NUMBER of superposed horizontal platens are formed of parallel pipes connected so as to form a continuous coil through which a heating medium is circulated. The platens are connected alternately to two frames one of which is movable. The movable frame is counterbalanced and is raised and lowered alternately so as to bring the platens connected therewith into contact with the upper and lower surfaces of the fixed platens.
—W. F. F.

Sizing or classifying comminuted material: Process of and apparatus for ——. H. M. Sutton, and W. L. and E. G. Steele, Dallas, Tex. U.S. Pats. 1,196,047 and 1,196,048, Aug. 29, 1916. Dates of appl., Feb. 5, 1914, and Oct. 8, 1915.

THE material is transported at progressively varying speed over a series of surfaces arranged in steps and inclined to the direction of movement of the material. A progressively varying undulating vibratory motion is imparted to the surfaces, so that the material spreads out transversely to the direction of movement into graduated sizes of grains which are separately collected from the last surface.—W. F. F.

Carboys for carrying acid or other products; Manufacture of crates or baskets for ——. L. Struys, Charleroi, Belgium. Eng. Pat. 101,249, Mar. 28, 1916. (Appl. No. 4551 of 1916.)

Annealing kiln or oven. T. W. Ridley, Middlesbrough. U.S. Pat. 1,196,152, Aug. 29, 1916. Date of appl., Feb. 21, 1916.

Furnaces; Tilting ——. H. J. Kitchen, and T. Balmforth and Co., Ltd., Luton. Eng. Pat. 101,310, Mar. 10, 1916. (Appl No. 3598 of 1916.)

Fabric for filter-plates and other purposes. E. J. Sweetland. Fr. Pat. 478,663, May 11, 1915.

SEE Eng. Pat. 7469 of 1915; this J., 1916, 729.

Filtration, aeration, and gasification of liquids; Apparatus for ——. T. K. Irwin. Fr. Pat. 479,670, Sept. 4, 1915.

SEE Eng. Pat. 19,901 of 1914; this J., 1915, 885.

Separating liquids and solids: Apparatus for ——. J. V. N. Dorr. Fr. Pat. 478,702, May 17, 1915.

SEE U.S. Pat. 1,140,131 of 1915; this J., 1915, 703.

Tube mill. J. S. Fasting. Fr. Pat. 478,746, May 19, 1915.

SEE Eng. Pat. 7160 of 1915; this J., 1916, 294.

Furnaces; Reverberatory ——. Manchester Furnaces, Ltd., W. A. Russell, and J. Lord. Fr. Pat. 478,909, June 4, 1915.

SEE Eng. Pat. 6050 of 1915; this J., 1915, 891.

Desiccating substances containing water. C. A. R. Steenstrup. Fr. Pat. 479,518, Aug. 14, 1915.

SEE Eng. Pat. 12,046 of 1915; this J., 1916, 521.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Fuel economy. Report of British Association Committee.

THE Committee points out the wastefulness in regard to our methods of getting and utilising coal, great economies in these directions being attainable. The Committee emphasises the value of the by-products, pointing out the field for greater expansion in the home demands for ammonium sulphate, and for motor spirit manufactured from our coal. Whilst Germany years ago abandoned the use of beehive coke ovens, we still carbonise about 6½ million tons in this wasteful type of oven. Attention is drawn to the steady increase in the total output of mines and to the phenomenal growth of the export trade. The importance of organising means to raise the coal left behind in the mines is also mentioned. Owing to the magnitude of the work the General Committee resolved itself into five Sub-Committees. The first Sub-Committee (Chemical and Statistical) is preparing a memorandum and bibliography on the chemistry of coal. Some of the members have undertaken experimental work on the constituents of coal, their mutual relations, and their influence upon the character of the products obtained by distillation or oxidation. The members are of the opinion that the time is ripe for the organisation of a scheme of systematic co-operative research aided by national funds. This section is also considering the purposes for which coal is used and the wastage due to coal left behind in the pits. The second section (Carbonisation) estimates that the amounts of coal used for the manufacture of town gas and metallurgical coke in 1913 were 18,200,000 and 20,000,000 tons respectively. The ammonium sulphate produced was 182,180 tons and 133,816 tons respectively, whilst of the 20 million tons of coal used in coke manufacture 13·3 million tons was carbonised in by-product ovens. This section is endeavouring to secure a complete return of the number of by-product ovens, the character of each installation, coking capacity, type of recovery plant used, number of benzol plants, method of utilising waste heat and surplus gas, etc., in order to arrive at an estimate of the margins of possible economies in coking practice. The section has instituted inquiries as to the present practice in the manufacture of town gas, and later on intends to consider the question of low temperature carbonisation.

The third section (Metallurgical, Ceramic, and Refractory Materials) has taken steps to secure data as to the amount of fuel used in the manufacture of various brands of pig-iron and is preparing a memorandum dealing with the heat balance of a modern blast furnace. The section will deal with the best methods of utilising surplus gas and the application of dry air to blast-furnaces. Inquiries are being instituted relative to fuel consumption in steel works, and to modern practice in iron foundries, wrought iron and specialised steel industries.

The fourth Sub-Committee (Power and Steam Raising) is to consider the amount of fuel used and the power developed in factories, mines, railways, ships, etc. It will deal with the present position of central electrical power plants and gas undertakings, and will discuss the merits of steam, gas, oil, and petrol engines as power producers. It will investigate the possible saving of fuel under varying conditions and will deal with the use of large turbine and gas-engines, and other aspects of the power question. The last section (Domestic Fuel) estimates that nearly one-fifth of the coal consumption is utilised for domestic purposes. Any reform in domestic fuel consumption should aim at reduction in cost of heating, diminishing the smoke nuisance, and better hygienic conditions in living apartments. The section is arranging for experiments on these lines and is carrying out experimental work on the relative efficiencies of coal-fires, gas-fires, electric heaters, and the like. It is also considering improvements in the construction and installation of open fire grates and the prospects of substituting for raw coal some form of carbonised fuel (semi-coke or coke).—J. E. C.

Coal ; The structure of ——. M. C. Stopes and R. V. Wheeler. Brit. Assoc., Section B.—Newcastle, 1916.

Suitably prepared transparent sections of coals reveal under the microscope the fact that different parts of the coal substance are composed of different materials. The authors have undertaken the further separation and examination of the different parts of the coal substance, aiming at an ultimate correlation of definite morphological tissues or portions of tissues of the original plants with specific chemical substances now in or yielded by coal. When various coals are treated in a suitable manner, certain vegetable débris, such as wood, spores, and cuticles, can be separated, and from some varieties of coal sufficient of each (botanically) distinct material can be obtained to enable a thorough chemical examination to be made. For example, the authors have obtained a supply of pure cuticle, freed from all other débris of the coal substance, sufficient to allow of a study of its behaviour under different modes of heat-treatment, from which the products of its destructive distillation can be determined and its chemical constitution deduced.

Coal ; Influence of iron pyrites on the oxidation of ——. T. J. Drakeley. Chem. Soc. Trans., 1916, **109**, 723—733.

Experiments are described showing that iron pyrites has a minor effect on the oxidation of coals, and its presence cannot be ignored, even though non-pyritic coals may be amongst those most liable to ignition. A difficulty is experienced in drawing conclusions from the percentage of sulphur in a coal, as pyrites disseminated throughout a coal in microscopical particles will act more effectively than larger quantities of nodular pyrites. Even though samples be drawn from the same seam, it is almost impossible to make inferences from analyses, as great differences may exist in the physical conditions of occurrence. A fault, or a poor roof, may have, it is stated, a more predominating influence than the percentage of sulphur on the ignition of the coal.—B. N.

Coal ; Yield of extract from —— *on treatment with benzene.* F. Fischer and W. Gluud. Ber., 1916, **49**, 1460—1468.

The yield of extract from coal is greatly increased by making the extraction at a temperature (about 275° C.) and pressure (about 55 atm.) approximating the critical constants of benzene (288° C., 50 atmos.). Under these conditions ordinary coal yielded 6½% extract, as compared with 0·1 to 0·15% at 80° C. ; lignite 25% as against 11% ; and cannel coal 4% as against about 1%. Apparently no material decomposition takes place and the original substances of the coal are extracted unaltered.—C. A. M.

Coal ; Extraction of —— *by means of liquid sulphur dioxide.* F. Fischer and W. Gluud. Ber., 1916, **49**, 1469—1474.

On treating coal with liquid sulphur dioxide it swells up, disintegrates into fine particles, and yields a reddish extract, which on evaporation of the solvent leaves a heavy mobile oil. When this is treated with sodium bicarbonate solution and distilled in a current of steam, it yields a light oil with faint fluorescence and an odour of petroleum. By extracting the residue with petroleum spirit, yellow oils stable in the air and distilling at 200° to 350° C. are obtained. In comparison with benzene extracts made at 275° C. (see preceding abstract), the extracts obtained by means of liquid sulphur dioxide contain much less solid substances. This is also the case with the extracts from lignite. When treated with benzene, lignite yields the so-called montan wax, which is a mixture of a wax with resins, whereas the extract obtained from lignite by means of liquid sulphur dioxide is a typical resin.—C. A. M.

Coal ; Conversion of —— *into soluble substances by means of ozone.* F. Fischer. Ber., 1916, **49**, 1472—1474.

By treatment with ozone the chief constituent of coal, corresponding to the original cellulose, is gradually converted into soluble products. For example, by six successive ozonisations of 14 to 40 hours, 92% of a sample of coal was rendered soluble in water. The soluble substance was dark brown, and had an odour of caramel and a pronounced acid taste. It was slightly soluble in alcohol, very sparingly soluble in ether, and nearly insoluble in petroleum spirit. It dissolved in ammonia, alkali solutions, and acids, and formed precipitates with the acetates of heavy and alkaline-earth metals.—C. A. M.

Gas from hard wood and heavy oil. A. M. Hunter. J. Gas Lighting, 1916, 135, 555.

The Bahia Blanca Gas Company, owing to the recent prohibition of coal exports from England, and to excessive freight charges, have found it impracticable to continue making gas from coal. A process has been evolved in which hard wood is distilled in the ordinary ∩-retorts, maintained at a high temperature, and after the first hour, when the wood is incandescent, crude heavy oil, of an asphaltic character, is introduced at a pressure of 80 lb. per sq. inch, through special atomising injectors. The resultant gas may average up to 575 B.Th.U. per cub. ft. and the yield from 8 tons of hard wood and 1·2 tons of heavy oil is approximately 137,700 cub. ft. The gas appears to be permanent and the wood-gas is found capable of carrying the richer hydrocarbon gases from the oil. —J. E. C.

Sulphate of ammonia ; Direct process for the manufacture of ——, *and the storage of ammoniacal liquor.* W. S. Curphey. Fifty-second annual report (1915) on alkali, etc. works by the Chief Inspector.

The report notes a further extension in the use of direct methods for the production of ammonium sulphate in coke-oven works and gas-works. The influence of these methods on the action of purifiers has been prejudicial to the yield of ammonium sulphate, yields of 12½, 16½, 17, 18, 18½, 19½, 20, 24½, 28 lb. per ton of coal being quoted. The character of the reactions taking place in purifying systems is discussed at length, as well as the effect of temperature, and of certain impurities in the crude gas. The following conclusions are drawn as to the conditions best suited for maintaining the highest efficiency in purifiers: 1. Due hydration of the oxide (5 to 10% moisture). 2. Crude gases should be dry and cool rather than moist and warm. The temperature of the oxide in the sulphiding zone should be about 70° F. (21° C.). 3. The gas should be freed from tar fog, oils, naphthalene, and hydrocyanic acid; should contain, say, 0·5 to 1 grain of ammonia per 100 cb. ft., and oxygen equivalent to half the volume of hydrogen sulphide present. 4. Purifier boxes should be sheltered and worked so as to bring the material richest in ferric hydroxide into contact with gas richest in hydrogen sulphide. 5. Direction of flow should be downwards. 6. Conditions of working should be regular. Temperature of oxide, and of inlet and outlet gases should be recorded as well as the oxygen content of the gas. Results of observations and tests at several plants are given in full detail. It is suggested that avoidable losses occur at many of the works using the direct process, and it is recommended that care be taken to ensure that the purifier temperature is not lowered by undue exposure of the boxes, that the moisture content is carefully regulated, and that the gas enters the purifiers, cool and dry, with a moderate regulated amount of ammonia. The use of a washer, fed with virgin liquor, and placed between the acid bubbler and the purifiers, has much to recommend it. Low working temperature of the purifiers might be corrected by introducing a steam pipe.

Attention is again drawn to the seriousness of the loss sustained by ammoniacal liquor when stored in contact with air, and the marked advantages of covering the liquor with a layer of mineral oil are clearly shown in tables giving actual results at various works (see this J., 1915, 1247). It is suggested that all pipes conveying liquor should be lengthened so as to seal the ends, and thus avoid a fall through the air of the entering liquor.
—J. E. C.

Corrosion in a steel gasholder tank. W. Wilson. North British Assoc. of Gas Managers, Sept. 1, 1916. J. Gas Lighting, 1916, **135**, 504—506.

Analysis of the tank water showed the presence of ammonium carbonate and compounds of ammonia with weak organic acids. At least two grains per gallon of a liquid fatty acid was present, similar to that contained in linseed oil, and apparently the acids were not derived from tar. The author concluded that ammonia had slowly acted on the linseed oil of the paint or on the free fatty acids therein, forming an ammonium soap, alkaline to litmus, decomposing on boiling and leaving acid behind. This might account for the destruction of the paint but not for the corrosion of the metal. On emptying the tank considerable incrustation was found. The deposits were brown or blue, and generally blue next to the plates which were badly corroded. A further analysis of the tank water showed iron in solution, produced by corrosion of the metal by organic acids. Various theories as to the cause of the corrosion are discussed. The tank sides had since been thoroughly scraped and brushed with steel wire brushes, and painted with "Bituferri" enamel. The bottom had been cleaned, dried, and then covered with a ½ inch layer of plastic pitch. The tank was to be filled with pure water and a film of oil placed on the surface to prevent absorption of cyanogen compounds from the gas.
—J. E. C.

Sulphur in coal gas; Rapid method for the determination of ——. F. Mylius and C. Hüttner. Ber., 1916, **49**, 1428—1443.

The combustion method for the determination of sulphur in coal gas has been modified to give a more rapid method. A quartz combustion tube, 30 cm. long, contains a tightly wound roll of the finest platinum gauze, 15 cm. long, to which is attached a small spiral of the finest platinum wire, which serves to ignite the gaseous mixture; the gas-air mixture is burnt completely in the first portion of the roll, which is heated to 300°—400° C., the sulphur dioxide is converted into trioxide in the intermediate portion at a lower temperature, and the trioxide and steam are condensed to sulphuric acid in the cooler portion of the catalyst. The sulphuric acid produced is later rinsed out from the quartz tube and titrated with *N*/1000 sodium carbonate solution, using as indicator an ethereal solution of iodoeosin (Mylius and Foerster, this J., 1891, 856). The removal of carburetting agents from Berlin illuminating gas has led to a decrease in the sulphur content. Phenylhydrazine may be used for the removal of sulphur on a small scale. Porous platinum, *i.e.*, a roll of finest platinum gauze, is suitable for the absorption of small amounts of sulphuric acid from acid gases.
—F. W. A.

Hydrogen; Volumetric determination of —— by oxidation with activated chlorate solution. Removal of carbon monoxide by means of mercuric chromate. K. A. Hofmann. Ber., 1916, **49**, 1650—1662.

The oxidation of hydrogen by means of activated chlorate solutions at ordinary temperatures in Hempel absorption pipettes presents certain advantages over the method of combustion by means of palladium-asbestos. The pipette is prepared by filling it as completely as possible with platinised porous tubes or rods, allowing 5 c.c. of 1% palladium chloride solution to flow on to the ends of the rods nearest the capillary where it is dried off by means of a small flame, and finally running in a solution of 5 grms. of sodium bicarbonate, 35 grms. of sodium chlorate, and 0·01 grm. of osmium dioxide in 250 to 300 c.c. of water. The full activity of the solution is not exhibited till 200—300 c.c. of hydrogen has been absorbed, but it is then capable of oxidising at least 60—70 c.c. in ten minutes, and this velocity is maintained for more than 100 determinations if contact poisons are scrupulously excluded, a condition which is fulfilled if the other constituents in a gaseous mixture are removed in the order usual in gas analysis. The oxidation is not affected by the presence of methane, which, moreover, is itself unattacked. In the case of gases of very high hydrogen content, it is sometimes advisable to dilute with carbon dioxide previous to the hydrogen absorption, as otherwise the oxidation of the last few c.c. of hydrogen may be very slow owing to the platinum-palladium contact material being almost entirely covered by the liquid in the pipette and thus rendered inoperative. The presence of as little as 0·1—0·2 c.c. of carbon monoxide, a quantity which always remains unabsorbed by the ordinary cuprous chloride pipette, causes a very great retardation in the oxidation of the hydrogen. Its complete removal is therefore necessary, and the best method at present found consists in passing the gas, after constant volume has been attained in the cuprous chloride pipette, into a second pipette prepared by introducing 10 c.c. of a paste of freshly precipitated mercuric oxide on porous tile and charging with a solution of 25 grms. of chromic anhydride in 250—300 c.c. of water. This mixture oxidises 15—20 c.c. of carbon monoxide and 0·9—1 c.c. of hydrogen in 10 mins., and by means of it the last traces of the former gas can be removed.—G. F. M.

Contact poisons; Retardation by carbon monoxide of the oxidation of hydrogen in the chlorate pipette, a contribution to the knowledge of ——. K. A. Hofmann and H. Schibsted. Ber., 1916, **49**, 1663—1669.

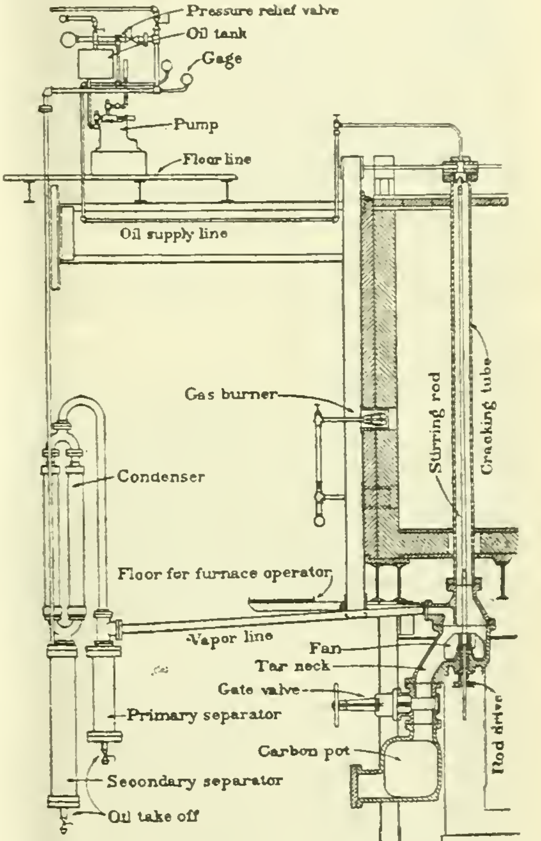
The retardation of the oxidation of hydrogen in the chlorate pipette by carbon monoxide (see preceding abstract) is a phenomenon of contact poisoning. Although pure carbon monoxide is itself continuously though slowly oxidised in the pipette, yet as little as 0·2% in hydrogen is sufficient to retard the oxidation of the latter over a long period. The pipette accordingly furnishes an extremely sensitive means of detecting minute traces of this gas. The injurious effect of carbon monoxide does not persist after the removal of the gas if the contact metal is allowed to remain covered for a short time with the osmium-containing chlorate solution. The carbon monoxide does not act as a mechanical poison, *i.e.*, by excluding the hydrogen from the active surface of the contact, since it is itself much more incompletely and slowly absorbed than is the hydrogen, but in some specific chemical way, at present unexplained, it retards the actual oxidation process. Confirmation of this is found in the fact that increase in concentration of the active oxidising agent, *e.g.*, by the addition of oxygen to the gaseous phase, very notably increases the reaction velocity, both of the oxidation of carbon monoxide alone, and of mixtures of carbon monoxide and hydrogen. —G. F. M.

Sodium pyrogallate as a reagent for the determination of oxygen. J. W. Shipley. J. Amer. Chem. Soc., 1916, **38**, 1687—1701.

Sodium pyrogallate solutions of suitable composition have been found to give better results than potassium pyrogallate solutions for the determination of oxygen in gaseous mixtures. The specific absorption (Anderson, this J., 1915, 853) of a solution composed of 7·36 grms. NaOH, 10 grms. pyrogallol, and 11·62 grms. water is five times that of the most efficient potassium pyrogallate solution (Anderson, *loc. cit.*), and this solution is recommended for use in technical gas analysis. It is somewhat viscous, and when the gas pipettes available have capillaries of less than 1·5 mm. internal bore, it is advisable to use a solution containing 7·36 grms. NaOH, 2—3 grms. pyrogallol, and 8·62 grms. water. No carbon monoxide is formed by the use of these sodium pyrogallate solutions. A new form of double pipette for use with liquid reagents is described. —A. S.

Gasoline and benzene-toluene from petroleum and other hydrocarbons; Manufacture of ——. W. F. Rittman, C. B. Dutton, and E. W. Dean. U.S. Bureau of Mines, 1916. Bull. 114. Petrol. Techn. 29. 268 pages. (See also this J., 1914, 626; 1915, 1199; 1916, 525).

The large-scale development of the benzene-toluene and gasoline processes was the result of investigations made jointly by the U.S. Bureau of Mines and the Aetna Explosives Co. of New York. As finally adopted for commercial operation, the benzene-toluene plant consisted of 6 furnaces, each heated by 22 gas-burners and containing 2 rows of 5 vertical cracking tubes (11½ ft. long and 8 in. in diameter), *i.e.*, 60 tubes in all; each tube was provided with a separate oil-feed and condenser, the arrangement being as shown in the accompanying figure. The removal of deposited carbon from the walls of each tube was effected during operation by means of wiping chains attached spirally to a central rotary stirring rod, this device requiring to be removed and cleaned every few days. The oil was fed at the rate of about 15 galls. per tube per hour in the benzene-toluene process, and at double this rate in the gasoline process; in both processes a much higher rate could be used after preheating the oil. A large number of petroleum oils, ranging in character from crude oils to gas oils and cylinder stocks, were used and, as in the case of laboratory experiments, the reactions desired were found to be practically independent of the kind of oil employed. The benzene-toluene process was also efficiently operated on other liquid hydrocarbon materials such as solvent naphthas and light oil distillates from water-gas tars and coal tar. Apart from the greater yields obtainable from these materials (2 or 3 times that from ordinary petroleum oils), the use of light oil distillates was found to be advantageous on account of the decreased carbonisation and the lower pressure required for the conversion, the results being as favourable at atmospheric pressure or with a vacuum as with higher pressures. As regards gas formation, 40 to 60 cub. ft. of permanent gas was generated per gallon of oil cracked in the benzene-toluene process; and since only 250 to 300 cub. ft. per tube per hour was required for the furnaces, a large surplus of gas of high calorific value (1000—1400 B.Th.U. per cub. ft.) was available for general plant purposes and other industrial uses. Very small amounts of gas were produced in the gasoline



process, the latter requiring an external supply of gaseous or oil fuel. The gasoline process was tested in the single-tube furnaces employed in the development of the benzene-toluene process, no large commercial plant being available: results distinctly favourable to operation on the large scale were obtained. With single-stage operation (*i.e.*, without re-running the unconverted residuum) the amounts of products recovered in the benzene-toluene process were: benzene, 6—8%; toluene, 6—8; xylenes, 4—6; gasoline, 6—8; creosote oil and pitch (including higher aromatic hydrocarbons and lubricating oil), 25—30; carbon, 3—5; and gas, 45—60% of the original oil. In the gasoline process the amount of gasoline recovered was 25—30%, and the residuum (above 150° C.) available for re-running, 70—73% of the original oil. The cost of a unit installation of 4 tubes for the benzene-toluene process, under conditions as in 1915, has been estimated at approximately $5500 (about £1146) per tube, this sum including the building and all equipment but not the cost of storage tanks or apparatus for the treatment of the furnace products. The cost of a gasoline plant would be considerably less. A comprehensive bibliography, compiled by M. S. Howard, and containing brief abstracts of all the publications mentioned, is appended.—W. E. F. P.

Aromatic hydrocarbons from a paraffin base oil; The time factor in the formation of ——. G. Egloff and T. J. Twomey. Met. and Chem. Eng., 1916, **15**, 245—250.

The effect of the time factor or rate of oil flow has been studied in connection with the formation of benzene, toluene, and xylene from a paraffin base oil. The oil was cracked at a constant temperature of 700° C., and at 150 lb. pressure, the rates of flow being 12, 16, 23, 30, and 36 galls. per hour respectively. As the time factor increased, *i.e.*, with a diminished rate of oil flow, the percentage of recovered oil decreased from 65·5 to 17·5%, and the sp. gr. of the oil increased from 0·879 to 0·978 at 15·5° C., the effects being similar to those produced by increasing the temperature of cracking. The maximum quantity of benzene in the recovered oil, viz., 26·3%, was obtained at the rate of 12 galls. per hour, the benzene formation increasing with decrease of the rate of oil flow. The maximum percentages of toluene (13·8%) and of xylene (5·9%) were both obtained at the rate of 16 galls. per hour. Toluene and xylene showed an increase, and then a decrease, while benzene increased continuously with increase of the time factor. On the basis of the oil used, the maximum proportion of benzene (6·6%) was obtained at 12 galls. per hour, of toluene (4·1%) at 16 and 23 galls. per hour, and of xylene (2·4%) at 23 galls. per hour. The percentage of recovered oil distilling up to 170° C. increased with increase of the time factor to a maximum of 44·7%, and then decreased, and the sp. gr. of the distillate increased to 0·875. The recovered oil obtained at a rate of 12 galls. per hour, yielded practically pure benzene, toluene, and xylene on fractionation. No regularity was apparent in the distillation fractions above 170° C., with the exception of tar or pitch, the formation of which decreased with increase of the rate of oil flow. Under the conditions of the experiments, a maximum total of 12·5 galls. of benzene, toluene, and xylene was obtained from 100 galls. of oil used at the rate of 16 galls. per hour at 700° C. and a pressure of 150 lb. per sq. in.—B. N.

Octylene: Action of sulphur on —— *under pressure.* W. Friedmann. Ber., 1916, **49**, 1551—1554.

The following substances were isolated from the product of the action of sulphur on octylene (methyl-*n*-amylethylene) at 270°—280° C. under pressure: a thiophene derivative, $C_8H_{12}S$, in about 20% yield, identical with that obtained under similar conditions from octane (see this J., 1916, 957); a substance $C_{16}H_{28}S$, b.pt. 160°—162° C., which is probably a dimethyldiamylthiophene although not giving the indophenin reaction; and a substance $C_{24}H_{38}S_2$, which as it is not a disulphide, is probably a dicyclic compound produced by the union of the two first-mentioned substances with elimination of two atoms of hydrogen.—G. F. M.

Ethane-propane fraction from natural gas condensate; Thermal decomposition of the ——. J. E. Zanetti and E. H. Leslie. J. Ind. Eng. Chem., 1916, **8**, 777—779.

The ethane-propane fraction from natural gas is placed on the market in cylinders under 500—1000 lb. pressure. The gas used in the experiments was free from carbon dioxide and contained less than 0·5% of unsaturated hydrocarbons. As in the case of the propane-butane fraction (this J., 1916, 957), the percentage of unsaturated hydrocarbons in the gaseous decomposition-products increased gradually to a maximum at about 750° C., and then decreased to a minimum at about 950° C. The hydrogen content increased slowly at first with rise of temperature, but a marked increase was shown above 750° C. Formation of aromatic hydrocarbons (tar fog) began at about 750° C. The highest yield of tar fog was 2·5 c.c. per cb. ft. of gas used. The tar contained a large proportion of naphthalene; benzene was also present but no toluene. Copper had no marked effect on the decomposition, but in presence of iron the formation of tar fog was inhibited, and decomposition into carbon and hydrogen promoted.—A. S.

Deterioration of leather used in gas meters. Lamb. *See page* 989.

Behaviour of chromous salts towards acetylene, and the reducing action of salts of divalent chromium. Traube and Passarge. *See* VII.

Patents.

Fuel: Manufacture of compressed ——. J. Hani, Paris. Eng. Pat. 101,166, Jan. 19, 1916. (Appl. No. 870 of 1916.)

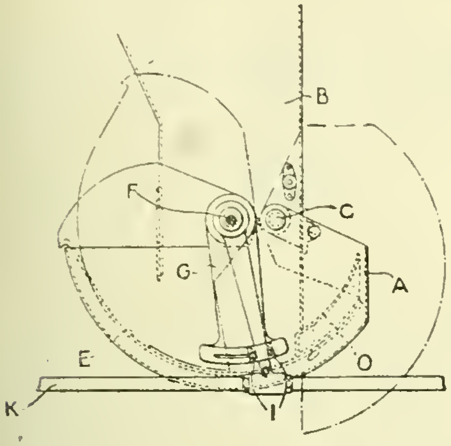
Briquettes are made from a mixture of 95 parts of washed anthracite duff, 3 parts of pitch or bitumen, and 2 parts of disintegrated white spar silica.—J. E. C.

Gas retorts; Setting of ——. H. A. Carpenter, Sewickley, Pa., and The Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 101,117, June 8, 1915. (Appl. No. 4129 of 1916.)

Horizontal retorts are built up of a large number of preformed blocks, preferably of silica material, and are arranged in vertical rows. The retorts are supported by cross supporting walls also built up of preformed blocks. The retorts and supporting walls, as assembled, assume a partially collapsed condition, certain joints being left open to an extent governed by the known rate of expansion of the material. On attaining the working temperature the blocks of the retorts are brought into close contact with each other and with the blocks of the columns. Dowel pins coacting with recesses in the faces of the blocks may be used to prevent displacement of the blocks whilst heating up.—J. E. C.

Vertical retorts; Discharging apparatus for ——. S. Glover, St. Helens, and J. West, Southport. Eng. Pat. 11,942, Aug. 18, 1915.

A trough, a, forming a stationary water-seal, is attached to the mouth, b, of a vertical retort, by means of trunnions, c. Within this trough is provided a tray-like element, e, carried by the trunnions, f, and adapted to be oscillated by the arms, g, the length of stroke being regulated by the adjustable stops, i. On moving the tray to the left by means of the rods, k, the raised portion, o, pushes forward a portion of the coke, whilst on the return stroke, a portion of the coke is forced over the delivery edge. To allow access to the retort for scurfing or other purposes, the trough, a, and the tray, e, may be turned to the positions shown in dotted lines.—J. E. C.



Gas producer plants; Generator for ——. G. H. Allen, North Fremantle, W. Australia. Eng. Pat. 10,881, July 27, 1915. Under Int. Conv., July 27, 1914.

Air is introduced into a continuous gas producer from below the grate by means of an air intake passing through the fire zone to a convenient height. The air then passes downwards through the fuel to a chamber below the grate, whence the gas produced is withdrawn.—J. E. C.

Gas making apparatus. A. M. Stanley, Lynn, Mass., Assignor to Hydrocarbon Converter Co., New York. U.S. Pat. 1,177,904, Apr. 4, 1916. Date of appl., Aug. 31, 1910.

The apparatus consists of a series of cylinders arranged to form concentric passages. The innermost cylinder consists of a porous refractory material of an earthy nature. Immediately outside this is a self-contained heating jacket, the heat being supplied by exhaust gases, etc. Surrounding this heating jacket is another concentric space for heating the air supply to the apparatus. Liquid fuel, along with a regulated supply of heated air from the outermost jacket, passes into the interior of the porous cylinder, its course being checked by baffles. Here, the fuel is gasified by partial combustion. The temperature is regulated by the intermediate heating jacket and a thermostat arrangement operated by the expansion of the vessel.—J. E. C.

Gas; Process of generating tarless ——. H. F. Wallmann, Chicago, Ill., Assignor to A., W. R., and H. H. Wallmann, Chicago, Ill. U.S. Pat. 1,195,934, Aug. 22, 1916. Date of appl., Dec. 17, 1912.

Fuel is passed continuously through a conduit in which it is subjected to distillation, and the solid residue is subjected to a higher temperature in another chamber. Liquid hydrocarbons are led into this second chamber and are gasified, whilst the solid residue is completely consumed in the lower portion by a supply of air.—J. E. C.

Washer scrubbers for use in the purification of gas. E. Hanappe, Highgate. Eng. Pat. 101,106, Feb. 17, 1916. (Appl. No. 2392 of 1916.)

The scrubber is filled with small, regularly shaped sticks or splints of wood placed indiscriminately. —J. E. C.

Hydrocarbons; Process and apparatus for cracking —— and separating the resulting products. G. P. Lewis, London. Eng. Pat. 7535, May 19, 1915.

Liquid hydrocarbons are heated under pressure and allowed to escape into a low-pressure chamber. The condensed liquid from the latter is heated in a still and the vapours fractionally condensed. The residue from this still may be returned to the cracking plant or destructively distilled till all volatile matter is driven off, leaving a residue of coke. One or more stills may be used for treating the liquid residues either from the low-pressure chamber or from another still. The stills may be operated at different temperatures and the fixed gases may be led to a suitable gasholder.—J. E. C.

Petroleum oils; Apparatus for heating ——. M. J. Trumble, Artesia, Cal., Assignor to The Simplex Refining Co. U.S. Pat. 1,194,577, Aug. 15, 1916. Date of appl., Sept. 16, 1912.

Petroleum oil is passed through a series of tubular retorts and U-connections heated by interior steam jet pipes. A by-pass is arranged to draw gas from the retorts and deliver it into the heated oil outlet pipe.—J. E. C.

Gasoline from natural gas; Process of extracting ——. J. P. Foucart, Muskogee, Okla. U.S. Pat. 1,195,158, Aug. 15, 1916. Date of appl., May 11, 1914.

Natural gas is forced into steam which is under a pressure of 20 lb. per sq. in., whereby the constituents which are not in a state of vapour are vaporised. The mixture is then led out of one end of the containing vessel, while a fresh charge of steam and gas is introduced at the other end. The mixture is passed through a condenser and the condensed liquid is collected in a closed tank, in which the gasoline and water form two layers which can be drawn off separately, while the residual gas is withdrawn from above the surface of the liquid.—J. H. J.

Asphaltic products and process of making the same. L. Kirschbraun, Chicago, Ill. U.S. Pat. 1,194,750, Aug. 15, 1916. Date of appl., Mar. 29, 1912.

Semi-asphaltic petroleum residue is heated at a temperature increasing to 700° F. (about 370° C.), and superheated steam, at a temperature not above 700° F., is blown into the mass. A considerable portion of paraffin hydrocarbons is expelled, leaving a highly ductile product.—J. E. C.

Coke oven doors. J. E. Mitchell and H. Morfey, Barnsley. Eng. Pat. 13,819, Sept. 29, 1915.

Gas retorts; Apparatus for charging ——. H. Bird, R. Cort and Son, Ltd., and A. G. Sims, Reading. Eng. Pat. 12,776, Sept. 7, 1915.

Burning gas; Means for ——. I. Hall, Birmingham. Eng. Pat. 12,695, Sept. 4, 1915.

Combustion residues from locomotives; Utilisation of ——. J. S. Bean and H. Nash. Fr. Pat. 479,298, July 17, 1915.

See Eng. Pat. 14,618 of 1914; this J., 1915, 824.

Agglutinant for briquettes, etc. P. J. Mitchell and A. C. Evans. Fr. Pat. 479,635, Sept. 2, 1915.

See Eng. Pat. 19,933 of 1914; this J., 1915, 899.

Fuel; Manufacture of artificial or agglomerated ——. H. Faraday. Fr. Pat. 479,640. Sept. 3, 1915.

See Eng. Pat. 19,495 of 1914; this J., 1915, 824.

Coke: Manufacture of —— *from non-coking or difficultly coking coal.* T. M. Hickman. Fr. Pat. 478,828. May 27. 1915.

See Eng. Pat. 4214 of 1914; this J., 1915, 706.

Coke; Manufacture of ——. A. McD. Duckham. Fr. Pat. 479,372, July 23. 1915.

See Eng. Pat. 17,502 of 1914; this J., 1915, 787.

Retort for distilling or carbonising coal or other carbonaceous substance. C. W. Tozer. Fr. Pat. 478,040. Mar. 15. 1915.

See Eng. Pat. 7116 of 1914; this J., 1914, 912.

Retorts for carbonisation of coal and the like. A. McD. Duckham. Fr. Pat. 479,373. July 23. 1915.

See Eng. Pat. 13,934 of 1914; this J., 1915. 1044.

Coal gas-making apparatus. L. D. Carroll, London. From C. S. Chrisman. Philadelphia. U.S.A. Eng. Pat. 101,306. Feb. 24, 1916. (Appl. No. 2783 of 1916.)

See U.S. Pat. 1,176,432 of 1916; this J., 1916, 527.

Shale or coal; Distillation of —— *for production of oil-gas or lighting gas.* J. W. Fell. Fr. Pat. 478,652, May 10, 1915.

See Eng. Pat. 6613 of 1915; this J., 1916, 626.

Gas producer. G. H. Bentley and E. G. Appleby. Fr. Pat. 477,998. Mar. 12, 1915.

See Eng. Pat. 9040 of 1914; this J., 1915, 540.

Oil-gas; Manufacture of ——. Hollandsche Residugas Maatschappij Systeem Rincker-Wolter. Fr. Pat. 478,836, Mar. 23, 1915.

See Eng. Pat. 6285 of 1915; this J., 1916, 625.

Gas; Manufacture of ——. Anglo-Mexican Petroleum Products Co., and R. P. Brousson. Fr. Pat. 479,751, Sept. 16, 1915.

See Eng. Pat. 6873 of 1915; this J., 1916, 958.

Carbon monoxide: Method of absorbing —— [*from gases*]. W. Gaus, Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,196,101, Aug. 29, 1916. Date of appl., Oct. 21, 1914.

See Ger. Pat. 282,505 of 1913; this J., 1915, 651.

Hydrocarbons of low boiling point; Production of ——. Iroline Co. of America. Fr. Pat. 477,891, Mar. 5, 1915.

See Eng. Pat. 3327 of 1915; this J., 1916, 828.

Fuel for internal combustion motors. R. Wood. Fr. Pat. 478,070. Mar. 17. 1915.

See Eng. Pat. 24,262 of 1914; this J., 1915, 483.

Motor compound: Process and apparatus for production of a liquid ——. B. L. Rinehart. Fr. Pat. 478,614. May 5. 1915.

See Eng. Pat. 6290 of 1915; this J., 1916. 104.

Hydrocarbons; Treatment of liquid ——. New Process Oil Co. Fr. Pat. 478,316, Apr. 7, 1915.

See Eng. Pat. 4856 of 1915; this J., 1916, 528.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

A source of flotative agents [*for ore concentration*]. [*Wood tar from sage brush.*] Clevenger. *See* X.

Patents.

Destructive distillation of coal or other carbonaceous substances; Furnace settings for ——. S. N. Wellington, London. Eng. Pat. 7769, May 25, 1915.

In a furnace setting for vertical retorts, the horizontal heating flues are divided into three spaces by two vertical partitions. Gas and air are fed into the central combustion space, and the heating gases pass to one end, and are then deflected into the two outer spaces adjoining the retorts proper. The proportion allocated to either of the outer spaces is controlled by an angular damper block. The exhaust and air supply flues communicate with a recuperator or regenerator.
—J. E. C.

Oils, spirits and gases; Method of and apparatus for obtaining —— *from peat or other material or substances.* A. N. Macnicol, Melbourne, Australia. Eng. Pat. 10,679. July 22, 1915. Under Int. Conv., July 22, 1914.

The apparatus consists of a retort and a separately heated retort extension. The material is heated in the main retort along with catalytic agents, such as iron oxide, nickel, etc., and in presence of steam, hydrogen, or water-gas. The volatilised oils are then heated in the extension, with or without steam, etc. Condensers are used, and any part of the system may be subjected to pressure by means of a compressor with the necessary valves.—J. E. C.

Volatile products; Separation of —— *from solid carbonaceous material.* L. Del Monte y Aldama, Assignor to Oil and Carbon Products, Ltd., London. U.S. Pat. 1,196,470, Aug. 29, 1916. Date of appl., Sept. 21, 1914.

Solid carbonaceous material is distilled in an inclined retort. The upper end of the retort is heated to a higher temperature than the remainder, and the distilled vapours on their passage to the lower end are condensed by contact with progressively cooler material. The liquid condensed products are prevented from returning to hotter regions of the retort.—J. E. C.

Charcoal powder; Process of making active ——. L. Pilaski, Warsaw, Russia. U.S. Pat. 1,195,720, Aug. 22, 1916. Date of appl., Aug. 7, 1913.

See Ger. Pat. 267,443 of 1912; this J., 1914, 216.

Neon lighting. G. Claude. Fr. Pat. 478,076, July 16, 1914.

See Eng. Pat. 8312 of 1915; this J., 1915, 1005.

Metallic filaments for electric incandescence lamps; Manufacture of ——. K. Nishimoto. Fr. Pat. 478,693. May 14, 1915.

See Eng. Pat. 7829 of 1915; this J., 1916, 731.

Heating furnaces [*for metals*]. Eng. Pat. 15,226. *See* X.

III.—TAR AND TAR PRODUCTS.

Toluene: Formation of —— *by the action of anhydrous aluminium chloride on xylene and benzene.* F. Fischer and H. Niggemann. Ber., 1916. 49, 1175—1482.

By boiling xylene with 2 to 4% of aluminium chloride for 2 hours beneath a reflux condenser, about 12% of toluene may be obtained, together with a certain proportion of benzene and of higher homologues of xylene. By using the so-called "solvent benzol I" (a mixture of alkylbenzenes yielding 3% distilling up to 134° C.) instead of xylene, only a small amount of toluene is produced, although products of lower boiling point are formed. In the case of "solvent benzol II" (which yields 2% distilling up to 140° C.) no products of lower boiling point are formed. The energetic action of aluminium chloride causes decomposition of benzene, but only traces of toluene are produced. Attempts to transfer a methyl group from xylene to benzene by the simultaneous decomposing and synthetic action of aluminium chloride gave indecisive results.—C. A. M.

Chlorination of hydrocarbons with aqua regia. R. L. Datta and F. V. Fernandes. J. Amer. Chem. Soc., 1916, **38**, 1809—1813.

Further experiments have been made on the action of *aqua regia* on aromatic hydrocarbons (compare this J., 1911, 1198). *m*-Xylene yielded the monochloro-, the 4.6-dichloro-, and the tetrachloro-derivatives, together with a small quantity of a trichloro-derivative (m.pt. 117° C.). *o*-Xylene yielded the monochloro-, the 4.5-dichloro-, and the tetrachloro-derivatives. *p*-Xylene yielded the monochloro-, the 2.5-dichloro-, and the tetrachloro-derivatives. From ethylbenzene the chief product was monochloroethylbenzene, $C_6H_5.C_2H_4Cl$; when the action was prolonged, a crystalline substance of m.pt. 171·5° C., which is under investigation, was formed. Dibenzyl yielded *p*-dichlorodibenzyl. Higher homologues and more complex hydrocarbons gave complex mixtures of reaction products, or were completely decomposed, with formation of chloropicrin.—A. S.

Chloropicrin and tetrachloroquinone [chloranil]; Formation of —— by the action of aqua regia on organic substances. R. L. Datta and N. R. Chatterjee. J. Amer. Chem. Soc., 1916, **38**, 1813—1821.

The action of *aqua regia* on a large number of organic substances has been studied, and it has been found that in all cases where the compound is destroyed by the action of *aqua regia* chloropicrin is formed, though in very varying quantities (compare this J., 1915, 377). Many aromatic compounds yield chloranil (tetrachloroquinone) by the action of *aqua regia*. This is especially the case with compounds having easily replaceable groups in the *para*-position and compounds of quinonoid structure. Chloranil is not formed from compounds, such as naphthalene and anthracene derivatives, containing complex nuclei. The existing method for the commercial manufacture of chloranil by the oxidation of trichlorophenol with potassium bichromate, could probably be advantageously replaced by a method in which *aqua regia* is used. The following yields of chloranil were obtained by the action of *aqua regia* on 20 grms. of the substances mentioned: quinol, 13—14 grms.; *p*-phenylenediamine, 13—14 grms.; trichlorophenol, 10 grms.; sulphanilic acid, 6—7 grms.—A. S.

2.3-*Dihydroxytoluene (isohomocatechol) and the nitro-derivatives of its methyl ethers.* R. Majima and Y. Okazaki. Ber., 1916, **49**, 1482—1496.

2.3-Dihydroxytoluene, the lowest homologue of hydrourushiol (this J., 1916, 128), behaves in an analogous manner to the latter on treatment with iron chloride and alkali, and the dimethyl ethers of both substances yield analogous mono- and dinitro-derivatives (see this J., 1914, 91). Amino-2.3-dimethoxytoluene was converted by the diazo reaction into hydroxy-2.3-dimethoxytoluene, which was transformed into the quinone. The hydroxy or amino group appeared to be in the 5-position, whilst comparison with nitro compounds of veratrol indicated that the dinitro derivative is 5.6-dinitro-2.3-dimethoxytoluene. Cain and Simonsen (Trans. Chem. Soc., 1914, **105**, 156) described both nitro derivatives, but the melting points of their products (viz. 76°—77° C. and 95° C.) did not correspond with those found by the authors (viz., 105°—106° C. and 112°—113° C. respectively). The discrepancy is attributed to the preparations of Cain and Simonsen being 4.6-dinitro-2.3-dimethoxytoluene and 4-amino-6-nitro-2.3-dimethoxytoluene. This was confirmed by the preparation of the 4- and 6-mononitro-derivatives from 2-methoxy-3-hydroxytoluene, and the conversion of the 4-nitro derivative into 4-nitro-2.3-dimethoxybenzoic acid, which Cain and Simonsen were unable to obtain. It melted at 91° to 95° C. All the theoretically possible nitro-derivatives of 2.3-dimethoxytoluene have thus been prepared. The 4.5-trinitro derivative melted at 131°—132° C.—C. A. M.

Phenol ethers, and esters; Hydrolysis of —— by means of the hydrochlorides of aromatic bases. Preparation of anilides and their homologues. A. Klemenc. Ber., 1916, **49**, 1371—1376.

One molecular proportion of the ether or ester is heated to fusion (180°—230° C.) with 2 to 3 mols. of aniline hydrochloride, or a homologue; the reaction is generally complete within an hour, when the fused mass is poured into concentrated hydrochloric acid and the product worked up by suitable means. With aniline hydrochloride anisic acid gave an 80% yield of *p*-hydroxybenzoic-anilide (m. pt. 201°—202° C.); *m*-methoxybenzoic acid gave *m*-hydroxybenzoic-anilide (m. pt. 156° C.); pyrogalloltrimethyl ether gave pyrogallol (m. pt. 132° C., after one recrystallisation from benzene); 14 grms. of hemipinic acid gave 4 grms. of nor-hemipinic-anil, $C_{14}H_9O_4N$ (m. pt. 226° C.); anisol is unattacked even after several hours heating in an autoclave. With *p*-toluidine hydrochloride anisic acid gave a quantitative yield of *p*-hydroxybenzoic-*p*-toluidide (m. pt. 207—209° C.); with *m*-toluidine hydrochloride a high yield of the *m*-toluidide was obtained. Isovanillic acid (m. pt. 255°—257° C.) was obtained when hemipinic acid (1 part) was heated for 4 hours at 200° C. with dimethylaniline hydrochloride (2 parts). Experiments with aniline hydriodide and anisic acid showed that about two-thirds of the methyl radical split off was liberated as methyl iodide; the remaining one-third served to methylate some of the aniline.—E. W. L.

Benzoylene-anthranil and bisanthranils and anthraquinone-azides. A. Schaarschmidt. Ber., 1916, **49**, 1632—1637.

Anthraquinone diazonium salts combine with sodium azide to form anthraquinone-azides. The azide from the 2-type of anthraquinone compound is stable in boiling water but the product of the 1-derivative readily loses two atoms of nitrogen yielding a pure, finely crystalline and stable compound, 3.4-benzoyleneanthranil, m. pt. above 300° C. Similarly from 1.5-diamino-anthraquinone there is obtained the corresponding bisanthranil derivative and from 1.4-diamino-anthraquinone the isobisanthranil derivative, reddish brown powders both giving strongly fluorescent solutions. Anthraquinone-2-azide, which is stable to boiling water, is a colourless powder crystallising from acetic acid in yellow needles, m. pt. 160° C., and decomposed on warming with strong sulphuric acid into hydroxyaminoanthraquinone.—J. F. B.

Manufacture of gasoline and benzene-toluene from petroleum and other hydrocarbons. Rittman and others. *See* IIa.

The time factor in the formation of aromatic hydrocarbons from a paraffin base oil. Egloff and Twomey. *See* IIa.

Thermal decomposition of the ethane-propane fraction from natural gas condensate. Zanetti and Leslie. *See* IIa.

Fifty-second annual report on alkali, etc., works, by the Chief Inspector. 1915. *See* VII.

Coumarone resin and its uses. Ellis and Rabinovitz. *See* XIII.

Hydrogenation of heterocyclic compounds. Skita and Brunner. *See* XX.

Patents.

Sulphonation of organic compounds. A. Heinemann, Birmingham. Eng. Pat. 12,260, Aug. 25, 1915.

The sulphonation of aromatic compounds can be carried out with weaker acid, in a shorter time, and without carbonisation, if a small quantity of iodine be added. *Example.*—146 grms. of sulphuric acid, 70 grms. of benzene, and 0·25 grm. of iodine are heated and stirred together under a reflux condenser for five hours. The whole of the benzene will then have been converted into benzenemonosulphonic acid. The iodine can be recovered by adding water to the product and filtering.—F. Sp.

Toluene; Production of ——. W. B. Sifton, and Harding Bros., Ltd. Fr. Pats. 479,295 and 479,296, July 17, 1915.

See Eng. Pat. 8886 of 1915; this J., 1916, 248.

Toluene; Apparatus for prdouction of ——. W. B. Sifton. Fr. Pat. 479,297, July 17, 1915.

See Eng Pat 9437 of 1915; this J., 1916, 248.

IV.—COLOURING MATTERS AND DYES.

Absorption of colouring matters by charcoal and silica. E. Knecht and E. Hibbert. J. Soc. Dyers and Col., 1916, 32, 226—230.

A detailed account of the literature referring to the subject is given, and emphasis is laid on the fact that animal charcoal cannot be regarded as one form of the element carbon. The examination of charcoals which have been treated to remove or introduce nitrogen has shown that the nitrogen content has a direct influence on the absorption of Crystal Scarlet and Methylene Blue. The product obtained from pure silk, and activated by heating with potash, absorbed a considerable amount of Crystal Scarlet, and hence the sulphur present in animal charcoal is not responsible for its colour-absorbing properties. A sample of bone charcoal had not such a great absorptive power as a sample of blood charcoal, although the former contained a higher percentage of nitrogen; this is probably due to the condition of the nitrogen, and Glassner and Suida (this J., 1907, 1915) have suggested that cyanamino-compounds are present in animal charcoal. In accordance with the results of Glassner and Suida (this J., 1908, 803), it was found that the oxygen content of charcoal plays an important part in the absorption of Methylene Blue. Experiments on the dyeing of silica and silicic acid led to the same results as those of Suida (this J., 1904, 1144; 1907, 1236); powdered quartz does not absorb Methylene Blue, and the absorption of this dyestuff by calcined silica is due to the fact that the silica is capable of being hydrated in the air or in contact with the solution of dyestuff.—F. W. A.

Tetramethyldiaminophenazine. P. Karrer. Ber., 1916, 49, 1643—1644.

Symmetrical tetramethyldiaminophenazine is a violet-red dyestuff obtained in moderate yield by the oxidation of an equimolecular mixture of dimethyl-*p*- and -*m*-phenylenediamines by potassium bichromate in presence of dilute hydrochloric acid: the reaction is completed by heating to 80° C. The zinc salt is precipitated by the addition of zinc chloride and saturated sodium chloride solution and converted into the hydriodide, which may be recrystallised from dilute alcohol. There is no change of colour on the addition of alkali. This dyestuff is not suitable for use in biological investigations like the similarly constituted Methylene Blue.—J. F. B.

Patents.

o-[Hydr]oxyazo dyestuffs; Manufacture of direct ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 12,250, Aug. 25, 1915.

Direct *o*-hydroxymono-, dis-, or poly-azo dyestuffs are obtained by coupling an o-hydroxydiazo compound of the benzene or naphthalene series with an N-substituted 2-amino-5-naphthol-7-sulphonic acid or 2-amino-5-naphthol-1.7-disulphonic acid (except an N-alkyl or N-aryl derivative), in some cases using simultaneously any aromatic diazo-compound; or with the unsubstituted acids mentioned above or any substitution product, in some cases using simultaneously another end component or a middle component capable of being further diazotised and any aromatic diazo-compound. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act of 1907, to Eng. Pat. 21,473 of 1910; this J., 1911, 1109.)—F. W. A.

[Anthracene] vat dyes and process of making them. A. Lüttringhaus, Mannheim, Assignor to Badische Anilin u. Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,196,127, Aug. 29, 1916. Date of appl., Oct. 20, 1913.

See Fr. Pat. 463,508 of 1913; this J., 1914, 415.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Paper-making materials [Tambookie grass and Papyrus] from South Africa. Bull. Imp. Inst., 1916, 14, 163—167.

Tambookie grass (*Cymbopogon Nardus* var. *validus*) grows extensively in the Transvaal, particularly in the northern parts. The sample examined ranged in length up to a maximum of 5 ft. 6 in., with a diameter of about ¼ in. at the base. On digestion with caustic soda tambookie grass yields 37·1% of an easily bleachable pulp (dry pulp referred to air-dry material), showing an average length of fibre of 0·081 in., and is considered to be well adapted for paper-making and to have a value higher than that of Algerian esparto. Papyrus is found in the St. Lucia Bay districts of Zululand and samples of this reed have been compared with those obtained from East Africa and the Sudan. It is easily digested with caustic soda and gives a good bleaching pulp, but the yield of pulp from the South African variety is somewhat lower than from those obtained from other parts. In the case of both these South African materials, it is considered that export in the raw state would not be profitable on account of freight, but they could be converted into half stuff for export or for the manufacture of paper locally.—J. F. B.

Patents.

Fibrous compositions. [*Roofing sheets.*] J. C. Woodley, Pelham Manor, N.Y., U.S.A. Eng. Pat. 8815, June 15. 1915.

Fibrous material, *e.g.* waste paper or pulped stock, preferably in the moist condition, is steeped in or coated or sprayed with a hot liquid binding medium which subsequently becomes gummy on cooling. Generally, the binder may consist of a mixture of a natural or artificial flux oil or soft asphalt with harder asphalts such as gilsonite or hard pitch, for instance, a mixture of 88% of residuum oil, m.pt. 100°—120° F. (38°—49° C.), and 12% of grahamite. The saturated paper, cooled to a semi-solid consistence, is disintegrated into its ultimate fibres by forcing the mass repeatedly through perforated plates, so as to draw out the fibres between the surrounding elastic material. When the mixture is homogeneous it is subjected to pressure, *e.g.* by rollers, and formed into sheets, in which the fibres are completely coated with bituminous matter and felted together. The proportion of fibrous material should not exceed 50% of the mass and may preferably be between 5 and 30%.—J. F. B.

Textile belts or the like: Process for impregnating —— with gutta-percha, balata, indiarubber or the like. E. C. R. Marks, London. From A./S. Roulunds Fabriker, Odense, Denmark. Eng. Pat. 101,127, Apr. 3, 1916. (Appl. No. 4882 of 1916.)

Textile materials are treated with gutta-percha, balata, or rubber dissolved in suitable solvents, containing also 2—20% of a sulphonated oil to make the solution more fluid and assist penetration. The mixture may, if desired, also contain sulphur, preferably in solution, with a view to subsequent vulcanisation.—J. F. B.

Stenciling fabric; Method of producing a ——. A. E. Strippel, New York. U.S. Pat. 1,194,899, Aug. 15, 1916. Date of appl., Nov. 22, 1912.

The fabric is treated whilst protected from the light with a heated solution containing gelatin, glycerin, and potassium bichromate, in which the proportion of glycerin by weight exceeds that of the gelatin; it is then dried with exposure to light, treated with warm water, then with a 15% solution of calcium chloride, subjected to heat and pressure for drying, and finished.—J. F. B.

Cellulose or paper-pulp from fibrous vegetable materials; Method of isolating or extracting —— and apparatus therefor. W. Raitt, London. Eng. Pat. 16,488, Nov. 23, 1915.

In carrying out the process of fractional digestion, *e.g.*, of bamboo, described in Eng. Pat. 15,779 of 1912 (see Fr. Pat. 453,307 of 1912; this J., 1913, 715), the operation may be reduced to two stages by extracting in an auxiliary vessel, those constituents which are soluble in water and in a dilute solution of caustic soda at a moderate temperature (100° C.), and subsequently removing the lignin by digestion with a stronger solution of caustic soda at a higher temperature (162° C.). The strength of the alkali used for the main (lignin) digestion may be such that the spent liquor contains sufficient unconsumed caustic soda to perform the preliminary extraction of a succeeding batch of material. The auxiliary vessel and the main digester may be so arranged that the charge of the former may be transferred to the latter, and the steam escaping from the main digester may be conducted into the auxiliary vessel to boil the contents at a lower pressure.—J. F. B.

Paper pulp and the like [from sunflower stalks]; Process for the manufacture of ——. H. McCormack, Chicago, and E. W. McMullen, Kenosha, Wis., Assignors to F. Orth and J. Harbaugh, Indiana Harbour, Ind. U.S. Pat. 1,196,708, Aug. 29, 1916. Date of appl., Nov. 25, 1914.

Cellulosic material, *e.g.* sunflower stalks, is dried and shredded, then digested in a solution containing 5% of sodium hydroxide, 10% of carbonate, 8% of sodium chloride, and 25% of sodium oxychloride (hypochlorite), calculated on the weight of the material, under a pressure of 80 lb. per sq. in. for about 10 hours. The digested material is beaten to a pulp in a pebble mill or the like, which may contain a dilute solution of permanganate.—J.F.B.

Paper size and process of making same. G. Muth, Butzbach, Assignor to Dr. Graf und Co., Neubabelsberg, Germany. U.S. Pat. 1,194,866, Aug. 15, 1916. Date of appl., Jan. 25, 1916.

An artificial resin obtained from coal tar (coumarone resin) is melted with natural resin or a saponifiable fat until frothing has ceased, and the mixture boiled with an alkali until a uniform emulsion is produced.—J. F. B.

Paper; Method and apparatus for sizing [surface-starching] ——. H. M. Wheelwright, Ware, Mass. U.S. Pat. 1,195,888, Aug. 22, 1916. Date of appl., July 22, 1915.

The paper is led through a series of wet-presses and while passing between the last pair of press rolls a size composed of a soluble starch compound or " feculose " is applied to both sides of the moist web of paper by means of the press rolls, which transfer the starch solution to the paper.—J. F. B.

Wool-scouring and analogous liquors; Concentration of —— and recovery of the grease and alkaline substances present therein. E. V. Chambers, T. C. Hammond, and G. G. Jarmain. Fr. Pat. 478,641, May 8, 1915.

See Eng. Pat. 13,005 of 1914; this J., 1915, 276.

Textile driving belts and the like: Impregnation of ——. Aktieselskabet Roulunds Fabriker. Fr. Pat 479,333. Oct. 24, 1914.

See Eng. Pat. 101,127 of 1916; preceding.

Cellulose esters: Preparation of new ——. Soc. Chim. Usines du Rhône (anc. Gilliard, P. Monnet, et Cartier). Fr. Pat. 478,436, Aug. 4, 1914.

See Eng. Pat. 10,822 of 1915; this J., 1915, 1086.

Collodion [artificial silk]: Machines for spinning ——. H. de Chardonnet. Fr. Pat. 478,405, Aug. 1, 1914.

See Eng. Pat. 10,857 of 1915; this J., 1916, 533.

Collodion [artificial silk] and like threads; Process and apparatus for denitrating, bleaching, dyeing, and otherwise treating ——. H. de Chardonnet. Fr. Pat. 478,404, Aug. 1, 1914.

See Eng. Pat. 10,858 of 1915; this J., 1916, 302.

Paper pulp: Separation of metallic particles and other foreign matter from —— A. J. Newell and R. J. Marx. Fr. Pat. 477,995, Mar. 12, 1915.

See Eng. Pat. 2865 of 1915; this J., 1915, 1138.

Paper: Process and apparatus for pulping printed or unprinted —— and for removing ink from printed paper. General Waste Paper Recovery Co. Fr. Pat. 478,288, Mar. 20, 1915.

See Eng. Pat. 3702 of 1915; this J., 1916, 833.

Paper-making machines, and manufacture of paper. R. J. Marx. Fr. Pat. 478,839, Mar. 30, 1915.

See Eng. Pat. 3708 of 1915; this J., 1915, 1007.

Pulp mills: Process of treating waste liquors from ——. E. L. Rinman, Harnäs, Sweden. U.S. Pat. 1,196,290, Aug. 29, 1916. Date of appl., Mar. 12, 1912.

See Fr. Pat. 441,186 of 1912; this J., 1912, 812.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Absorption of colouring matters by charcoal and silica. Knecht and Hibbert. *See* IV.

Note on the cause of the pink colour observed in certain hypochlorite bleaching solutions. Elledge. *See* VII.

Patents.

Textile materials; Scouring, bleaching, dyeing and the like machines for treating ——. F. F. Larivei, Bradford. Eng. Pat. 11,583, Aug. 11, 1915.

In machines of the type in which the textile materials are supported on rollers or frames independent of the vats containing the treating liquids, these vats are supported by vertical columns formed as racks having teeth on one side. By means of toothed wheels and gear operated from two shafts, constantly rotated in the same direction and brought into action by hand-controlled clutches, the vat may be either raised or lowered and caused to come to rest at any predetermined point by means of a stop motion actuated automatically.
—J. F. B.

Bleaching process. H. R. Anders and M. E. U. Schoedler, Perth Amboy, N.J., Assignors to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,195,325, Aug. 22, 1916. Date of appl., Mar. 30, 1912.

The container, which is divided into compartments, is packed in a horizontal position with the goods to be bleached, and is then inserted vertically in the vat; the dividing partitions prevent vertical displacement of the material. Bleaching liquor is passed through the goods in alternate directions until the desired result is attained.
—F. W. A.

Dyeing fabrics; Apparatus for ——. H. L. Quick, New York. U.S. Pat. 1,195,606, Aug. 22, 1916. Date of appl., July 30, 1914.

The roll of fabric is carried by a rotating cylindrical frame, and the ends of the roll are closed by flanges having concentric circular grooves on the faces which abut against the ends of the roll. Dye liquor is supplied through a central perforated tube, which extends through the frame.
—F. W. A.

Dyeing machines. J. Benosch, Assignor to Klauder-Weldon Dyeing Machine Co., Amsterdam, N.Y. U.S. Pats. (A) 1,195,646 and (B) 1,195,647, Aug. 22, 1916. Dates of appl., (A) May 11, and (B) June 9, 1911.

(A) A dyeing machine is provided with a rotary carrier having series of concentric inner and outer stick sockets and an independently rotating slide for locking simultaneously the sticks in a number of the sockets of one of the series. (B) A dyeing machine has a circular rotary carrier provided with means for supporting a pair of sticks oppositely disposed with respect to their ends, a locking member which fixes the pair of sticks simultaneously in working position, and also an arrangement which allows of the lateral removal or insertion of the sticks individually or collectively.
—F. W. A.

Weighting silk; Process of ——. Schmid frères. Fr. Pats. 479,312 and 479,316, July 19, 1915.

See Ger. Pats. 287,754 and 291,009; this J., 1916, 174, 596.

Sericin soap substitute for silk dyeing; Manufacture of ——. Schmid frères. Fr. Pat. 479,304, July 19, 1915.

See Eng. Pat. 100,169 of 1916; this J., 1916, 734.

Dyeing silk in a foam bath. Schmid frères. Fr. Pat. 479,726, Sept. 13, 1915.

See Eng. Pat. 100,336 of 1916; this J., 1916, 630.

Dyeing fabrics, etc.: Method and apparatus for ——. Bradford Dyers Assoc., Ltd., and E. J. Wilkinson. Fr. Pat. 479,390, July 27, 1915.

See Eng. Pat. 17,215 of 1914; this J., 1915, 902.

Producing bronze kid [leather]. Eng. Pat. 101,109. *See* XV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Alkali, etc., works: Fifty-second annual report on —— *by the Chief Inspector. Proceedings during the year* 1915. 100 pages. Price 2s.

The number of registered works in England, Ireland, and Wales was 1372, including 63 "alkali works," and in Scotland 170, making a net increase of 16 for the United Kingdom compared with 1914. The increased activity is associated largely with the manufacture of chemicals used in production of munitions of war, and with the distillation of tar. The general average figures for the escape of acid gases vary, in most classes of works, but slightly from those for the two previous years. In the present report a differentiation is made between smelting works and other kinds of works, in regard to the acidity of chimney gases: for smelting works the general average acidity was 3·056 grains SO_2 per cb. ft.; for other works, 0·719 grain per cb. ft.; and for all works, 1·059 grains per cb. ft. There were three cases of contravention of provisions of the Act, but in view of the exceptional conditions no proceedings were taken. In two cases back fees were accepted in lieu of taking proceedings in regard to non-registration of processes. *Alkali and copper (wet process) works.* The production of hydrochloric acid was hampered by difficulty in obtaining sulphuric acid, and the difficulty was only partly overcome by an increased use of nitre cake in the salt-cake furnaces; in some districts the supply of hydrochloric acid was insufficient to meet the demand. The use of mechanical furnaces in connection with the extraction of copper by the wet process made further progress, and in one works an improved form of packing for the condensers was used, which is more readily washed than coke packing and shows less tendency to choke and cause interference with the draught on the furnaces. Efforts to increase the production in sulphuric acid works by using larger quantities of pyrites resulted in leaving a larger proportion of residual sulphur in the burnt pyrites than formerly and in consequence of this the acidity of the copper works' chimney gases increased.

In one works where hydrochloric acid is made from salt and nitre cake, the presence of undecomposed sodium nitrate in the nitre cake caused trouble owing to the formation of chlorine, which partly passed the condenser and escaped from the chimney. The difficulty was overcome by the addition of sulphur to the charge.

Smelting works. There was some increase in the utilisation for the manufacture of sulphuric acid of the gases from furnaces for the calcination of zinc sulphide ores, but regret is expressed that considerable extensions of calcining plant for zinc ores were erected during 1915, and further extensions are under construction, which will not permit of the utilisation of the gases. The use of electrical methods to aid in the deposition of dust and fume is to be tried in one works.

Cement works. Reference is made to the presence of potassium compounds in the flue-dust from cement kilns.

Sulphuric acid works continued working under great pressure; nevertheless the general average acidity of the escaping gases was only 1·137 grain SO_3 per cb. ft., as compared with 1·191 grain in 1914. A mechanical washer for recovery of nitrous gases from the residual gases leaving the last chamber has been installed in one works with successful results, and is to be introduced in other works. This method of washing presents advantages over the use of large absorption towers, especially towers packed with coke. Of 338 Glover towers in the United Kingdom, 130 are packed with flints, 127 with bricks, 28 with bricks and flints, 23 with rings, 16 with bricks or tiles and rings, 8 with tiles, and 6 with bricks and tiles; and of 440 Gay Lussac towers, 269 are packed with coke, 53 with bricks, 43 with glass, 25 with rings, 17 with tiles, 10 with bricks and tiles, 8 with rings and coke, 7 with bricks or tiles and coke, 4 with rings and tiles, 3 with Lunge-Rohrmann tiles, and 1 with balls. Two deaths occurred as a result of gassing by nitrous fumes during the cleaning of a tank railway waggon and a tank used for storing Glover tower acid respectively, and in view of the repeated occurrence of such fatalities a re-statement of the precautions which should be taken (see this J., 1913, 787) was embodied in a circular letter which was sent to owners of sulphuric acid works. The manufacture of sulphuric acid by the contact process was carried on to the full capacity of existing plants, and several extensions of plant were brought into operation. Extensive additions were also made to plants for the concentration of acid and numerous new installations were erected. In this connection much trouble was caused through inefficient design and construction of plant, especially with the cascade system and, to a lesser extent, with the Gaillard tower system. Less trouble was experienced with the Kessler system, but the increased use of plant of this type was interfered with very seriously owing to lack of the necessary material. The Kessler type of plant seems less suitable for certain kinds of impure acid which are concentrated for use a second time. For the efficient and satisfactory operation of the cascade type of concentrating plant: (1) there must be a greater draught in the flue leading the vapours and gases to the condensers than in the flue leading the fire gases to the chimney; (2) local overheating must be avoided; and (3) adequate means for condensing the acid vapours must be provided. The following tables have been compiled from experience gained in the use of the cascade system of concentration:—

Cascade plant and condensers.

Basins of silica, "ironac," "narki." and "tantiron," with preheaters.

Acid feed strength.	Number of basins.	Output, tons of acid (166°—169° T.) per 24 hours.	Water and acid evaporated per 24 hours. Tons per 100 basins.			Packing in condenser.			
			Loss of strong acid assumed to be:			Per basin.		Per ton of strong acid made.	
			Nil.	5%	15%	Volume, cubic feet.	Sectional area, sq. feet.	Volume, cubic feet.	Sectional area, sq. feet.
							Coke packing.		
105° T.	727	61·5 (=1·69 cwt. per basin)	4·5	5·1	6·4	6·5	1·6	77	18
123° T.	1440	112 (=1·55 cwt. per basin)	3·1	3·6	4·7	8·2	0·7	105	10
136° T.	40	4 (=2 cwt. per basin)	2·7	3·3	4·6	6·2	1·2	62	12
147° T.	100	15 (=3 cwt. per basin)	2·9	3·8	5·5	7·5	—	50	—
							Ring packing.		
120° T.	40	2·5 (=1·25 cwt. per basin)	2·5	2·9	3·8	5·0	—	76	—

Cascade plant and condensers, with preheaters.

Acid feed strength.	Description of plant.	Output of acid.		Packing in condensers.				
					Per basin.		Per ton of strong acid made.	
		Tons per 24 hours.	Strength ° T.	Nature.	Volume, cubic feet.	Sectional area, sq. feet.	Volume, cubic feet.	Sectional area, sq. feet.
110° T.	3 Tantiron pans and basins	5	168	Coke	—	—	43	7
120° T.	12 Tantiron dishes (3 ft. diam.)	12	166	Bricks and tiles	—	—	30	—
126° T.	80 Silica basins and 2 iron "pots" (8 ft. × 3 ft.)	14	168	Rings	—	—	15	—
135° T.	"Webb" plant—30 vessels	4·5	168	Coke and brick	14·5	15·1	96	101

Chemical manure works. The scarcity of sulphuric acid interfered very seriously with production in some districts. The quantities of the more important manure materials imported into the United Kingdom during the past three years, were :—

	1915.	1914.	1913.
	tons.	tons.	tons.
Guano	26,720	39,285	25,548
Mineral phosphates	374,639	555,605	539,016
Sodium nitrate	132,158	171,910	140,926

The exports of ammonium sulphate in 1915 amounted to 294,000 tons, as compared with an estimated home consumption (for all purposes) of 128,000 tons, the corresponding figures for 1914 being 314,000 tons and 106,000 tons respectively.

Sulphate and muriate (chloride) of ammonia, and gas liquor works. The quantity of ammonia (expressed as tons of sulphate) recovered as a by-product in the United Kingdom was :—

	1915.	1914.	1913.
Gas works	173,675	175,930	182,180
Iron works	15,142	16,008	19,956
Shale works	58,826	62,749	63,061
Coke oven works	145,406	137,430	133,816
Producer gas and carbonising works (bone and coal) ..	33,218	34,295	33,605
Totals	426,267	426,412	432,618

"Direct" process for manufacture of sulphate of ammonia; and storage of ammoniacal liquor. See under IIA., page 1001.

Nitric acid works. Many new works were erected and large additions were made to some existing works. Conditions were satisfactory in works in which nitric acid was made from sodium nitrate, but left much to be desired in those works in which the acid was recovered by treatment of nitrous fumes; improvements have, however, been effected and the conditions are becoming more satisfactory. No works came under inspection in which nitric acid was made by a synthetic method, although in other countries where cheap power is available, large quantities are obtained by such means.

Chlorine works. Two additional works were started. In one works the local diffusion of dust in the operation of "knocking down" bleaching powder when packed in casks has been very largely reduced by placing over the cask a wooden hoop covered with cloth.

Tin plate flux works. An investigation of the efficiency of the method used for the recovery of hydrochloric acid and metallic fumes evolved during the operation of calcining scruff and flux skimmings showed that considerable quantities of the metallic fumes escape condensation. It is suggested that improvement, without undue complication of plant, might be effected by :—(1) A lower working temperature at the furnace; (2) provision of a condensing flue of larger sectional area, preferably one with sumps and baffles; (3) regulation of draught at the chimney end of the flue instead of at the furnace; (4) cooling of the gases by bringing them into contact with water soon after entering the flue, so as to obtain the full cooling effect due to evaporation. About 63 gallons of water would be required to reduce the temperature of 100,000 cb. ft. of gases (at 0° C. and 760 mm.) from 400° to 200° C., and the best method would be to introduce atomised water.

Picric acid works. New works of large productive capacity have been erected and large extensions made to existing works. In some works there was too great an emission of noxious gases, but improvement is being gradually effected.

Tar works. The number of works increased by 43, largely due to the extending practice of preparing tar for road surfacing and light oils rich in benzol and toluol from crude tar. The amount of tar distilled in the United Kingdom is given as 1,311,383 tons in gas works and 163,927 tons in other works, the corresponding figures for the amount of pitch produced being 669,189 and 80,907 tons respectively.

Industrial scientific control. Little or no change was observed as regards mutual effort to improve working methods or as regards the fuller appreciation of the value of the properly trained technical chemist. There are numerous instances where individual firms keep themselves informed regarding developments, but co-operative action is needed as a means towards general increased efficiency.

Scotland. The production of ammonium sulphate was less than in 1914, chiefly owing to diminished output from shale works. The comparative figures (those for 1914 being given in brackets) are :—Gas works, 22,861 (22,362) tons; iron works, 14,091 (14,703); shale works, 58,826 (62,749); bone works, and producer gas, coke and carbonising works, 22,400 (22,244); total, 118,178 (122,058) tons.

The amount of pyrites burned was 144,946 tons (130,435 tons in 1914), and of bones and phosphates dissolved, 64,892 tons (61,712 tons in 1914). 70,719 tons of pitch was produced in gas works and 72,292 tons in other works, the corresponding figures for the amount of tar distilled being 135,517 and 149,584 tons respectively.—A. S.

Felspar; Decomposition of —— for the commercial production of potassium salts. B. Neumann and F. Draisbach. Z. angew. Chem., 1916, 29, 313—319, 326—331.

LABORATORY experiments were made in order to ascertain the yields of water-soluble potassium compounds obtainable by heating felspar with various substances (1) in the dry state, (2) in the presence of water in an autoclave, and (3) to very high temperatures in order to volatilise the potassium compounds. Better yields were obtained by the dry method than by heating in an autoclave, and the most suitable reagents were found to be lime mixed with magnesium chloride or calcium chloride. From a mixture of equal quantities of commercial ground felspar, lime, and calcium chloride, over 95% of the potash was recovered after heating for 3 hours at 650° C., but with the proportions recommended by Cushman and Coggeshall (this J., 1915, 79), *i.e.*, 20% each of lime and calcium chloride, together with water to form the mass into lumps, the maximum yield obtained in 1½ hours was 47·4% at 750° C. Above 750° C. the amount of potash volatilised steadily increases. The economic aspects of the extraction of potash from seaweeds, alunite, felspar, etc., are discussed, and it is concluded that under normal conditions none of these processes will be able to compete successfully with the German potash industry.—A. S.

Leucite; Solubility of —— in sulphurous acid. J. Schroeder. J. Ind. Eng. Chem., 1916, 8, 779—780.

A SAMPLE of finely ground leucite was sifted into different grades, and the different fractions shaken with a saturated solution of sulphurous acid, left overnight, and then filtered. From 16·4 to 26·2% of the leucite was dissolved, and the solution contained from 41·7% to 76·4% of the total potash present. It is suggested that the porous leucite rock of the Leucite Hills, Wyoming, might be leached with sulphurous acid obtained from the waste gases of the smelting plants in

Utah, Colorado, and Montana. The amount of potash in the rocks of the Leucite Hills region has been estimated at 197,349,600 tons.—A. S.

Hypochlorite bleaching solutions; Note on the cause of the pink colour observed in certain ——. H. G. Elledge. J. Ind. Eng. Chem., 1916, **8**, 780—781.

Sodium hypochlorite solutions prepared from bleaching powder and so-called neutral washing powder (a mixture of sodium carbonate and bicarbonate) are invariably pink. If normal sodium carbonate or sulphate is used, a green solution is obtained, which becomes pink when agitated with sodium bicarbonate. Tests in which small quantities of manganous sulphate or of ferric chloride were added, indicated that the coloration is not due to sodium ferrate, as has been suggested, but to sodium permanganate, and this was confirmed by comparison of the absorption spectrum of the pink solution with that of a solution of permanganate. The manganese is derived from the bleaching powder.—A. S.

Magnesium sulphide; Preparation of pure —— and its phosphorescence. E. Tiede. Ber., 1916, **49**, 1745—1749.

Magnesium sulphide prepared by the method of Mourlot (this J., 1898, 881) was found to contain only 8% of sulphur instead of 56·86%, the theoretical figure. Reichel's process of heating magnesium in a current of hydrogen followed by a current of the same gas mixed with sulphur vapour, gave a product containing 30—50% of sulphur. Magnesium sulphide made in this way was purified by heating it in a highly evacuated quartz tube to 600°—700° C. for two hours, whereby the excess of metal was volatilised. It was also purified by boiling it (10 grms.) with fresh, absolute ether (100 c.c.), ethyl iodide (10 grms.), and a crystal of iodine for 3 hours, moisture being rigorously excluded. The metal dissolves in the alkyl halide whilst the sulphide is unaffected. The purified sulphide was then washed with ether and dried in a vacuum desiccator placed in the water bath. Analysis showed it to be pure and the spectroscope proved the absence of alkaline-earth metals. It had a reddish-white colour, was amorphous, and feebly luminescent after exposure to daylight or to an arc light. The luminescence is apparently best excited by rays of long wave-length: radium-, X-, and ultra-violet rays did not excite it. When exposed to direct cathode rays, magnesium sulphide shows a bright blue and red fluorescence and a feeble after-glow.—E. H. T.

Barium sulphate; Laboratory experiments concerning the reduction of —— to barium sulphide. A. E. Wells. J. Ind. Eng. Chem., 1916, **8**, 770—777.

Below 750° C. the reduction of barium sulphate by carbon or by reducing gases was too slow to be of use commercially. The maximum yield of sulphide was obtained at the highest temperatures employed, *i.e.*, at about 1000°—1150° C. Taking both consumption of carbon and yield of sulphide into account, the best results were obtained with 15—16% of carbon when reduction was effected in a muffle furnace. When reduction was effected in a direct-fired furnace (a rotary cement kiln, a shaft furnace, or a multiple-hearth roasting furnace), in which the material came in direct contact with reducing gases or products of combustion, the proportion of reduction products insoluble or sparingly soluble in water was higher than when reduction was effected in a muffle furnace. For example, in a muffle furnace, with 15·5% of carbon, a yield of 96% of water-soluble sulphide was obtained at 1050° C. and 99% at 1150° C., whereas the best results in a direct-fired furnace were 85 to 87% of water-soluble sulphide. The amount of insoluble reduction products was less when reduction was effected rapidly at high temperatures (above 1000° C.) than when lower temperatures were used with longer duration of heating.—A. S.

Nickel in cobalt salts; Detection of ——. A. R. Middleton and H. L. Miller. J. Amer. Chem. Soc., 1916, **38**, 1705—1711.

By the following method considerably smaller quantities of nickel can be detected than has been possible hitherto, and with a smaller consumption of dimethylglyoxime, even in presence of relatively large quantities of cobalt. The solution containing nickel and cobalt (about 10—15 c.c.) is treated with 10% potassium cyanide solution until the precipitate which forms at first just redissolves, and the solution is heated and rotated for 5 mins. after the colour changes from greenish-brown to pale yellow. It is then diluted to 50 c.c. with water at 85° C., and treated with 1 c.c. of a 1% alcoholic solution of dimethylglyoxime, after which 1% silver nitrate solution is added, drop by drop, with constant stirring, until a permanent precipitate is produced. The presence of nickel is indicated by a pink colour, which appears only after some hours when the quantity of nickel is very small. It is possible to detect 0·02 mgrm. of Ni in 1 hour and 0·002 mgrm. in 24 hours. The effect of the silver nitrate is to precipitate the cyanide ion as silver argenticyanide and promote decomposition of the nickelocyanide ion, thus increasing the concentration of nickel ions, whilst the cobalticyanide ion remains practically unaffected. The increased sensitiveness of the test is probably due to increased concentration of nickel ions owing to adsorption by the precipitated silver argenticyanide. A similar effect is produced if silver chloride be precipitated in the mixture, but precipitation of a positive colloid, such as aluminium hydroxide, has no effect.—A. S.

Manganous to manganic salts; Oxidation of —— by nitrous acid. W. Prandtl. Ber., 1916, **49**, 1613—1614.

When a cold solution of a manganous salt is acidified with excess of strong hydrochloric acid and a few drops of sodium nitrite solution added, or when cooled strong hydrochloric acid is mixed with a little nitrite solution and a few drops of a solution of manganous salt added, the liquid darkens to an intense brownish-yellow, owing to the formation of manganic chloride. When a neutral solution of a manganous salt is mixed with excess of neutral sodium nitrite, the addition of oxalic acid produces an intense cherry red coloration, owing to the formation of manganic oxalate. This reaction is extremely sensitive and may be used for the detection of small quantities of manganese in presence of considerable quantities of iron.—J. F. B.

Chromous salts; Electrolytic preparation of —— from chromic salts, and some new salts of divalent chromium. W. Traube and A. Goodson. Ber., 1916, **49**, 1679—1691.

Solutions of chromous salts were obtained by the electrolytic reduction of chromic salts in a divided cell with prepared lead electrodes (Tafel, this J., 1900, 909) and a current density of 2·5 ampères per sq. dcm. The reduction was followed quantitatively by measurements of the hydrogen liberated at the cathode and in a voltameter included in the same circuit, and also by iodometric determinations of the chromous salt produced, and it was found that the highest current yields (from 70 to 86%) were obtained by the use of violet chromic salts in concentrated solution containing about 1% of mineral acid. The last stages were, however, slow and the current yields very low, when electrolysis was continued until complete reduction of the chromic solution was attained. The green chromic salts were reduced with greater difficulty than the violet salts in equal concentrations, but in the initial stages of the reduction and when a complete reduction is not desired, this is compensated for by their greater solubility. In all cases it was necessary to protect the chromous solutions from the oxidising action of the air either by entirely closing the cathode compartment, or else by covering the surface of the liquid with a layer of petroleum spirit. From the chromous salt solutions prepared in this way chromous formate, $Cr(H.COO)_2.2H_2O$, was obtained as a red crystalline powder by the addition of an excess of sodium formate. In a similar way chromous glycollate was prepared. Both these salts can be recrystallised from water in the absence of air. Sodium malonate precipitates in blue needles a double salt, sodium chromous malonate, $Na_2Cr(C_3H_2O_4)_2.4H_2O$, but in presence of an excess of chromous chloride and free malonic acid the red, almost insoluble, and comparatively stable, chromous malonate is formed.—G. F. M.

Chromous salts ; Behaviour of —— towards acetylene, and the reducing action of salts of divalent chromium. W. Traube and W. Passarge. Ber., 1916, **49**, 1692—1700.

By agitation with acid solutions of chromous chloride, prepared by the reduction of chromic chloride with zinc and hydrochloric acid, acetylene was converted quantitatively into ethylene. Provided sufficient zinc and hydrochloric acid were present, a very small quantity of chromium salt acted catalytically in the above reaction, as was shown by the fact that in its absence no appreciable alteration of the acetylene was observed, nor could it be successfully replaced by other chlorides, such as ferrous or manganous chloride. That the reaction stops at the ethylenic stage, is probably due to physical conditions, for in other cases, such as maleic and fumaric acids, and phenylpropiolic and cinnamic acids, complete reduction to the saturated compounds was brought about by chromous chloride. Alkaline chromous chloride solutions energetically and quantitatively reduced nitric acid and nitrates, and also hydroxylamine, to ammonia, and the reducing agent may therefore be advantageously employed for the determination of these substances as ammonia. In acid solution the reaction is not quantitative, and the reduction of nitrites under all conditions gave low results, which is probably to be ascribed to the formation, and subsequent decomposition, of ammonium nitrite. Oximes, as for example benzaldoxime, in alkaline solution, are reduced by chromous solutions to amines.—G. F. M.

Cæsium and rubidium ; Separation of —— by the fractional crystallisation of the aluminium and iron alums, and its application to the extraction of these elements from their mineral sources. P. E. Browning and S. R. Spencer. Amer. J. Sci., 1916, **42**, 279—281.

A SOLUTION obtained from the decomposition of lepidolite by heating with fluorspar and sulphuric acid was freed from calcium sulphate and evaporated until crystals of the mixed alums appeared. The mother liquor was separated, further evaporated, the crystals separated, and so on. The first crystals formed were dissolved, recrystallised, the liquor added to the second crop, and the process continued as in ordinary fractional crystallisation. After about seven crystallisations, the crystals in the first vessel consisted of pure cæsium alum, but twenty-two crystallisations were necessary to obtain the more soluble rubidium alum in a state of purity. Better results were obtained with cæsium and rubidium iron alums ; the solution of the mixed alums from lepidolite was treated with ammonia, the aluminium hydroxide separated by filtration, the filtrate evaporated, and mixed with crystals of ammonium ferric alum. The mixture was warmed, then cooled and allowed to crystallise ; the first crop of crystals consisted of pure cæsium iron alum and contained no rubidium. For the extraction of cæsium from pollucite, the mineral was decomposed with hydrochloric acid, the silica separated, and the acid solution poured on ammonium aluminium alum, and warmed. Cæsium alum separated on cooling ; the crystals were twice recrystallised and then found to be pure ; the remainder of the cæsium was obtained by a few crystallisations of the mother liquors.
—W. P. S.

Colloidal arsenious sulphide ; Coagulation of —— by electrolytes, and its relation to the potential difference at the surface of the particles. F. Powis. Chem. Soc. Trans., 1916, **109**, 734—744.

FIVE c.c. of a colloidal solution of arsenious sulphide, containing 11 grms. per litre, was mixed with 5 c.c. of electrolyte solution of the required concentration. Experiments made with barium chloride of concentrations varying from 0·3 to 0·8 millimol. per litre, have shown that there is no definite concentration above which coagulation occurs almost immediately, but below which no coagulation occurs. The mixture containing 0·4 millimol. slowly changed, so that after 8 days nearly all the arsenious sulphide had been precipitated. If equal quantities of colloid and electrolyte solutions are mixed, the progress of coagulation and settling is influenced but little by the subsequent shaking of the tube, unless the electrolyte concentration is near that which causes immediate turbidity, but not immediate coagulation and settling, *e.g.*, 0·5 millimol. in the case of barium chloride. The relation between the stability and the potential difference at the surface of the particles was determined with electrolytes, in which the concentrations were such that the colloid has the same stability as in the presence of 0·5 millimol. of barium chloride, the electrolytes being hydrochloric acid 30 millimols., potassium chloride 40 millimols., aluminium chloride 0·05, and thorium nitrate 0·05 to 0·1 millimol. per litre. The results obtained were very constant in the cases of barium and aluminium chlorides and thorium nitrate, varying from − 0·024 to − 0·027 volt, but in the cases of potassium chloride and hydrochloric acid were much higher, viz., −0·044 and −0·05 volt. A critical potential difference appears to determine the stability or instability of a colloidal solution, so far as barium and aluminium chlorides and thorium nitrate are concerned, but the behaviour of potassium chloride has suggested that electrolytes also exert a kind of salting-out effect. The lack of sharpness in the coagulation concentration is explained as being due to the critical value of the potential difference being slightly different for particles of different size.—B. N.

Ozonates ; The so-called alkali ——. W. Traube. Ber., 1916, **49**, 1670—1679.

THE so-called ozonates, coloured compounds formed superficially on the alkali hydroxides by the action of ozone, if decomposed by water or a dilute acid immediately after their formation, give up all the absorbed oxygen almost completely as gas, slight traces only of hydrogen peroxide being formed. On keeping for several days, and more rapidly still if water is not rigidly excluded, the compounds lose their colour, and on decomposition as above give oxygen and hydrogen peroxide in practically molecular proportions, indicating complete conversion into alkali tetroxides. A second decomposition proceeds at the same time as this conversion into tetroxide, in that the "ozonates" part with molecular oxygen, and revert to hydroxides. At 0° C. these changes occur more slowly, and to the advantage of the tetroxide formation, so that by repeated ozonisation it was possible to prepare a substance containing 10 % of potassium tetroxide. Regarding the constitution of these ozonates, the author prefers to consider them as molecular compounds (or compounds of the second order), formulating them either as $KOH.O_2$, or $(KOH)_2.O_2$, the tetroxides being $K_2O_2.O_2$ or $KO.OK.O_2$, and thereby offering some explanation why the excess oxygen is evolved in both cases as molecular oxygen and not as active oxygen, as might have been expected from such highly oxidised substances. The conversion of the ozonates into tetroxides would be accordingly represented by one of the following equations:—

$$3(KOH)_2.O_2 = 2K_2O_2.O_2 + 2KOH + 2H_2O, \text{ or}$$
$$4KOH.O_2 = 2K_2O_2O_2 + 2H_2O + O_2.$$

—G. F. M.

Azides of alkali and alkaline-earth metals; Decomposition of —— in high vacua. Preparation of pure nitrogen. E. Tiede. Ber., 1916, **49**, 1742—1745.

The azides of the alkali and alkaline-earth metals were decomposed by heating them in Jena glass tubes of 10 mm. diameter immersed in a paraffin or sand-bath, and evacuated with a Gaede mercury pump. A small sparking-tube was let in at the side of the Jena tube in order that the gas evolved might be examined spectroscopically. The azides were prepared by neutralising 5 % hydrazoic acid (azoimide) with the metallic hydroxide, and were purified by re-crystallisation, and dried *in vacuo* over sulphuric acid. The temperatures at which the azides began to decompose and at which the evolution of nitrogen became regular were as follows: sodium 330° and 280° C., potassium 320° and 360° C., rubidium 260° and 310° C., cæsium 290° and 300° C., calcium 110° and 100° C., strontium 140° and 110° C., barium 160° and 120° C. The alkali metals formed lustrous, silver-white mirrors on the sides of the tubes, but the sodium mirrors had a yellowish tinge. The alkaline-earth metals were first left in the bottom of the tube as very finely divided, blackish powders, which were volatilised—and also formed mirrors—when the temperature was raised. When the powders were heated in a slow current of air they ignited without loss of colour and the smell of ammonia afforded evidence that nitrides were present. When heated further in the Bunsen flame, they ignited anew and were converted into pure oxides. With the exception of lithium azide, the azides used did not explode when heated. In every case the nitrogen evolved was found to be of exceptional purity.—E. H. T.

Direct process for the manufacture of sulphate of ammonia, and the storage of ammoniacal liquor. Curphey. *See* IIa.

Volumetric determination of hydrogen by oxidation with activated chlorate solution. Removal of carbon monoxide by means of mercuric chromate. Hofmann. *See* IIa.

Retardation by carbon monoxide of the oxidation of hydrogen in the chlorate pipette, a contribution to the knowledge of contact poisons. Hofmann and Schibsted. *See* IIa.

Patents.

Acids; Method of, and apparatus for, concentrating ——. T. C. Oliver, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,195,075, Aug. 15, 1916. Date of appl., Mar. 22, 1916.

Hot gases are passed over the surface of the acid, and then upwards through a tower packed with impervious material down which more acid flows into the main body. Jets of air are passed through the acid to agitate it, and to expose fresh surfaces to the hot gases.—E. H. T.

Oxides of nitrogen; Production of —— and catalysts to be employed therein. J. Y. Johnson, London. From Badische Anilin- und Soda-Fabrik, Ludwigshafen, Germany. Eng. Pats. (a) 7651, May 21, 1915.: Addition to Eng. Pat. 13,848, June 8, 1911 (this J., 1915, 799) and (b) 13,298, May 21, 1915.

(a) In the preparation of oxides of nitrogen by the method described in the chief patent, the catalyst may be composed of almost any metal or metallic oxide along with bismuth or its oxide. The best proportion of bismuth varies considerably. Particulars are given of the preparation of a copper-bismuth oxide, fireclay with a platinum-bismuth oxide, and a magnesium-bismuth oxide. (b) When noble metals are used in the catalyst, especially those of the platinum group, lead may be used instead of a part or the whole of the bismuth or of the tellurium specified in Eng. Pat. 13,297 of 1915.
—B. V. S.

Sodium bisulphite; Manufacture of ——. T. W. S. Hutchins, L. Hargreaves, and A. C. Dunningham, Middlewich. Eng. Pat. 10,556, July 21, 1915.

Sodium bisulphite is prepared by the action of sulphur dioxide on hydrated sodium carbonate. The sulphur dioxide is generated by burning sulphur, and freed from oxygen and sulphur trioxide by means of hydroxides or carbonates or both of the alkali or alkaline-earth metals. It is then passed on to the sodium carbonate which is so arranged in a tower or other suitable vessel that the carbon dioxide generated by the reaction in the first layers passes on to the succeeding layers, converting them to the bicarbonate, so that the bulk of the reaction occurs between sulphur dioxide and the bicarbonate. By using the monohydrated carbonate or a mixture of soda crystals and soda ash to give the same amount of water as in the monohydrate, solid dry bisulphite is formed. If the decahydrate is used the liberated water serves to dissolve the bisulphite formed and a strong bisulphite solution is obtained. Any sulphur dioxide occluded in the solid bisulphite is driven out by passing through the mass the carbon dioxide-nitrogen mixture issuing from the reaction chamber.—B. V. S.

Sodium pyrophosphate and active oxygen; Manufacture of products containing ——. O. Imray, London. From Soc. of Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,749, Nov. 8, 1915.

If 3 mol. proportions of hydrogen peroxide are caused to interact with 1 mol. of sodium pyrophosphate, a solid, dry product containing active oxygen equivalent to over 27 % of hydrogen peroxide is obtained, and products containing less than this amount of active oxygen can be made by suitably reducing the proportion of peroxide employed. Powdered sodium pyrophosphate, dry or dissolved in water, is mixed with peroxide of the desired strength, and the solution is evaporated to dryness as quickly as possible either *in vacuo* or in a current of dry air; or, anhydrous pyrophosphate may be shaken or ground with peroxide in ethereal solution and the solvent removed by evaporation. To obtain products with a relatively low active oxygen content and in a dry state, anhydrous pyrophosphate is ground with aqueous hydrogen peroxide which contains only as much water as will combine with the phosphate. Similar products may be obtained by condensing steam containing hydrogen peroxide upon the anhydrous salt. Instead of using the ordinary salt, acid pyrophosphate or the free acid may be decomposed, in presence of a solvent for hydrogen peroxide, by means of sodium peroxide or sodium percarbonate, and then, if necessary, peroxide added to bring the product up to the desired strength.—E. H. T.

Potassium salt; Process of producing a —— from insoluble silicates. H. P. Bassett, Catonsville, Assignor to The Spar Chemical Co., Baltimore, Md. U.S. Pat. 1,194,161, Aug. 15, 1916. Date of appl., Mar. 8, 1915.

AN insoluble silicate containing potassium is mixed with a sulphate, *e.g.*, sodium bisulphate, and a catalyst, *e.g.*, a fluoride, and the whole is heated in a furnace to a red heat. The catalyst accelerates the action of liberated sulphur trioxide upon the silicate.—E. H. T.

Alunite and the like; Treatment of ——. H. F. Chappell, Assignor to Mineral Products Corporation, New York. U.S. Pat. 1,195,655, Aug. 22, 1916. Date of appl., Sept. 23, 1913.

ALUM, alum stone, alum rock, or alunite is heated in a reducing atmosphere to a temperature between 650° and 1000° C. The excess sulphur over that required for the formation of potassium sulphate is driven off as such and is recovered. A residue of potassium sulphate and alumina is left, from which the former is separated by lixiviation.—B. V. S.

Titanium compound; Method for producing a ——. Method of treating titanic oxide. Titanium compound. A. J. Rossi and L. E. Barton, Niagara Falls, N.Y., Assignors to The Titanium Alloy Manufacturing Co., New York. U.S. Pats. (A) 1,196,029, (B) 1,196,030, and (C) 1,196,031, Aug. 29, 1916. Dates of appl., (A) Nov. 29, 1912, (B) Mar. 10, 1915, (C) Feb. 10, 1916.

(A) A SUBSTANCE containing titanic oxide (TiO_2) and iron oxide is heated with a reducing agent, such as carbon, so as to form titanous oxide (Ti_2O_3). The resulting melt is treated with sulphuric acid, titanous sulphate being formed, and the solution is then diluted and boiled to precipitate basic titanium sulphate. The addition of a little nitric acid to the dilute solution renders the precipitation more rapid and complete. (B) The substance containing titanic oxide is digested at 100° to 150° C. with about 2½ parts by weight of sulphuric acid to 1 part of titanic oxide, the resulting mass dissolved in water, the solution diluted and boiled to precipitate basic titanic sulphate. The iron present may be reduced to the ferrous state before the solution is boiled. (C) A new basic titanium sulphate is described containing less combined water than titanic oxide and less sulphuric anhydride than combined water.—B.V.S.

Sulphuric acid; Concentration of ——. La Fabr. de Soie Artificielle de Tubize. Fr. Pat. 479,320, July 20, 1915.

SEE Eng. Pat. 10,386 of 1915; this J., 1916, 537.

Salt; Process and apparatus for converting rock salt into table ——. L. W. Damman. First Addition, dated June 23, 1915, to Fr. Pat. 475,235, May 1, 1914.

SEE Ger. Pat. 291,265 of 1914; this J., 1916, 690.

Salts from sea water; Extraction of ——. Y. I. A. Laljee. Fr. Pat. 479,770, Sept. 17, 1915.

SEE Eng. Pat. 6678 of 1915; this J., 1916, 690.

Ammonia; Extraction of —— from ammoniacal liquor. British Coke Ovens, Ltd. Fr. Pat. 477,962, Mar. 9, 1915.

SEE Eng. Pat. 6061 of 1914; this J., 1915, 787.

Sodium carbonate; Apparatus for producing ——. M. Spazier. Fr. Pat. 477,964, Mar. 9, 1915.

SEE U.S. Pat. 1,127,691 of 1915; this J., 1915, 282.

Alkali carbonates; Recovery of —— from alkali nitrates obtained by absorbing nitrous gases with alkali carbonates. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 478,976, June 8, 1915.

SEE Eng. Pat. 8270 of 1915; this J., 1916, 468.

Silicates: Manufacture of soluble ——. J. W. Spensley and J. W. Battersby. Fr. Pat. 478,508, Apr. 24, 1915.

SEE Eng Pat. 11,959 of 1914; this J., 1915, 831.

Aluminium nitride; Process and apparatus for manufacture of ——. Soc. Gén. des Nitrures. Fr. Pat. 478,886, Aug. 14, 1914.

SEE Eng. Pat. 11,271 of 1915; this J., 1916, 115.

Nitrogen: Process of fixation of ——. A. Badin, Assignor to Soc. Gén. des Nitrures, Paris. U.S. Pat. 1,196,639, Aug. 29, 1916. Date of appl., Nov. 18, 1914.

SEE Eng. Pat. 22,586 of 1914; this J., 1915, 353.

Nitrogen; Process for the fixation of —— by means of ferro-aluminium. P. Bunet, Assignor to Soc. Gén. des Nitrures, Paris. U.S. Pat. 1,196,657, Aug. 29, 1916. Date of appl., Apr. 3, 1915.

SEE Eng. Pat. 4287 of 1915; this J., 1915, 961.

Carbon monoxide from carbon and oxygen; Preparation of ——. Soc. pour l'Ind. Chim. à Bâle. Fr. Pat. 478,166, July 22, 1914.

SEE Ger. Pat. 280,968 of 1913; this J., 1915, 613.

Hydrogen and lampblack; Process for making ——. American Nitro Products Co. Fr. Pat. 478,212, Mar. 31, 1915.

SEE U.S. Pat 1,168,931 of 1916; this J., 1916, 309.

Carbon dioxide and nitrogen; Production of —— by combustion of carbonaceous substances. American Nitro Products Co. Fr. Pat. 478,213, Mar. 31, 1915.

SEE U.S. Pat. 1,151,172 of 1915; this J., 1915, 1111.

VIII.—GLASS; CERAMICS.

PATENTS.

Firebrick chequer work used in regenerative chambers and the like. Gibbons Bros., Ltd., Lower Gornal, and F. W. Clark, London. Eng. Pat. 11,911, Aug. 18, 1915.

[Glass] furnaces; Recuperative ——. Empire Machine Co. Fr. Pat. 479,289, July 16, 1915.

SEE Eng. Pat. 10,157 of 1915; this J., 1916, 540.

Glass; Manufacture of ——. R. G. Kann. Fr. Pat. 479,379, July 24, 1915.

SEE Eng. Pat. 10,446 of 1915; this J., 1916, 541

IX.—BUILDING MATERIALS.

Portland cement; Properties of the calcium silicate and calcium aluminates occurring in ——. P. H Bates and A. A. Klein. U.S. Bureau of Standards, Technologic Paper 78. J. Franklin Inst., 1916, **182**, 398—401.

To obtain $3CaO,SiO_2$ and $2CaO,SiO_2$, the corresponding mixtures of lime and silica were heate in the presence of small amounts of boric acid o chromic oxide; six successive burnings wer required to obtain the tricalcium compound. Tricalcium aluminate is not stable at its melting point; it was produced by heating for some time below this point without the use of any catalyst. The aluminate sets and hydrates so rapidly and with so much evolution of heat that it is almost impossible to make test pieces. It never attains a greater tensile strength than 100 lb. per sq. in. When mixed with the silicate it reduces the time of setting and slightly reduces the strength of the silicate. Dicalcium silicate sets so slowly that it is difficult to obtain satisfactory test-pieces. After 1 year it has a tensile strength of 600 lb. per sq. in. at 5·5% water of hydration. After 14 days test-pieces break at 60 lb. per sq in. Even after 1 year the mass is sandy, granular, and porous. Its strength is slightly increased by mixing with 3% plaster or with 19 parts of $3CaO,Al_2O_3$. When mixed with equal parts of $3CaO,SiO_2$, it reduces the early strength of the latter, but later gives a good cement. The tricalcium silicate has properties resembling those of Portland cement. At the end of a week the mass is very dense with a semi-vitreous lustre. It is not adapted to withstand moisture or changes of temperature. The addition of aluminate to it reduces the early strength; plaster and aluminate increase the early strength but reduce the later strength. Addition of the disilicate reduces the early strength, but the strength increases constantly with age. The addition of aluminate to the mixture of the two silicates increases the early strength, but is of no advantage later. The preponderance of either silicate in a cement is undesirable.—A. B. S.

Plaster of Paris; Influence of various substances on the setting of ——. E. Canals. J. Pharm. Chim., 1916, **14**, 33—37, 78—83. (See also this J., 1916, 470.)

The sulphates, chlorides, nitrates, bromides, and iodides of potassium, sodium, and ammonium, sodium and potassium hydroxides, sulphuric, hydrochloric, and nitric acids, the sulphates of zinc, iron, and copper, sodium phosphate, potassium carbonate, calcium oxide, and soap accelerate the rate of setting of plaster of Paris, whilst boric acid, borax, sodium and potassium silicates, sodium, calcium, and magnesium carbonates, sugar, glycerin, and alcohol have a retarding action, and manganese dioxide, copper oxide, barium hydroxide, ammonia, silica, and barium sulphide have little or no influence. In general, substances which increase the solubility of plaster of Paris accelerate the rate of setting, whilst conversely those substances such as borax, sodium carbonate, sugar, alcohol, and mucilaginous substances, which diminish the solubility, retard the rate of setting. In the case of salts which accelerate the rate of setting of plaster of Paris, the stronger the acid or base the greater is the acceleration.—T. C.

Patents.

Stone; Treated ——. R. W. Hyde, Lakewood, Ohio. U.S. Pat. 1,196,693, Aug. 29, 1916. Date of appl., Dec. 18, 1911.

Sandstone is hardened, toughened, and rendered non-absorbent and non-conducting for electrical purposes by filling the interstices with linseed or other vegetable oil.—A. B. S.

Impermeable [building] materials; Manufacture of ——. L. S. Van Westrum. Fr. Pat. 478,360, Apr. 12, 1915.

See Eng. Pat. 6823 of 1915; this J., 1916, 691.

Building materials; Manufacture of ——. J. J. W. H. Van der Toorn. Fr. Pat. 479,720, Sept. 11, 1915.

See Eng. Pat. 13,081 of 1915; this J., 1916, 424.

Portland cement; Manufacture of ——. J. F. Goddard. Fr. Pat. 478,585, May 4, 1915.

See Eng. Pat. 13,542 of 1914; this J., 1915, 426.

Cement; Manufacture of slow-setting hydraulic ——, *containing little or no alumina.* J. Gresly. Fr. Pat. 478,936, June 7, 1915.

See Eng. Pat. 8551 of 1915; this J., 1916, 180.

Shaft-furnace for burning cement, lime, and similar substances. Steiger-Krauer und Co., and O. Frey. Fr. Pat. 479,292, July 16, 1915.

See Eng. Pat. 10,338 of 1915; this J., 1916, 891.

Cement-asbestos tiles and the like; Manufacture of ——. R. E. Golightly. Fr. Pat. 479,321, July 20, 1915.

See Eng. Pat. 18,005 of 1914; this J., 1915, 835.

Slag; Treatment of —— *for the manufacture of bricks, etc.* E. R. Sutcliffe. Fr. Pat. 479,332, Aug. 19, 1914.

See Eng. Pat. 18,806 of 1913; this J., 1914, 964.

Fibrous compositions. [*Roofing sheets.*] Eng. Pat. 8815. *See* V.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Mineral survey of the British Empire.

A memorandum has been submitted to the Government by the Iron and Steel Institute, Institute of Metals, Institution of Mining Engineers, and Institution of Mining and Metallurgy, pointing out the necessity of forming a central Imperial Department of Minerals and Metals, the object of which would be to protect and advance the economic welfare of the mineral and metal industries of the Empire. It is pointed out that several of the home Government departments have been concerned with collecting information on sources of supply of minerals and metals, but that there has been much overlapping and duplication of effort, since no serious attempt has been made to co-ordinate and render available the information so collected. The proposed Department of Minerals and Metals should be in intimate relationship with the Geological Surveys and Mines Departments of the Dominions, and also with the organisations representing the different branches of the mining and metallurgical industries. The Geological Survey of Great Britain and Ireland and the Museum of Practical Geology should also form an integral part of the Department. The duties of a Department of Minerals and Metals would include:—

1. Arrangements for expediting the completion of mineral surveys of the United Kingdom and of the Crown Colonies and other British possessions.

2. The systematic collection and co-ordination of information bearing on the occurrence, uses, and economic value of minerals and their products, special attention being devoted to securing industrial applications for newly-discovered minerals or metallurgical products, and to finding mineral materials required for new metallurgical products or inventions. Some of this information should be promptly and widely disseminated in summarised form to those interested in the industries, through the medium of the existing publications of the institutions directly concerned.

3. The investigation of all questions and problems relating to the utilisation of the mineral or metallurgical resources of the Empire.

4. The co-ordination and dissemination of information on mining laws, development of mineral areas, output, processes of extraction, plant, capital employed, markets, etc.

5. A general review from time to time of the developed and undeveloped mineral resources, and of the position of each mineral or metal, to ensure that the mineral wealth of the Empire is being exploited with due regard to Imperial interests.

6. Generally, to advise the Imperial Government on all questions bearing on the mining and metallurgical industries. To perform this function efficiently, it is essential that complete information should be available, and also that the industries concerned should be consulted through their respective organisations.

Wrought iron : Effect of blast-furnace gases on ——. J. E. Stead. Iron and Steel Inst., Sept., 1916. [Advance proof.] 7 pages.

AFTER exposure to hot blast-furnace gases for a year, closed wrought iron tubes (containing test-bars of polished steel) were found to be blistered and superficially disrupted in places and to have carbon deposited within and upon them; a slight deposition of carbon upon the polished test-bars was also observed. As the result of investigation it is concluded that, at 400 – 500° C., carbon monoxide is decomposed by the external scale and enclosed magnetic cinder of wrought iron, carbon being deposited: that wrought iron containing free oxides is liable to disruption from this cause; and that, under the conditions named, even initially unoxidised steel acts upon carbon monoxide and induces carbon to be deposited on its surface.—W. E. F. P.

[Steel] ingots : Some properties of ——. A. W. and H. Brearley. Iron and Steel Inst., Sept., 1916. [Advance proof.] 34 pages.

THE effects of crystal growth, crystalline structure, shrinkage, and variations in casting temperature, shape of mould, etc., on the properties of steel ingots were studied by direct examination of the latter and by analogy from the behaviour of molten stearine cast under various conditions. By this means the common defects and peculiarities of steel ingots were found capable of simple explanation and to be often preventable. For the production of sound steel ingots, bottom casting is regarded as advantageous mainly because the shrinkage cavities are more likely to be clean and therefore capable of being welded up. Segregation and the occurrence of ghost lines in large ingots are also considered and explained by reference to the behaviour of molten stearine on cooling. The use of stearine for studying the properties of ingots is strongly advocated, the higher coefficient of shrinkage, lower resistance to tensile stresses, and lower heat conductivity of this material as compared with steel being considered advantageous, since the defects found in the ingots, although similar to those likely to occur in steel, are generally exaggerated and therefore more clearly visible.—W. E. F. P.

Carbon steels ; Influence of heat treatment on the thermo-electric properties and specific resistance of ——. E. D. Campbell. Iron and Steel Inst., Sept., 1916. [Advance proof.] 18 pages.

MEASUREMENTS of specific resistance and thermo-electromotive force were made on similar specimens of nine different carbon steels which had been quenched from 908° or 903° C. and reheated to temperatures increasing by approximately 100° from 100° to 800° C.; the steels contained up to 1·05% C, 0·221% Mn, 0·016% P, 0·011% S, and 0·169% Si, and in one case 0·018% Cu. From the parallelism found between the two sets of results, it is concluded that, like the total specific resistance, the total thermo-electromotive potential of steel is made up of two components, due to the solvent iron and the solutes, respectively; the proportion due to the latter depends upon the extent to which they are in solution. This parallelism is regarded as strong confirmatory evidence of the essential unity of mechanism existing between metallic and aqueous solutions. The transformation of the allotropic into the α-form of iron was found to be nearly completed after reheating to 300° C.; but complete equilibrium, as indicated by minimum specific resistance and thermo-electromotive force, was only attained after long heating at about 700° C. Neither the specific resistance nor the thermo-electromotive force due to carbon in solution as carbides was found to be directly proportional to the atomic concentration of the carbon, the effects produced by equiatomic concentrations of carbon as hypoeutectoid carbides and eutectoid or hyper-eutectoid carbides being as 1 : 2 approximately. From the results of the investigation it is also concluded that constancy of thermo-electromotive force in couples can only be obtained when the molecular concentration of those members not consisting of strictly pure metals remains constant over the required temperature range; since the thermo-electromotive force is independent of the size and shape of the cross-section between the points of contact but wholly dependent on the molecular composition and the temperature gradient between these points, it should not be difficult to devise a method for detecting the molecular changes which may have been induced in a given piece of steel by heat treatment.

—W. E. F. P.

Nickel-steel scale, and the reduction of solid nickel and copper oxides by solid iron. J. E. Stead. Iron and Steel Inst., Sept., 1916. [Advance proof.] 6 pages.

CHEMICAL and micrographical examination of a nickel-steel (25% Ni) ignition tube, after prolonged use in a gas engine at temperatures approximating 800° – 1000° C., showed that the iron had been selectively oxidised and the nickel concentrated in the outer part of the metal by interdiffusion of nickel and iron and removal of the latter as oxide at the surface. Oxidation had proceeded along the crystal junctions of the metal, the grains of which had become gradually diminished in size, enriched in nickel, and enveloped in oxide scale, until they finally appeared as independent inclusions in the latter. The adherence of the scale to the alloy (and nickel steels generally) was found to be due to interpenetration of the metals and oxides. Further investigation showed that, at temperatures much below the melting point of either material, nickel and copper oxides were reduced to the respective metals by iron, with formation of iron oxide. This interchange was not confined to the surfaces of contact, but extended for a considerable distance below the surface of the iron, showing that interdiffusion had occurred between iron and nickel, iron and copper, and the corresponding oxides.—W. E. F. P.

Nickel [in iron and steel] ; Use of diphenylglyoxime as indicator in the volumetric determination of by Frevert's method. G. L. Kelley and J. B. Conant. J. Ind. Eng. Chem., 1916, **8**, 804–807.

FREVERT'S volumetric method for the determination of nickel in iron and steel (Blair, "Chem. Anal. of Iron," 7th ed., 1912), modified as described below, has been found to give results nearly as accurate as the gravimetric determination with dimethylglyoxime. The sample (1 grm. for a nickel content between 0·1 and 5%) is dissolved in 50 c.c. of hot nitric acid of sp.gr. 1·13 or in 60 c.c. of hydrochloric acid (1 : 1); iron and carbides are oxidised by adding nitric acid, drop by drop. to the solution until effervescence ceases. After boiling to expel nitrous fumes, and cooling, the solution is treated successively with 12 grms. of citric acid, 20 c.c. of ammonia solution of sp.gr. 0·9, sufficient dimethylglyoxime solution (20 grms. dissolved in 1300 c.c. of ammonia of sp.gr. 0·9 and made up to 2000 c.c.) to precipitate the nickel, and a slight excess of ammonia. The precipitate, after standing for 1 hour if the quantity of nickel is small, is collected on asbestos, washed with water, and dissolved on the filter in nitric acid. The solution and washings are treated, whilst nearly at the boiling point, with 1 grm. of potassium chlorate or ammonium persulphate, and boiled until clear. Alternatively the precipitate may be dissolved in a mixture of 40 c.c. of hydrochloric and 10 c.c. of nitric acid, and the solution boiled until clear. The clear solution is cooled, made slightly ammoniacal, using rosolic acid as indicator, and is then treated with 10 c.c. of potassium iodide solution (8 grms. per litre) and 10 c.c. of silver nitrate solution (0·5 grm. per litre), and titrated with potassium cyanide solution (1 c.c. = 0·001 grm. Ni) until the last trace of opalescence disappears. A blank test is made by titrating with potassium cyanide a nickel solution which has already been titrated and to which 10 c.c. each of the potassium iodide and silver nitrate solutions have been added subsequently; the volume of the solution to be titrated should always be about 250 c.c.

By using diphenylglyoxime (Atack, this J., 1913, 769) as indicator, the end point of the titration may be recognised by a colour change. The dimethylglyoxime precipitate (see above) is dissolved in concentrated hydrochloric acid containing 10% of nitric acid, the solution and washings are evaporated nearly to dryness, diluted to 150—200 c.c., and rendered alkaline by adding 5 c.c. of dilute (1 : 3) ammonia. Excess of standard potassium cyanide solution is then added and the excess titrated with a standard solution of nickel sulphate, using 5 c.c. of diphenylglyoxime solution (1 grm. dissolved in a solution of 5 grms. of sodium hydroxide in 100 c.c. of water, and the solution diluted to 1 litre) as indicator.—A. S.

Gold and copper ores, Mount Morgan, Queensland; Flotation of ——. W. Shellshear. Proc. Australasian Inst. Min. Eng., 1916, 51—74.

THAT portion of the ore too silicious for economical smelting, containing approximately Cu 2, Fe 10, S 10, SiO_2 73, Al_2O_3 1·5, $CaCO_3$ etc. 3·5%, and Au 5·5 dwt. per ton (or about 6% of iron pyrites, 16 of copper pyrites, and 78 of quartz, calcite, etc.) was dry crushed to pass a 50-mesh screen and then subjected to flotation in a laboratory apparatus and in a 6-box standard 24-inch Minerals Separation machine, the latter being subsequently incorporated in an experimental plant having a capacity of 100 tons per day. In a typical experiment with the large machine, the rate of feed was 15 tons per hr.; dilution of pulp, 3·5 to 1; oil (eucalyptus), 1 lb. per ton; and duration of run, 3 hrs.; the recoveries of gold, copper, and iron were 69·8, 84·2 and 48·7% by weight, respectively. Owing to the low recovery of gold as compared with that of copper, various large and small-scale concentration tests were made on the ore on Wilfley tables and with Sonstadt's solution (mercuric iodide in aqueous potassium iodide), before and after flotation. The results indicated that the gold, although mainly associated with the copper, was really "free" but very finely divided and therefore only fully released by fine grinding. This was confirmed by the results of further direct flotation tests in which recoveries of 80% of the gold and 96·3% of the copper were obtained on the 120-mesh, as against 70% and 86% respectively on the 50-mesh ore. In all cases flotation was effected in a neutral medium, acid not being employed with ores of this class. As flotative agents, eucalyptus oils alone or in admixture with other oils were used; and of the former, those containing phellandrene (*viz.*, *Eucalyptus amygdalina* and *E. dives*) gave the best results. Various mixtures of good eucalyptus with "residuum" oils were also employed, with highly satisfactory results as regards both extraction and oil cost. Further tests were made in which both non-smelting and smelting ores were concentrated by vanning and the tailing treated by flotation; and in most cases the recovery of gold was appreciably greater than that obtained by direct flotation. Consequently, the treatment finally adopted for the non-smelting ore consisted in crushing to about 40-mesh size, concentrating by means of tables, re-crushing the "table rejects" to 80 or 120-mesh size and treating the latter by flotation. The following are details of results obtained and costs incurred over a period of one month, during which the non-smelting ore was treated by direct flotation in the experimental plant:—Crude ore milled, 83 tons per day; average rate of rock-breaker, 12 tons per hr.; average rate of ball mills, 0·98 ton per hr. per mill; average feed to flotation plant, 17·3 tons per hr.; assay of crude ore, Cu 2·10%, Au 6·01 dwt. per ton; actual recoveries, 68·58% of the gold and 80·00% of the copper; total cost of treatment, 5s. 4·09d. per ton, including 1s. 5·18d. for flotation of which 4·98d. represented the cost of oil.—W. E. F. P.

Silver; Allotropy of ——. W. D. Helderman. Inst. of Metals, Sept., 1916. [Advance proof.] 24 pages.

FROM pycnometric and dilatometric observations made on silver obtained by various methods and after different treatments, it is concluded that pure silver consists of at least three allotropic (enantiotropic) forms, and has a transition point at about 77° C.; that all objects made of silver are in a metastable condition owing to retardation of the transition of the altered form; and that all the present physical constants of silver, except the atomic weight, refer to indefinite mixtures of the different allotropic forms.—W. E. F. P.

[Copper] leaching plant; A 2000-ton —— *at Anaconda, Mont.* F. Laist and H. W. Aldrich. Min. and Eng. World, 1916, 8, 321—325.

THE plant, completed in May 1915, works up tailings from a dump of about 20,000,000 tons, averaging Cu 0·64% and Ag 0·48 oz. per ton. The material is conveyed to wooden storage bins holding 6000 tons, thence by belts to 28 roasting furnaces of the McDougall six-hearth type. The furnaces are air-cooled, the heated air being used in the leaching plant for warming the liquors. The tailings are subjected to a simple oxidising roast at about 535° C., and the calcinate passes through a cylindrical cooler, the dust being settled by adding about 1% of water. The leaching plant consists of 10 redwood tanks of a capacity of 1000 tons of calcinate each. The leaching is done by continuous downward percolation through cocoa matting covered by a grating. The charge is treated successively with (1) 250 tons of liquor containing 5% of sulphuric acid and 7% of salt; (2) 100 tons of solution containing 20% of acid, and salt equal to 1% of the weight of calcine; (3) 150 tons of solution containing 0·5% of acid and 3·5% of salt; (4) 300 tons of hot water. The iron oxide in the calcinate yields ferric chloride which dissolves much unaltered sulphide, while the strong brine leaches out the silver. The spent liquors, after removal of the copper, are used over again except one-third of the first liquor, which is discarded so as to prevent accumulation of iron and aluminium sulphates. The precipitation of copper and silver is accomplished by scrap iron resting on heavy wood gratings in concrete launders, 250 ft. long and 4 by 8 ft. in section. The salt in the solution prevents the copper from plating the iron, and gives a soft spongy cement copper which is easily washed off with a hose. The precipitate, containing 70 % of copper, is deposited in settling-tanks, washed, and briquetted for blast-furnace treatment. The extraction averages 80 % of the copper and 60 % of the silver.—W. R. S.

Copper : Occurrence and significance of twinned crystals in electrolytic ——. H. S. Rawdon. U.S. Bureau of Standards. Amer. Inst. Metals, Sept., 1916. [Advance proof.] 12 pages.

From a study of deposits of electrolytic copper obtained at various current densities, it is concluded that the variation in crystal size alone is not sufficient to account for the observed differences in physical properties. Except when obtained at low current densities, the deposits have similar properties to those of metals hardened by cold working, and the existence of this condition is confirmed by the behaviour on annealing. These conclusions are regarded as applicable to all electro-deposited metals.—W. E. F. P.

Tinned sheet copper : A case of corrosion of ——. P. D. Merica. Amer. Inst. of Metals, Sept., 1916. [Advance proof.] 10 pages.

The upper side of tinned sheet copper that had been in use for 22 years as roofing material showed numerous small pits 1/32—1/64 in. in diameter, and furrows of the same width with a length of up to 2 in. The pits were distributed along lines of surface scratches, the scratch passing through the centre of each pit. Micrographs showed the tin coating to be composed of three layers, the one next to the copper, 0·002 mm. thick, being identified as Cu_3Sn. This has been shown to be electro-negative to copper, tin, and their eutectic. It is concluded that the corrosion is due to galvanic action between the constituents of the layers ; its local character is explained by scratches and mechanical injuries.—W. R. S.

Spelter : Cadmium in ——. W. R. Ingalls. Inst. of Metals, Sept., 1916. [Advance proof.] 3 pages.

Slabs of spelter as supplied by the smelter are not of exactly uniform composition, as the kettle into which the metal is received from the furnace holds a relatively small quantity, and the impurities passing over with the zinc vary in amount in different parts of the furnace, according to the temperature of the retort. To ensure uniformity the zinc should be remelted in large pots or furnaces before being cast into slabs for delivery. Spelter free from cadmium can only be obtained by single smelting when the ore is free from cadmium, but by redistilling common spelter with proper control of the temperature, and separating the first distillate, a high-grade spelter, low in cadmium, is easily produced. It is stated that excessive prices have recently been paid for American high-grade spelter, which is merely redistilled common spelter. Zinc free from cadmium is easily obtained electrolytically, but the electrolytic process is commercially applicable only under limited favourable conditions. Cadmium is deleterious in zinc to be used for slush castings, and is objectionable in cartridge brass, but for brass that is to be cast and machined, the adverse effect of cadmium is probably overestimated, and may be non-existent.
T. St.

Manganese bronze ; Initial stress produced by the burning-in of ——. P. D. Merica and C. P. Karr. U.S. Bureau of Standards. Amer. Inst. Metals, Sept., 1916. [Advance proof.] 8 pages.

From an investigation of the causes of failure of large valve castings of manganese bronze, which had been treated or repaired by welding or burning-in, it is concluded that unless the shape of the casting is such as to permit extensive distortion, local initial tensional stresses—equal in value to the true elastic limit of the material—are set up within or near the burnt-in zone. These stresses may be eliminated, and danger from subsequent cracking prevented, by heating the whole casting before welding so that all parts of the finished product cool down together from a dull red heat, or by annealing the finished casting at 400°—500° C. for 2 hours.—W. E. F. P.

Alloys to withstand internal air pressure. S. D. Sleeth. Amer. Inst. of Metals, Sept., 1916. [Advance proof.] 3 pages.

Density and strength are the indispensable qualities of alloys (chiefly brass and bronze) used in the manufacture of articles intended for the retention of gases under pressure. The variable factors which influence these qualities, viz., design of article to be cast, design of pattern with reference to its position in the flask, composition of the alloy, treatment of the metal in the furnace, and temperature of pouring, are briefly discussed. The presence of aluminium in the alloys is especially injurious.—W. R. S.

Lead : Volumetric determination of ——. J. Waddell. Analyst, 1916, **41**, 270—272.

About 1 grm. of the ore is digested with 10 c.c. of hydrochloric acid, and then evaporated with 5 c.c. of nitric acid till the volume is reduced to about 7 c.c. An excess of ammonia is added, then sufficient acetic acid to prevent precipitation of basic ferric acetate at a temperature near the boiling-point. The solution, measuring about 25 c.c., is treated with 10 c.c. of 10% potassium chromate solution ; the precipitate may be filtered off after 5 minutes. After the excess of precipitant has been washed out with boiling water, the lead chromate is dissolved on the filter with 100 c.c. of hydrochloric acid (1 : 3) and the filtrate received in the original flask. It is best, though not indispensable, to dissolve most of the lead chloride formed on the filter by alternate washings with acid and water. The cold filtrate is made up to 200 c.c., treated with 1 grm. of potassium iodide, and titrated with sodium thiosulphate solution (18 grms. per litre) at the rate of 2—3 drops per second ; the thiosulphate is standardised against lead or lead sulphate ; a little starch solution is added towards the end of the titration. When the blue colour has almost disappeared, 10 c.c. of strong hydrochloric acid is added, the solution heated to about 40° C., and the titration finished. If the ore contains antimony, bismuth, silver, or decomposable silicates, the lead is first separated as sulphate, which is dissolved in ammonium acetate.—W. R. S.

Radio-lead from pure Norwegian cleveite ; Density of ——. T. W. Richards and C. Wadsworth. J. Amer. Chem. Soc., 1916, **38**, 1658—1660.

Radio-lead prepared from purified lead sulphide from Norwegian cleveite, was found to have a density, 11·273, distinctly lower than that of Australian radio-lead (11·289 ; see this J., 1916, 363), and much lower than that of ordinary lead (11·337). The atomic weight of the radio-lead from Norwegian cleveite was 206·085.—A. S.

Flotative agents [for ore concentration] ; A source of ——. [*Wood tar from sage brush.*] G. H. Clevenger. Bull. Amer. Inst. Min. Eng., Sept., 1916. Eng. and Min. J., 1916, **102**, 420—424.

In seeking a convenient source of flotative agents for use in the arid mining regions of the Western States (U.S.A.), the native sage brush (*Artemisia* *tridentata*) was destructively distilled and the products—acid liquor, alkaline liquor, and tar oil—tested qualitatively in conjunction with finely-ground galena, cinnabar, pyrites, and other minerals. The acid liquor behaved like ordinary pyroligneous acid; the alkaline liquor was a good frothing agent, but the froth carried up little mineral; the tar oil proved a very efficient flotative agent. In quantitative tests with the latter on zinc, lead, mercury, and silver-gold ores from various Western mines, the results obtained were generally better, and the oil consumption less, than with the majority of oils previously tried. The sage brush (30 lb. lot) yielded 3·96% of tar oil, 3·66% being with the acid liquor and 0·30% with the alkaline liquor; probably 4% would be an average yield if the plant were collected at the proper season and the distillation efficiently conducted. By steam distilling the tip ends of the shrub, a quantity of essential oil corresponding to 0·43% of the whole plant was obtained; but for flotation purposes this product was much less efficient than the tar oil.—W. E. F. P.

Ferro-tungsten and tungsten powder; Prices of ——. Board of Trade J., Sept. 21, 1916.

The Ministry of Munitions announces that the price of ferro-tungsten is officially fixed at 5s. 6d. per lb. of tungsten content, and of tungsten powder at 6s. 3d. per lb., based on ore at 60s. per unit. The price of the product is on a sliding scale which rises or falls 1d. per lb. with each variation of 1s. per unit of ore.

Japanese mines output in 1915. Eng. and Min. J., Sept. 16, 1916.

The production of Japanese mines in 1915 was valued at £17,595,000, a gain of about 13·5% over the production of 1914. This figure does not include the production of the Government Iron Works, known to be greatly increased, through co-operation with the Russian Government in supplying war munitions. The amounts of the various products are shown in the following table:—

	Amount.	Percentage increase over 1914.
Gold, kg.	8,213	16·2
Alluvial gold, kg.	89	—
Silver, kg.	159,261	5·5
Copper, m. tons	75,415	7·0
Lead, m. tons	4,764	4·4
Bismuth, kg.	1,074	—
Bismuth ore, m. tons	21	—
Tin, m. tons	341	253·3
Antimony, refined, m. tons	8,320	116·0
Antimony, crude, m. tons	27	—
Mercury, kg.	38	—
Zinc, metal, m. tons	21,131	274·0
Zinc, ore, m. tons	6,121	—56·9
Pig iron, m. tons	64,897	—12·2
Wrought iron, m. tons	1,168	69·0
Steel (except government works), m. tons	16,741	8·9
Pyrites, m. tons	67,536	—41·7
Chromite, m. tons	2,979	41·3
Manganese, m. tons	25,870	51·5
Scheelite, m. tons	352	90·9
Wulfenite, m. tons	11	—
Wulfenite, crude, m. tons	10	—
Arsenic, kg.	14,885	—
Phosphate, m. tons	57,723	50·9
Graphite, m. tons	666	16·0
Coal, m. tons	20,490,702	—8·1
Oil, litres	470,390,580	10·8
Asphalt, m. tons	1,975	—1·5
Sulphur, m. tons	61,405	2·6
Sulphur, ore, m. tons	17,174	—

Iron and steel production of Canada. Board of Trade J., Sept. 7, 1916.

The production of iron and steel of various kinds in Canada during 1913, 1914, and 1915 was as follows:—

	1913.	1914.	1915.
	Tons.*	Tons.	Tons.
Pig iron	1,015,118	705,972	825,420
Steel ingots and castings	1,042,503	743,352	912,755
Finished rolled iron and steel	967,097	659,519	653,318
	Kegs.†	Kegs.	Kegs.
Cut nails and wire nails	1,520,000	1,144,000	1,636,000

* 2240 lb. † 100 lb.

The production of pig iron in Canada during the first six months of 1916 amounted to 507,750 long tons.

Metals, ores, etc.; Trading in ——. Board of Trade J., Sept. 21, 1916.

The Ministry of Munitions has announced that Defence of the Realm Regulation 30A applies to the following war material:—Aluminium and its alloys, unwrought and partly wrought, including ingots, notched bars, slabs, billets, bars, rods, tubes, wires, strand, cable, plates, sheets, circles, and strips. Granulated aluminium, aluminium powder, "bronze," "flake," and "flitter." Platinum metal and ores, residues, and bars containing the same.

Under Defence of the Realm Regulation 30B, except under certain conditions, it is not lawful for any person on his own behalf or on behalf of any other person to sell or buy, or to offer to sell or buy, (*a*) any of the following metals:—Iron (including pig-iron), steel of all kinds, copper, zinc, brass, lead, antimony, nickel, tungsten, molybdenum, ferro-alloys; or (*b*) any other metal which may be specified in an order of the Admiralty or Army Council or the Minister of Munitions as being a metal required for the production of any war material. Transactions will not be permitted, except under special licence, in scrap from high speed steel, scrap from copper, or scrap from brass. Transactions in other scrap metals do not require a licence.

Applications for licences in this connection should be addressed to the Director of Materials, Ministry of Munitions, Armament Buildings, Whitehall Place, London, S.W.

Development of the spelter industry. Smith. *See page* 996.

Corrosion in a steel gasholder tank. Wilson. *See* IIa.

Fifty-second annual report on alkali, etc., works by the Chief Inspector. 1915. *See* VII.

Electro-analytical method for determination and separation of metals of the copper-tin group. Schoch and others. *See* XXIII.

Electro-analysis of silver with solutions of silver chloride in ammonia. Schoch and Crawford. *See* XXIII.

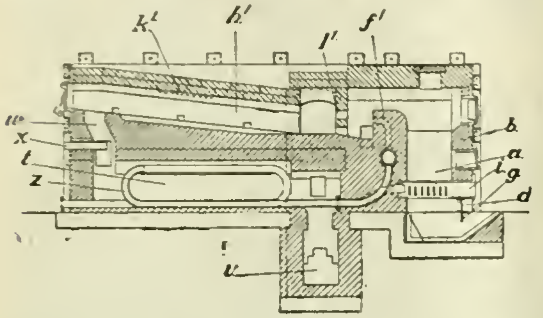
Patents.

Metal plates; Coating of —— *with tin, terne or other metal or alloy.* P. B. Taylor, Briton Ferry, S. Wales. Eng. Pat. 12,311, Aug. 26, 1915.

A set of finishing rolls revolve in the flux, one or more of the lower rolls being of a different material from the top pair of tinning rolls. The lower rolls either do not take a coating of tin, or they permit the tin to drain from them more quickly than from the top rolls. The rolls on one side of the plates may be such as to produce a coating of different thickness from that on the other side. A cleaning, wiping, or distributing roll may be provided in contact with the tinning roll, with or without a trough for molten metal.—W. F. F.

Furnaces; Heating —— [*for metals*]. R. F. Hislop, Paisley. Eng. Pat. 15,226, Oct. 28, 1915.

The front wall, *b*, of the firebox, *a*, rests on a beam, *d*, spanning the ash-pan and having a plate, *g*, dipping into a water seal. An inverted V-shaped grate, *i*, is provided, and the products of combustion pass over the bridge, *f'*, and through openings, *l'*, to the longitudinally divided combustion chambers, *h'*, which are provided with ribs, *k'*, to deflect the gases on to the material on the floor. The gases then pass by the passage, *w*, controlled by dampers, *x*, to three parallel flues, *t*, and thence to the chimney, *v*. The flues, *t*, contain coils, *z*, for heating the air supply to the grate, *i*, and to the bridge, *f'*, and also a coil for generating steam to be supplied to the grate.
—W. F. F.

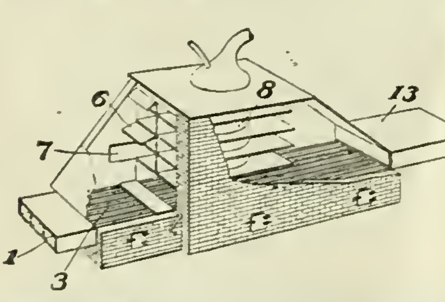


Furnaces; Utilising waste heat from open-hearth ——. R. M. Snyder, Wilkinsburg, Pa. U.S. Pat. 1,195,521, Aug. 22, 1916. Date of appl., Dec. 27, 1915.

The hot waste gases from two open-hearth furnaces are drawn by two similar fans through separate regenerators to two boilers. The supply of gases to the boilers is equalised by providing a cross connection between the two conduits.—W. F. F.

Smelter or ore furnace; Apparatus for utilising the heated fumes from a —— G. P. Luedke, Chatham, Ill. U.S. Pat. 1,196,123, Aug. 29, 1916. Date of appl., Mar. 16, 1914.

A casing is provided with a grate, 3, below which a flue, 1, with vertical partitions opens, and above which an exit flue, 13, is arranged. The upper part of the casing has inclined roof members, and contains an arrangement of horizontal and vertical plates forming flues which can be controlled by dampers, 2, 6, 7. A vessel, 8, contains water which is heated by the fumes passing through the flues.—W. F. F.



Metal ingots; Manufacture of ——. Steel, Peech and Tozer, Ltd., and E. H. Saniter, Sheffield. Eng. Pat. 101,229, Jan 12, 1916. (Appl. No. 497 of 1916.)

Steel and other metal ingots are manufactured with little or no "pipe" by wholly or partly covering the ingot when liquid with a plate of non-conducting material such as firebrick, or asbestos and cardboard, removing the covering just before solidification of the centre, and pouring additional liquid metal into the centre. To avoid any "pipe" from the added metal extending into the ingot, a head of brick or other non-conducting material is placed on the top of the ingot before filling the "pipe."—W. F. F.

Tin ores; Process for removing iron from ——. G. von Rauschenplat, Steglitz, Germany, Assignor to Barilla, Ltd., London. U.S. Pat. 1,196,049, Aug. 29, 1916. Date of appl., Jan. 28, 1914.

Ferruginous tin ores containing tin oxide are subjected to a reducing treatment at a temperature below 500° C. and then treated with acid which dissolves the iron compounds but not the tin.
—W. F. F.

Metal articles; Apparatus for disintegrating ——. A. de Back, Essen, Germany, Assignor to Goldschmidt Detinning Co., New York. U.S. Pat. 1,196,343, Aug. 29, 1916. Date of appl., Dec. 29, 1914.

Waste enamelled metal articles are passed between at least two pairs of rollers, the first pair having circumferential ribs and the second pair longitudinal ribs. The circumferential speed of the second pair is greater than that of the first pair so that a tension is exerted on the articles between the two pairs of rollers which corrugate the articles in two directions at right angles.—W. F. F.

Blast-furnaces; Apparatus for detection of leakages in the water-jackets of ——. L. S. Burt, London. From E. R. y Rizo, Portugalete, Spain. Eng. Pat. 101,327, May 31, 1916. (Appl. No. 7683 of 1916.)

Cleaning metallic or like objects; Method and apparatus for ——. A. Stöckli, Geneva, Switzerland. Eng. Pat. 101,313, Mar. 24, 1916. (Appl. No. 4390 of 1916.)

Cementation process for armour-plates employing mixed cementation agents. F. Giolitti, Turin, Assignor to Soc. Anon. Ital. Gio Ansaldo & Co., Genoa, Italy. U.S. Pat. 1,195,459, Aug. 22, 1916. Date of appl., Oct. 14, 1914.

See Eng. Pat. 18,386 of 1914; this J., 1915, 88.

Iron, steel, and the like from waste enamelled articles; Method of recovering ——. A. de Back, Essen, Germany, Assignor to Goldschmidt Detinning Co., New York. U.S. Pat. 1,196,342, Aug. 29, 1916. Date of appl., Nov. 12, 1910.

See Fr. Pat 418,971 of 1910; this J, 1911, 92.

Steel; Treatment of —— C. H. A. F. L. Ross. Fr. Pat. 478,232, Apr. 1, 1915.

See U.S. Pat. 1,151,049 of 1915; this J., 1915, 1017.

Steel; Treatment of ——. C. P. Sandberg. Fr. Pat. 479,497, Aug. 10, 1915.

See Eng. Pat. 8257 of 1915; this J., 1916, 363.

Iron and steel; Manufacture of —— *and melting of ores, metals, and other refractory materials.* F. G. C. Rincker. Fr. Pat. 479,168, June 29, 1915.

See Eng. Pat. 14,215 of 1915; this J., 1916, 969.

Iron, steel, etc.; Superficial oxidation of articles of ——. B. Guerini. Fr. Pat. 479,370, May 6, 1915.

See Eng. Pat. 7097 of 1915; this J., 1915, 1149.

Rust; Electrolytic process for removing oxide or ——. P. Marino, London. U.S. Pat. 1,195,704, Aug. 22, 1916. Date of appl., Apr. 25, 1916.

See Eng. Pat. 14,230 of 1915; this J., 1916, 849.

Agglomerating finely-divided granular or friable materials [ores, flue-dust, etc.]; Process of ——. A. V. M. Kroll, Luxemburg. U.S. Pat. 1,196,705, Aug. 29, 1916. Date of appl., Dec. 3, 1912.

See Fr. Pat. 452,631 of 1912; this J., 1913, 757.

Melting metals: Process and furnace for ——. E. Bosshardt. Fr. Pat. 477,961, Mar. 8, 1915.

See U.S. Pat. 1,164,983 of 1915; this J., 1916, 260.

Metals: Electrolytic process for cleaning ——. *Apparatus for electrolytic and analogous processes.* A. E. Battle. Fr. Pats. 479,004 and 479,005, June 11, 1915.

See Eng. Pat. 14,513 of 1914; this J., 1915, 910.

Alloy. C. R. Denton. Fr. Pat. 479,275, July 13, 1915.

See Eng. Pat. 17,157 of 1914; this J., 1915, 35.

Sulphide ores; Roasting of ——. Nichols Copper Co. Fr. Pat. 479,279, July 15, 1915.

See Eng. Pat. 9958 of 1915; this J., 1915, 1150.

Tin; Electrolytic refining of ——. American Smelting and Refining Co. Fr. Pat. 479,569, Aug. 20, 1915.

See U.S. Pat. 1,157,830 of 1915; this J., 1915, 1212.

Zinc; Electrolytic recovery of —— *from ores and other materials.* U. C. Tainton. Fr. Pat. 479,702, Aug. 16, 1915.

See Eng. Pat. 11,335 of 1915; this J., 1916, 969.

XI.—ELECTRO-CHEMISTRY.

Alkaline storage battery; The active materials and electrolyte of the ——. L. C. Turnock. Met. and Chem. Eng., 1916, **15**, 259—262.

Nickelous hydroxide is prepared by converting the metal into pure nickel sulphate, and then precipitating with caustic soda; pure metallic iron is prepared from Norwegian or Swedish iron by converting it into pure ferrous sulphate, roasting this to ferric oxide, and reducing with hydrogen liberated when dissolving the nickel and iron. The metallic iron is mixed with a small quantity of mercuric oxide. The electrolyte consists of a 21 % solution of potassium hydroxide for a "first" electrolyte, and a 25 % solution for "renewal" electrolyte, containing respectively 50 grms. and 15 grms. of lithium hydroxide per litre. These are produced respectively from potassium chloride electrolytically and from lithium carbonate by the action of lime. The method of testing the nickelous hydroxide and the iron for electrical capacity in miniature cells is described.—B. N.

Light; A new way of converting —— *into electrical energy.* T. W. Case. New York Elec. Soc., June 14, 1916. 12 pages.

Experiments have been made with a cell containing plates of copper, oxidised in a flame, immersed in tapwater or a sodium chloride electrolyte, and a feeble current was produced on exposing the front plate to sunlight, the back plate being shielded and acting as the zinc of an ordinary battery. Similar results have been obtained with polished unoxidised copper plates, the one exposed to light turning gradually red, then purple and greyish-black, even though the plates were covered with several coats of white paint or bath enamel, and, though the action is somewhat weaker, exposed merely to diffused daylight. An E.M.F. of over 0·1 volt and a current of 0·2 ampère have been thus obtained from a cell containing two plates of copper, 6 in. square; the plate exposed to light was oxidised in a flame and the other plate was polished.—B. N.

Electrolytic preparation of chromous salts from chromic salts, and some new salts of divalent chromium. Traube and Goodson. *See* VII.

Electro-analytical method for determination and separation of metals of the copper-tin group. Schoch and others. *See* XXIII.

Electro-analysis of silver with solutions of silver chloride in ammonia. Schoch and Crawford. *See* XXIII.

Patents.

Electric furnaces of the electrode type. H. J. Kitchen, and T. Balmforth and Co., Luton. Eng. Pat. 101,201, Mar. 10, 1916. (Appl. No. 8533 of 1916.)

The water jackets for cooling the electrodes, instead of being fixed to the roof, are each supported by arms fixed to a vertical rod carried by a bracket on the side of the furnace. The rod is adjustable vertically and is pivoted on the bracket, thus enabling the arms and water jacket to be swung clear of the roof.—B. V. S.

Furnace; Electric arc —— *for the treatment [reduction] of gases.* C. O. A. Dövle, Notodden, Assignor to Norsk Hydroelektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,194,606, Aug. 15, 1916. Date of appl., May 10, 1915.

Gas inlet openings are disposed at an angle in the side walls of the furnace to deliver gas over the area of a disc-like flame spread magnetically, and gas outlets are located between the centre and the periphery of the disc. Each outlet is surrounded by a number of inlet openings, and the outlets are provided with means for cooling the gases; with the object of obtaining short gas passages in the furnace and an effective cooling of the gases after leaving the furnace chamber.—B. N.

Electrolytic cell. H. T. Shriver, West Orange, N.J. U.S. Pat. 1,181,549, May 2, 1916. Date of appl., Apr. 3, 1915.

Several flat plates, forming the electrodes, are bound face to face to form a cell of the filter-press type, each of the plates being recessed centrally to form a cell between the faces. A diaphragm is arranged between each pair of plates to separate the gases formed on the faces of adjacent plates, the gases being led from the recessed portions to closed gas chambers above, through ducts in walls separating the chambers and recesses. The gases are conveyed from the gas chambers to horizontal ducts extending through non-recessed parts of the plates from face to face, so that the recessed portions may be completely filled with liquid to a level normally higher than the horizontal ducts, without fear of the electrolyte entering the gas ducts.—B. N.

Electric furnaces. J. L. Dixon. Fr. Pat. 479,444, Feb. 20, 1915.

See Eng. Pat. 1742 of 1914; this J., 1915, 233.

XII.—FATS; OILS; WAXES.

Chinese wood oil; Examination of ——. F. Browne. Chem. News, 1916, **114**, 123.

A specimen of oil expressed from genuine nuts from Wuchow had the following characters:—Sp.gr. at 15° C., 0·9415; iodine value, 167; saponif. value, 191; heat test, 12 mins.; refractive index at 20° C., 1·5206; at 15° C., 1·5226. Based on these figures and on the examination of oils accepted by buyers as genuine and satisfactory, the following specification was drawn up for South China wood oil:—(1) The oil shall be pale in colour (according to season's production) and commercially free from foots, dirt, and moisture. The total impurities shall not exceed 1 %. Impurities, not obviously adulterations, up to 5 % shall not justify rejection unless so arranged, but an allowance shall be made for such impurities in excess of 1 %. (2) The refractive index shall not be less than 1·5204 at 15° C.; the temperature correction shall be −0·0004 for each 1° C. from 15° to 35° C. (3) The sp.gr. at 15° C. shall not be less than 0·9400. (4) The oil shall satisfy the requirements of one or other of the heat tests devised by Worstall (this J., 1912, 997), Bacon (this J., 1912, 782), Browne (this J., 1912, 731, duration of test not to exceed 13 mins.), or Chapman (this J., 1913, 32). The method of sampling adopted by the Hongkong Government is to draw about 1 oz. from each cask, and to condemn for export any sample with a refractive index below the specification figure. The approved samples are united and the heat test and sp.gr. determined. The casks of oil passing these tests are sealed with official lead seals for shipment. For determining the sp.gr. at temperatures other than 15° C. a correction of 0·00064 is applied for each 1° C. In the heat test the following thermometric correction is made for the cool column—$T - 0{\cdot}00016(T-t)N$, where T represents the observed temperature, t the mean temperature of the emergent column, and N the number of scale degrees on the emergent column.—C. A. M.

Chrysalis oil: Hardened ——. M. Tsujimoto. J. Ind. Eng. Chem., 1916, **8**, 802—804.

CHRYSALIS oil (see this J., 1908, 455) can be refined satisfactorily by heating it with 5—10% by vol. of sulphuric acid of sp.gr. 1·39, and then treating with Kambara earth (this J., 1913, 12; 1915, 840). The refined oil when hydrogenated with the aid of a nickel catalyst, yields a white fat suitable for soap making. The liquid acids of chrysalis oil when hydrogenated in presence of platinum black yield a product consisting mainly of stearic acid. The solid fatty acids of the raw oil when treated by fractional precipitation with magnesium acetate from alcoholic solution, yield palmitic acid and a higher acid or acids, or, more probably, an eutectic mixture of palmitic and stearic acids. According to Marcusson and Meyerheim, the inner iodine values (iodine values of liquid fatty acids) are higher than 100 in the case of hardened fish oils, whereas hardened terrestrial animal oils give lower values. Two samples of hardened chrysalis oil having iodine values of 35·8 and 45·5 respectively, gave inner iodine values of 87·6 and 103·2.—A. S.

Calamary oil. M. Tsujimoto. J. Ind. Eng. Chem., 1916, **8**, 801.

CALAMARY oil is obtained from the internal organs, especially the livers, of various species of cuttle-fish, and is produced in considerable quantities in Japan as a by-product in the manufacture of "dried cuttle-fish" (Jap. *Surumé*). A sample examined by the author was a brownish-red liquid, of disagreeable odour and taste, and having the following characters: sp.gr. at 15°/4° C., 0·9316; acid value, 3·88; saponif. value, 189·6; iodine value (Wijs), 177; $n^{30}_{D} = 1{\cdot}4806$; unsaponifiable matter, 1·14%; glycerol (extraction method), 10·21%; oxidised acids, 0·7%; m.pt. of mixed fatty acids, 35°—36° C.; polybromide of mixed fatty acids (70·9% Br), 57·5%. The oil solidified in a few hours when cooled by ice. Its drying power is similar to that of sardine oil. The oil cannot be refined satisfactorily by means of Kambara earth, but the unpleasant odour is removed almost completely and the oil bleached to a pale yellow by mixing it with about 5 % of a 20 % solution of caustic soda, heating to 60°—70° C., and filtering. The oil can be easily hydrogenated with a nickel catalyst, yielding a white, tallow-like fat of m.pt. 43°—44° C., and iodine value 49.—A. S.

Water-melon seeds from the Sudan [*: Fatty oil from* ——]. Bull. Imp. Inst., 1916, **14**, 160—162.

SEEDS of the water-melon, extensively cultivated in the Kordofan province, yielded 23·6 % of a brownish-yellow oil calculated on the air-dry weight. The oil had the following characters: sp.gr. at 15° C., 0·9230; solidif. point of the fatty acids, 30·5° C.; acid value, 8·4; saponif. value, 191·4; iodine value, 117·1 %; Hehner value, 95·1. The oil appears to be very similar to others derived from cucurbitaceous seeds but the yield is somewhat low. The residual cake contains a high proportion of fibre, 41·9 %, and its food value is low: crude proteins, 18·3; starch, 26·9 %. The oil would be suitable for soap making but the cake could not be largely used in fodders on account of the high proportion of fibre. Valuations of the seeds (Sept.—Oct., 1915) ranged from £5 10s. to £7 per ton.—J. F. B.

Surface tension measurements of solutions of soap and of solutions of soap and various alkalis; Results of relative ——. *Chemistry of laundering.* H. G. Elledge and J. J. Isherwood. J. Ind. Eng. Chem., 1916, **8**, 793—794.

EXPERIMENTS were made with soap solutions of 0·05, 0·1, 0·15, 0·2, and 0·25% concentration and solutions of sodium carbonate of 0·05, 0·1, 0·15, 0·2, and 0·25% concentration respectively, or equivalent solutions of trisodium phosphate, sodium hydroxide, or sodium bicarbonate. The measurements of surface tension were made by the drop method at 100° C., using kerosene as the medium in which the drops were formed. Solutions which gave the highest drop numbers showed also the greatest detergent action as measured by the power of carrying lampblack through filter paper. Within the field examined the detergent power of a soap solution was greater the greater the quantity of alkali added. Equivalent quantities of sodium carbonate and trisodium phosphate gave practically identical results. Sodium hydroxide increased the drop number to a greater extent than the carbonate. The results indicate that in regard to their effect on the detergent power of soap the alkali salts of weak acids are equally efficient, with the exception of sodium bicarbonate which, in cold solutions, has no influence on the drop number of soap solutions.—A. S.

PATENTS.

Copra: Machine for drying ——. D. N. McChesney, Manila, P.I. U.S. Pat. 1,196,128, Aug. 29, 1916. Date of appl., Apr. 10, 1914.

THE copra is dried on trays placed in a series of compartments, through which passes a pipe from a heater, whilst air is forced through a second pipe, which is fixed above the heating pipe and has openings, controlled by shutters, into each compartment.—C. A. M.

Cotton and other oil seed or material; Heater or cooker for ——. O. Sheppard, jun., Assignor to The Murray Co., Atlanta, Ga. U.S. Pat. 1,196,597, Aug. 29, 1916. Date of appl., Mar. 15, 1913.

THE material is fed from a hopper and feeding chamber into a series of superposed heating chambers with communicating outlets. Outside the hopper and compartments is a vertical shaft

on which are mounted rotary gates in vertical alinement. These co-operate with the hopper and compartments, so that regulated quantities of the material can be automatically delivered at timed intervals into the successive chambers.
—C. A. M.

Hydrogenation of unsaturated oils or fats. J Dewar and A. Liebmann. Fr. Pat. 479.143. July 1. 1915.

See Eng. Pat. 15,664 of 1914; this J., 1915, 1102.

Waste waters from oil factories; Utilisation of ——. D. A. Hansen. Fr. Pat. 479.249. July 10. 1915.

See Eng. Pat. 17.915 of 1915; this J., 1916, 898.

Soap: Product and process of manufacturing a product having the properties of ——. G. Petroff. Assignor to Aktious Co. "Kontakt." Petrograd. U.S. Pat. 1.196.274. Aug. 29. 1916. Date of appl., July 25. 1913.

See Fr. Pat. 452,051 of 1912; this J., 1913, 665.

Washing compounds. J. T. Freestone. and W. and F. Walker. Ltd. Fr. Pat. 478.717. Dec. 17. 1914.

See Eng. Pat. 19.229 of 1914; this J., 1915, 491.

Grinding machine [*for oil-cake, etc.*]. Eng. Pat. 12.015. *See* I.

Hydrogenated oil food product. U.S. Pat 1.187,999. *See* XIXa

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Pigments and paints: Physical characteristics of ——. H. A. Gardner. J. Ind. Eng. Chem., 1916, **8**, 794—797.

The opacity or hiding power of a pigment is greater the greater the degree of fineness (up to a certain limit: compare Ostwald. this J., 1916. 697). the higher the refractive index. and the smaller the amount of oil absorbed by the pigment. The refractive indices of some pigments, determined with the petrographic microscope, were as follows:—quartz silica, 1·55; barium sulphate. 1·6: zinc oxide, 1·9—; white lead (basic carbonate and basic sulphate), 2·0; zinc sulphide, 2·2—2·37. White lead and zinc white thus have about the same refractive power. but in a workable paint the proportion of pigment to oil is 70 : 30 in the case of white lead and 50 : 50 in the case of zinc white, and hence the former has the greater hiding power. The refractive power of lithopone appears to be 1·9—2·0; it was not possible to increase the hiding power by increasing the proportion of zinc sulphide in the pigment. Microscopical examination of lithopone indicates that the particles of barium sulphate are coated with particles of zinc sulphide: a product prepared by mixing together barium sulphate and zinc sulphide in the same proportions as in lithopone has an inferior hiding power. The adhesive properties and cementing values of paint pigments apparently increase with approach to the colloidal condition. Experiments are described showing that when pigments, even the so-called inert pigments, such as barium sulphate and silica, are ground with linseed oil, some of the pigment forms a colloidal suspension in the oil. According to Ingalls, the purest carbon black obtainable by burning oil contains only 80—90% of carbon, the remainder consisting of adsorbed carbon monoxide and dioxide, hydrocarbons, nitrogen, oxygen, and water. When the pigment is ground in oil, the adsorbed gases appear to be displaced by the oil owing to preferential adsorption of the latter. Other cases of preferential adsorption are the displacement of water from white lead pastes and of alcohol from zinc white and lithopone pastes by linseed oil. The "foots" present in linseed oil and in varnish appears to be present in the form of a colloidal suspension and would be better removed by centrifuging, preferably after addition of suitable mineral matter, than by settling (compare Ayres, this J., 1916, 676).—A. S.

Coumarone resin and its uses. C. Ellis and L. Rabinovitz. J. Ind. Eng. Chem., 1916, **8**, 797—801. (See also this J., 1890, 275.)

Solvent naphtha (b.pt. 160°—180° C.) was stirred for several hours with 1% of sulphuric acid of 66° B. (sp.gr. 1·84); the temperature did not rise above 35° C. After washing and distilling with superheated steam, the residue formed a transparent brown resin of the consistence of molasses, which carbonised but did not become harder when heated with 10% of sulphuric acid of sp.gr. 1·84 at 220° C. Other polymerising agents tried instead of sulphuric acid gave unsatisfactory results, except silver oxide which gave a product harder than that obtained with sulphuric acid; part of the silver oxide was reduced to metal. When the soft resin was distilled at 29 in. vacuum, 57·5% distilled over up to 180° C. The distillate was a highly viscous liquid, iodine value 28·5. The residual resin softened at 38° C., and melted at 71° C.; its iodine value was 38—43·5 and its saponif. value did not exceed 0·2. Films prepared from a solution of the hard resin in benzol proved resistant to the alkaline aqueous extract of cement. A review of the journal and patent literature on coumarone and indene resins is given.—A. S.

Storax: Researches on ——. *I. Identification of conifer resin acids* (*abietic and pimaric acids*). M. Henze. Ber., 1916, **49**, 1622—1632.

The composition of storax resin, the solid constituent of the balsam, had apparently been established, notably by Tschirch and van Itallie, according to whom the resin consists of a single storesinol. m.pt. 156°—161° C., $C_{16}H_{26}O_2$, in combination with cinnamic acid. The author has arrived at very different results and recognises at least five, possibly six, distinct substances. The major portion of the resin consists of a mixture of two isomeric acids, $C_{20}H_{30}O_2$, which have been found to be completely identical with abietic and pimaric acids, the principal components of the conifer resins. This is the first record of the production of these acids by a non-coniferous tree (*Liquidambar orientalis* M.). For isolating the resin acids. the storax was dissolved in 70% alcohol on the water-bath and allowed to stand in the cold overnight. A heavy dark oil separated, apparently consisting of styracin: the alcoholic solution was treated with alcoholic lead acetate, the precipitate redissolved by heating. and allowed to crystallise out. The lead salt was separated, dried, and purified by recrystallisation. then dissolved in acetic acid and alcohol and poured into water. The resin acids, after recrystallisation, melted at 140°—150° C. and were finally separated, through their sodium salts and by recrystallisation from diluted methyl alcohol. into sparingly soluble pimaric acid, m.pt. 210°—211° C., in smaller quantity, and more soluble abietic acid, m.pt. 158°—165° C., in larger quantity. The filtrate from the lead precipitate yielded on saponification, besides cinnamic acid, a resinous mixture containing three or four bodies unidentified. one of which is ketonic and another alcoholic in function. also a resene body of high melting point.—J. F. B.

Resin acids: Artificial ——. G. Cohn. Chem.-Zeit., 1916, **40**, 725—727.

The resinous acid condensation product from formaldehyde and phenoxyacetic acid is typical of a whole group of compounds. The oxyacetic acids of cresol, guaiacol, carvacrol, resorcinol, etc., yield analogous substances; only the product derived from α-naphthoxyacetic acid appears to be of a different type. It gives different colour reactions and its composition corresponds to that of a methylenedi-α-naphthoxyacetic acid. These resin acids may also be prepared by condensing alkali-soluble phenol-formaldehyde resins with chloroacetic acid. They contain the $O.CH_2.COOH$ group and have a high molecular weight. A mixture of 50 grms. of phenoxyacetic acid, 50 grms. of formaldehyde solution, and 20 grms. of strong hydrochloric acid is heated for 4 to 5 hours on the water-bath until the bulk of the acid has evaporated. The residual resin is kneaded with hot water and dried for about 10 hours on the water-bath (yield about 65 grms.). By reducing the proportion of formaldehyde to 1 mol. to 2 mols. of phenoxyacetic acid, soft resinous masses apparently containing unaltered phenoxyacetic acid are obtained. Increasing the proportion of formaldehyde has no effect on the results. Phenoxyacetic resin acid is soluble in acetone, methyl alcohol, amyl alcohol, terpineol, and glacial acetic acid, and sparingly soluble in alcohol, but insoluble or nearly so in benzene, chloroform, ether, carbon bisulphide, carbon tetrachloride, acetylene tetrachloride, and oil of turpentine. Fused with colophony it yields a homogeneous mass. It may be purified by dissolving it in water containing a trace of ammonia, filtering the solution, and re-precipitating the resin with glacial acetic acid. It gives a red coloration with strong sulphuric acid, and when heated with resorcinol and zinc chloride yields a deep-brown amorphous dyestuff, showing pronounced fluorescence in alkali solution. When treated with absolute alcohol and sulphuric acid it is converted into an amorphous ester, which is softer than the resin acid, and is readily soluble in acetone, sparingly soluble in methyl alcohol, and insoluble in dilute ammonia and sodium hydroxide solutions. It gives a red coloration with strong sulphuric acid. The resin acid is soluble in dilute sodium hydroxide solution, and the sodium salt is left as a vitreous residue on evaporating the solution. The ammonium salt may be obtained as an amorphous powder by evaporating the ammoniacal solution of the resin acid. Flocculent precipitates are obtained on adding solutions of the salts of heavy metals to the ammoniacal solution. For example, copper sulphate gives a greenish blue precipitate which dissolves in ammonia to an azure-blue solution. On adding a dilute solution of the ammonium or sodium salt to a solution of a basic dyestuff, such as Magenta, Methyl Violet, Methylene Blue or Malachite Green, and adding acetic acid, voluminous precipitates are obtained, the precipitation being quantitative under suitable conditions. The presence of a little hydrochloric acid does not interfere with the precipitation, which is attributed to adsorption of the dyestuff by the precipitated resin acid. Acid dyestuffs are not precipitated in this way. The ammonium salt also reacts with alkaloids, but antipyrine gives no precipitate. When heated at 140° C. for 30 mins. the resin acid lost 10 to 20 % in weight and was converted into a soft porous mass, much less soluble in the ordinary solvents than the original resin acid. The resin acid produced by the interaction of trioxymethylene with phenoxyacetic acid and hydrochloric acid is a hard mass which does not melt again, but only softens a little when heated. When dried and powdered it forms a white powder which is only sparingly soluble in hot alcohol, methyl alcohol, and acetone. *Bakelite acetic resin acid* is obtained by condensing "bakelite A" with phenol and formaldehyde in presence of hexamethylenetetramine. Slight variations in the conditions of preparation affect the properties of the acid. For example, some preparations melt at 115° C. whilst others remain unaltered at 200° C. It is insoluble in the usual organic solvents, but is fairly soluble in hot aniline. It gives an orange-red coloration with strong sulphuric acid, and with resorcinol yields a dyestuff. *Tricresoxyacetic resin acid* is prepared by heating together for 2 hours 50 parts of tricresol, 60 parts of chloroacetic acid, and 150 parts of 33 % sodium hydroxide solution, and condensing the white product with an equal quantity of formalin and half the quantity of hydrochloric acid. The resulting resin acid is pale green, plastic while hot, but hard when cold. It is readily soluble in acetone, alcohol, methyl alcohol, pyridine, and dilute ammonia solution. It gives a deep brown-red coloration with sulphuric acid. *Resorcinol-diacetic resin acid* is prepared in an analogous manner from resorcinoldiacetic acid. It is sparingly soluble in boiling acetone, and nearly insoluble in alcohol, ether, and glacial acetic acid. It gives a magenta coloration with sulphuric acid. *Guaiacolacetic resin acid* is soluble in cold acetone, hot alcohol and glacial acetic acid, insoluble in ether. It gives a red-violet coloration with sulphuric acid. The ammonium salt precipitates dyestuffs and alkaloids. *α-Naphthoxyacetic resin acid* may be crystallised from glacial acetic acid. It melts at 227° to 228° C., and gives a blue-green coloration and solution with steong sulphuric acid. It is readily soluble in hot acetone and alcohol, but only slightly soluble in ether.—C. A. M.

Vulcanisation of gum resins. Hutin. *See* XIV.

Petrographic microscope in analysis. Wright. *See* XXIII.

PATENTS.

Pigment and paint; Aluminous ——. O. W. Pickering, Springfield, Mass., Assignor to Pickering Paint and Pigment Co. U.S. Pat. 1,195,604, Aug. 22, 1916. Date of appl., Oct. 10, 1914.

THE pigment consists of a substantially water-insoluble, flocculent metal aluminate, and the paint of a mixture of this and an oily vehicle, with or without driers.—E. W. L.

Coating composition; Liquid ——. R. Picker, Assignor to Durlacque Manufacturing Co., St. Louis, Mo. U.S. Pat. 1,196,276, Aug. 29, 1916. Date of appl., June 26, 1914.

PONTIANAK gum copal, 90 lb., and shellac, 10 lb., are dissolved in alcohol, 14 galls., and benzol, 6 galls. Whiting may also be added.—E. W. L.

Lead oxide; Process of carbonating ——. F. H. Sharpe, Liverpool. U.S. Pat. 1,196,595, Aug. 29, 1916. Date of appl., July 12, 1915.

SEE Eng. Pat. 17,579 of 1914; this J., 1915, 92.

Lead oxide; Process and apparatus for carbonating ——. F. H. Sharpe. Fr. Pat. 479,219, July 7, 1915.

SEE Eng. Pat. 17,579 of 1914; this J., 1915, 92.

Calcium sulphate and zinc sulphide; Process for making a compound of ——. J. L. Carpenter. Fr. Pat. 478,289, Mar. 24, 1915.

SEE U.S. Pat. 1,146,690 of 1915; this J., 1915, 914.

Varnish, lacquer, or the like and process of making same. R. Grüter, Charlottenburg, Germany. U.S. Pat. 1,195,673, Aug. 22, 1916. Date of appl., Nov. 15, 1913.

SEE Fr. Pat. 461,617 of 1913; this J., 1914, 557.

Rosin soap : Method and apparatus for preparing dilute solutions of —— containing dissolved unsaponified rosin. R. J. Marx and J. A. de Cew. Fr. Pat. 478,830, Feb. 20, 1915.

See Eng. Pat. 2142 of 1915 ; this J., 1916, 317.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

Vulcanisation of caoutchouc : Chemical investigation of the —— and the possibility of its regeneration from the vulcanised product. II. C. Harries and E. Fonrobert. Ber., 1916, **49**, 1390—1398. (See this J., 1916, 747.)

Vulcanisation of Para rubber with 10 % of sulphur for 30 minutes at 145° C. gives a product which, when exhaustively extracted (for 60 days) with acetone, contains only 0·29 % of sulphur. The extracted product is less elastic than the unvulcanised rubber and does not give a satisfactory product on further vulcanisation. It is therefore another modification of the unvulcanised rubber, the sulphur present being regarded by the authors as negligible. The hydrochloride prepared from the unextracted product is similar in appearance to that derived from unvulcanised rubber, but is harder, and is insoluble in the usual solvents. Hydrochloric acid is split off at 155° C., 10° C. higher than in the case of the hydrochloride from unvulcanised rubber. Vulcanisation of the same mixing for 3 hours gives a product containing, after exhaustive extraction, 2 % of sulphur. Commercial vulcanised rubber always contains some rubber which yields a soluble hydrochloride ; in red motor tyres, for example, this amounted to 20 % of the whole. The "reclaimed rubber" obtained by decomposing this hydrochloride with pyridine, however, differed from the original unvulcanised rubber in that its ozonide yielded diacetylpropane on hydrolysis, indicating a change in position of the double bond. The sulphur present in the insoluble hydrochloride remains in the reclaimed rubber prepared by the action of pyridine. That there is no structural alteration in the molecule during vulcanisation is demonstrated by the fact that the ozonide of vulcanised Para rubber gave only traces of methylcyclohexenone on hydrolysis. The acetone-extracted vulcanisate was ozonised with difficulty and the oxyozonide formed gave much acid and little aldehyde on hydrolysis. Natural rubber gave the same products as highly purified caoutchouc, but was slightly less readily attacked by ozone in ethyl acetate solution. The change brought about by vulcanisation is apparently one in the size of the molecule.—E. W. L.

Rubber thread ; Physical and chemical analysis of ——. A. Dubosc. Caout. et Gutta-percha, 1916, **13**, 9007—9008.

The use of rubber thread has undergone considerable expansion during the war owing to its employment in shock-absorbers, catapults, etc., and in view of its importance analyses were made of a number of samples. The results were as follows :—

Sample No.	1.	2.	3.	4.	5.	6.	7.
Dimensions, mm.	0·80 × 0·82	0·70 × 0·70	0·60 × 0·60	0·60 × 0·60	0·66 × 0·68	0·70 × 0·70	0·60 × 0·60
Tensile strength, grms. per sq. mm.	693	606	717	717	483	594	669
Elongation (times original length)	12·4	12·7	12·5	12·5	12·6	11·9	10·4
Elastic limit (times original length)	3·5	4·9	3·7	3·4	3·7	3·6	4·0
Acetone extract (per cent.)	2·30	3·30	2·25	2·38	1·87	2·37	3·61
Moisture ,,	0·72	0·85	0·85	0·92	0·73	0·98	0·99
Ash ,,	2·51	2·73	1·84	2·19	1·75	2·26	2·48
Total sulphur ,,	2·77	2·77	3·04	2·84	2·68	2·95	2·75
Chloroform extract ,,	1·50	1·60	4·20	0·80	7·02	1·75	1·01
Alcoholic potash extract ,,	0·13	0·08	0·03	0·11	0·13	0·05	0·14
Caoutchouc ,,	90·07	88·69	87·79	90·77	86·23	89·65	89·23

In sample 5 the high chloroform extract and low tensile strength are noteworthy. The ash consists in each case mainly of talc, used in manipulating the rubber before vulcanisation.—E.W.L.

Gum-resins ; Vulcanisation of ——. Hutin. Caout. et Gutta-percha, 1916, **13**, 9025—9026.

It has been found that the addition of gum-resins, such as shellac, to ebonite mixings, retards the cure, and gives a product which does not polish well. The gum-resins can, however, be vulcanised, and, if added to the mixing in the vulcanised form, give satisfactory results. Shellac can be vulcanised by mixing 93 parts with 7 parts of sulphur and heating for 12 hours—including 2 hours "rise"—at 65—70 lb. steam pressure. The minimum temperature for vulcanisation is that corresponding with 50—55 lb. steam pressure, a preliminary decomposition of the shellac taking place with the formation of an unsaturated compound capable of combining with sulphur. The fully vulcanised product is insoluble in acetone. Copal and sandarac give similar results. Colophony does not vulcanise.—E. W. L.

Sun-cracking [of rubber] ; C. O. Weber's test for ——. [Acetone peroxide.] D. F. Twiss. India-Rubber J., 1916, **52**, 325.

The mixture of acetone with an aqueous solution of hydrogen peroxide, the use of which is recommended by Weber for the determination of liability to "sun-cracking" in vulcanised rubber goods, may, after keeping for a month or so, deposit compact colourless crystals of acetone peroxide, $C_9H_{18}O_6$ (Wolffenstein, Ber., 1895, 28, 2265). Although this substance can be melted with safety (at 97° C.), it is capable of exploding with great violence when subjected to shock, or if heated above its melting-point, and great care should therefore be taken to prevent its accumulation in any quantity, especially in a dry condition. 0·03 grm. of the substance, when heated in an open test-tube, will explode with such force as to shatter the tube.—E. W. L.

Some aspects of the synthesis of caoutchouc. Luff. *See page* 983.

Raw materials used by the rubber manufacturer. Porritt. *See page* 986.

Patents.

Plasticity of rubber and rubber mixings : Apparatus for and method of measuring ——. H. H. Grundy and P. Schidrowitz, London. Eng. Pat. 15,438, Nov. 2, 1915.

The degree of plasticity of rubber or rubber mixings is ascertained by measuring the electrical power consumed over a time interval during the mixing and masticating operations. This may be done by observations of an electricity meter from time to time, or by a drum meter recording the consumption on a curve. The latter has a definite relationship to the degree of plasticity, and a device may be used for signalling the position of the curve by means of a bell or similar apparatus. As an alternative, two index hands may be used on one dial of the meter, one hand moving, independently of the meter, at a uniform speed corresponding to the speed of the meter hand when the proper degree of plasticity is obtained.—B. N.

Rubber: Process of reclaiming ——. H. O. Chute, New York. U.S. Pat. 1,196,334, Aug. 29, 1916. Date of appl., June 3, 1913.

Scrap rubber is heated below the vulcanising temperature, first in a solution of halogen acid, alone or in presence of a soluble halide, such as calcium chloride; or in a mixture of sulphuric acid and excess of a solution of a chloride; and then in a solution of caustic alkali. The alkali is then removed, and the rubber rendered plastic by heating with water at a high temperature.—E.W.L.

Rubber goods; Eliminating porosity in ——. W. J. Mellersh-Jackson, London. From Boston Rubber Shoe Co., Malden, Mass., U.S.A. Eng. Pat. 16,226, Nov. 17, 1915.

See U.S. Pat. 1,164,860 of 1915; this J., 1916, 264.

Rubber from rubbered fabrics, especially tyres; Recovery of ——. C. de Villers. Fr. Pat. 478,280, July 11, 1914

See Eng. Pat. 10,146 of 1915; this J., 1916, 931.

Rubber sponge; Manufacture of ——. P. Schidrowitz and H. A. Goldsbrough. Fr. Pat. 478,369, Apr. 13, 1915.

See Eng. Pat. 1111 of 1914; this J., 1915, 624.

Impregnating textile belts or the like with gutta-percha, balata, or rubber. Eng. Pat. 101,127. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Leather; Chemical and microscopical examination of ——. E. Seel and A. Sander. Z. angew. Chem., 1916, **29**, 325—326, 333—334.

Most of the reactions which have been proposed for the detection of the synthetic tanning agent Neradol in leather are either not sufficiently sensitive or are rendered ineffective by the presence of other tanning materials. The authors have found the following hydroxyazo and indophenol reactions satisfactory for the detection of Neradol D. 20 grms. of the leather, in small pieces, is boiled with 250 c.c. of water for ¼—½ hour, and 100 c.c. of the hot filtered solution is treated with 20 c.c. of a mixture of equal parts of 40% formaldehyde, concentrated hydrochloric acid, and water (compare Stiasny, this J., 1906, 275), and boiled for ½ hour under a reflux condenser. After cooling, the solution is filtered and concentrated, preferably after a preliminary purification by dialysis. An alternative method of treating the leather infusion consists in treating it with lime water, or neutralising it with ammonia and treating it with a calcium salt, and then filtering and concentrating. *Hydroxyazo reaction.* 5 c.c. of the concentrated solution is treated with excess of alkali, cooled with ice, mixed with about half its volume of alcohol, and three or four drops of a solution of diazotised *p*-aminophenol added. A blue coloration indicates the presence of Neradol D. If the blue colour does not appear immediately, the solution is acidified with hydrochloric acid, shaken vigorously with ether, the ethereal solution separated and added to water, and then sodium hydroxide added, when a dark bluish-green colour appears at the surface of contact of the two layers if Neradol D be present. *Indophenol reaction.* 5 c.c. of the concentrated aqueous extract of the leather is treated with a drop of a solution of the hydrochloride of dimethyl-*p*-phenylenediamine (obtained by reduction of Methyl Orange), the mixture is made alkaline with caustic soda, and treated with one or two drops of a 5% solution of potassium ferricyanide: a blue coloration indicates the presence of Neradol D. The test is rendered more sensitive if alcohol be introduced to form an upper layer before adding the ferricyanide: a blue ring forms slowly at the surface of contact and gradually extends into the alcohol layer. Neradol ND (prepared by condensation of naphthalene-β-sulphonic acid and formaldehyde), not being a phenolic compound, does not give either of the above reactions directly, but responds to both after oxidation with sodium hypochlorite solution.

For staining sections of leather for microscopical examination, in order to ascertain whether the skin has been tanned completely through, the best results were obtained with Malachite Green, Brilliant Green, Methyl Green, Bismarck Brown, and Rhodamine, all of which dye the leather whilst leaving the untanned skin unaffected. By dyeing first with a basic dyestuff, washing with water and alcohol, and then again dyeing with an acid dyestuff, the untanned skin and the leather may be stained different colours: specially effective results were obtained with combinations of Brilliant Green and Eosin and of Rhodamine and Patent Blue.—A. S.

Sole leather tests with Australian pine barks; Comparative ——. F. A. Coombs. Collegium (London), 1916, 205—215.

Systematic tanning experiments were carried out with Australian pine bark liquors, wattle bark liquors, and liquors made from five-sixths wattle-bark and one-sixth myrobalans and valonia. Precautions were taken to make the tests strictly comparative by selecting similar hide pieces, using the same liming process, tanning in liquors of corresponding specific gravity, etc. The leather made with pine bark showed the highest degree of tannage, though the rate of penetration of tannin was slower. It also proved to be more resistant to water than the other leathers, at least in the unrolled condition.—F. C. T.

Chrome-tanned leather; Determination of chromic oxide in ——. M. C. Lamb and A. Harvey. Collegium (London), 1916, 201—203.

The presence of iron sometimes leads to too high results in the estimation of chromium. To remove the iron, it is best to fuse the leather ash with sodium peroxide and subsequently treat with water, not acid, when ferric oxide remains undissolved and may be filtered off. The percentage of chromic oxide should be calculated on the weight of degreased leather and not on the original material. The degreased leather should contain at least 2·8—3·0% of chromic oxide or it will be found to be undertanned.—F. C. T.

Deterioration of leather used in gas meters. Lamb. *See page* 989.

Patents.

Bronze kid [*leather*]: *Producing* ——. A. G. Bloxam, London. From A. Combe et Fils et Cie., Paris. Eng. Pat. 101,109, Feb. 21, 1916. (Appl. No. 2575 of 1916.)

Bronze kid is produced by the aid of Magenta and allied colouring matters, the dyeing operation being followed by smoothing and topping operations. The dyeing and topping liquors are prepared from crystallised Magenta and "Violet" and tannic acid dissolved in 90% alcohol, nitrobenzene being also added to the dyeing liquor, and resin, used as a varnish, added to the topping liquor. The process may be applied as a finishing operation to leather, the final polishing being facilitated by the addition of amyl alcohol to the topping liquor, or it may be used for staining or maintaining the colour of boots and shoes.—B. N

Gelatinous substances; Production of solid ——. E. Salm. Assignor to A.-G. fur Chem. Produkte vorm. H. Scheidemandel. Berlin. U.S Pat. 1,195,099, Aug. 15, 1916. Date of appl., Feb. 15, 1916.

Solid gelatinous substances are obtained in a divided condition by bringing them, when in the liquid state, into contact with a non-volatile oil of sp.gr. 0·8 to 1·2. The globules of glue are removed by a mechanical device as they are formed, and then washed by benzene or the like, which is afterwards recovered; the globules are dried in a warm room.—B. N.

Tanning hides and skins; Process and apparatus for ——. E. Wilson. Fr. Pat. 478,138, Mar. 24, 1915.

See Eng. Pat. 7762 of 1914; this J., 1915, 437.

Tanning extracts; Production of ——. W. E. Horrocks and J. K. Tullis. Fr. Pat. 479,426, July 31, 1915.

See Eng. Pat. 18,332 of 1914; this J., 1915, 1062.

XVI.—SOILS; FERTILISERS.

Fifty-second annual report on alkali, etc., works, by the Chief Inspector, 1915. See VII.

Petrographic microscope in analysis. Wright. *See* XXIII.

Patents.

Phosphatic fertilisers; Manufacture of ——. A. Dickson. Fr. Pat. 478,707, Sept. 7, 1914.

See Eng. Pat. 18,999 of 1913; this J., 1914, 1067.

Composition and process for treating plants. U.S. Pat. 1,194,608. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

White [cane] sugar manufacture: Study of the syrup precipitate in ——. C. E. Coates and L. C. Slater. J. Ind. Eng. Chem., 1916, **8**, 789—792.

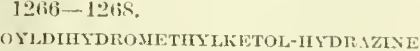
In the direct sulphitation process for the manufacture of white cane sugar, a precipitate, difficult to remove by filtration, is formed when the hot syrup is allowed to stand. The authors examined two specimens of this precipitate. One specimen was obtained from a factory in which phosphoric acid is added to the filtered juice before concentration and the other from a factory in which no phosphoric acid is used: the dried precipitates consisted largely of organic matter and silica, together with calcium phosphate in that from the factory using phosphoric acid; copper was present in both cases. The organic matter appears to be chiefly calcium salts of organic acids. It is estimated that the amount of dry precipitate is less than 0·01 % of the weight of syrup, and the best method of dealing with it appears to be to allow the hot syrup to settle for at least 4 hours in tanks sheathed to prevent radiation as far as possible, then decant the syrup, and add the "bottoms" to the limed juice previous to filtration.—A. S.

Dextrose; Action of hydrogen sulphide on ——. W. Schneider. Ber., 1916, **49**, 1638—1643.

When hydrogen sulphide is passed into a solution of dextrose in pyridine, with every precaution for the expulsion and exclusion of air and with repeated renewal of the supply of gas over a period of 22 days, combination takes place and a syrupy residue is left after removal of the excess of hydrogen sulphide and most of the pyridine by distillation under reduced pressure. By means of an anhydrous solution of ammoniacal silver nitrate in pyridine, the thioglucose derivative is precipitated in the form of its silver compound, insoluble in a mixture of alcohol and pyridine. This compound resembles the similar derivative prepared from sinigrin and analogous synthetic thiourethaneglucosides. It is an amorphous pale yellow powder, very soluble in water, insoluble in alcohol and ether; it dissolves in cold pyridine but is precipitated in a flocculent form on warming; it melts at about 144° C. and is readily decomposed by hydrogen sulphide with separation of silver sulphide. It differs, however, from the derivative prepared from the glucosides in its higher proportion of sulphur, and it would appear that the product of the direct action of hydrogen sulphide on dextrose is a mixture of about 2 parts of monothioglucose with 1 part of dithioglucose. —J. F. B.

Galactose; Benzoyldihydromethylketol-hydrazine, a new reagent for ——. J. von Braun. Ber., 1916, **49**, 1266—1268.

Benzoyldihydromethylketol-hydrazine,



$$CH_3.CH<\begin{matrix}CH_2 & \text{——}\\ N(COC_6H_5) & \end{matrix}>C_6H_3.NH.NH_2,$$

is a specific reagent for galactose, with solutions of which it gives a colourless crystalline precipitate in from ½ to 2 hours according to the concentration. With dextrose, lævulose, mannose, arabinose, and xylose no precipitate is produced. The base is prepared from benzoyldihydromethylketol, which is nitrated and reduced to *m*-amino-N-benzoyldihydromethylketol. This is diazotised and reduced with stannous chloride, and the hydrazine isolated in the usual way. It crystallises from alcohol in colourless needles, m.pt. 150—151° C., and is apparently quite stable when dry. The hydrochloride melts at 197° C., and the semicarbazide derivative at 213° C. —G. F. M.

Petrographic microscope in analysis. Wright. *See* XXIII.

Patent.

Starch products; Manufacture of ——. A. S. Hoyt. Fr. Pat. 479,236, July 9, 1915.

See U.S. Pat. 1,148,453 and 1,148,454 of 1915; this J., 1915, 917.

XVIII.—FERMENTATION INDUSTRIES.

Glycylglycine; Kinetics of enzymic hydrolysis of ——. K. G. Dernby. Comptes rend. Trav. Lab. Carlsberg, 1916, **11**, 263—295.

The optimum reaction for the hydrolysis of glycylglycine by the ereptase of yeast is $p_H = 7·8$. The concentration of hydrogen ions diminishes continuously during hydrolysis, owing to a difference between the electrolytic dissociation constants of the substrate and of the product; and this change affects the activity of the enzyme and therefore the course of the action. If the reaction of the medium is maintained constant, by addition of phosphate "buffer" salts, hydrolysis proceeds as a unimolecular reaction, provided sufficient enzyme is present to render losses due to auto-digestion negligible. In alkaline liquids, and even at the optimum reaction, the activity of the enzyme is slowly destroyed, but glycylglycine exerts a protective influence. Glycine and the ions K, Na, Cl, Br, F, SO_4, and NO_3 have no influence on the enzyme, at low concentrations, but chlorates have a retarding action and cyanides act as powerful poisons.—J. H. L.

Patent.

Agave plant; Process of treating the juices of the —— *[preparatory to fermentation].* L. Lavedan, New Orleans, U.S.A. Eng. Pat. 101,261, Apr. 19, 1916. (Appl. No. 5762 of 1916.)

See U.S. Pat. 1,182,691 of 1916; this J., 1916, 704.

XIXA.—FOODS.

Bread making ; Use of certain yeast nutriments in ——. H. A. Kohman, C. Hoffman, T. M. Godfrey, L. H. Ashe, and A. E. Blake. J. Ind. Eng. Chem., 1916, **8**, 781—789.

THE rate of fermentation in bread making is markedly accelerated by small quantities of ammonium and calcium salts, so that it is possible to use considerably less yeast than usual and yet obtain equally good results as regards size of loaf, whilst the colour and texture of the bread are improved. If a small quantity of potassium bromate be added, the quantity of yeast may be still further reduced. The ammonium and calcium salts act chiefly as yeast nutriments or stimulants, whilst the potassium bromate exerts a marked ageing or maturing effect on the dough, due to its oxidising power ; a similar but less pronounced ageing effect is produced by passing oxygen through the dough. If ammonium chloride, calcium sulphate or chloride, and potassium bromate be used together, from 50 to 65% of the usual quantity of yeast can be saved, and this results in a saving of about 2% of fermentable carbohydrates, calculated upon the total flour used, due to the diminished consumption of these by the yeast. The use of these salts, moreover, ensures more uniform results as to quality of bread in different localities irrespective of the character of the local water supply. In practice the salts are dissolved in the water used in the dough batch, about 2 oz. of a calcium salt, a little less than 1 oz. of ammonium chloride, and 0·02 oz. of potassium bromate being used per 60 lb. of water or per 160 lb. of bread. The process has been used successfully with different kinds and grades of flour and in the manufacture of different kinds of bread.

A suggested method of utilising stale bread consists in "cooking" it and then digesting with malt. The gluten remains in flakes and can be separated by filtration from the sugars formed by hydrolysis of the starch. Glutamic acid hydrochloride can be obtained by digesting the gluten residue with concentrated hydrochloric acid, and is of value both as a yeast stimulant and for its ageing or maturing effect on dough.—A. S.

Milk ; Comparison of the bacterial count with the sediment or dirt test of ——. H. C. Campbell. U.S. Dept. Agric., Bull. No. 361, 1916, 1—6.

THE quantity of sediment or dirt collected when milk is filtered through a cotton disc is no criterion of the number of bacteria present in the milk, and, consequently, gives no indication of the hygienic conditions under which the milk has been produced. For instance, a milk showing but little, if any, sediment or dirt, may contain up to one million bacteria per c.c., whilst the number of bacteria in a dirty milk may be as low as 7000 per c.c. Since the sediment test has been used in factories, etc., for controlling the quality of milk, producers have begun to strain the milk, and the test is now of little value, except for the detection of actual dirt in a sample.—W. P. S.

Casein ; Influence of ethyl alcohol and glycerol on the rate of solution of —— by sodium hydroxide. T. B. Robertson and K. Miyake. J. Biol. Chem., 1916, **26**, 129—142.

ALCOHOL and glycerol retard the penetration of casein particles by 0·016*N* sodium hydroxide solution. The penetration formula $x = Kt^m$ (see this J., 1916, 939) expresses the relationship between the quantity of casein dissolved and the time of stirring in all glycerol-water mixtures and in alcohol-water mixtures containing less than 4·5 grm.-mols. or more than 7 grm.-mols. alcohol per litre, but the formula does not apply to the rate of solution of casein in 0·016*N* sodium hydroxide solution containing between 4 and 8 grm.-mols. alcohol per litre. In these mixtures the initial solution of the casein is succeeded, after prolonged stirring, by partial re-precipitation. In concentrations below 4·5 grm.-mols. per litre the coefficient of penetration decreases, with negative acceleration (*loc. cit.*), as the concentration of alcohol increases ; in concentrations above 7 grm.-mols. per litre the coefficient decreases, with positive acceleration, as the concentration of alcohol increases. The relationship of the magnitude of the coefficient of penetration to the concentration of alcohol is indeterminate in the case of mixtures containing between 4·5 and 7 grm.-mols. alcohol per litre.

It is inferred that in concentrations of alcohol below 4·5 grm.-mols. per litre, the casein molecules in the presence of 0·016*N* sodium hydroxide solution are all of the single type, whilst at concentrations above 7 grm.-mols. they are practically all of a polymerised type. With intermediate concentrations of alcohol, the proportion of polymerised molecules to single molecules progressively increases with the alcoholic concentration.—W. P. S.

Proteins ; Origin of the humin nitrogen formed by the acid hydrolysis of ——. *Hydrolysis in the presence of carbohydrates and of aldehydes.* R. A. Gortner. J. Biol. Chem., 1916, **26**, 177—204.

GORTNER and Blish have stated previously (J. Amer. Chem. Soc., 1915, **37**, 1630) that in all probability the humin nitrogen of protein hydrolysis has its origin in the tryptophane nucleus, a statement to which exception has been taken by other workers. The author now shows that the humin nitrogen is greatly increased when the hydrolysis is carried out in the presence of a carbohydrate, whilst the amount of ammonia nitrogen is not materially altered. Tryptophane cannot be determined accurately by hydrolysing proteins in the presence of carbohydrates ; if the quantity of carbohydrate greatly exceeds that of the protein, the distribution of the nitrogen cannot be determined accurately by Van Slyke's method (this J., 1911, 771, 1135). When fibrin is hydrolysed in the presence of furfural, the humin nitrogen is increased ; this may be due to the absorption or occlusion of other amino-acid nitrogen by the humin. A black, insoluble mass is obtained by boiling furfural with concentrated hydrochloric acid and it is possible that the humin, derived from carbohydrates, is actually formed from furfural, which is in turn formed from carbohydrates. The quantity of humin nitrogen also increases when fibrin is hydrolysed in the presence of benzaldehyde or of small quantities of formaldehyde ; large quantities of the latter decrease the yield of humin nitrogen. Both tryptophane and tyrosine yield a considerable proportion of "acid-insoluble" humin nitrogen when boiled with hydrochloric acid in the presence of benzaldehyde ; when tryptophane is hydrolysed in the presence of formaldehyde, a considerable part of the nitrogen is retained in the "acid-insoluble" humin, but a similar hydrolysis of tyrosine does not yield an "acid-insoluble" humin.—W. P. S.

Proteins ; Behaviour of purified —— *towards proteolytic enzymes.* E. M. Frankel. J. Biol. Chem., 1916, **26**, 31—59.

IN pepsin-hydrochloric acid digestion the pepsin is the effective agent ; hydrochloric acid alone, in the concentrations usually employed, has very little proteolytic action on proteins. Experimental evidence was obtained that there is, during digestion, a parallelism in the cleavage curves of egg-albumin, casein, cottonseed globulin, edestin, gelatin, coagulated lactalbumin, phaseolin, soya bean globulin, squash-seed globulin, amandin, conglutin, and legumelin, if the cleavage is calculated as the ratio of the amino nitrogen liberated at any one time to that obtained by total hydrolysis of the protein with concentrated acid. The results obtained in proteolysis are comparable only when the substrates are in solution; otherwise, differences of 10 to 15% may be obtained in duplicate experiments. Pepsin-hydrochloric acid can liberate about 20% of the total amino nitrogen of a protein within 100 hours; trypsin acting on proteins partially digested with pepsin effects a cleavage of about 70%. The action of trypsin on native proteins causes a cleavage of about 50% of the peptide linkages; further addition of trypsin may cause increased disintegration of the protein. Erepsin following the action of pepsin may cause a cleavage of about 85% of the protein, whilst the successive action of pepsin, trypsin, and erepsin liberates about 90% of the total amino nitrogen of the protein.—W. P. S.

Trypsin; Dialysis of —— and the proteoclastic action of the protein cleavage products. C. Funk. J. Biol. Chem., 1916, **26**, 121—128.

The author has repeated certain experiments described by Herzfeld (this J., 1915, 811) and finds that trypsin, when subjected to dialysis in collodion bags, loses a large part of its amino-nitrogen, corresponding with the passage of the amino-acids into the dialysate. The latter has no hydrolysing action on proteins, whilst the residue has distinct proteoclastic properties. The diminution of amino-nitrogen, when the dialysate is allowed to act on proteins, is possibly due to the adsorption of a certain quantity of the cleavage products by the membrane, or by the protein substrate, and is apparently not due to synthetic action. Glycine, glycylglycine, *l*-leucine, and *l*-alanyl-*d*-alanine do not hydrolyse proteins, as an increase of amino-nitrogen is never found; occasionally, an increase in the total nitrogen is observed, for which an explanation cannot be offered.—W. P. S.

Hydric acid (benzoic and m-cresotic acids); Hygienic influence of ——. K. B. Lehmann. Chem.-Zeit., 1916, **40**, 725.

Hydric acid is composed of a mixture in equal parts of benzoic and *m*-cresotic acids, and is used as a preservative for marmalade, etc. Practical tests in which four persons ate 100 grms. of marmalade containing 0·25 grm. of the preservative daily for 14 days, caused no unpleasant effects. The conclusion is drawn from these results and from theoretical considerations that no injury to health need be feared from the use of marmalade containing 0·2 to 0·25% of hydric acid.—C. A. M.

Kinetics of enzymic hydrolysis of glycylglycine. Dernby. *See* XVIII.

PATENTS.

Artificial milk; Manufacture of —— and the treatment of its residues. W. J. Melhuish, Upper Parkstone, Dorset. Eng. Pat. 13,903, Sept. 30, 1915.

Earth nuts, pine kernels, pine nuts, or palm nuts are ground and the meal is treated with hot water containing added alkali salts and malto-dextrin. The aqueous portion is then strained off, a further quantity of salts, and fatty acids (including butyric acid) are added, the liquid is treated with lactic bacteria, then pasteurised, and cooled. The resulting product resembles ordinary milk in appearance; the quantities of water, nuts, etc., used are such that the final liquid contains about 13% of total solids. The liquid may be concentrated to any desired consistence, or dried to a powder; if a butter "starter" is added, the liquid may be used in the manufacture of margarine. A product resembling cream is obtained by emulsifying the liquid with any desired fat, treating the mixture with milk bacteria, and pasteurising it; the addition of butyric acid may be omitted and the liquid treated with lactic bacteria to obtain a milk having a nutty flavour. The residue of nut meal obtained in the process may be dried, roasted, and mixed with other foodstuffs. (See also Eng. Pat. 24,572 of 1913; this J., 1915, 196.)—W. P. S.

Milk and other liquids; Apparatus for sterilising ——. M. M. Pfeiff, Fullersta, Sweden. Eng. Pat. 100,692, June 14, 1916. (Appl. No. 8428 of 1916.) Under Int. Conv., June 16, 1915.

The apparatus comprises a rectangular tank having double upper walls, the tank, and the space between the double walls, being nearly filled with water which is heated to boiling. An inclined cover fits into the top of the tank at a level below that of the water in the double walls; the milk or other liquid is admitted to the upper end of this cover, flows to the lower end and thence through a channel extending round three sides of the tank and adjacent to the inner part of the double wall. Perforated transverse plates are provided in the cover and in the channel for the purpose of mixing the milk during its passage. The milk is discharged from the channel into suitable receptacles.—W. P. S.

Alfalfa [lucerne] extract. Alfalfa products. M. C. Rich, Bellefourche, S.D., Assignor to The American Alfalfa Products Co., Denver, Colo. U.S. Pats. (a) 1,195,152, (b) 1,192,153, and (c) 1,195,154, Aug. 15, 1916. Dates of appl., (a) and (b) May 15, and (c) May 17, 1915.

(a) Alfalfa, which is naturally free from woody fibre, and from which woolly hairs, secretions, and impurities have been removed, is infused with alcohol, and the infusion filtered and concentrated. (b) To render alfalfa fit for human consumption, it is cut before it has become woody and fibrous, then washed to remove impurities, heated to prevent bleaching, and ground to a flour. (c) Alfalfa, which is naturally free from woody fibre and which has been washed to remove impurities, is mixed with a saccharine material and the mixture heated sufficiently to caramelise it. The mass is then extracted, and the extract mixed with gelatin or concentrated by evaporation. —J. H. J.

Hydrogenated oil food products. A. Lowenstein, Chicago, Ill. U.S. Pat. 1,187,999, June 20, 1916. Date of appl., Aug. 31, 1915.

Cottonseed or other oil is catalytically hydrogenated until non-glyceridic constituents (*e.g.*, those giving Halphen's or Milliau's reactions) are modified or destroyed, the process being stopped before the solidifying point has been raised more than 0·1° to 0·5° C. Oil thus treated will keep much better than ordinary cottonseed oil or other fatty oils, while the dissolved "stearin" crystallises readily.—C. A. M.

Food products; Preparation of ——. M. Franzie. Fr. Pat. 477,949, Feb. 17, 1915.

See Eng. Pat. 2607 of 1915; this J., 1916, 324.

Flour;. Treatment of ——. W. G. Andrews and F. D. Larabee. Fr. Pat. 478,292, Apr. 1, 1915.

See Eng. Pat. 2466 of 1915; this J., 1915, 884.

Pectous alimentary product, and process for extracting it from fruits and legumes. R. Douglas. Fr. Pat. 478,608, May 5, 1915.

See Eng. Pat. 6497 of 1915; this J., 1916, 614.

Alimentary and similar products; Concentrated ——. Techno-Chemical Laboratories, Ltd. Fr. Pat. 479,000, June 11, 1915.

See Eng. Pat. 14,671 of 1914; this J., 1915, 848.

Chocolate or soluble cocoa powder; Manufacture of —— J. Gloor. Fr. Pat. 479,067, June 19, 1915

See Eng. Pat. 7041 of 1915; this J., 1916, 378.

Grinding machine [for oil-coke, etc.]. Eng. Pat. 12,015. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Mineral water; Analysis of —— by volumetric methods. [Determination of magnesium.] E. B. Jensen. Proc. Australasian Inst. Min. Eng., 1916, 75—98.

Two methods are described for the volumetric determination of magnesium in waters. In the first, the magnesium, after removal of calcium, is precipitated as ammonium magnesium arsenate, which is collected, washed with dilute ammonia, then with 50% alcohol, dissolved in a known volume of *N*/10 hydrochloric acid, and the excess of acid titrated with sodium carbonate solution, using methyl orange as indicator. The quantity of magnesium present is calculated from the volume of hydrochloric acid neutralised by the precipitate:

$$MgNH_4AsO_4+2HCl=MgCl_2+NH_4H_2AsO_4.$$

In the second method, the ammonium magnesium arsenate precipitate is digested for two hours with sulphurous acid to reduce the arsenate to arsenite, the solution then boiled to expel sulphur dioxide, cooled, neutralised with sodium hydroxide, using phenolphthalein as indicator, next rendered slightly acid with tartaric acid, treated with an excess of sodium bicarbonate, and titrated with standard iodine solution; 1 c.c. of *N*/10 iodine solution is equivalent to 0·0012 grm. of magnesium. Both methods yield accurate results.—W. P. S.

Lime-sulphur solutions; Determination of thiosulphate sulphur in —— by iodine titration. P. R. Blumenthal and S. D. Averitt. J. Amer. Chem. Soc., 1916, **38**, 1701—1704.

TETRATHIONATE is oxidised to sulphate by excess of iodine in neutral or faintly acid solutions, on standing, but the amount which can be thus oxidised in an ordinary iodine titration does not cause an appreciable error in the determination of thiosulphate. The iodine values obtained by titrating lime-sulphur solutions, after decomposing polysulphides by hydrochloric acid and expelling hydrogen sulphide by boiling, actually represent the thiosulphate content, for the results agree closely with those obtained by oxidising the solutions with bromine, after the titration, and precipitating with barium chloride. If sulphates were present the thiosulphate figures by iodine titration would be higher than those obtained by weighing the barium sulphate, whereas actually the gravimetric results were slightly higher than those obtained volumetrically.—A. S.

Methylheptenone as an insecticide. Perfum. and Essent. Oil Rec., 1916, **7**, 295.

THE efficacy of lemongrass oil as an insecticide has been traced to the presence of methylheptenone in the oil. Lemongrass oil contains only a relatively small proportion of methylheptenone, but the latter can be readily prepared by the action of alkali on citral, and experiments have shown that it is much more effective than anisol as an insecticide.

Use of solutions of borax and boric acid in the colorimetric determination of the concentration of hydrogen ions in sea water. Palitzsch. *See* XXIII.

PATENTS.

Water; Process for the purification of ——. P. W. Oscroft, Sutton-on-Sea. Eng. Pat. 11,922, Aug. 18, 1915.

FERRIC hydroxide is deposited on asbestos wool, and the latter is then lightly packed into a tube, which is fitted to the outlet nozzle of the receptacle containing the water to be treated. The water that comes through the filter is quite free from arsenic. The tube is cleaned out from time to time and refilled with asbestos on which ferric hydroxide has been deposited. The apparatus is suitable for field use.—J. H. J.

Plants; Composition and process for treating ——. C. W. Eastman, Great Falls, Mont. U.S. Pat. 1,194,608, Aug. 15, 1916. Date of appl., Nov. 27, 1915.

THE plant is sprayed with a solution containing an arsenical insecticide, a bichromate, and dextrin. Under the influence of light, the bichromate and the dextrin interact to produce an insoluble compound, which forms a closely adherent coating on the plant, and maintains the arsenical insecticide in close contact therewith.—J. H. J.

Water; Softening of ——. R. Gans, Assignor to J. D. Riedel A.-G., Berlin. U.S. Pat. 1,195,923, Aug. 22, 1916. Date of appl., Aug. 5, 1911. Renewed Mar. 26, 1915.

SEE Eng. Pat. 3870 of 1911; this J., 1912, 356.

Water; Purification, clarification, and sterilisation of ——. H. Neel. Fr. Pat. 479,154, Nov. 7, 1914.

SEE Eng. Pat. 19,722 of 1914; this J., 1915, 1163.

Water; Apparatus for softening, sterilising, and otherwise treating ——. H. J. Magrath. Fr. Pat. 479,455, Aug. 3, 1915.

SEE Eng. Pat. 18,867 of 1911; this J., 1915, 1030.

Sterilisation of liquids. P. H. Dawe. Fr. Pat. 479,657, Apr. 17, 1915.

SEE Eng. Pat. 9567 of 1914; this J., 1915, 631.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Thebaine, and phenyldihydrothebaine; Reduction of ——. M. Freund and E. Speyer. Ber., 1916, **49**, 1287—1307.

THE investigation of phenyldihydrothebaine, which from its manner of preparation must be regarded as having the same structure as the alkaloid itself, leads to the conclusion that no aliphatic double bonds are present as suggested by Knorr's formula (compare this J., 1907, 943), since it completely resisted reduction by the ordinary methods both in acid and alkaline solution. The absorption of 1 mol. of hydrogen was observed in presence of colloidal palladium, but the product was a secondary base, $(C_{24}H_{25}O_3)NH.CH_3$, and had been formed by the rupture of the nitrogen ring, and not by addition at a carbon double linking. Further, the formation of dihalogenphenyldihydrothebaine occurs not smoothly, but with obvious structural changes, and offers therefore additional evidence of the absence of ethylenic linkages. On the other hand the reduction of thebaine with hydrogen in presence of metals of the platinum group led to the isolation of two hydrogenised bases of the formulæ, $C_{19}H_{23}NO_3$ or $C_{19}H_{25}NO_3$ and $C_{18}H_{23}NO_3$. Both are tertiary bases; the former still contains two methoxyl groups, whilst the latter has only one and possesses also a ketonic character. The relation of these substances to thebaine and the bearing of the whole work on the structure of that alkaloid are discussed at length. —G. F. M.

N-Demethylocodeine. O. Diels and E. Fischer. Ber., 1916, **49**, 1721—1724.

IN addition to the method of preparing N-demethylocodeine previously described (this J., 1914, 765), it can also be made from codeine oxide as follows: 4 grms. of the oxide is treated with a 10% solution of potassium bichromate, and after the initial effervescence has subsided, the mixture is heated on the water-bath until all the formaldehyde produced has disappeared. It is then cooled and sufficient alcohol added to dissolve the brown flocculent precipitate and to separate inorganic compounds. After centrifuging, the liquid is decanted, evaporated on the water-bath, and the residue triturated with hydrochloric acid. The codeine derivative is thus obtained as a crystalline mass, which should be crystallised from 50 % alcohol. The "codeine-oxide-sulphonic acid hydrate" of Freund and Speyer (Ber., 1911, **44,** 2339) is identical with N-demethylocodeine. —E. H. T.

Picrotoxin; The decomposition of —— with methyl alcoholic potassium hydroxide: and picrotoxinic acid. P. Horrmann and H. Wächter. Ber., 1916, **49,** 1551—1567. (See also this J., 1916, 864.)

By treatment in the cold with methyl alcoholic potassium hydroxide, picrotoxin was resolved into the potassium salt of β-picrotinic acid (9·5 %), the mono-methyl ester of picrotoximindicarboxylic acid (16 %), and the methyl esters of picrotoxinic acid and α-picrotinic acid, which on saponification gave picrotoximic acid, $C_{15}H_{18}O_7$ in 41 % yield, α-picrotinic acid, $C_{15}H_{20}O_8$, in 17·5 % yield, and picrotiniclactone $C_{15}H_{18}O_{17}$ (7·8 %). α-Picrotinic acid bears to picrotoxinic acid the relation of a hydroxy acid to the corresponding unsaturated acid, and by the ozone oxidation method an attempt was made to determine the position of the double bond in the latter substance. The results indicate the presence of an end methylene group in picrotoxinic acid, and that the oxidation to picrotoxinonic acid follows the scheme:

$$CH_2 : C(C_{12}H_{15}O_5).CO_2H \rightarrow H.COOH + CO(C_{12}H_{15}O_5).CO_2H.$$

—G. F. M.

Saponin from the epicarp of Sapindus mukurosi. Y. Asahina and T. Shimidzu. Yakugakuzasshi, 1916, No. 410. J. Pharm. Chim., 1916, **14,** 188—190.

The saponin of *Sapindus mukurosi* appears to be present in the form of a sodium or potassium salt, from which it is liberated by the action of acid. It was isolated as a white amorphous powder, which gives a yellowish-pink colour, changing to reddish-violet, with sulphuric acid. A solution in acetic anhydride yields a reddish-violet colour with a few drops of sulphuric acid. The saponin is insoluble in chloroform, ether, acetone, and light petroleum spirit, but soluble in ethyl and methyl alcohol. It is almost insoluble in water. If a little sodium bicarbonate solution is added to a suspension of the saponin in water, the saponin dissolves, forming a solution which lathers abundantly, and possesses to a marked degree the property of hæmolysis. An aqueous solution of the saponin does not reduce Fehling's solution, but does so if previously boiled with dilute acids. It is dextro-rotatory ($[\alpha]^{20}_{D} = +13·28°$ in alcohol). It contains 63·02 to 63·45 % of carbon and 8·21 to 8·49 % of hydrogen, and determinations of its molecular weight gave values of 772, 811, and 820. Hydrolysis with 3 % sulphuric acid, or better with alcoholic hydrochloric acid, produces *d*-arabinose and a sapogenin. The latter substance, having the formula $C_{31}H_{\,8}O_5$, crystallises from alcohol in small, tabular, colourless and tasteless crystals, of m.pt. 319° C. It is insoluble in water, ether, chloroform, light petroleum spirit, or acetone, slightly soluble in ethyl or methyl alcohol, and very soluble in alcoholic potash. It gives the same colour reactions as the saponin. The authors suggest that the relation between saponin, sapogenin, and arabinose is given by the equation:

$$C_{41}H_{64}O_{13} + 2H_2O = C_{31}H_{48}O_5 + 2(C_5H_{10}O_5).$$

—F. Sp.

Betel vine leaves: Chemistry, physiology, and commercial bleaching of ——. H. H. Mann and V. G. Patwardhan. Mem. Dep. Agric. India, 1916, **4,** 281—322. (See also this J., 1907, 1293; 1913, 922.)

Commercial betel-vine leaves from *Piper Betle,* intended for chewing, are usually mature or over-mature leaves which have not become brittle. In growing leaves which are not yet mature, the starch, non-reducing sugars, and nitrates increase in amount during the day, whilst the reducing sugars, which form two-thirds of the total sugars, and the tannin and essential oil remain fairly constant throughout the day. In over-mature leaves the proportion of reducing sugars is very much smaller, whilst the non-reducing sugars are fairly constant and are present in by far the larger amount. A leaf for chewing should contain little starch and reducing sugars but a high proportion of sucrose. The most important factor in determining the value of the leaf is the amount and particularly the nature, of the essential oil present. The amount of essential oil increases very largely as the leaf becomes more suitable for use and declines when the leaf is over-mature. The essential oil of betel leaf (*pan* oil) consists essentially of phenols and terpene-like substances, the relative proportions of which vary in different varieties of leaves, the proportion of phenols being higher the more esteemed the quality of the leaf. The proportion of phenols in the oil from light green unbleached leaves varies from 12 % (Poona green leaves) to 70 % (Ramtek *kapuri* leaves) and in dark-green leaves from 39 % to 45 %. Bleaching of betel-vine leaves increases the total amount of essential oil and also the proportion of phenols contained in the oil. The phenols consist chiefly of eugenol, mixed with a small amount of betel-phenol (chavibetol, 1-allyl-3-methoxy-4-hydroxybenzene), but no chavicol is present. An investigation into the method of bleaching betel leaves showed that (1) the bleaching must be carried out in absence of light, (2) the atmosphere in contact with the leaves must be sufficiently saturated with moisture to prevent the slightest drying of the leaves but must not contain more moisture than this, otherwise rotting ensues, (3) bleaching can be effected more rapidly and uniformly, with less loss, by rotting at 29° C. to 33° C. whilst temperatures above 35° C. are injurious and below 24° C. are useless. If bleaching is carried out beyond the stage when the leaves are yellowish-white the amount of essential oil and the quality of the leaves rapidly decline.—T. C.

Hydrogenation of heterocyclic compounds. Catalytic hydrogenation. XII. A. Skita and W. Brunner. Ber., 1916, **49,** 1597—1605.

Pyridine was readily reduced to piperidine in dilute hydrochloric acid solution by hydrogen in presence of colloidal platinum. Traces of pentane were produced at the same time. The hydrogenation of α-picoline, αγ-lutidine, and 2.4.5-collidine proceeded with greater difficulty, but good results were obtained in acetic acid solution at 25°—45° C. under an excess pressure of 3 atm. αγ-Phenylquinolinecarboxylic acid was reduced to tetrahydrophenylquinolinecarboxylic acid when treated in dilute glacial acetic acid solution at 50°—60° C. with hydrogen under an excess pressure of 1 atm., in presence of the platinum catalyst, whilst the decahydro-compound was obtained by working under a pressure of 3 atm., and using a larger quantity of catalyst. The tetrahydro-compound is crystalline and melts at 218° C., whilst the decahydro-derivative is amorphous, melting at 330° C. (with decomp.). The hydrogenation of the cinchona alkaloids, although presenting greater difficulty, was also effected. Thus quinine, or dihydroquinine, absorbed 3 or 6 mols. of hydrogen according to the duration of treatment, being converted into hexahydrocinchonidine, m.pt. 206° C., and dodecahydrocinchonidine, m.pt. 104° C. The same hexahydrocinchonidine was also obtained by catalytic reduction of dihydrocinchonidine. Similarly by the hydrogenation of quinidine and cinchonine a hexahydrocinchonine of the formula $C_{19}H_{25}N_2O$, m.pt. 241° C., was obtained.—G. F. M.

Cholesterol into coprosterol : Conversion of ——. A. Windaus. Ber., 1916. **49**, 1724—1734. (See this J., 1915, 198.)

By the reduction of cholesterol with hydrogen in presence of nickel, a new product, γ-cholestanol, was obtained, which has the same melting point and rotatory power as β-cholestanol but differs from it in crystallising from dilute alcohol without water of crystallisation. It was proved to be an addition compound of several hydrogenised cholesterols, and from it pseudo-coprosterol and ε-cholestanol were obtained. The separation of these compounds proved extremely difficult, but was eventually effected by boiling with sodium amylate and amyl alcohol, precipitating with digitonin, and repeating the operation. In this way a filtrate was obtained containing practically pure pseudo-coprosterol. As the last named can be easily converted into coprosterol, the synthesis of the latter from cholesterol, which has hitherto only been effected by intestinal bacteria, is now possible by chemical means.—E. H. T.

1.3-*Diamines ; Synthesis of* —— *by reduction of* 2-*mercapto*-6-*oxypyrimidines.* T. B. Johnson and A. W. Joyce. J. Amer. Chem. Soc., 1916, **38**, 1851—1860.

The reduction of 6-oxypyrimidine-2-mercaptan derivatives by sodium and alcohol has been found to furnish a practical method for the synthesis of the corresponding 1.3-diamines, and the authors describe the preparation in this way of trimethylenediamine from 6-oxypyrimidine-2-methylmercaptan and from 5-ethoxy-6-oxypyrimidine-2-ethylmercaptan, of diaminobutane from 4-methyl-6-oxypyrimidine-2-ethylmercaptan and from 2-thio-4-methyl-6-oxypyrimidine, of 1.3-diaminoisobutane from 5-methyl-6-oxypyrimidine-2-ethylmercaptan, of 1-amino-3-methylaminopropane from 1-methyl-6-oxypyrimidine-2-ethylmercaptan, and of 1-methylamino-3-aminobutane from 1.4-dimethyl-6-oxypyrimidine-2-ethylmercaptan. The oxypyrimidine derivatives are easily synthesised, and it is possible to prepare from them mono-alkylated diamines difficult to obtain by any other method.—A. S.

Acetylsalicylic acid ; Physical and chemical tests for ——. D. E. Tsakalotos. J. Pharm. Chim., 1916, **14**, 174—177.

Acetylsalicylic acid when heated just to its melting point on an object glass, and allowed to solidify, crystallises in concentric rings. If heated to a somewhat higher temperature solidification is slow and a vitreous mass is formed. When acetylsalicylic acid is maintained in a fused condition acetic acid is evolved and salicylosalicylic acid is formed. For this reason an accurate determination of its melting point is impossible since this depends on the rate of heating. A solution of pure acetylsalicylic acid prepared rapidly by dissolving in alcohol and adding water, gives at first no reaction with dilute ferric chloride. If the solution stands for some time before being tested, a violet coloration is produced. If the acid is heated just to its melting point and then dissolved, it gives an immediate intense violet coloration with ferric chloride. If it is heated above its melting point and then dissolved in alcohol, water precipitates salicylosalicylic acid and ferric chloride gives a pale violet colour. Self's vanadium reagent for salicylic acid (this J., 1915, 511) is more simply prepared by dissolving a little ammonium vanadate in concentrated sulphuric acid, and adding water until the intensity of the orange colour begins to diminish ; the formaldehyde may be omitted. Solid acetylsalicylic acid with this reagent gives no result at first, but after a few instants a yellowish-green colour develops, changing to an intense green. If the acid is previously heated to its melting point, it gives an intense green colour at once, while if previously heated above its melting point, a deep green colour changing instantly to brown is observed.—F. Sp.

Arseno-compounds ; Aromatic ——. *XI. Mixed arseno-compounds.* P. Karrer. Ber., 1916, **49**, 1648—1650.

Unsymmetrical arseno-compounds are obtained by the interaction in solution of two symmetrical compounds according to the equation :—

$$R.As:AsR + R'As + AsR' = 2RAs:AsR'.$$

Thus when 3.4.5.3′.4′.5′-hexa-aminoarsenobenzene hydrochloride and 3.3′-diamino-4.4′-dihydroxyarsenobenzene hydrochloride are rapidly heated to 80° C. in aqueous solution, and a large excess of hydrochloric acid (sp.gr. 1·12) added, the mixed arseno-compound of the formula $(OH)(NH_2)C_6H_3{\cdot}As:As{\cdot}C_6H_2(NH_2)_3,3HCl$, is precipitated in bright yellow flakes. The mixed arseno-compound obtained in a similar way from hexa-aminoarsenobenzene and tetra-aminodimethyldiaminoarsenobenzene is also described. —G. F. M.

Arsenobenzene derivatives ; Causes of the injurious effects observed after the injection of ——. J. Danysz. Comptes rend., 1916, **163**, 246—248.

The injurious effects sometimes produced by the injection of products containing the arsenobenzene group (*e.g.* neo- and novo-salvarsan) are due to vaso-dilation and to the formation of a precipitate which clogs the capillaries. The mono- and disodium salts of the arsenobenzene derivatives are particularly liable to give precipitates in the presence of mineral salts, including sodium chloride, but the precipitation may be retarded or prevented by the presence of blood serum, sugar, or glycerol. Prolonged treatment with very dilute solutions is recommended. The di-sodium salts of the products are more active, and at the same time safer, than the neutral products. It is pointed out that the formation of a precipitate, manifested by the appearance of unpleasant symptoms within 6 hours after the injection, is an essential factor in the therapeutical efficiency of the products.—W. P. S.

Hydrolysis of phenyl ethers and esters by means of the hydrochlorides of aromatic bases. Preparation of anilides and their homologues. Klemenc. *See* III.

Behaviour of chromous salts towards acetylene, and the reducing action of salts of divalent chromium. Traube and Passarge. *See* VII.

Action of hydrogen sulphide on dextrose. Schneider. *See* XVII.

Methylheptenone as an insecticide. *See* XIXb.

Petrographic microscope in analysis. Wright. *See* XXIII.

Patents.

Anhydrides of fatty acids ; Process of manufacturing ——. K. Goldschmidt and F. Spitzer, Essen, Germany, Assignors to General Chemical Co., New York. U.S. Pat. 1,195,205, Aug. 22, 1916. Date of appl., Oct. 29, 1909.

See Eng. Pat. 25,433 of 1908 ; this J., 1910, 112.

Anhydrides ; Manufacture of organic acid ——. F. W. Jahn, Assignor to General Chemical Co., New York. U.S. Pat. 1,195,227, Aug. 22, 1916. Date of appl., Mar. 27, 1909.

See Eng. Pat. 5939 of 1910 ; this J., 1910, 1227.

Nicotine ; Process of extracting —— *from green or uncured tobacco.* H. Villiers-Stuart, Lismore, Ireland. U.S. Pat. 1,196,184, Aug. 29, 1916. Date of appl., May 9, 1913.

See Eng. Pat. 20,347 of 1912 ; this J., 1913, 924.

Unsaturated hydrocarbons containing the conjugated bond ; Process for the purification of ——. F. E. Matthews. Blackheath, and E. H. Strange. London. U.S. Pat. 1,196,259, Aug. 29, 1916. Date of appl.. Mar. 16, 1915.

See Eng. Pat. 6897 of 1914 : this J., 1915, 635.

Unsaturated hydrocarbons ; Process for purifying ——. F. E. Matthews and E. H. Strange. Fr. Pat. 477,983, Mar. 11, 1915.

See Eng. Pat. 6897 of 1914 ; this J., 1915, 635.

Menthyl methylsalicylate ; Manufacture of ——. New York Salesthyl Corporation. Fr. Pat. 478,102, Mar. 20, 1915.

See U.S. Pat. 1,133,832 of 1915 ; this J., 1915, 575.

Benziminazoles containing the ethylamino group, and their preparation. D. Maron. Fr. Pat. 478,299, Apr. 6, 1915.

See Eng. Pat. 1752 of 1915 ; this J., 1916, 197.

4-*N-Alkylnitrosaminoaryl*-1-*arsenic acids ; Preparation of* ——. Les Etabl. Poulenc frères, and K. J. Oechslin. Fr. Pat. 479,616. Dec. 28, 1914.

See Eng. Pat. 22,522 of 1914 ; this J., 1916, 557.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Collodion silver bromide emulsions. Lüppo-Cramer. Koll.-Zeits., 1916, **18**, 18—20. Chem.-Zeit., 1916, **40**, Rep., 301.

Unlike gelatin emulsions in which an increase in size of grain is accompanied by an increase in sensitiveness, collodion emulsions lose sensitiveness with increase of size of grain if digested for some hours with an excess of ammonium bromide. It is advisable therefore to work with as small an excess of bromide as possible and to wash the emulsions soon after preparation.—B. V. S.

Antimony toning of developed pictures. L. Strasser. Phot. Rundsch., 1916, **53**, 33—35. Chem.-Zeit., 1916, **40**, Rep., 304.

By treatment of a bleached silver print with a 0·5% solution of Schlippe's salt (sodium thioantimonate) a stable red-brown tone is obtained with no alteration of gradation. Simultaneous or subsequent sulphide toning gives a colder brown tone.—B. V. S.

Petrographic microscope in analysis. Wright. *See* XXIII.

Patents.

Photographic transfer processes. F. W. Kent, Clapham, and T. P. Middleton, Farnham. Eng. Pat. 12,091, Aug. 21, 1915.

The process described in Eng. Pat. 29,616 of 1912 (this J., 1914, 221) is extended and modified. Paper to be used as base for a transfer process is saturated with paraffin wax and the surface buffed with a rotary brush while the wax is still soft. One side of the paper is coated with a substratum solution of pyroxylin and then with a sensitised gelatin emulsion. By dissolving the pyroxylin in a mixture of alcohol and ethyl acetate or similar solvent containing a little water, a porous friable film is obtained which is sufficiently adherent to retain the emulsion on the waxed paper, but allows easy stripping. A description is given of an apparatus for waxing, buffing, substratum-coating, and emulsion-coating in a continuous operation. The surface to which the print is to be transferred is preferably prepared with a solution of gelatin, fish-glue, or similar water-soluble cement, instead of with a solution of resin or rubber or similar substance as explained in the first patent.—B.V.S.

Colour photography. A. N. Pierman, Newark, N.J. U.S. Pat. 1,196,718, Aug. 29, 1916. Date of appl.. Apr. 8, 1908.

A multicolour screen is composed of flexible coloured strands woven together in a regular pattern and embedded in a thin flexible transparent or translucent ribbon by soaking the screen in a suitable solution, *e.g.*, a collodion solution, and drying off. The composite film is coated with sensitive emulsion.—B. V. S.

Röntgen photography ; Sensitive plate for —— *and process of making the same.* H. Arnold, Charlottenburg, and M. Levy-Dorn, Berlin, Germany. U.S. Pat. 1,195,132, Aug. 22, 1916. Date of appl., Mar. 1, 1915.

See Eng. Pat. 2243 of 1915 ; this J., 1916, 386.

Photographs in colour and method of making the same. J. G. Capstaff, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,196,080, Aug. 29, 1916. Date of appl.. Sept. 21, 1914.

See Eng. Pat. 13,430 of 1915 ; this J., 1916, 907.

Coloured images ; Process for obtaining ——. Kinemacolor Co. of America. Fr. Pat. 478,011, Mar. 13, 1915.

See Eng. Pat. 3666 of 1915 ; this J., 1916, 73.

Screens for colour photography and photography in general. J. Rheinberg. Fr. Pat. 478,117, Mar. 22, 1915.

See Eng. Pat. 9929 of 1914 ; this J., 1915, 637.

Photography in colours. J. E. Thornton. Fr. Pat. 478,928, June 5, 1915.

See Eng. Pat. 13,711 of 1914 ; this J., 1915, 818.

Photographic images in colours ; Production of ——. P. D. Brewster. Fr. Pat. 479,160, Jan. 21, 1915.

See Eng. Pat. 1073 of 1915 ; this J., 1916, 329.

Photographic developer. T. J. Brewster. Fr. Pat. 479,665, Sept. 4, 1915.

See Eng. Pat. 9331 of 1915 ; this J., 1916, 907.

XXIII.—ANALYSIS.

Petrographic microscope in analysis. F. E. Wright. J. Amer. Chem. Soc., 1916, **38**, 1647—1658.

It is possible with the aid of the petrographic microscope to measure readily, and with sufficient accuracy, the optical constants of crystal grains measuring only 0·01 mm. in diameter, and the author discusses briefly the application of the instrument to chemical problems. It is possible, for example, to identify any one of the pentose- and hexose-osazones by means of their optical constants, even though only a few milligrams of substance is available. In the identification of alkaloids, also, where chemical methods are unsatisfactory or difficult to apply, the petrographic microscope should prove of value. Other applications mentioned include the examination of baking and cleaning powders, abrasives, paints, fertilisers, cements, drugs, sugars, salt, and photographic developers.—A. S.

Hydrogen ions ; Use of solutions of borax and boric acid in the colorimetric determination of the concentration of —— *in sea water.* S. Palitzsch. Comptes rend. Trav. Lab. Carlsberg, 1916, **11**, 199—211.

Solutions of known concentration of hydrogen ions, to serve as standards in colorimetry, may be conveniently prepared from suitable proportions of boric acid and borax, both of which can be easily obtained sufficiently pure and stored for long periods, in the crystalline form, without change. The author has studied in particular the preparation of solutions having p_H between 7 and 9, for use in testing the reaction of sea water during an Arctic expedition. The values of p_H for mixtures of an M/20 solution of borax and an M/5 solution of boric acid, in various proportions, are given, and also the "salt error" for quantities of sodium chloride up to 3·5 % when phenolphthalein, naphtholphthalein (see this J., 1910, 1178), or neutral red is employed.—J. H. L.

Metals of the copper-tin group; Electroanalytical method for determination and separation of ——. E. P. Schoch, D. J. Brown, and T. E. Phipps. J. Amer. Chem. Soc., 1916, 38, 1660—1681.

ANTIMONY, bismuth, copper, lead, tin, and cadmium may be deposited quantitatively from hydrochloric acid electrolytes, if a suitable reducing agent, *e.g.*, hydroxylamine hydrochloride, is present in the solution and oxides of nitrogen or nitric acid are absent, and the same electrolytes may be used to separate the metals mentioned from each other and from other metals of the copper-tin group by the graded potential method. The authors use the Sand-Fischer apparatus and electrodes (Sand, this J., 1907, 490; 1908, 963; Fischer, *Elektroanal. Schnellmethoden*), with a special clamp which allows either of the electrodes to be removed and replaced quickly without disturbing the other, and renders the apparatus more rigid, so that it is possible to rotate the stirrer at a speed of 800 revolutions per minute without loss of electrolyte by splashing. The electrolyte (150—200 c.c.) should be of such concentration as to give a deposit of at least 0·1 grm. of any constituent and a total for any single deposit not exceeding 0·67 grm., and 2 grms. of hydroxylamine hydrochloride is added to remove oxides of nitrogen and free chlorine. If arsenic is present, 3 grms. of hydroxylamine hydrochloride is added, and the arsenic is removed by distillation in a current of hydrogen chloride. Bismuth, copper, and antimony are deposited together with the minimum electromotive force, then tin and lead together, and subsequently cadmium. Detailed descriptions are given of the determination of tin; determination of copper; separation of copper from tin; determination of bismuth; determination of antimony; separation of antimony or bismuth from tin; determination of lead; simultaneous deposition of lead and tin, and their separation; separation of tin from cadmium; separation of copper from antimony; simultaneous deposition of copper and antimony in presence of lead; simultaneous deposition of copper, bismuth, and antimony in presence of tin or of tin and lead; separation of bismuth from antimony; simultaneous deposition of copper and bismuth in presence of antimony; separation of bismuth and copper by precipitation of the bismuth as phosphate.—A. S.

Silver; Electroanalysis of —— with solutions of silver chloride in ammonia. E. P. Schoch and F. M. Crawford. J. Amer. Chem. Soc., 1916, 38, 1682—1683.

ABOUT 150 c.c. of solution containing from 0·16 to 0·59 grm. of silver in the form of chloride dissolved in excess of ammonia and 20 grms. of ammonium chloride is electrolysed in the apparatus described in the preceding abstract. An initial current of 0·35 ampère is used, corresponding to a potential difference of 1·1 volts between the electrodes, and the voltage is kept constant until the current drops to zero, and then allowed to rise gradually to 1·3—1·4 volts, and electrolysis continued for 25—30 mins. About 99·6% of the total silver is thus deposited; 3 grms. of crystallised oxalic acid is then added, the solution is made slightly acid to litmus by means of concentrated hydrochloric acid, and electrolysis continued for 20 mins. to deposit the last traces of silver.—A. S.

Rapid method for determination of sulphur in coal gas. Mylius and Hüttner. *See* IIA.

Volumetric determination of hydrogen by oxidation with activated chlorate solution. Removal of carbon monoxide by means of mercuric chromate. Hofmann. *See* IIA.

Retardation by carbon monoxide of the oxidation of hydrogen in the chlorate pipette, a contribution to the knowledge of contact poisons. Hofmann and Schibsted. *See* IIA.

Sodium pyrogallate as a reagent for the determination of oxygen. Shipley. *See* IIA.

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Oxidation of manganous to manganic salts by nitrous acid. Prandtl. *See* VII.

Behaviour of chromous salts towards acetylene, and the reducing action of salts of divalent chromium. Traube and Passarge. *See* VII.

Use of diphenylglyoxime as indicator in volumetric determination of nickel in iron and steel by Frevert's method. Kelly and Conant. *See* X.

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Benzoyldihydromethylketol-hydrazine, a new reagent for galactose. Von Braun. *See* XVII.

Comparison of the bacterial count with the sediment or dirt test of milk. Campbell. *See* XIXA.

Origin of the humin nitrogen formed by the acid hydrolysis of proteins. Hydrolysis in the presence of carbohydrates and of aldehydes. Gortner. *See* XIXA.

Analysis of mineral waters by volumetric methods. [Determination of magnesium.] Jensen. *See* XIXB.

Determination of thiosulphate sulphur in lime-sulphur solutions by iodine titration. Blumenthal and Averitt. *See* XIXB.

Physical and chemical tests for acetylsalicylic acid. Tsakalotos. *See* XX.

PATENTS.

Detecting and indicating the presence and proportion of a gas mixed with air or other gases; Apparatus for ——. H. R. Webster. Fr. Pat. 478,367, Apr. 13, 1915.

SEE Eng. Pat. 9196 of 1914; this J., 1915, 639.

Apparatus for and method of measuring the plasticity of rubber and rubber mixings. Eng. Pat. 15,438. *See* XIV.

Book Received.

GAS CHEMISTS' SUMMARY, 1915. By A. V. HENDRICKSON. Published by Walter King, 11, Bolt Court, Fleet Street, E.C. 216 pages. Price 3s. 6d.

THE appearance of this useful annual will be welcomed by all those interested in the chemistry of gaseous fuels. It is divided into chapters as follows.—I. Carbonisation. II. Condensation, washing, purification, naphthalene and cyanogen extraction. III. Tar and ammonia. IV. Oil and carburetted water-gas. V. Photometry and calorimetry. VI. Gaseous heating and ventilation. VII. Gas analysis. VIII. Tests. IX. Miscellaneous. A bibliography and subject and name indexes conclude the volume.

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Official Notice.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY.

The first volume of the Reports of the Progress of Applied Chemistry is now in active preparation, and will, it is hoped, be published in December. It will cover recent progress to the end of June, 1916. The second volume will deal with the period up to the end of 1917, and subsequently it is proposed to issue the Reports annually.

The Reports will present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. It has not been found practicable to treat every section of the Journal classification. Agricultural chemistry, the chemistry of foods, and analysis are fully dealt with in the admirable series of Reports issued annually by the Chemical Society, and for the present there will be no sections on general plant and explosives.

The following is a list of the subjects which will be dealt with, together with the names of the experts who are contributing to this volume:—

Fuel—J. W. Cobb, B.Sc.
Gas, destructive distillation, tar products—E. V. Evans, F.I.C.
Mineral oils—A. W. Eastlake.
Dyestuffs—G. T. Morgan, D.Sc., F.R.S.
Fibres, paper, dyeing, printing—Julius Huebner, F.I.C.
Acids, alkalis, salts, etc.—H. A. Auden, Ph.D.
Glass, ceramics, cement, etc.—J. A. Audley, B.Sc.
Metals, metallurgy—W. R. E. Hodgkinson, Ph.D., F.I.C.
Electro-chemistry—J. T. Barker, Ph.D.
Fats, oils, waxes—G. H. Warburton.
Paints, pigments, varnishes, resins—R. S. Morrell, M.A., Ph.D.
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Fine chemicals, medicinal substances, essential oils—F. L. Pyman, D.Sc., Ph.D.
Photographic materials and processes—B. V. Storr, M.Sc.

The price of issue will be, to members, 2s. 6d. (plus 6d. postage), and non-members, 5s. (plus 6d. postage). As the issue is to be a limited one, those desirous of securing copies are requested to fill in the order form attached to the cover of the Journal, and return it to the Secretary at an early date.

Editorial.

RUBBER—NATURAL AND SYNTHETIC.

The papers communicated by Messrs. Luff and Porritt to the Edinburgh Section of this Society, and printed in the last issue of the Journal, present in a comprehensive form some of the difficulties against which the rubber chemist has to contend. The efforts that have been made during recent years to produce rubber by synthesis have been of the most absorbing interest to chemists. The problem is one which presents greater difficulties than are usually experienced in synthetic chemistry, since in the first place the exact constitution of the caoutchouc molecule has not yet been determined, owing to its colloidal nature, and secondly the commercial value of rubber depends almost entirely on its physical characteristics and only to a very minor degree on its chemical properties. As early as 1879 Bouchardat succeeded in producing a substance similar to caoutchouc in composition and properties, by the action of hydrochloric acid on isoprene; since that time a large number of methods have been devised for converting isoprene, as well as its lower and higher homologues, butadiene and dimethylbutadiene, into caoutchouc-like products. Of the products thus obtained, that from butadiene appears to be the most satisfactory from the point of view of physical properties though of course it is not chemically identical with natural caoutchouc. Again, the polymerising agent used has a considerable effect on the properties of the resulting product; many substances have been suggested for this purpose, particularly sodium and acetic acid, sodium appearing to give the most satisfactory results.

But the chief difficulty which has to be surmounted is the production of isoprene at a sufficiently low price to enable the synthetic rubber to compete with natural rubber. It is computed that plantation rubber can be produced profitably at from 1s. to 1s. 3d. per lb., so that it is essential to find a cheap and abundant source of isoprene or its homologues. The earlier experiments were made with turpentine, but yields were low and supplies became somewhat limited. Coal tar would appear to be out of the question (this J., 1916, 985), and whilst petroleum provides the necessary hydrocarbons, the increasing use of the lighter products as motor fuels may prevent their extended adoption in other directions. Starch and cellulose would thus seem to be the most promising raw materials for the purpose, and methods of preparing isoprene from these sources have been worked out (*loc. cit.*).

Even when these problems have reached a satisfactory conclusion, it will remain to produce a product which the rubber manufacturer can substitute for natural rubber. It will probably be necessary to incorporate with the synthetic product the necessary amount of resins and possibly the nitrogenous constituents before a satisfactory product is obtained (this J., 1916, 987); even then, however, it is not certain that the product will possess the "nerve" which is so important a property of natural rubber.

Whilst these efforts to produce an artificial rubber have been in progress, it is satisfactory to note that those engaged in the production of natural rubber have not been standing idly by and watching events. One of the greatest difficulties with which the rubber manufacturer has to contend is lack of uniformity in the raw material. This lack of uniformity results in variation of vulcanising properties, which in turn leads to variations in strength of the finished product, since it would be impracticable to alter the conditions of treatment to suit each individual batch. A considerable amount of research work has been and is being carried out with a view to the production of a uniform product, and it is to be hoped that improved methods of collection and coagulation may be devised that will bring about the desired result. The planters, too, have availed themselves of scientific methods in selection and cultivation of the trees, and have increased their production from 28,500 tons in 1912 to 98,000 tons in 1915 (the production of other kinds of rubber has remained stationary at about 50,000 tons per annum). Provided that scientific methods and research are applied vigorously and continuously to this industry, there does not seem to be much immediate danger that it will suffer the fate which has overtaken the natural indigo industry.

Annual Meeting.

THE PROGRESS OF THE BRITISH RARE EARTH INDUSTRY DURING THE WAR.

BY SYDNEY J. JOHNSTONE.

(See this Journal, July 31st, 1916, pp. 811-813.)

Reply to discussion.

Mr. S. J. Johnstone, who was not present when his paper was read, in a written reply states:—"As regards Professor Louis' criticism of my estimate of the cost of producing 90% monazite sand from the Travancore Minerals Co.'s concessions, I have every reason to believe that the figure which I gave, *i.e.*, £1 per ton f.o.b., is very nearly correct. This amount does not include such items as royalty to the Travancore Government, directors' fees, office expenses, agents' commission, etc. I understand that for a number of years, until shortly before the outbreak of war, the sand was regularly produced for the Company, by a contractor, at a price very close to the amount quoted above.

"The other concessions recently granted, in Travancore, are to be operated by a Company called Hopkin and Williams (Travancore), Ltd., whilst Thorium Ltd. will confine its attention to the manufacture of thorium salts and allied products. The latter Company is manufacturing thorium nitrate from monazite sand, but I understand that it is premature to state that this is being obtained from the recently granted concessions in Travancore."

Edinburgh Section.

Meeting held at Edinburgh University on Wednesday, October 4th, 1916.

PROF. JAS. WALKER IN THE CHAIR.

THE ORGANISATION OF BRITISH CHEMICAL MANUFACTURES.

BY SIR CHARLES BEDFORD, D.SC., LL.D., GENERAL SECRETARY, ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

I am not going to attempt to offer more than very general reasons for the necessity for the formation of a special Association to carry out the organisation of chemical industries in this country. For the best evidence to my mind of the necessity of combination for mutual advantage in this industry is the fact that practically all the chief chemical manufacturers in the country, who are after all the best judges of such matters, have hastened to join our Association, and that we have in our council some of the ablest and most progressive representatives of the British chemical industry.

Sir Robert Borden, the Canadian Premier, has described only too truly the British Empire as a mere disorganisation, whose industries are not related, and have no economic coherence. Our German enemies offer, on the other hand, the best examples of highly organised industries. It is held that this organisation is merely an extension and adaptation of their highly elaborated army machinery, but in any case we have only too bitter reason to deplore its efficient and practical success, largely, if not chiefly, at our expense in the industrial field. But the German has a natural bent towards combination and reaps the advantages due to union being strength. In Great Britain initiative has been essentially private and when we were not confronted, as we now are, with a highly developed and most intensely hostile organisation it worked well, as it more or less had the field to itself. That state of affairs can never return, and now we must set to work to learn from the successes of our enemies what to adopt and what to reject in order to safeguard and properly develop our industrial future. No one suggests for a moment slavish imitation, but merely a critical stock-taking and review, for we can no longer hope to fight an efficient organisation by means of disorganisation, and it is admitted that we have failed to keep pace with our competitors in industrial chemistry. In Germany, practically every manufacture and trade has its own organised association and also one or more special trade journals. By these and other means manufacturers in the same line are brought either into personal touch or put into communication with each other. Home and foreign markets are studied and new opportunities carefully exploited. It is found that co-operation is a paramount necessity in certain keenly competitive businesses. The more they specialise in certain lines of production the greater is this necessity. Further, markets are scientifically studied by syndicates controlling production and sales and when the home market is fully supplied then foreign outlets are developed by "dumping" and otherwise, as we all know to our cost. Combinations are held to make for cheap production, and this is often effected not only by the large scale of production but by the development of by-products. By entering such a combination it is possible to be able to afford effective research, and when tariffs and Government assistance are also available for the protection and fostering of industry—whether developing or full grown—the handicap to rivals working unaided and on a small scale is overwhelming in most instances. In addition to such aids, we see transport facilities by sea, river, canal, and railways, given on a far-reaching scale, and in the most effective manner. And in addition there is *trained* diplomatic and consular support of a vigorous kind to back the German trader at every turn. Again we have to note the systematic efforts to teach the science of international trading. You are probably aware of the comparatively recent initiation of two German institutes—one is the Institut für Seeverkehr und Weltwirtschaft. The other is the Weltwirtschaftliche Gesellschaft. Both were started in 1914 with the object of teaching international trading. And there are combinations of trading societies in order that they may learn from each other's trading experience and form leagues of the various interests in order authoritatively to place their views before the Government. Systematic commercial intelligence operations are conducted on a considerable scale. Overseas' branch factories are established for producing the products required by those special markets and of which the enormous South-American electrical combine is perhaps the most striking instance. These are, broadly, the lines along which the Teuton has worked with, it must be admitted, enormous advantage. It is our clear duty to examine how far we may profit by this system and to what extent we should adapt it to our own needs. Comparatively recently Germans have announced a combination of all their leading chemical works, and we know that that amounts to a declaration of industrial war after the war. No effort will be spared and all national aids will be brought to bear more ruthlessly than ever to recover, consolidate, and extend their hold over the world's chemical industries.

But it is not by any means Germany alone that we have to fear in this life-and-death struggle. For, as we know, chief among our rivals is the United States. They are working feverishly to make the most of the present opportunities and of future possibilities. As examples, trade associations are being actively formed; and, regarding the application of science to industry, the American Chemical Society's Central Committee has been appointed by representatives of the universities and industries to study opportunities and to make public recommendations for researches on industrial problems common to specific industries which would be conducted in universities and the results published for the common use of the manufacturers concerned. Or again, where problems are not adapted to university research as being special to a particular industry, special manufacturers' researchers are employed. Manufacturers also are invited to inform universities of problems not of sufficient importance to the industry to study directly, but which the universities may employ as practical objects of research by students. It is evidently realised that the industry alone is able to bring forward its problems and to finance investigations of such by one or more of the universities; and industries must, it is held, be prepared to devote time and money to training researchers for their own investigation work, given the fundamental university training. Manufacturers' associations in the United States have adopted in great measure Professor Duncan's scheme of industrial research scholarships at universities or technical colleges, which 10 years' experience has proved successful. The foregoing is only one indication of activities in other countries which connote a more strenuous international industrial competition directed by scientific organisation and experience in such a way as the world has never before witnessed.

Let us turn from this to see how we in the British chemical industry stand. I am assured on every hand by those who ought to know from long experience and daily contact with the facts that there is probably no such disorganised industry as the chemical. For this there are several reasons assigned, apart from the diversity of manufacture, and also the jealousy and fear of disclosure of secret manufacturing processes. First, there is the small scale of most chemical businesses in this country, which renders it impossible for any small firm to finance or organise research in an effective manner. The small manufacturer cannot risk the initial failures which researchers must expect to encounter, and he cannot afford to wait long for the return in capital. Again, labour and political uncertainties, due to party needs, enforce short views. The Paper Manufacturers' Association of Great Britain and Ireland have recently pointed out to the Advisory Committee on Commercial Intelligence of the Board of Trade that the papermaker wishing to call to his aid scientific investigation on new lines of research must personally bear the whole burden of the high fees of the scientific expert, and gets usually in return only one investigator's skill and knowledge. The remedy proposed was a central institute like the Charlottenburg Materialprügungsamt. Then, again, as the Privy Council Committee point out in their last report, the conversion of businesses into limited liability concerns places control in the hands of salaried managers usually with too narrow an outlook, and who are apt to resist proposals for improvement. They fail to grasp the fact that research is an investment, not a speculation. Again, there are very legitimate doubts as to after-the-war security for expenditure in research with a view to improvements and developments, and this raises the tariff question. Protection alone will not suffice unless associated with combination and organisation, and Government aid, financial and otherwise. The Privy Council Committee consider that essential industries relatively small in size—especially if key, pivotal, or master—require special State protection, and they cite among others as chemical examples, chemical glass and porcelain, fine chemicals, dyes, synthetic drugs, and high explosives. These are considered essential to the national well-being, and consequently demand special State assistance.

Now I may go on to outline shortly the ambit of this new Association's activities. In the first place, perhaps some very short account of the evolution of the Association may not be out of place. The Association of British Chemical Manufacturers arose out of a joint meeting of the Councils of the Chemical Society, the Society of Chemical Industry, and the Society of Dyers and Colourists held on the 4th of November, 1915, to consider the best methods both for promoting co-operation amongst chemical manufacturers themselves, and between them and the teachers in universities, colleges, and technical schools, and for the initiation and prosecution of researches in connection with the chemical industry. A joint committee of nine, comprising the three presidents and other six eminent chemists, was thereafter appointed to consider the points raised, and to report. They recommended that in view of the vital need for organisation among the component parts of the chemical industry, the three societies should invite representatives of the various branches to meet in conference for the purpose of establishing such organisation. They recommended further that an association of British firms engaged in chemical manufacture should be formed. In response to this invitation, representatives of over 100 firms engaged in the chemical industries assembled at a meeting in Burlington House last May and resolved that "It is desirable that British firms engaged in chemical and allied trades should form an association to promote closer co-operation and to place before the Government the views of the chemical trade generally, to further industrial research, and to facilitate closer co-operation between the chemical manufacturers and the various universities and technical schools." The recent report of the Committee of the Privy Council for science and industrial research (1915–16) says, "It is clear, we think, from these examples that we may expect in growing measure to have the help and sympathy of the manufacturers in the work that lies ahead. It is natural that those who have felt the fires of adversity should be the first to welcome the new movement, but there is growing evidence that many of the most enlightened firms engaged in prosperous industries are alive to the need of long views. The engineering trades have always been able to hold their own, yet they had become convinced before the war that association was necessary, especially in the markets of China and Russia, if they were to compete successfully with Germany." They intend to include the prosecution of research among their activities throughout the country, as mentioned in the Privy Council Committee's report.

Now to return to the Chemical Manufacturers' Association, the objects of the Association are stated in the Articles of Association to be (1) to promote co-operation between British subjects engaged as manufacturers in the chemical or closely allied industries; (2) to place before Government and Government officials and others either in the British dominions or elsewhere the views of members of the Association and others upon matters affecting the chemical industries; (3) to develop technical organisation, to promote industrial research, industrial efficiency, and the advancement of applied chemistry; (4) to keep in touch with the progress made in chemical knowledge and practice, and to facilitate the development of new British industries and the extension of existing ones; (5) to improve the methods of education in chemistry and its allied subjects so that the methods shall be better adapted to the practical necessities of the chemical industry, and to encourage the sympathetic association of members of the Association and others engaged in the chemical industry with the various universities and technical colleges, either in the British Dominions or elsewhere, and to arrange conferences between manufacturers and teachers; (6) to found, manage, and control a journal or journals for the purpose of making known and advancing the objects of the Association; (7) to supervise and finance researches undertaken in the interest of the chemical industry, and to raise special funds for this and other purposes by voluntary contribution; (8) to found scholarships or lectureships, and to give prizes or in other ways to subsidise or support by subscriptions, donations, or otherwise, universities, colleges, schools, and institutions for the promotion of objects similar to those of the Association in any part of the British Dominions; (9) to obtain any Royal Charter, Provisional Order, or Act of Parliament, or other authority, either in the British Dominions or elsewhere, for enabling the Association to carry any of its objects into effect, and to institute, promote, support, or oppose legislative or other measures or proceedings affecting the interests of the chemical industry, and generally to consider questions concerning it; (10) to act as arbitrator or to appoint arbitrators to act in the settlement of disputes arising out of transactions in or relating to the chemical industry; (11) to affiliate with any other organised body or bodies in the British Dominions having objects similar to those of the Association; (12) to further the objects herein contained or any of them by acting directly or indirectly through (or by promoting co-operation between, or co-operating with) any other organised body or bodies whatsoever in any part of the British Dominions and by appointing members of the Association and others to represent the Association or any such body or bodies; (13) to promote, found, support, or finance any other company or other organised body in any part of the British Dominions for the furtherance of the objects herein contained or any of them; (14) to purchase, take on lease, hire or otherwise acquire for the purposes of the Association, or as an investment of its funds any real or personal property, and to maintain, improve, and develop and dispose of the same; (15) to borrow money, within the limit fixed from time to time by the members, for the purposes of the Association; and, lastly, to do all other lawful things incidental or conducive to the attainment of the above objects of the Association.

The Association is at present being registered under the Companies' Act as a company limited by guarantee and not having capital divided into shares. The qualification for membership is carrying on business as manufacturers in the chemical or closely allied industries either as corporations or individuals or in co-partnership as a British firm.

Then, as regards definitions in connection with the qualification of members of a British Corporation, a British Corporation is a body which in fact and in spirit fulfils the following conditions:—It must be incorporated by Royal Charter of the Crown of the United Kingdom or by, under, or in pursuance of the laws of some part of the British Dominions. A preponderating majority in number and influence of the governing body must be British individuals. It must be mainly controlled in and from some place within the British Dominions. A preponderance of the share-capital and also of the loan-capital, if any, so far as can be ascertained, must be held and owned by British individuals or corporations.

A British firm is an unincorporated body which in fact and in spirit fulfils the following conditions:—A preponderating majority in number and influence of the partners must be British individuals or corporations. It must be mainly controlled in and from some part of the British Dominions. A preponderance of the share-capital and also of the loan-capital, if any, must be held and owned by British individuals or corporations. A "British individual" is a British subject who is habitually resident within the limits of the British Dominions.

Subscriptions to the Association vary with the amount of capital (if share-capital, the amount paid up or issued as paid up), including loan-capital, if any, declared by the member or his firm as to be used in chemical or closely allied industries. The amount varies from 25 guineas as a minimum up to 250 guineas as a maximum, according to capitalisation.

As regards management, the Association will be managed by a council of not more than 20 members, 16 elected members, and 4 co-opted. The elected members must be members of the Association or a director, manager, or other prominent official of a Corporation, being a member of the Association. The co-opted members must be British subjects, and each must be a member of the governing body or an officer of a corporation or institution connected with the chemical or closely allied industries, or any other fit and proper person being a British subject.

In addition to the council—the principle underlying whose selection will be personal fitness for office, and not merely representation of firms or corporations, however rich and considerable (that is a very important point)—the various branches of the chemical industry have been grouped tentatively into 10 sections. Each will elect members of a representative committee, and matters on which they desire the council to take action would be laid before the council by the Chairman of the committee or possibly by other representative selected by the particular committee. It is quite impracticable in such an industry as the chemical to have representation of each branch of chemical industry on the council, as the effect of this would be to make its dimensions so unwieldy that it would be impossible to transact rapidly and efficiently the Association's business. Ample opportunity will be afforded for representations from any particular branch, however small, in or out of London, to be made direct to the council, either through the committee-chairman or, in special cases, such special representative as may desire to place the case of his own business before the council. It is certain not infrequently to happen that recommendations and requests for action will be put forward by members representing one particular line of business which are perhaps diametrically opposed to the interests of other firms connected with the Association. In such cases there must be negotiations between the representatives of the opposing interests, and the council would then have to support with all its resources and influence, the proposals which are in the interests of the Association as a whole. We must look to a spirit of conciliation and broad-mindedness, of give-and-take, in the settlement of such differences which must always be expected to occur in business relations. As regards the sections or groups of industries, a member may, at any time, elect to be classed as belonging to one or other group, and of course where a number of different chemicals are manufactured by the same firm or individual, there would be membership of such groups as included the articles manufactured. Group committees are to consist of not less than three members, and each elects its own chairman. I may point out that the Privy Council Committee stated in their most recent report that, "it seems unlikely that a single chemical committee with the large number of special sections that would be necessary can usefully be established at the present moment, and we are disposed to think that a series of standing committees dealing with particular branches of chemical trades may be a better method of proceeding." The council of the Association had previously arrived independently at the same conclusion, and it is difficult to see what possible alternative there can be. It is most important that as soon as possible these group committees should get to work and state the problems, in order of urgency, with which the Association is required to deal. This opinion is reinforced by the Privy Council Committee who express the belief that the "shortest means" to convince the manufacturing world in general that scientific research is a paying proposition is to attack the pressing problems of manufacture which arise in course of the ordinary routine—problems which no doubt the manufacturers "ought to solve by means of their own scientific staffs, but which their present staffs are too small to undertake, often because the firms are too small to bear the cost. It was in this way that the universities of the Middle States of America convinced the farmers that science was useful to agriculture."

There are a number of other points which I may very briefly touch upon. The benefit accruing from the discussion together of problems is found to be mutually advantageous in similar and allied branches of the industry. Experience shows that very clearly. Hitherto, fears regarding trade secrets, processes, etc., have prevented this, but the balance on the whole in a give-and-take policy is found to be satisfactory. Mutual co-operation will prevent overlapping of effort, duplication of researches and of plant, and also to ensure effective dealing with general problems of the most varied kind. Problems necessitating research undertaken for chemical industry as a whole, as you have seen, should be dealt with by sectional committees in the first place.

As regards the after-the-war position, problems will arise with regard to the utilisation of munitions' plant, equipment and works, and works' staffs, including chemists, to the best private and national advantage, and it is very easy to see that this can only be worked on a co-operative basis. To assist new industries and to increase enormously the productiveness of essential industries like dyes, fertilisers, nitrates, etc., are also points which will require special attention. Concerted action regarding legislation affecting industry is another most important point. Parliament will help those who know how to help themselves. Then again as regards Patent Law Reform—much of our failure in certain branches of industry has been due to our Patent Laws having helped the foreign, especially German, patentees. Lawyers in and out of the House of Commons have often been the best friends of large German chemical concerns. Everything has been done to help them, to the detriment of home industries, especially chemical, which are usually process patents, as against engineering and mechanical, which are products patents, and ought to be dealt with on different legislative lines.

Of course there is the great educational question which demands close co-operation between universities, technical institutes, and manufacturers. The co-opting of suitable experienced manufacturers on certain university committees appears to be requisite and this in some quarters already obtains to some extent. But usually the details are badly worked out, or badly managed. Pure research must, I fancy we all agree, always be the function of the universities and technical institutes, though of course we all know the difficulty of drawing a line between pure and applied science, which merge into each other at many points.

Individual manufacturers must clearly abandon the idea that other manufacturers are rivals to be fought. All must combine against the German manufacturers, whose chief strength in the past has been due to splendid organisation, largely carried out by a powerful society in close touch with chemical manufacturers on the one hand and State Departments of trade and industry on the other, which have helped in every way to further home and foreign exploitation. I believe the name of this society is the Society for the Promotion of the Interests of the German Chemical Industries.

Effective research needs continuity of time and effort. Hence usually it is only possible for combines to finance it. Trade associations, formed originally to fix prices, regulate production, or deal with labour questions, are now turning to co-operative and scientific inquiry to relieve them from difficulties created by foreign monopolies of manufacture.

I understand that there exists a widespread misunderstanding that this new Association is in the nature chiefly of a combine for mutual protection and development of the interests of the largest chemical manufacturers in the country. I may at once deny this in the most emphatic manner. It is intended to protect and promote the interests of the very smallest manufacturers equally with those of the millionaire businesses. So far from there being the slightest basis for this erroneous belief, it may be pointed out that the council is composed of representatives of small, as well as large businesses, and that the decision to man the council by the best available brains and not by the longest purses, is a sufficient guarantee of the protection and assistance which will be offered to all alike, for isolated they will fall, while united they will stand and flourish. Indeed, the small manufacturer will certainly receive an amount of help from collective investigations, and political and other action, disproportionately great to his contribution to the common funds. In this organisation, while each firm will retain its special entity, combination will allow of all participating in the advantages of such combination. I repeat that this Association mainly exists in order to bring the largest and the smallest firms together to settle how best to secure future progress and obtain the needful help and legislation for the interests of our industry.

When I was appointed recently to the General Secretaryship of the Association, I ventured to send our Chairman some notes which were hurriedly put together, but which on looking over again, I thought might be usefully brought before your notice to-night. It will be understood that these views are purely personal. The first point I noted was the question of sectional treatment of the industry, and the means for bringing the sections into active co-operation at once. I think that is a most pressing need at the present moment. Then again I proposed that we should have a Political Committee, first of all to organise a public propaganda regarding the necessity for Government assistance and concessions, fiscal and otherwise, for chemical industries. I feel exceedingly strongly on this question, personally, as the result of some experience of Government Departments and their often curious ways. As regards the Cabinet Minister, he is not likely to take much interest in any subject unless he realises that there is a strong, well-organised body of public opinion behind the proposals. Then, again, the Political Committee would have to consider questions of possible Patent Law modifications. It will have to deal with the thorny question of tariffs. It will have to affiliate or combine with other manufacturers' organisations to secure further political action, for instance, with the Associations of engineers, iron and steel, textiles, electrical, shipping industries, etc. Then again, Parliamentary action will have to be co-ordinated with regard to giving effect to the above. And, further, such a Committee would have to keep a very watchful eye on commercial treaties; and questions relating to commercial intelligence require very close attention. I think I am correct in saying that this is a subject with which the Society of Chemical Industry has concerned itself very actively of late, and we hope to co-operate with the Society in pressing forward action in the matter. Commercial intelligence, of course, is a very difficult question, and a well devised scheme to secure such is costly beyond the resources of any Association. We must look for State aid to some extent, but there is a limit to what we can demand in the matter of State aid. There are certain special lines concerning which special commercial intelligence is required, which, I think, properly fall within the ambit of a special trade association, and we may have to look forward to financing such special inquiries ourselves. We will have to get as much as we can out of Government generally, but at the same time we must probably face the necessity of ourselves financing special sections of commercial intelligence. Then again, I think we all feel that early action regarding the re-organisation of the Consular services is very urgently required. It was a great pleasure to see Lord Faringdon put this forward as one of the spheres of activity of the new Trade Bank. We will probably have to co-operate in that work, and we must see that as far as possible only trained Britishers are appointed to most posts, and that the service is made possibly a graded service with adequate prospects to attract promising men. That is a matter for negotiation and arrangement, but it is one which, of course, if you are going to maintain a hold on the markets, you will all agree with me is one of paramount importance.

There is also a question which your Society considered so important at its recent meetings that they passed a special resolution concerning it, namely, industrial alcohol. The difficulties and disabilities connected with it are keenly felt by many manufacturers in the chemical industry, and though it will be an exceedingly uphill fight, it is one which I think will, in great measure, be determined by the amount of political pressure we may be able to bring to bear on it. We must look forward to considerable fiscal modifications. There is no reason why this question of industrial alcohol should be treated on the same basis as it would appear to be by at least some heads of Departments, as potable alcohol. I personally hope to see some day industrial alcohol placed on a duty-free basis. Probably we may arrive at that stage by a half-way measure such as a small *ad valorem* tax, but I think it is a perfectly reasonable proposition to expect that industrial alcohol should ultimately win the position of being duty free. Of course, one of the great difficulties with regard to this question is the question of adequate denaturation, but this is merely a matter for further investigation. Then side by side with that there is the matter of cheapening of its production.

I also suggest that we should institute a system of visiting chemical laboratories throughout the United Kingdom which are available for general and special research, and that we should keep a register for our members' use of research chemists with the necessary qualifications, and perhaps have a system of confidential reports from teachers and employers. The question of conjoint researches will have to be dealt with, and we will have to look to some extent for a State subsidy for research, at any rate in the early stages.

I hope we will soon develop Overseas branches of this Association. Again, affiliation with British chemical societies generally, such as your own, is essential. Then we hope to get into close relationship with the Advisory Councils of the Privy Council Committee, of the Board of Trade and other Government Offices. Further, we must try to have a Bureau of industrial chemical information, apart from research, and to consider the best channel for the dissemination of this information to members. There is also the question of developing laboratory and other arrangements for the use of the smaller manufacturers, that is, those unable to support separate laboratories for themselves. Then again (though at this stage it is perhaps a minor and remote issue), we should look forward to having a Bureau of standards, instruments, physical constants, and dealing with properties of materials, purity of reagents, etc., either to be developed by the Association, or possibly by, or in conjunction with, some Government agency.

Others of our main objects certainly would be the co-ordination and direction of investigations to prevent overlapping; also the training of industrial chemists, and the co-ordination of the work of technical colleges throughout the United Kingdom so as to supply not only chemists but also scientifically trained craftsmen. Another very important point is the avoidance of duplication in the supply of raw materials for chemical industries (for example, in fine chemicals, dyes, and other branches) by allocation of manufactures. We shall have to look forward to mutual arrangements for the manufacture of intermediate and other products to prevent this duplication, and one of the earliest steps will be a census of firms and output capacities. In fact, we must work up to a census of British and Colonial chemical resources generally. We must also closely consider the systematic study of markets, overseas and foreign, and the science of international trading. Syndicates will no doubt in time be developed to control production and sales, and when the home markets are fully supplied to direct products abroad; and broadly we shall all have to bend ourselves to improving the quality of manufacture and reducing the cost of production, to the utilisation of waste materials, and we should consider the trade control (where applicable) of a complete line of production, as for instance, coal, blast furnaces, steel works, tubes, etc. Another very important point is our relationship to transport agencies at home and overseas. And lastly, there is the fuel question, with special reference to the chemical industries.

There are also most important questions relating to trade marks and their protection abroad, financial assistance from Government or (when started) from the new Trade Bank for the development of commercial intelligence with special reference to the needs of the chemical industry; trade exhibitions; the much debated question of a Ministry of Commerce—and I hope that we shall avoid in this country the mistake which was made by Lord Curzon in India when he started his Ministry of Commerce and Industry. When any new Department is proposed by a Government, a wave of pleasant hope and anticipation passes over many of the other Departments. They immediately set to work to try to unload much of their most unpopular and troublesome work on the new Department. Thus the new Ministry's energies are deflected from many spheres of essential usefulness by such re-distribution of Departmental work. Well, one looks forward to a new Ministry independent of party changes, and also independent of the other Departments as far as possible.

Other subjects are, for example, the extension of the system of Trade Commissioners under the Board of Trade or a Ministry of Commerce; questions relating to commercial travellers in the

British Dominions with regard to preferential treatment in respect of licence fees; trade catalogues, and, lastly, tariff protection. Most of these have been very shortly touched on in the recent report of the Advisory Committee to the Board of Trade on commercial intelligence after the war. Each of these headings will have to form the subject of careful inquiry by representatives of chemical manufacturers, and efforts must be made to secure adequate co-operation with representatives of other great industries and scientific and teaching institutions of the country for combined action. All this naturally will take time but we must all be deeply impressed with the great urgency of these matters.

Vigorous action must be taken without further delay to formulate our requirements as chemical manufacturers, and to press forward joint action with other industrial associations. Personally, as previously stated, I strongly hold the view that Government will not move actively in these matters until subjected to very strong political pressure, both in Parliament and in the country, and it is hoped that this will be vigorously pushed forward as soon as we decide what we want and what is the minimum action on each point we require.

I leave the question of the Association for a moment to touch on what we are doing in connection with the British Science Guild. The British Science Guild was founded as most of you know in 1905 with the object of bringing home to all classes the necessity for the scientific treatment of affairs of all kinds, and at the present moment we hope to take very vigorous action with regard to pressing forward the relation of science to industry and education. I may mention perhaps that I am a member of a standing committee of three which has just been appointed by the Guild to conduct an active propaganda throughout the country on this point, and to press our views very strongly on the Government, mainly through political and other agencies.

The war surely has taught us the folly of relying on foreign, possibly enemy, manufacturers for goods which ought with proper foresight and organisation to have been produced at home. The advantages which have enabled the foreigner to undersell the British manufacturer are also ours, if people will now insist on obtaining a proper organisation and also the fiscal and other requirements to enable us successfully to compete. Unless we set vigorously to work to equalise and, as far as possible, to better our competitive conditions and to train a large supply of practical and efficient researchers, and unless we agree to set aside purely selfish aims and heartily to co-operate and co-ordinate with those who were and are our competitors for our mutual advantage, as well as with every agency, labour, manufacturing, educational, and Governmental, the future of chemical industries in this country is, indeed, gloomy. Both self-interest and patriotism require us to combine against our common enemy, the German, rather than waste our energies in home competition. Full discussion of plans and the necessity for cautious advance are, of course, necessitated by the situation, but it seems that the first requirement now is action, and again action. Do not let us be too timid as to launching our measures of reform until they are elaborated to a high pitch of perfection. Every new departure is an experiment more or less, and time is pressing. Let us evolve and readjust as working experience indicates, and not wait too long in the hope of producing an, at best, doubtfully perfect scheme which seems to meet the views of everyone. Compromise in such matters can be carried too far, and may lead to adjusting a scheme out of all working proportions. Let us get to work then without further delay, and push on with the enormous programme of improvements and reforms which lies ahead of us.

Meanwhile, until we ascertain clearly what the present needs of each chemical manufacturer are, and the plan most likely to put matters on a proper footing, and again until we come together and discuss, as actual manufacturers are alone best qualified to do, the common needs of the industry, it would be a mere speculative and probably useless exercise on my part at present to attempt to forecast the specific action which may be taken, or the decisions which may be arrived at. What I have tried to do is to outline very roughly the machinery which has been prepared in order to deal with the situation and some of the objects in view.

I have not attempted to deal with one of the most difficult and important points—labour—for one feels there is much educative work ahead for both employers and labourers in this matter. Co-operate we must, and that cordially, but sympathy and confidence are essentials to sound development, and will be the result of faithful work and much patience. The interests of employers and labourers in this matter are really identical, but it will take time and patience to bring this home to both groups, though it must be done unless both are to suffer as never before.

Many other points doubtless occur which I have not had time to touch on, but my object is to arouse interest and enlist practical support for the great effort that lies ahead of us in organising the chemical industries of this country. Personally, I view the situation hopefully. A nation which has performed in a short time, comparatively, the prodigies in the way of raising and training an Army—and such an Army!—of millions, and in effecting what we have as regards munitions, not to speak of the wonderful work of our glorious Navy, has no cause to fear its ability also to wrest industrial victory from the German enemy or other rivals. The dangers are complacence and a lapse into the easy, comfortable, pre-war trot. From now onwards such easy ways must be abandoned, and we must be prepared to work and organise as never before in our past history. In order to do so we only require fully to realise the needs, and to obtain efficient direction and adequate protection and stimulation for our efforts. Then we shall again come to occupy the place in the world of industry which is the due of our national qualities.

Sydney Section.

Meeting held at Sydney on Wednesday, 19th July, 1916.

MR. H. G. SMITH IN THE CHAIR.

A CAUSE OF MUSTINESS IN BREAD.

BY A. M. WRIGHT.

During 1915 the author was engaged by a firm of bakers to examine some flour, which, it was alleged, had been the cause of mustiness in the bread baked from it. For the purposes of the investigation six samples of flour were taken; and of these, two, which liquefied nutrient gelatin in 48 hours at 20° C., were examined bacteriologically by Dr. A. B. Pearson, Pathologist to the Christchurch Hospital Board, who drew fresh samples under strictly aseptic conditions; as a result of his investigations, he reported that in the flours represented by the two samples noted above as doubtful, prolific growths of both *Rhizopus nigricans* and an *Aspergillus*, probably *glaucus*, were present. Subsequently pure cultures of the *Rhizopus nigricans* and of the *Aspergillus* were handed to the author for further investigation and the results recorded in this paper were obtained.

The samples of flour drawn by Dr. Pearson contained 10·6 and 11·1% moisture and were thus quite normal in this respect; further the samples were not caked, and in no way showed evidence of having been at any time in a moist condition. Portions of the flour containing the prolific growths of *Rhizopus nigricans* and *Aspergillus* were made into bread by independent bakers, and all such bread was found to be musty and unpalatable.

Laboratory experiments were carried out as follows:—1. Sound palatable bread was sterilised, and then mixed with an extract from the *Rhizopus nigricans* and the *Aspergillus* cultures, filtered through C. S. and S. hardened paper. 2. Sound palatable bread was sterilised and mixed with a fluid extract of the *Rhizopus nigricans* and of the *Aspergillus* cultures. 3. A check with the sterilised bread was carried out.

All were incubated at 37° C. for 24 hours, and it was then found in the results from (1) that the *Rhizopus nigricans* extract produced a marked mustiness, and slight sourness, in the odour and flavour of the bread; with the *Aspergillus* extract the bread was very sour in odour and flavour. From (2) similar results were obtained, with the addition that growths of *Rhizopus nigricans* and *Aspergillus* appeared in the dishes treated respectively with *Rhizopus* and *Aspergillus*. In (3) neither mustiness nor sourness developed in the bread; it was therefore concluded that *Rhizopus nigricans* is capable of producing mustiness in bread, while *Aspergillus* is merely productive of souring.

Subsequently experiments were carried out in order to determine what enzymes were present in the *Rhizopus* and the *Aspergillus*, which might be responsible for the results noted. An extract of each culture was prepared by mixing the cultures with sand and triturating the mass with water; after filtering the solution through absorbent cotton, the filtrate was used for the demonstration of enzymes. The methods used were mainly those described in some detail by Houghton,* the following enzymes being tested for in each filtrate:—lipase, invertase, diastase, catalase, and proteolytic enzymes. In the case of the *Rhizopus* extract, lipase, catalase, and a proteolytic enzyme were found; in the *Aspergillus* extract, there were found lipase and invertase; in neither extract could diastase be demonstrated. A. Percy Smith† has shown that *Mucor mucedo* is a responsible agent in the production of musty bread, and has noted that putrefaction of the affected bread is also associated with mustiness. In the case under review no putrefaction of the bread was found in the sense at least that it became foul and putrid in odour even after fourteen days; the bread certainly was unpalatable. The *Rhizopus nigricans* extract when mixed with gluten produced after 24 hours at 37° C. an odour similar to musty bread, but no putrid odour could be noted.

From a consideration of the data presented above it appears clear that *Rhizopus nigricans* is a cause of mustiness in bread, and that the proteolytic enzyme present in this organism probably brings about the changes in the bread which are associated with the odour and flavour noted as mustiness.

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* Journal Ind. Eng. Chem., 3, 505.

† Analyst, 10, 181—183.

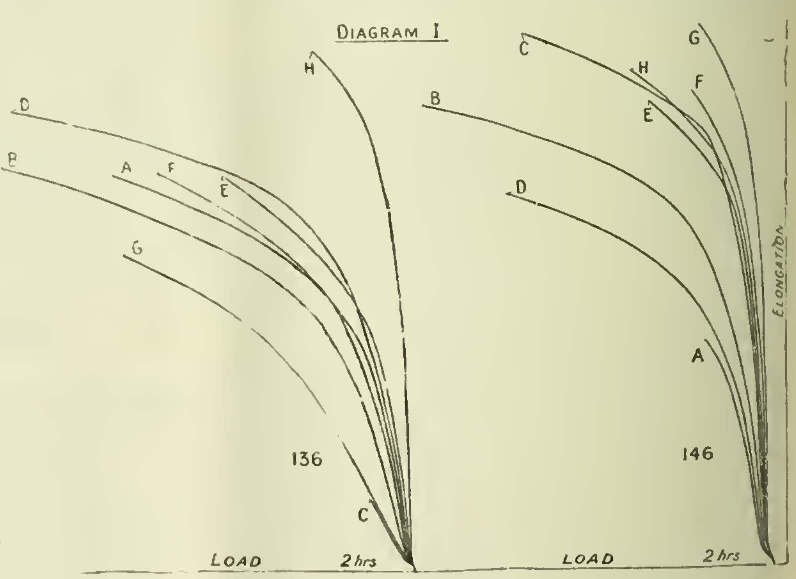
Communication.

VARIABILITY OF PLANTATION PARA RUBBER WITH DIFFERENT TECHNICAL MIXINGS.

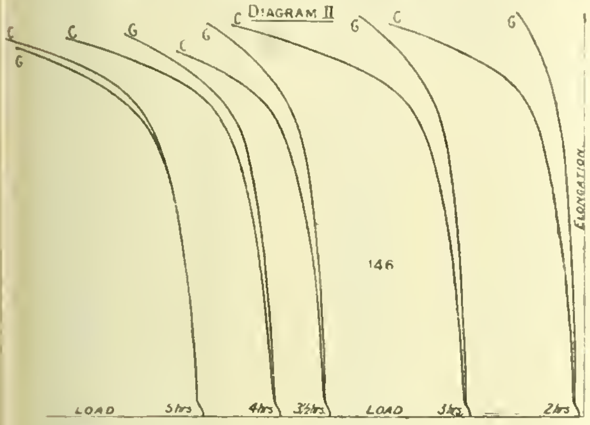
BY B. J. EATON, F.I.C., AND J. GRANTHAM, B.A.

Chemical Laboratory, Agricultural Department, Federated Malay States.

The question of the variability of plantation Para rubber, when vulcanised with various technical mixings in addition to sulphur, has been raised by Stevens in a discussion on a paper recently submitted to this Society by G. Stafford Whitby, entitled "A Comparison of the Brazilian and Plantation Methods of Preparing Rubber" (this J., 1916, 35, 493). Stevens says: "There was too great a tendency to limit tests to what was really a very theoretical mixing, consisting of rubber with perhaps 8% to 10% of sulphur added to it. Such a mixing was very seldom used in manufacturing work, and it was assumed, without experimental proof, that what applied to a theoretical mixing of this description also applied in the same manner and degree to the great variety of technical mixings which were used in a rubber factory." (N.B.—In Whitby's experiments, in which the vulcanisation tests were carried out by Schidrowitz, 100 parts of rubber to 8 parts of sulphur was used; in our researches 90 parts of rubber to 10 parts of sulphur was employed in all the experiments so far published.)



In the experiments described here, we hope to show that what applies to a theoretical mixing (as Stevens describes an 8% or 10% sulphur mixing) also applies to smaller proportions of sulphur in rubber mixings and also to mixings containing, in addition to sulphur, mineral substances such as oxide of zinc and oxide of magnesium, a result which would be expected from the nature of the vulcanisation process. That a "theoretical" mixing of 8% or 10% of sulphur would apply in the same manner or to the same degree to rubber mixings containing mineral ingredients, etc., has not, so far as we are aware, been assumed, nor is it probable that it would do so, although the differences in rate of cure, which Schidrowitz and Goldsbrough and independently our own researches have shown to be marked in the case of plantation Para rubber (due to methods of coagulation and preparation), still exist, whatever mixing be employed, provided such mixings do not contain powerful accelerators such as oxide of lead, which, as would be expected in view of the theory put forward by us as to the cause of variability in rate of cure, would obscure the issue.

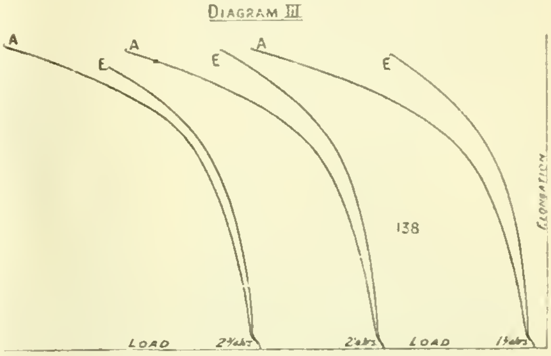


Experimental.

For details of technique, reference should be made to our first Communication. "Vulcanisation Experiments on Plantation Para Rubber.—The Cause of Variability" (this J., 1915, **34**, 989).

The mineral additions were added in a similar manner to the sulphur, and the vulcanisation was carried out as in our previous experiments in a double jacketed steam autoclave at 140° C. (N.B.—The temperature is controlled both by a thermometer and pressure gauge, as it was found that the latter reacted immediately to any change of steam pressure, while the thermometer took an appreciable time to register a slight change of steam pressure; the steam gauge was therefore used as the control after adjusting to correspond with the temperature of 140° C.)

The samples were vulcanised in moulds, as described in the paper to which reference is made. All tests are carried out on the third day after vulcanisation, a point we omitted to mention in a previous communication. The tests were carried out on the Schopper-Dalen rubber testing machine, with ring specimens, using the autographic apparatus to register the load-stretch curves, which illustrate differences in rate of cure more satisfactorily than numerical results.



In each case the same mixing was used on a fast curing and a slow curing rubber, *i.e.*, rubbers which, under the usual conditions employed by us, are fast and slow curing, and which represent the extreme limits of cure met with in the case of rubber coagulated with approximately the minimum quantity of acetic acid, viz., about 3 oz. of a 5% solution per gallon of latex diluted to contain 1½ lb. of dry rubber per gallon. Portions of the same fast and slow curing rubbers were used for all the different mixings. The fast and slow curing rubbers were also derived from the same latex, the differences in rate of cure being due entirely to the method of preparation.

The fast curing rubber was prepared by allowing the coagulum, after lightly pressing, to remain in this form for at least six days before washing and crepeing, and the slow curing rubber by crepeing the coagulum a few hours after coagulation. (*Vide* previous researches by us).*

The following table gives the mixings employed:—

	Actual quantities (grms.).					Percentage on total mix.				
	Rubber.	S.	ZnO.	MgO.	PbO.	Rubber.	S.	ZnO.	MgO.	PbO.
136 A & E	240	12	148			60	3	37		
,, B & F	240	12	140	8		60	3	35	2	
,, C & G	200	16	160		40	48	3·8	38·5		9·6
,, D & H	400	30				93	7			
138 A & E	300	15	180			60·6	3	36·3		
,, B & F	300	15	160	20		60·6	3	32·3	4	
,, C & G	300	15	140		40	60·6	3	28·2		8·1
,, D & H	300	15	160		20	60·6	3	32·3		4·0
146 A & E	450	50				90	10			
,, B & F	400	30				93	7			
,, C & G	500	25				95·2	4·8			
,, D & H	500	50				90·9	9·1			

In the above tables samples A, B, C, and D are the fast curing rubber, and samples E, F, G, and H the slow curing rubber. As will be seen the mixing usually employed in our previous experiments and on which the differences in rates of cure have been based hitherto, is that used in 146 A & E.

The results of the vulcanisation tests are given in the tables below and in the diagrams of the load-stretch curves, which explain themselves.

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* This J., 1916, **30**, 715—728.

It will be seen that some of the figures are somewhat erratic, as would be expected when only two rings at each cure are tested, since rubber loaded with mineral mixings does not break as regularly as mixings containing only sulphur and rubber. The curves however are of much more importance in illustrating the differences in rate of cure between the samples, and show conclusively that the differences obtained in this respect between the rubbers, when using what Stevens terms "theoretical mixings," are still maintained when various technical mixings are employed, although, as would be expected, the type of rubber obtained is very different. The differences in type for different technical mixings and also for different sulphur and rubber mixings are well illustrated by the curves given in Diagram 1 for all the samples 136 and 146 cured for 2 hours, in which it will be observed that the curves for the different mixings are not parallel beyond the point of inflexion.

DIAGRAM IV

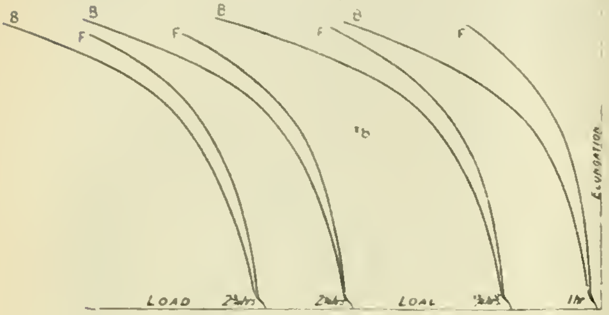
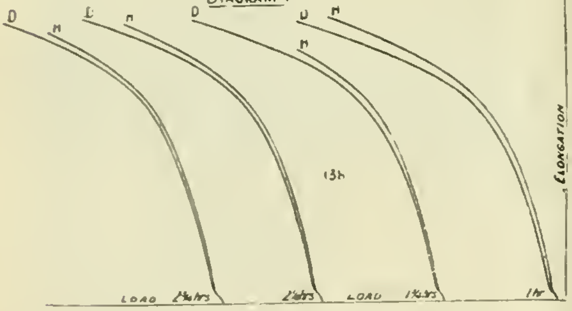


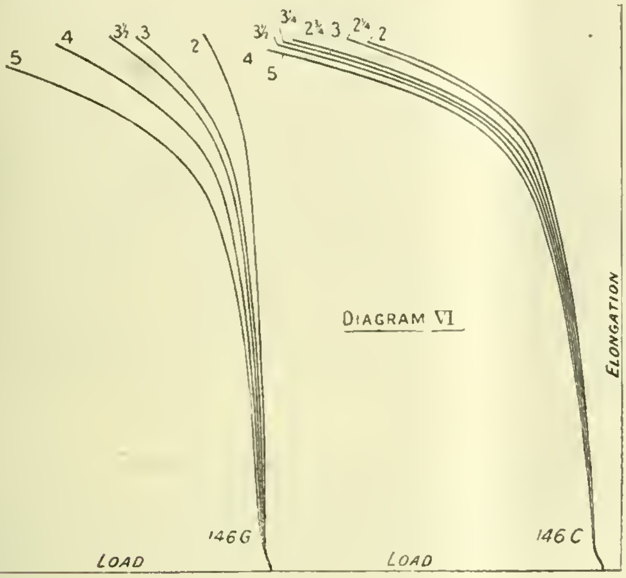
DIAGRAM V



In order to show the effect of the period of vulcanisation on the figures for tensile strength and elongation, the results obtained at all the different times of cure adopted are included in the following table :—

Ref. No.	Time of cure.	Breaking load. (Kilos. per sq. mm.)	Elongation at break. (Original length=100.)	Product.
	Hours.	(a)	(b)	(a × b)
136 A ..	1	1·30	938	1219
	1¼	1·36	916	1245
	1¾	1·27	900	1143
	2	1·33	914	1215
	2¼	1·22	890	1085
136 E ..	1¼	0·61	935	570
	2	0·87	927	806
	3½	1·00	913	913
136 B ..	1¼	1·57	933	1464
	1½	1·61	910	1465
	1¾	1·38	888	1225
	2	1·54	912	1404
136 F ..	1¼	0·81	905	733
	2	1·01	895	903
	2¼	0·90	848	763
136 C ..	1	1·43	759	1085
	1¼	1·31	761	996
	2	0·88	675	594
136 G ..	1	1·22	741	904
	1¼	1·23	759	933
	1¾	1·08	709	765
	2	1·12	731	818
	2¼	0·87	647	562
136 D ..	1	1·04	1024	1064
	1¼	1·22	1070	1305
	1¾	1·41	1053	1484
	2	1·42	1018	1445
	2¼	1·44	1005	1447
136 H ..	2	0·39	1137	443
	3¼	0·90	1079	971
	3¾	0·99	1043	1032
138 A ..	1	1·33	931	1238
	1¾	1·49	930	1385
	2¼	1·44	917	1320
	2¾	1·46	923	1347
138 E ..	1¾	0·79	901	711
	2¼	0·87	910	791
	2¼	0·80	863	690
138 B ..	1	1·35	871	1175
	1¾	1·54	895	1378
	2¼	1·49	892	1329
	2¾	1·39	870	1209
138 F ..	1	0·73	874	638
	1¾	0·95	871	827
	2¼	0·97	873	846
	2¾	1·15	986	1133
138 C ..	1	1·43	818	1169
	1¾	1·25	844	1055
	2¼	1·27	870	1104
	2¼	1·15	878	1009
138 G ..	1	1·45	861	1248
	1¾	1·30	873	1134
	2¼	1·14	858	978
	2¾	1·25	892	1115
138 D ..	1	1·52	863	1311
	1¾	1·36	885	1203
	2¼	1·31	882	1155
	2¾	1·15	875	1006
138 H ..	1	1·27	878	1115
	1¾	1·16	886	1027
	2¼	1·09	874	952
	2¾	0·94	844	793
146 A ..	1	1·18	1052	1241
	1¼	1·41	1007	1419
	1½	1·57	968	1519
	1¾	1·46	920	1343
	2	0·33	588	194
146 E ..	2	0·54	1043	563
	2¾	1·17	1036	1212
	3	1·17	1010	1181
	3¼	1·20	996	1195
	3½	1·23	958	1178
	4	0·26	560	145
146 B ..	1¾	1·44	1081	1556
	2	1·50	1039	1558
	2¼	1·35	1007	1359
	2½	1·31	981	1285
	2¾	1·29	957	1234
146 F...	2	0·37	1070	395
	3	0·84	1093	918
	3¼	0·88	1088	957
	3½	0·93	1065	990
	4	1·13	1034	1168
	5	1·22	956	1166
146 C ..	2	1·05	1168	1226
	2¼	1·02	1151	1177
	2¾	1·28	1161	1486
	3	1·33	1157	1538
	3¼	1·28	1142	1461
	3½	1·33	1194	1588
	4	1·28	1140	1459
	5	1·26	1150	1449
146 G ..	2	0·35	1199	419
	3	0·63	1186	747
	3½	0·70	1164	814
	4	0·88	1144	1006
	5	1·08	1099	1186
146 D ..	1	1·16	1088	1262
	1¼	1·27	1031	1309
	1½	1·50	1006	1509
	1¾	1·53	972	1487
	2	1·21	874	1057
146 H ..	2	0·62	1007	624
	3	1·05	1037	1088
	3¼	1·12	1021	1143
	3½	1·17	994	1162
	4	1·39	951	1321

It will be seen practically throughout the tables, whatever mixing is used, that the tensile properties of the slow curing rubber are decidedly inferior to the fast curing rubber. This agrees with our previous results on the mixing usually employed. In the fast curing rubber with the mineral mixings (except those containing oxide of lead) and in the rubber-sulphur mixing containing 5% of sulphur reckoned on the rubber (Ref. No. 146 C), it will be seen that the figures for breaking load and elongation remain constant over a considerable range. This is obviously what one would expect, owing to the small amount of sulphur employed, since, after a certain period of cure, little or no further change takes place in such a rubber, on account of the relatively small proportion of free sulphur remaining in the rubber, compared with a sample containing say 10% of sulphur.

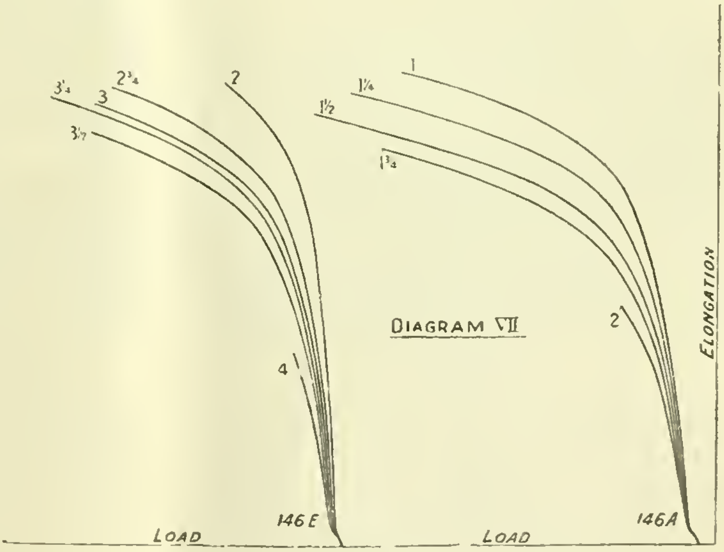


This slowing up of the cure is shown very clearly in the load-stretch curves given, *e.g.*, the curves in Diagrams II and VI for 146 C & G, showing the progression of the cure with time. In these mixings there is not sufficient sulphur to give the very marked and obvious over-cures obtained even in ¼ hour at a similar vulcanising temperature (140° C.) when 10% of sulphur is employed. Secondly, an additional ¼ hour cure, with these low sulphur contents, produces very small differences in the load-stretch curves and greater time intervals must be used to illustrate the differences due to period of cure for any particular sample. This again would be expected, in view of the mass action of sulphur. The greater change in the curve over a smaller range of time when using 10% of sulphur is shown in Diagram VII for samples 146 A & E.

If reference is made to Diagrams II, III, IV, and V the comparative curves of samples 146 C & G, and samples 138 A & E, B & F, D & H at different times of cure, it will be seen that, while at the lower times of cure considerable differences exist in the load-stretch curves, if the cure be carried on sufficiently long, the slower curing rubber eventually overtakes the rapid curing rubber, since with low sulphur content, the latter does not change appreciably after a certain period of vulcanisation, even if the cure is carried further, so that, if these rubbers had been cured for a prolonged period, say 5 hours in the case of samples 146 C & G, the load-stretch curves would have coincided, and the only difference between the samples would have been the inferior tensile properties of the slower curing rubber. Although the difference in rates of cure would thus have been obscured, nevertheless it would still have existed between these rubbers. The comparatively small change in the curves for the fast curing rubber 146 C is shown in Diagram VI, while in the same diagram the slow curing rubber 146 G has altered considerably over the same range.

This point appears to be of importance in connection with the so-called "heat" test for rubbers of this quality, that is, rubbers containing mineral mixings and having a comparatively small proportion of sulphur.

Thus, assuming samples 146 C & G had both been manufactured under identical conditions as to period of cure and temperature, say 3 hours at 140° C., and the "heat" test had been applied to sample 146 C, little or no change would have taken place in this sample, whereas in the case of sample 146 G the rubber would have continued to cure.



The use of such technical mixings, with low sulphur content, and especially mixings containing oxide of lead, which are largely used for experimental work in America, is possibly responsible for the obscuring of variability in speed of vulcanisation in previous researches, and for the adoption of standard times and temperatures in such work, and many differences in tensile properties of vulcanised rubbers may have been due to incorrect curing rather than real differences in inherent tensile strength, etc.

In the case of the samples containing oxide of lead, as will be seen, especially from the curves in Diagram V for sample 138 D & H, the differences in rate of cure are largely obscured. This is intensified in samples 138 C & G containing a higher content of lead oxide, the curves of which are not given. This again might have been anticipated, *i.e.*, the addition of a powerful accelerating agent such as oxide of lead obscuring the effect of a natural accelerator present in the raw rubber. We have also been able to show this to be the case when fast and slow curing rubbers are soaked in alkalis, *e.g.*, caustic soda or potash (*vide* Agricultural Bulletin, F.M.S., Vol. iv., No. 6, March, 1916), and also when small proportions (about 1%) of various organic nitrogenous accelerating agents, *e.g.*, piperidine, hydrobenzamide, benzylamine, and *p*-nitrosodiphenylamine are added to rubber-sulphur mixings. (These results have not yet been published by us.) (N.B.—The alkali treatment is not recommended for manufacturing purposes, but is of some scientific interest.) The effect on type of rubber, of substituting equivalent amounts of magnesium oxide and lead oxide for zinc oxide, is shown in Diagrams III, IV, and V. There is a small difference, however, between the fast and slow curing samples even with lead oxide mixings, as will be seen from the curves, especially at the lowest times of cure given, while at the longer cures, the curves approach each other more closely.

The flat nature of the load-stretch curves for the lead-oxide mixings may be noted, showing a tough and hard but not very elastic rubber. Another feature which may be observed is the variation in type with different percentages of sulphur (Diagram I, Ref. No. 146 A—H), the curves actually crossing each other. With low sulphur content (4·8 and 7·0%) much greater elongation for similar loads is obtained than with the 10% sulphur mixing.

We should like here to refer also to the question of the stability of these samples, in view of the fact that no tests have been published by us so far, after the vulcanised samples have been kept for, say, 6 months or a year before testing. Experiments have been carried out, but so far no results have been published. These experiments show that, with the 10% sulphur mixing employed by us, the rubber continues to vulcanise slowly during six months and the extra vulcanisation which has taken place, in all samples so far tested, represents about a quarter-hour cure at 140° C., *i.e.*, the load-stretch curve of a sample vulcanised for say, 1 hour, when tested after six months would coincide with the load-stretch curve for a 1¼ hour cure tested 3 days after vulcanisation. A certain amount of deterioration in tensile properties had also taken place. It can be stated here, however, that, while the 10% mixing is an excellent mixing for the purpose in view, viz., to ascertain variations in rate of vulcanisation between different rubbers, especially when it is required to test the samples shortly after vulcanisation, it is, in our opinion, not a good mixing for testing the keeping or ageing properties of different rubbers after vulcanisation, since there is a large amount of free sulphur remaining in the rubber, which gradually exudes and leaves the sample porous and liable to rapid oxidation.

Since, however, the stability of the vulcanised rubber depends largely on whether it has been properly vulcanised, as well as on the nature of the raw material, the rate of vulcanisation must be of great importance, and the failure of many samples of plantation rubber, especially first grade samples, to keep after vulcanisation, may probably be attributed to the samples not having been properly vulcanised.

Another point which may be discussed here is the use of the term "optimum" cure. Stevens, in a written criticism in the same paper to which reference has been made, says: "It may be stated with confidence that the samples vulcanised by Eaton and Grantham at their 'optimum cure' are much overcured." In this respect Stevens may be perfectly correct, and we have pointed out already in private correspondence, that the testing of rubber from the point of view of its curing capacity is entirely relative and not absolute, and that our "optimum" cure may not be considered by a manufacturer to be the most satisfactory cure. Perhaps a preferable term, and this has also been suggested to us by the chief chemist of a well-known rubber firm, would be "relative rate of cure." We should like, however, to emphasise this by pointing out in reference to our previous results, that if, say, the "optimum" cures of two samples are given by us as 1¼ hours and 3¼ hours, then, assuming the correct "optimum" for the latter should have been 3 hours, the correct "optimum" of the former should be 1 hour, *i.e.*, each cure is relative to the other.

Conclusions.—The experiments quoted in this paper show definitely:—

(1) That the variability of plantation Para rubber in respect to rate of cure continues to exist in various technical mixings in which the rubber is loaded with mineral constituents in addition to sulphur, and also in rubber-sulphur mixings containing different proportions of sulphur.

(2) That the variability is not of the same degree as with mixings containing, say, 8% to 10% sulphur, as would be expected.

(3) That the use of strong accelerating agents such as oxide of lead tends to obscure these differences which are produced in the raw rubber by the presence of a natural accelerator.

(4) That other substances, *e.g.*, caustic soda and potash and various organic nitrogenous accelerators, also obscure these differences, since these substances behave in a somewhat similar manner to the natural accelerators present in raw rubber.

(5) That, for the purpose in view, viz., to illustrate the differences in rate of cure between different rubbers, which we believe to be the most important variability in plantation Para "first latex" rubbers, an 8% or 10% sulphur mixing, without any other addition, is a very satisfactory mixing, even though it may not be suitable for stability or ageing experiments.

Note.—It may be found by comparing some of the numerical results with the curves, that these do not agree at breaking point. In tracing these curves, however, we have always taken the curves which were drawn from the same point for comparison of rates of cure, whereas the maximum breaking strain, which is always given in the tables, may have been obtained with the second ring, used to compare the curves for the same sample at different times of cure. As we have stated before, however, the duplicate curves invariably coincide, except at the breaking point, where one curve may extend further than the other, so that in utilising the curves for comparison of rates of cure, it is immaterial which of the two curves at each cure is used, since an actual flaw, such as an air bubble in the test ring, does not affect the coincidence of the curves in duplicate tests, although it affects the actual tensile strength.

Obituary.

WILLIAM GEMMELL.

A promising career has been cut short by the death of William Gemmell on September 12th, as a result of burns due to an explosion which occurred whilst working at Silloth.

He was born in Glasgow in 1885, and after serving an apprenticeship with Messrs. Tatlock and Thomson he entered the employ of the Corporation Gas Works, Provan, Glasgow. In 1906 he joined the staff of the Metallurgical Department of the National Physical Laboratory and in 1912 was appointed chief chemist to Sir W. G. Armstrong, Whitworth and Co.

He contributed some useful papers to this Society (see this J., 1908, 427; 1913, 581), and was the co-inventor, with O. Smalley, of a patented process for high speed cutting steels.

He was an active member of the Newcastle Section of this Society, having served on the Committee for some time, and had recently been appointed Hon. Treasurer of the Section.

JOHN MACKENZIE.

John Mackenzie was born in 1846. In his early life he was engaged in engineering practice, but early in the "eighties" he became associated with chemical industry, and for about 30 years was connected with Messrs. Sadler and Co., of Middlesbrough. He was the patentee of a number of inventions relating to chemical industry, among which may be mentioned his English Patent No. 6415 of 1909 (this J., 1909, 981) describing the use of fused silica dishes in the cascade system of sulphuric acid concentration. He died in Middlesbrough on September 28th last.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6d. each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1s. each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Feron 8, Paris (3e.) Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Counter-current extraction: Principles of ——. W. K. Lewis. J. Ind. Eng. Chem., 1916, 8, 825—833.

The principles of counter-current extraction are discussed and formulæ are deduced which show the influence of the size of the extraction system, the amount of extracting agent employed, and the velocity with which the vehicle carrying the substance to be extracted flows past the extracting agent, or *vice versa*. The formulæ are based on the assumption that the extraction process consists primarily in the diffusion of the substance to be extracted through a stationary film of fluid which envelopes the separate particles of the dispersed or subdivided phase of the system. This surface film is probably nearly in equilibrium with the dispersed phase, and the rate of diffusion will be determined by the difference in concentration between the surface film and the surrounding main body of the medium. The formulæ derived are:—

For extraction of solids by liquids:

$$\log\left[1+\frac{c_1}{x_0}\left(\rho-\alpha\right)\right]=\frac{\beta u V}{a A^2}\left(\rho-\alpha\right).$$

For transfer of substance from gas to liquid or *vice versa*:

$$\log\frac{x_0-\alpha c_0}{x}=\frac{K V}{u}\left(\rho-\alpha\right),$$

when the velocity of the gas past the liquid is constant, as in spray washers; or

$$\log\frac{x_0-\alpha c_0}{x}=\frac{\beta U l}{\rho A}\left(\rho-\alpha\right),$$

when the absorbing liquid forms a film over a stationary surface. In these formulæ c_1 or c_0 denotes the concentration of the substance to be extracted in the solution obtained, x_0 the initial and x the final concentration of the substance in the vehicle by which it is carried, α is the solubility constant of the substance, u is the velocity of the extracting agent, U is the velocity of the vehicle carrying the substance to be extracted, V is the total volume of the extraction system, A is the cross-section of the extraction system, l is the length of the extraction system, K and β are diffusion constants, and ρ is the weight of extracting agent per unit quantity of vehicle carrying the substance to be extracted, and is equal to u/U. In the extraction of solids by liquids perfect counter-current conditions are not realised in practice and the allowances which must be made for the introduction of a fresh tank at one end of the system and withdrawal of a tank at the other end are discussed, and auxiliary formulæ are deduced for use according to circumstances. The most striking fact brought out in the investigation is the fact that in those cases where the relation between the distribution of the substance in the original vehicle and in the extracting agent is linear, the coefficient of diffusion (K) is proportional to the square of the velocity of the gas or liquid; hence in the design of counter-current gas washers or extraction apparatus, the aim should be to obtain the maximum relative velocity of vehicle and extracting agent.—A. S.

Patents.

Temperatures; Means for regulating and/or indicating ——. I. Hall, Birmingham. Eng. Pat. 12,597, Sept. 2, 1915.

A melting pot, bath, container, or the like is provided with a pocket attached to the side either internally or externally, which communicates with the interior of the pot, and is adapted to contain a thermo-couple for measuring the temperature or controlling the heating apparatus.
—W. F. F.

Desiccating and circulating air; Apparatus for ——. G. R. Grubb, Dublin, and G. S. Higginson, London. Eng. Pat. 13,567, Sept. 24, 1915.

A portable apparatus for drying and circulating air comprises a desiccating chamber, air filters, and an air-pump driven by reducing gear from an electric motor, together with a suitable arrangement of valves.—W. H. C.

Emulsifying apparatus : Construction of ——. Maypole Margarine Works, Ltd., Southall, Middlesex. From Flakes A. S., Copenhagen. Eng. Pat. 17,306, Dec. 9, 1915.

To facilitate the opening and closing of the apparatus described in Eng. Pats. 23,653 of 1913 and 18,048 of 1914 (this J., 1914, 1167, 1218), one of the discs is supported by a hinge so that it can be swung open. When closed the discs are held together by a clamp tightened by an interrupted screw, and the joint is made by a hollow rubber ring which can be inflated with air after the discs are closed.—W. H. C.

Mixing-machines for granular or pulverulent substances. G. Porteus, Leeds. Eng. Pat. 17,660, Dec. 17, 1915.

The ratchet-mechanism which operates the discharge worm of a mixing machine is driven by a reciprocating rod with which it is connected by a swinging bar and lever so that it can be disconnected and the discharge worm stopped without interrupting the working of the mixer. —W. H. C.

Mixing apparatus for granular, powdered, or the like material. W. S. H. Bevin and J. S. Rawsthorne, Liverpool. Eng. Pat. 101,332, July 7, 1916. (Appl. No. 9575 of 1916.)

The material, *e.g.*, seeds, grain or meal for cattle foods, is fed from a hopper on to a pyramidal distributor from which it falls into a receptacle divided by vertical partitions into narrow compartments. The compartments are each provided with a pivoted floor operated by hand levers through the medium of rods, chains, or wire ropes, and the material is discharged into a similar receptacle below having its vertical partitions at right angles to those above. The material is finally discharged through a hopper on to a vibrating tray and thence to a vibrating riddle and a helical conveyor.—W. F. F.

Muffle-furnace. G. W. Batchell, Cincinnati, Ohio, and J. H. Wade, Moundsville, W.Va. U.S. Pat. 1,195,641, Aug. 22, 1916. Date of appl., Mar. 18, 1916.

The muffle chamber has a number of arched flues which extend up one side, across the top, and down the other side. A combustion flue extends longitudinally beneath the sole of the muffle, and a waste-gas flue is situated beneath the combustion flue. The arched flues communicate alternately on opposite sides with the combustion flue and on the other side with the waste gas flue.—W. H. C.

Condenser. F. F. Vega and R. Abarca, San Juan, Porto Rico. U.S. Pat. 1,195,752, Aug. 22, 1916. Date of appl., Dec. 29, 1915.

The body of the condenser is connected on opposite sides with two vacuum pans, the vapours being prevented from passing from one pan to the other by a baffle plate. The condenser is connected with a vacuum pump, and the condensed liquid is guided to the outlet by baffles.—W. H. C.

Evaporator. F. P. Pattno and G. S. Witham, jun., Au Sable Forks, N.Y. U.S. Pat. 1,196,020, Aug. 29, 1916. Date of appl., Nov. 29, 1915.

The supply of liquid to an evaporator is regulated by means of a float chamber connected with both the vapour and liquid spaces of the evaporator, a mercury seal being interposed in the connection with the liquid space to prevent liquid passing from the evaporator to the float chamber. —W. H. C.

Separator ; Centrifugal ——. D. B. Weston, Sharon, Mass. U.S. Pat. 1,195,056, Aug. 29, 1916. Date of appl., Dec. 1, 1911. Renewed Jan. 19, 1916.

The material is introduced into the bottom of a drum of double conical shape which is rotated about its vertical axis. The separated solids are guided towards the top of the drum and are discharged through ports provided with valves and situated in the conical portion of the drum near the apex.—W. H. C.

Dryer. W. V. Meyer, Chicago, Ill. U.S. Pat. 1,196,376, Aug. 29, 1916. Date of appl., Jan. 3, 1914.

An inclined rotary dryer is formed of two concentric cylinders spaced apart and having tangential shelves within each cylinder and communicating ports between the cylinders.—W. H. C.

Refrigerating apparatus. A. J. Jackson, Chicago, Ill. U.S. Pat. 1,197,636, Sept. 12, 1916. Date of appl., Jan. 2, 1915.

Cooling or heating fluids ; Apparatus for ——. A. J. E. Munters, Stockholm. U.S. Pat. 1,197,944, Sept. 12, 1916. Date of appl., Sept. 17, 1914.

See Eng. Pat. 20,017 of 1914 ; this J., 1915, 1041.

Process of drying and extracting. U.S. Pat. 1,197,097. *See* IX.

High-temperature centrifugal apparatus. U.S. Pat. 1,196,829. *See* X.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Explosive gases in coal mines ; Occurrence of ——. N. H. Darton. U.S. Bureau of Mines, 1915, Bull. 72. (248 pages.)

The following summary is based on the results of investigations made by the author in the northern anthracite basin of Pennsylvania and the southern part of the bituminous coalfield of Illinois, and on data previously obtained by other workers in Europe and America :—The gas emitted by freshly mined coal, whether *in situ* or in the laboratory, varies considerably in composition; in most cases it contains over 80% of methane, other constituents being carbon dioxide, nitrogen, and oxygen, the proportions of which are also very variable. These variations appear to be unconnected with any visible characteristics of the coal, and independent of the chemical constitution of the latter as expressed by the terms "fixed carbon," "volatile combustible matter," etc. The gas emitted at different stages of exposure, and from coal crushed to different degrees of fineness, also shows great variability in composition, for which absorption of air and subsequent combination with oxygen are doubtless largely responsible. Apparently, gas escapes from coal by percolation through the pores or interstices between the grains, and through small and large fissures, the emanation being thus dependent on the texture of the coal, the extent to which it is fissured, and the amount of pressure forcing the gas outwards. The most rapid and dangerous outbursts occur when the mining operation reaches a fissure or a body of shattered coal which constitutes a reservoir under high pressure, and when such a body of coal is thrown out in such large quantity that much of the gas is given off at once. Although occurring most often under the conditions named, or in places where the coal seam thickens and thins, such outbursts are not connected with any visible peculiarities of the coal, and no dependable means is yet available for detecting their proximity or preventing them. The pressure of gas in the solid coal has been determined in England, France, Belgium, Austria, and Illinois with results presenting anomalous variations, the suggestion that a precise ratio exists between pressure and depth of hole being negatived by most observations. In general, high pressure, if present at all, is manifested where the coal is most compact; and owing to leakage near the face, the higher pressures are found only in the deeper test-holes, the depth necessary for a high pressure depending on the compactness of the coal. As shown by the amounts given off by mining a definite quantity of coal, and by laboratory tests on coal samples, the volume of gas in coal is as variable as the pressure. While variation in the original volume of gas is no doubt related to the organic character and history of the coal and to other factors not yet ascertained, in many cases in the mines the coal containing the most gas, or gas with the highest pressure, does not have the most gaseous workings, the gas being emitted gradually over a long period and thus easily disposed of by adequate ventilation. Tests made to determine the amounts of gas given off by coals at ordinary temperature and at 212° F. (100° C.), in a vacuum, in the presence of various other gases, and in different periods of time, yielded a wide range of results without revealing any special relations. The volume of gas emitted generally increased with the time of exposure; and the rate of emission with the degree of fineness of the sample. At ordinary temperature coal yielded up to 5·5 times, and at 212° F. up to 8 times its own volume of gas; but the average yield at ordinary temperature was probably less than the volume of the coal employed, and however great the quantity liberated at first exposure, a long time always elapsed before the emission was complete. As regards the relation of methane accumulations to explosions in mines, deductions based on statistics are considered misleading, since most of the explosions on record are known to have been started by accidental ignition and many of the larger ones propagated mainly by coal dust, the controlling cause of most of the accidents being the human factor and not increased methane emanation due to atmospheric or other influences. Generally, fewer accidents occur during times of evident danger than when the need for precaution is less apparent.—W. E. F. P.

Coal: Spontaneous combustion and oxygen absorption by ——. J. I. Graham. Inst. of Min. Eng. J. Gas Lighting, 1916, **136**, 20.

Experiments on the formation of water in the oxidation of coal show that a very considerable proportion of water is produced relative to the quantity of oxygen absorbed, the proportion increasing slightly with the time of oxidation. The amount of water produced in the initial stages of an underground heating is small compared with the amount of water already in the coal. Experiments dealing with the permeability of coal to air and gas show that solid coal is extremely airtight, and that the amount of oxygen which can permeate any distance into a solid pillar of coal is quite negligible, but "breaks" in coal, letting in oxygen, may cause heatings and fires in the walls of main roads many years after the roads have been cut.—J. E. C.

Coal economy in London. [*Utilisation of coke in boiler-furnaces.*] E. W. Nicol. J. Gas Lighting, 1916, **136**, 17. (See also this J., 1916, 460.)

The author gives further data relating to the use of gas coke for steam-raising. Tests carried out at one of the stations of the Metropolitan Asylums Board show an overall efficiency of 78%, well above the average realised with coal-fired boilers. The consumption of fuel has been reduced by 10%, and the average evaporation (from and at 212° F.) of 9·94 lb. of water per lb. of coke has been attained.—J. E. C.

Briquetting and tar distilling plant at Nuremberg gasworks. R. Terhaest. J. Gasbeleucht., 1915, **58**, 300—301. J. Gas Lighting, 1915, **130**, 755.

Coke breeze and pitch dust are incorporated in a mixer heated by superheated steam at 200° C. and the mixture treated in a rotary press; 8% of hard pitch is used and the crushing strength of the oval briquettes averages 80 kilos. (1137 lb. per sq. in.). The strength of the briquettes depends chiefly on three factors—viz.: the proportion of binding material; the description or softness of the pitch used; and the pressure (15 tons) which the outer edges of the two rollers exert on one another. The proportion of pitch added cannot be varied much, because if it is too low the briquettes lack solidity or strength, and if it is too high they stick in the mould. The resistance of the briquettes to pressure in the direction of the small axis of the oval is tested by a very simple apparatus. A piston working in a short cylinder is of such a size that, at 9 atmospheres, it exerts a pressure of 120 kilos. The briquette resting on a plate is compressed by the piston. The cylinder is connected with the steam-pipe, so that only condensed water passes under the piston. When the steam valve is slowly opened, the pressure, read on a gauge, gradually rises until a small jerk shows that the briquette has been crushed. The briquettes are suitable for steam boilers or household purposes. They now serve as fuel for the whole of the boilers on the works, and a considerable quantity remains over for sale. The boilers produce more steam in a given time, and require less attendance and cleaning, and less dust is produced. Excluding cost of material, the cost of manufacturing is only 30 Pf. per 100 kilos. briquettes (3s. per ton). In the Nuremberg gasworks the pitch required for making the briquettes is about double the quantity of retort pitch produced; the balance is obtained from the tar plant which splits up the tar into hard pitch, light oil (up to 170° C.), and heavy oil (up to 360° C.). Naphthalene wash oil is regenerated in this plant.
—J. E. C.

Lignites; Economic methods of utilising Western (U.S.A.) ——. E. J. Babcock. Bull. 89, U.S. Bureau of Mines. 73 pages.

The bulletin deals with the economical use of lignites, with special reference to schemes comprising the distillation of the lignites, collection of by-products (sulphate of ammonia and tar), utilization of the gas evolved, and conversion of the solid residue into briquettes. The bulletin quotes average yields of 11,038 cub.ft. of gas per ton (396 B.Th.U. per cub.ft.), 54·6% of residue, 17·4 lb. of sulphate of ammonia per ton, and 50·7 lb. of tar per ton. A good working temperature is given as 1200°—1400° F. (650°—760° C.). In abrasion and compression tests, lignite briquettes compared favourably with anthracite and bituminous coals. Briquettes made from the coked residue were found superior to briquettes made from the raw lignite.—J. E. C.

Calorific power of lignites; Use of ammonium nitrate in determining the ——. R. Salvadori. Annali Chim. Appl., 1916, 6, 113—114.

Satisfactory combustion of lignites, even of samples containing 50% of water, in a Thomson calorimeter can be obtained by adding ammonium nitrate to the usual mixture of potassium chlorate and nitrate. Using 2 grms. of the sample a mixture of 20 grms. of the chlorate-nitrate mixture (3 : 1) and 1 grm. of ammonium nitrate is recommended. With these quantities and using

2 kilos. of water in the glass cylinder of the calorimeter, a correction of 0·51° C. should be deducted from the observed temperature. If necessary 18 grms. of the chlorate-nitrate mixture and 3 grms. of ammonium nitrate may be used, in which case the correction is 1·62° C.—A. S.

Acetylene ; Colorimetric determination of ——. A. Schulze. Z. angew. Chem., 1916, **29**, 341—342.

Ilosvay's reagent (solution of a copper salt decolorised with hydroxylamine hydrochloride; this J., 1899, 1158) is used for the colorimetric determination of acetylene. The solution is prepared from copper chloride, as described, but an addition of 6 c.c. of 2 to 3% gelatin solution is made to prevent the precipitation of colloidal copper acetylide. A measured quantity (50 c.c.) of the mixture of air and gas is aspirated by means of a capillary tube through 5 c.c. of the reagent, and the coloration is matched with that produced by a given quantity of air containing 1% of acetylene. The test is capable of detecting 0·001 c.c. of acetylene.—C. A. M.

Platinum and illuminating gas. Mylius and Hüttner. *See* X.

Use of powdered coal in metallurgical furnaces : a discussion of the engineering problems involved. Gadd. *See* X.

Patents.

Mond gas ; Utilisation of —— *and the recovery of by-products* [*ammonium nitrate*] *therefrom.* T. Twynam, Redcar, Yorks. Eng. Pat. 14,391, Oct. 12, 1915.

Mond gas is utilised to produce electrical energy which is used in electric furnaces for the combination of atmospheric oxygen and nitrogen, from which nitric acid is manufactured. The ammonia from the Mond gas is absorbed in the nitric acid, forming ammonium nitrate.—W. F. F.

Peat or other carbonaceous matter ; Process of producing power [*gas*] *from* ——. G. F. Dinsmore, Boston, Mass., Assignor to Dinsmore Power Process Co. U.S. Pat. 1,197,456, Sept. 5, 1916. Date of appl., May 24, 1909. Renewed Nov. 5, 1914.

A mass of fuel is maintained incandescent in a pressure-tight vessel by forcing in compressed air, and regulated supplies of wet peat are added. The peat is converted into fixed combustible gas and steam, which is used in a pressure engine. The steam in the exhaust is condensed, and the gas is burnt for power purposes.—W. F. F.

Vertical retorts ; Apparatus for charging and discharging ——. S. N. Wellington, London Eng. Pat. 13,254, Sept. 15, 1915.

IIb.—DESTRUCTIVE DISTILLATION ; HEATING ; LIGHTING.

Electrodes ; Arc-light ——. C. R. Böhm. Chem.-Zeit., 1916, **40**, 637—639, 655—657, 667—669, and 690—693.

The development of the arc-light carbon industry is traced and the patent literature dealing with the manufacture of simple, cored, impregnated, and other types of electrode critically reviewed, whilst the behaviour of the various types of electrode under burning conditions in the lamp is discussed. Pure carbons are shown to be steadily giving place to treated carbons for the production of so-called flaming arcs, especially in Germany where, in 1913, only 61·5% of those sold were of the former type. There is a heavier import duty on German carbons entering the United States and Canada than on carbons imported from other countries, the difference amounting to 13—14% and 37—87% *ad val.* respectively. A bibliography is appended to the paper.—F. Sodn.

Patents.

Bituminous substances ; Process for distilling ——. J. G. Aarts, Dongen, Holland. Eng. Pat. 100,952, July 17, 1916. Under Int. Conv., July 17, 1915. (Appl. No. 10,024 of 1916.)

Bituminous substances, *e.g.* coal, peat, wood, are distilled in vertical retorts of substantially constant cross-section. The charge moves downwards and the retort is heated externally by gas in zones varying from over 1500° C. at the bottom to below 500° C. at the top. The resulting gas is free from naphthalene and heavy tar, and rich in ammonia and benzene.—W. F. F.

Incandescent electric lamp. R. Winne, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,197,705, Sept. 12, 1916. Date of appl., Apr. 24, 1913.

See Eng. Pat. 18,447 of 1913; this J., 1914, 913.

III.—TAR AND TAR PRODUCTS.

Phenols ; Identification of —— *by the spectroscope.* H. Gsell. Z. anal. Chem., 1916, **55**, 417—426.

Individual phenols can be readily identified by the measurement of the darkest bands in the absorption spectra of alkaline solutions of their corresponding phthaleins. 0·1—0·2 grm. of the phenol, 0·05—0·1 grm. of phthalic anhydride, and 1—2 drops of concentrated sulphuric acid or stannic chloride solution, are heated together for 10—15 minutes in a paraffin bath at 140°—180° C., and after the addition of a few c.c. of alcohol and 10—12 c.c. of *N*/20—*N*/50 sodium hydroxide, the liquid is filtered and examined spectroscopically. The method is simple, reliable, and exact, though obviously not applicable to phenols which do not yield coloured phthaleins. Measurements were made on 20 phthaleins derived from monohydric phenols, and also on the corresponding derivatives of resorcinol, naphthoresorcinol, quinol, and thymol.—E. H. T.

2.7-*Dimethoxynaphthalene.* O. Fischer and W. Kern. J. prakt. Chem., 1916, **94**, 34—48.

The main products of the nitration of 2.7-dimethoxynaphthalene are the 1-nitro- and the 1.8-dinitro-derivatives. The former forms yellow prisms or plates, m.pt. 141° C., and is reduced by stannous chloride to the corresponding amine, white silky needles, m.pt. 82°—83° C., which become violet on exposure to light. Alcoholic ammonia at 190°—200° C. replaces a methoxyl group of the nitro-compound by the amino-group, the resulting 1-nitro-2-amino-7-methoxynaphthalene forming reddish-yellow needles, m.pt. 115°—116° C. On reduction it is converted into 1.2-diamino-7-methoxynaphthalene, the constitution of which follows from its condensation with benzil to 7-methoxy-1.2-diphenylnaphthoquinoxalin, m.pt. 168° C. The 1.8-dinitro-derivative of dimethoxynaphthalene yields a similar series of derivatives to the above, but it is noteworthy that by the action of alcoholic ammonia or methylamine both methoxy-groups are replaced by amino-groups. —G. F. M.

Briquetting and tar distilling plant at Nuremberg gas works. Terhaest. *See* IIa.

Changes in the import duties on dyestuffs, etc., in the United States. See IV.

Patents.

Nitriles: Preparation of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,091, Jan. 24, 1914.

Aromatic compounds containing halogen combined directly with the nucleus are mixed with finely divided or dissolved, simple or complex metallic cyanogen compounds, with addition of a substance which promotes the reaction, and heated to temperatures up to 350° C. Halogen compounds in which the halogen atom is " mobile " owing to the presence of an *ortho* or *para* nitro group are not suitable, and the action of cuprous cyanide on halogenanthraquinones is disclaimed. Examples given are :—(1) 14 parts of finely ground anhydrous calcium ferrocyanide, 6 of fullers' earth, 1 of copper (" Naturkupfer C "), and 44 of chlorobenzene, heated for 20 hours at 300°—320° C. ; (2) 18 parts of *a*-chloronaphthalene, 60 of pyridine. and 8 of copper ferrocyamide heated for 18 hours at 270° C.—A. S.

5.8-*Dichloro*-1-*nitronaphthalene: Preparation of* ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,318, Dec. 24, 1914.

5.8-Dichloro-1-nitronaphthalene is obtained by chlorination of *a*-nitronaphthalene in presence of a chlorine-carrier.—A. S.

Benzyl chloride sulphonic acids and their homologues; Preparation of salts of ——. Rohner und Co., Pratteln, Switzerland. Ger. Pat. 293,319, Aug. 29, 1914.

Dry salts of toluenesulphonic acids or their homologues, suspended in an inert medium, such as carbon tetrachloride, tetrachloroethane, etc., are treated with chlorine, the reaction mixture being boiled under a reflux condenser during the operation.—A. S.

IV.—COLOURING MATTERS AND DYES.

1.6-*Dihydroxynaphthalene.* O. Fischer and C. Bauer. J. prakt. Chem., 1916, **94**, 1—12.

A number of derivatives of 1.6-dihydroxynaphthalene, m.pt. 137°—138° C., are described, of which the following are the most important :—The dibenzoyl-derivative, m.pt. 103°—104° C. ; 1.6-dimethoxynaphthalene, obtained in colourless needles, m.pt. 60°—61° C., by the action of methyl sulphate ; 2-nitroso-1.6-dihydroxynaphthalene, as red glittering leaflets, and 4-nitroso-1.6-dihydroxynaphthalene as bright yellow needles by the action of nitrous acid on dihydroxynaphthalene. On reduction with stannous chloride and hydrochloric acid these nitroso-compounds are converted into the corresponding amino-derivatives. The tin double salt of 4-amino-1.6-dihydroxynaphthalene is readily oxidised by ferric chloride to 6-hydroxy-1.4-naphthoquinone, a reddish-yellow substance melting at 170° C. (with decomp.), and yielding on gentle reduction with stannous chloride 1.4.6.-trihydroxynaphthalene, a somewhat unstable substance melting at 138°—140° C. By the action of phenyldiazonium chloride on 1.6-dihydroxynaphthalene, mono-, bis-, and tris-azo-compounds were produced according to conditions. 4-Benzeneazo-1.6-dihydroxynaphthalene forms red needles, m.pt. 230° C., and dyes orange-red shades. Bisazobenzene-1.6-dihydroxynaphthalene forms dark red flakes and is more sparingly soluble than the mono-azo compound. The trisazo-compound forms dark metallic-looking needles.—G. F. M.

1.5-*Dihydroxynaphthalene.* O. Fischer and C. Bauer. J. prakt. Chem., 1916, **94**, 13—23.

Commercial 1.5-dihydroxynaphthalene can be purified by treatment in suspension in diluto alcohol, with steam, followed by sulphur dioxide. On filtering and cooling the liquor, it separates in colourless needles, m.pt. 258° C. Its dibenzoyl- and diethyl-derivatives melt at 235° C. and 130° C. respectively. The monomethyl ether is formed as the principal product when methyl sulphate acts on 1.5-dihydroxynaphthalene in presence of 1½ mols. of potassium hydroxide. It melts at 68° C., and is converted by nitrous acid into 5-methoxy-2-nitroso-1-naphthol, m.pt. 165° C. (with decomp.), and this on reduction with phenylhydrazine gives the corresponding aminonaphthol as glistening leaflets, which rapidly colour when not perfectly dry. By the action of nitrous acid on 1.5-dihydroxynaphthalene only a mononitroso-derivative is formed, viz., 2-nitroso-1.5-dihydroxynaphthalene, reddish-brown needles, decomposing at 190° C. The dihydroxynaphthalene and its monomethyl ether yield yellow to red mono-azo-compounds on coupling with phenyldiazonium chloride or its substitution products. Bisazo-derivatives can also be obtained.—G. F. M.

2-*Hydroxy*-7-*methoxynaphthalene.* O. Fischer and F. Hammerschmidt. J. prakt. Chem., 1916, **94**, 24—34.

2-Hydroxy-7-methoxynaphthalene was obtained in flat plates of m.pt. 117° C. by methylation of the dihydroxy compound with methyl sulphate and potassium hydroxide (1 mol.). A number of derivatives were prepared by the usual methods (see preceding abstract), *e.g.*, the 1-nitroso-derivative forming bronze-coloured needles, m.pt. 129° C., and the 1-amino-derivative, white leaflets, m.pt. 170° C. By the action of ammonia, methylamine, and ethylamine on the nitroso-compound the hydroxyl group was replaced by an amino group, with formation of 1-nitroso-2-amino-7-methoxynaphthalene, yellowish-brown needles, m.pt. 194° C., and its N-methyl- and N-ethyl derivatives. These bases are re-converted into the hydroxynaphthaleno by warming with dilute sodium hydroxide. Yellow and red azo-dyestuffs were obtained by coupling 2-hydroxy-7-methoxynaphthalene with phenyldiazonium chloride and *p*-nitrophenyldiazonium chloride respectively. The azo-complex enters the 1-position.—G. F. M.

Dyestuffs, etc.; Changes in the import duties on —— *in the United States.* Board of Trade J., Oct. 12, 1916.

The Bill passed by the House of Representatives on July 10th, dealing with the duties to be levied on dyestuffs and intermediate products imported into the United States, has been passed by Congress and was approved on Sept. 8th subject to the following modifications in the original (this J., 1916, 885) :—

Group I. (*Free list*). In place of "anthracene," " carbazol," and " naphthalene," there are now inserted " anthracene having a purity of less than 25 %," " carbazole having a purity of less than 25 %," and " naphthalene having a solidifying point less than 79° C." ; *o*-, *m*-, and *p*-cresols having a purity of less than 90 % are added.

Group II. The following additions have been made :—Anthracene having a purity of more than 25 %, benzoic acid, carbazol having a purity of more than 25 %, naphthalene having a solidifying point of 79° C. or above, *o*-, *m*-, and *p*-cresols having a purity of 90 % or more. The last sentence of the paragraph now reads " all the foregoing not colours, dyes, or stains, photographic chemicals, *medicinals, flavours,*" etc.

Group III. Medicinals, flavours, and synthetic phenolic resin are added. The special duty of 5c. per lb. does not apply to medicinals and flavours.

Influence of catalysts (alkaloids, dyes, etc.) on yeast fermentation. Somogyi. *See* XVIII.

Soap as indicator in volumetric analysis. [*Titration of solutions of colouring matters.*] Sacher. *See* XXIII.

Patents.

Gallocyanine series ; Manufacture of blue to greenish-blue colouring matters of the ——. G. B. Ellis, London. From Chemical Works, formerly Sandoz, Basle, Switzerland. Eng. Pat. 101,301, Jan. 4, 1916. (Appl. No. 145 of 1916.)

New condensation products are obtained by condensing gallocyanine dyestuffs with *m*- and *p*-aminobenzamide in presence or absence of oxidising agents. *Example:* 180 kilos. of *m*-aminobenzamide and 60 kilos. of Coelestine Blue are heated for 4—5 hrs. at 110° C., with or without an oxidising agent, *e.g.*, air or aromatic nitro-compounds, the melt is extracted with hot water, and the condensation product is filtered off. The condensation may be carried out in alcoholic solution. The leuco-compound is readily soluble in water, and when printed with chromium acetate or formate mordant gives, after steaming for a short time, greenish-blue shades of remarkable purity and of excellent fastness to light, soap, and chlorine. —F. W. A.

Indoxyl, its homologues, and their derivatives ; Manufacture of ——. E. A. Bourcart, Paris. Eng. Pat. 101,316, Apr. 1, 1916. (Appl. No. 4832 of 1916.)

In the manufacture of indoxyl, its homologues, or their derivatives, an arylglycinate, or a homologue or derivative, is fused with a dehydrated mixture of caustic soda and caustic potash, in the presence of an inorganic substance capable of decomposing water, in an autoclave under a pressure of 6 to 10 atm. *Example:* Into an autoclave fitted with a stirrer is introduced a dehydrated and heated mixture of 70 parts of caustic potash and 30 parts of caustic soda to which is added 30 parts of sodamide, and the pressure is raised to 6 to 10 kilos. by means of ammonia or aniline vapours. When the temperature has fallen to 180° C., 50 parts of potassium phenylglycinate is introduced as quickly as possible while the temperature is prevented from rising substantially above 190° C. As soon as the evolution of ammonia has ceased, the melt is dissolved in iced water, and indigo precipitated by the usual methods.—F. W. A.

Dyestuffs of the acridine series ; Preparation of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 292,818, Apr. 23, 1915.

Yellow to orange-red dyestuffs giving level shades, fast to lime, and hence of special value for dyeing leather, are obtained by fusing together formyl derivatives of *m*-diamines of the benzene series and salts of N-monoalkyl or unsymmetrical N-dialkyl derivatives of such *m*-diamines.—A. S.

Sulphur dyestuffs : Preparation of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,186, Jan. 22, 1914.

Dyestuffs giving fast shades are obtained by heating azo compounds of N-ethyl-arylamines with sulphur to a high temperature, with or without addition of aromatic amines or compounds especially nitroamines, capable of yielding amines. —A. S.

Sulphur dyestuffs : Preparation of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,557, Jan. 29, 1914.

Fast yellow dyestuffs, which, unlike those described in Fr. Pat. 394,832 of 1908 (this J., 1909, 305), are resistant to chlorine, are obtained by the action of sulphur on a mixture of *m*- or *o*-phenylenediamine or nitroaniline with toluidines or xylidines.—A. S.

[Azo] *dyestuffs ; Preparation of diazotisable* ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,551, Sept. 11, 1915.

A 1-amino-8-naphtholsulphonic acid or an O-acidyl derivative is diazotised and coupled with a suitable amino compound of the benzene or naphthalene series, with the exception of 1-amino-5-naphthol and its 6- or 7-sulphonic acids, and ethers of 1-amino-2-naphthol and their derivatives, and the aminoazo compound is diazotised and coupled with a derivative of 2-amino-5-naphthol-7-sulphonic acid containing a diazotisable amino group. When an acidyl derivative is used, the acidyl group is removed after the first or second coupling. The products dye cotton blue shades which are converted into clear green tints, fast to washing and to light, by diazotising, and developing with pyrazolone derivatives or compounds containing a $CO.CH_2.CO$ group, *e.g.*, acetoacetanilide. —A. S.

Triarylmethane dyestuffs ; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pats. (A) 292,998, Nov. 10, 1914, and (B) 293,322, Dec. 25, 1914.

Dyestuffs giving fast shades are obtained by heating triarylmethane dyestuffs containing (A) a nitro group or (B) an esterified hydroxyl group in the para position to the methane carbon atom, with unsubstituted or substituted primary aromatic amines, with or without addition of salts of the amines.—A. S.

Monoazo dyestuffs for wool ; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,173, July 1, 1914.

Dyestuffs giving level shades fast to washing and to alkalis are obtained by coupling diazotised amino-sulphonic or amino-carboxylic acids of the benzene or naphthalene series, with the exception of *o*-aminophenol derivatives, with 2-amino-7-naphthol in alkaline solution. The fastness of the dyed shades is improved by treatment with formaldehyde.—A. S.

Anthraquinone series ; Preparation of a nitrogenous condensation product of the ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,576, July 23, 1913.

A product of value for the manufacture of dyestuffs is obtained by heating 1-amino-5-methylanthraquinone with an alkali alkyloxide.—A. S.

Sulphur dyestuffs ; Preparation of yellow ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,558, Mar. 26, 1915. Addition to Ger. Pat. 292,148 (this J., 1916, 832).

Other N-diacidyl derivatives are used in place of the N-diacetyl derivatives specified in Ger. Pat. 293,187 (this J., 1916, 922). The products give pure yellow shades, clearer than those given by the dyestuffs described in the chief patent. Except in the case of the benzoyl derivatives, "souring" of the dyed material is not necessary.—A. S.

Dyestuffs of the pyrone series ; Preparation of chrome ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,185, Dec. 10, 1914.

Chrome dyestuffs giving red shades are obtained by condensing 2.4-dihydroxybenzene-1-carboxylic acid esters or their homologues with benzo-trihalides or their nucleus substitution derivatives, and saponifying the products.—A. S.

Quinophthalonesulphonic acids containing halogen [halogenated Quinoline Yellow dyestuffs], and process of making same. E. Hoffa, Assignor to Farbwerke vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,197,632, Sept. 12, 1916. Date of appl., Apr. 6, 1914.

See Eng. Pat. 8577 of 1911; this J., 1914, 743.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Patents.

Cotton; Treatment of raw ——. O. Röhm, Darmstadt, Germany. Eng. Pat. 100,221, Mar. 7, 1916. (Appl. No. 3383 of 1916.) Under Int. Conv., Mar. 29, 1915.

The treatment of raw cotton with boiling alkalis, preparatory to bleaching, is omitted, and the material is softened by steeping in a 0·1 % aqueous solution of pancreatin at 20°—40° C. for some hours and then bleached with the usual agents. Other enzymes, such as papayotin, ricinus enzymes, etc., may be used, or fresh organs or preparations, instead of the commercial enzyme.—J. F. B.

Wool, hirsute and other animal fibres, fabrics or textiles; Process for treating ——, and the products. H. P. Jefferson, Boston, Mass. U.S. Pat. 1,197,495, Sept. 5, 1916. Date of appl., Sept. 18, 1914.

Raw wool is treated in a continuous process under diminished pressure, first with an acid gas, such as carbon dioxide, to render soluble the substances which otherwise would form an emulsion, then with cold distilled water to remove the soluble substances, and next with a preheated weak alkaline solution containing suint ingredients. The solution is drained off and the moisture removed by centrifuging the goods and treating with preheated compressed air. The material is extracted with a preheated volatile fat-solvent, *e.g.*, trichloroethylene, and subjected under diminished pressure to heated carbon dioxide, hot water, and cold water successively. The mass is finally dried by centrifuging and treatment with hot compressed air.—J. F. B.

Textile materials: Process of treating [with rubber] —— and the article produced thereby. W. J. Mellersh-Jackson, London. From Rubber Regenerating Co., New York. Eng. Pat. 101,318, Apr. 13, 1916. (Appl. No. 5463 of 1916.)

Fibrous material, animal or vegetable, combed or carded so that the fibres are disposed substantially parallel to one another, is subjected to a vacuum to displace the air, etc., from the interior of the fibres and the interstices, and impregnated in this condition with a binding medium, *e.g.*, rubber, with or without heat, so that there is intimate and direct contact with the binding medium both in the interior ducts and around the fibres.—J. F. B.

Pyroxylin compositions; Method of producing ——. C. E. Arnold, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,195,431, Aug. 22, 1916. Date of appl., Feb. 3, 1915.

About 150 parts of celluloid scrap and 200 parts of a volatile solvent are mixed in a tumbling drum which is rotated at approximately the minimum rate necessary to impart a constant flow to the jelly produced, *i.e.*, about two revolutions per minute.—F. Sp.

Waterproofing the soles of footwear [with cellulose acetate]. A. V. St. Armande, Nitshill, Renfrew. Eng. Pat. 12,839, Sept. 8, 1915.

A layer of cellulose acetate, to which may be added a little β-naphthol as a germicide, is inserted between the inner and the outer sole of a boot or shoe.—J. F. B.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Patents.

Cotton fabrics; Process for imparting novel effects to ——. Heberlein & Co., Wattwil, Switzerland. Eng. Pat. 100,483, May 1, 1916. (Appl. No. 6218 of 1916.) Under Int. Conv., May 19, 1915.

Transparent and wool-like effects on cotton fabrics are obtained by alternate and repeated treatment with alkali-lye of over 15° B. (sp.gr. 1·116) and sulphuric acid of over 48° B. (sp.gr. 1·498). The sulphuric acid may be replaced by phosphoric acid of 55° to 57° B. (sp.gr. 1·616—1·652), hydrochloric acid (sp.gr. 1·19) below 0° C., nitric acid of 43° to 46° B. (sp.gr. 1·424—1·468), or zinc chloride solution of 66° B. (sp.gr. 1·843) at 60°—70° C. The fabric may be subjected to longitudinal or transverse tension during treatment, and pattern effects may be produced by printing with the acid or alkali or with a resist.—F. W. A.

Patterns and woolly effects on fabrics: Production of ——. E. Zeidler, Guntramsdorf, Austria. Ger. Pat. 293,400, Apr. 21, 1914. Under Int. Conv., Mar. 30, 1914.

Union fabrics are printed with reserves which are capable of destroying one of the two kinds of fibres present, and woolly effects are produced on the unreserved parts of the fabric by raising the nap in the usual manner. The material is then subjected to a high temperature to cause the reserve to exert its destructive action, and thoroughly washed. For destroying the vegetable fibre a suitable reserve consists of a mixture of 200 parts of sulphuric acid of 66° B. (sp.gr. 1·84) and 800 parts of dextrin thickening (2 of dextrin to 1 of water); and for destroying the animal fibre, a mixture of 600 parts of caustic soda of 40° B. (sp.gr. 1·38) and 600 parts of dextrin thickening (2 : 1). When the latter is used, dextrin, glucose, glycerin, or gelatin should be added to the wash water to prevent damage of the animal fibre in the unreserved parts. Dyestuffs, etc., may be added to the reserve to colour the fibres which are not destroyed.—A. S.

Hairs, furs, skins, or the like; Process of dyeing dead or living ——. F. Fresenius and A. Zimmer, Frankfort. Ger. Pat. 293,232, Dec. 23, 1914. Addition to Ger. Pat. 291,138.

In the process described in the chief patent (this J., 1916, 834), ammonium molybdate solution was used in conjunction with aromatic hydroxy or amino compounds and metallic salts. It has since been found that other compounds of molybdic acid, *e.g.*, potassium or sodium molybdate, may be used in place of the ammonium salt.—A. S.

Trisazo dyestuffs: Preparation of green substantive —— [on the fibre]. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,358, July 11, 1915. Addition to Ger. Pat. 288,278 (see Eng. Pat. 8996 of 1915; this J., 1915, 1136).

Secondary disazo dyestuffs formed with a 1-aminobenzoylamino-8-naphtholsulphonic acid as an end component, are converted on the fibre into fast green trisazo dyes either by diazotising and coupling with a pyrazolone derivative, α-methylindole, or a compound containing a $CO.CH_2.CO$ group, or by treatment with a suitable diazo compound.—A. S.

White or coloured reserves in printing with chrome colours. Durand, Huguenin et Cie. Ger. Pat. 293,359, July 13, 1915.

The material is printed first with a reserve containing a reducing agent and citrate, and also some "Blandola" (pure vegetable gelatin) and then with a paste containing the colour and mordant, and is afterwards steamed for a short time and thoroughly washed. The process is applicable with gallocyanines and their leucoderivatives and bisulphite compounds, and the bisulphite compounds of Alizarin Blue and Coerulein.—A. S.

Azo dyes on the fibre: Process of producing yellow insoluble ——. E. Hoffa, Assignor to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,197,633, Sept. 12, 1916. Date of appl., June 15, 1915.

See Eng. Pat. 8189 of 1915; this J., 1916, 466.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Saltpetre; The reciprocal salt-pairs $KCl + NaNO_3 \rightleftarrows KNO_3 + NaCl$, and the preparation of "conversion" ——. W. Reinders. Z. anorg. Chem., 1915, 93, 202—212. Chem.-Zeit., 1916, **40**, Rep., 305.

Conditions for the separation of the single salts in the equilibrium $KCl + NaNO_3 \rightleftarrows KNO_3 + NaCl$ were obtained by a graphical method. At 5°, 50°, and 100° C., the solubility of sodium nitrate rises with an increase of potassium nitrate. In practice, for the preparation of potassium nitrate, a slight excess of sodium nitrate is desirable; and, after heating at 100° C. and removing the sodium chloride, the addition of water prevents the separation of sodium chloride with the potassium nitrate and saves subsequent washing. —F. Sodn.

Ammonium nitrate; Action of —— *on potassium chlorate.* R. Salvadori. Annali Chim. Appl., 1916, **6**, 115—118.

When a mixture of potassium chlorate and ammonium nitrate is heated at atmospheric pressure, reaction begins at about 120° C. and proceeds uniformly throughout the mass, a residue of potassium nitrate being left; during the decomposition a yellow liquid distils over, probably nitrosyl chloride. Calorimetric investigation of the reaction showed that the thermal effect per 1 grm. of ammonium nitrate is 1080 calories in the Thomson calorimeter and 1550 calories in the Mahler bomb. The solid residue in both cases is potassium nitrate, and the difference is due to differences in the mode of decomposition of ammonium chlorate in the two cases. The thermal effect due to the decomposition of 1 grm. of ammonium chlorate in the Mahler bomb is 698·5 calories. At 90° C. ammonium chlorate decomposes according to the equation:

$$NH_4ClO_3 = NOCl + 2H_2O; \text{ with}$$
$$NOCl + H_2O = HNO_2 + HCl$$

as a secondary reaction. At high temperatures the reaction: $2NOCl + H_2O = 2HCl + NO + NO_2$, takes place.—A. S.

Sodium nitrate industry in Chile. Oil, Paint, and Drug. Rep., Sept. 25, 1916.

The production and exportation of sodium nitrate from Chile continues to increase, the figures for the year ended June 30, 1916, being 70% in excess of those for the preceding year, though still somewhat lower than before the war. Production in 1915—1916 amounted to 57,715,614 Spanish quintals and exports to 55,285,814 quintals, compared with 62,322,617 and 58,751,291 quintals respectively in 1913—1914. Production in June, 1916, amounted to 5,153,701 quintals. Prices have not varied much recently, having been about 7s. 6d. per quintal for the 95% product, immediate delivery.

Iodine in Stassfurt sylvine and carnallite. L. W. Winkler. Z. angew. Chem., 1916, **29**, 342—343.

Many samples of Stassfurt sylvine and carnallite contained no iodine, whilst others contained small amounts ranging from 1·5 to 73·1 mgrms. per kilo. —C. A. M.

Iodine and starch iodide in aqueous media; Action of X-rays on ——. H. Bordier. Comptes rend., 1916, **163**, 291—293.

The action of X-rays on aqueous solutions of iodine and iodide of starch is analogous to that of light previously studied (this J., 1916, 962). The phenomena of decolorisation observed after some hours' exposure to light rays have been explained as the result of the ionising action of the violet and ultraviolet rays on the colloidal pseudo-solutions, and it is noted that the far more powerful ionising action of X-rays produces the same effect in a few minutes.—J. F. B.

Use of solutions of ammonium salts for the treatment of wood. Moll. *See* IX.

Quantitative analysis of antimony trisulphide and the products obtained from it by roasting. Von Bacho. *See* X.

"Marine kainit." *See* XVI.

Investigation of the chief methods of detecting hydrocyanic acid. Anderson. *See* XXIII.

Recovery of molybdic acid and ammonium nitrate from the residues from phosphoric acid determinations. Grete. *See* XXIII.

Titrimetric studies. [*Titration of hydrogen peroxide and hydrogen sulphide.*] Enell. *See* XXIII.

Patents.

Nitric acid; Process of concentrating ——. F. C. Zeisberg, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,197,167, Sept. 5, 1916. Date of appl., Oct. 15, 1914.

Nitric acid and a dehydrating agent, such as sulphuric acid, are continuously passed into a chamber, from which the nitric acid is driven off by contact with steam from a boiling solution of the dehydrating agent or from weak nitric acid previously concentrated by the process. The diluted sulphuric acid is continuously removed, the nitric acid vapour condensed, and the residual oxides of nitrogen recovered by absorption in water.—F. Sodn.

Sulphuric acid [and cement]; Manufacture of ——. L. P. Basset, Paris. U.S. Pat. 1,197,331, Sept. 5, 1916. Date of appl., July 5, 1916.

A mixture, comprising clay and a material containing calcium sulphate, is heated sufficiently to produce cement and gases containing sulphur dioxide. The latter, mixed with air, are passed into contact with a catalytic substance, comprising natural hydrated iron oxide mixed with gypsum. The sulphur trioxide is removed, and the unconverted sulphur dioxide is absorbed in a calcareous material suitable for use in the production of cement.—B. N.

Hypochlorous acid; Manufacture of ——. W. N. Haworth and J. C. Irvine, St. Andrews, Fife. Eng. Pat. 12,912, Sept. 9, 1915.

Chlorine is passed into water containing a catalyst, which is preferably a salt or oxide of copper, but may also be a nickel or cobalt salt. The mixture is placed in a series of bottles which are agitated on a shaking machine, and the chlorine, derived from the liquid element, is passed through the inlet tube of each series. The resulting liquid, which contains about 2% of hypochlorous acid, may be freed from dissolved copper by precipitation, or by distilling off the acid. For each bottle of 1¾ litres capacity, from 80—100 grms. of catalyst is used, but in the case of copper oxychloride only 10 grms. is necessary.—E. H.T.

Acetic acid and the like; Process for distilling ——. A. Bräuer, Assignor to Chem. Fabr. Grünau, Landshoff u. Meyer A.-G., Grünau, Germany. U.S. Pat. 1,196,329, Aug. 29, 1916. Date of appl., Mar. 28, 1916.

Acetic acid is prepared by covering the surface of a heated rotating surface evaporator with a mixture of an acetate and sulphuric acid, and scraping off the solid residue which remains after the acetic acid has evaporated, before a fresh supply of the mixture is taken up.—F. Sp.

Sodium thiosulphate; Manufacture of ——. W. S. Hutchins, L. Hargreaves, and A. C. Dunningham. Middlewich, Cheshire. Eng. Pat. 12,599, Sept. 2, 1915.

In the manufacture of sodium thiosulphate from sodium sulphite and sulphur, the latter and the water are used in such proportions that they yield a thiosulphate solution which can be at once crystallised without evaporation. By using a small or a large excess of either material, or of both, the time of digestion is reduced by about one-half, and the excess can be used over again after removal and washing. Excess of sulphite remains undissolved in the concentrated thiosulphate solution. If an excess of sulphite and of sulphur be used alternately, the excess of soluble and insoluble impurities can also be removed alternately. The process may be rendered continuous by passing a hot solution of sulphite through an intimate mixture of solid sulphite and sulphur: and it may be accelerated by adding small amounts (about 1% by bulk) of hydroxides or sulphides of alkali or alkaline-earth metals, any excess of sulphide or polysulphide being afterwards removed by treatment with sulphurous acid or bisulphite. Instead of sodium sulphite, hydrated carbonates, or a mixture of anhydrous and hydrated carbonates, together with sulphur dioxide or sodium bisulphite may be employed.—E. H. T.

Nitre cake; Utilisation of ——. J. Grossmann, Manchester. Eng. Pat. 12,832, Sept. 8, 1915.

Caustic soda and purified sodium sulphate are obtained from nitre cake by the following series of reactions:—I. $(3Na_2SO_4+H_2SO_4)+2CaSO_3=2NaHSO_3+2CaSO_4+2Na_2SO_4$. The calcium sulphate is removed, and lime is added with agitation: II. $2NaHSO_3+2Na_2SO_4+Ca(OH)_2=Na_2SO_3+CaSO_3+2Na_2SO_4+2H_2O$. The calcium sulphite is removed and more lime added:—III. $Na_2SO_3+CaSO_3+2Na_2SO_4+2H_2O+Ca(OH)_2=2NaOH+2CaSO_3+2Na_2SO_4+2H_2O$. During reactions II. and III. (which may be combined in one operation), heat may be applied and also an augmented pressure. The calcium sulphite is removed, washed, and used over again; the caustic liquor is evaporated until the sodium sulphate crystallises out, and after its separation, the liquid is further evaporated, if necessary, to dryness. The apparatus for I. is a leaden tank provided with a cover and a stirrer; that for II. and III. is similar, but means for applying heat is added. (See also this J., 1916, 155.)
—E. H. T.

Mineral silicates; Method of treating ——. [*Extraction of aluminium and potassium.*] J. C. W. Frazer, W. W. Holland, and E. Miller, Baltimore, Md. U.S. Pat. 1,196,734, Aug. 29, 1916. Date of appl., May 10, 1916.

Aluminium and potassium are extracted from felspar or other mineral silicates by heating a dry intimate mixture of the silicate with caustic alkali to between 185° and 300° C., treating the product with water to remove the soluble alkali silicate formed, and extracting the residue first with an amount of acid equivalent to the water-insoluble alkali silicate which it contains, and afterwards with an amount of acid equivalent to the aluminium. The latter extract is evaporated to dryness, heated, and treated with water, to separate the soluble aluminium salt from the insoluble silica.—F. Sp.

Alkali-metal compounds; Process of extracting ——. H. B. Slater, Riverside, Cal. U.S. Pat. 1,197,556, Sept. 5, 1916. Date of appl., May 16, 1912.

A mineral containing potash is leached with a solution of ferric chloride containing an oxychlorine compound, such as hypochlorous acid. When iron is present in the mineral the leaching solution may be prepared by first extracting it with hydrochloric acid, electrolysing the resulting solution in the presence of sodium chloride, so as to produce ferric chloride and a cathode liquor containing sodium hydroxide, and then further electrolysing in presence of some of the cathode liquor.
—F. Sodn.

Magnesium chloride [and precipitated calcium carbonate]; Process of making ——. R. C. Lord, Cincinnati, Ohio. U.S. Pat. 1,197,512, Sept. 5, 1916. Date of appl., Oct. 15, 1915.

Gas containing less than 30% of carbon dioxide is passed through a scrubber in which it is exposed to a suspension of magnesium hydroxide in calcium chloride solution, which preferably gravitates as a counter-current through the interstices of broken filling material in the scrubber.—F. Sodn.

Cobalt oxides; Electrolytic process for the extraction of ——. K. S. Guiterman. New York. U.S. Pat. 1,195,211, Aug. 22, 1916. Date of appl., Aug. 26, 1915.

A solution containing a soluble chloride and nickel and cobalt salts is electrolysed, and during the action the electrolyte is passed downwards over the anode, at a velocity permitting the retention of the liberated chlorine as a hypochlorite. The latter reacts with the cobalt solution, in the presence of an agent preventing the formation of free acid in the solution.—B. N.

Hydrogen peroxide; Manufacture of ——. F. Cobellis, Philadelphia, Pa. U.S. Pat. 1,195,560, Aug. 22, 1916. Date of appl., Aug. 23, 1915.

Hydrogen peroxide is produced by the decomposition by heat of ammonium persulphate in a solution containing ammonium persulphate and bisulphate. The process is applied continuously by electrolysing a solution of ammonium sulphate at a comparatively low temperature, so as to form ammonium persulphate, heating the solution under pressure in order to form ammonium sulphate and hydrogen peroxide, and finally distilling off the hydrogen peroxide under reduced pressure in a current of inert gas. The residual solution of ammonium sulphate can then be put through the same cycle of operations again.—F. Sp.

Hydrogen: Manufacture of pure ——. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat 12,698, Sept. 4, 1915.

Hydrogen prepared by passing steam over heated iron previously reduced from its oxide in a current of water-gas, or other commercial reducing gas, contains considerable quantities of carbon monoxide, due to the deposition of carbon during the reduction and its subsequent oxidation by the steam. Hydrogen free from carbon monoxide is obtained by employing for the reduction of the iron oxide a reducing gas containing substantially more carbon dioxide than carbon monoxide, a suitable ratio being 2 : 1. This may be obtained by adding carbon dioxide to water-gas, or by suitable modifications in the manufacture of the reducing gas, but dilution of the gas with nitrogen (*e.g.*, by partial combustion of the gas with air) or by steam must be avoided. The presence of carbon dioxide in the reducing gas prevents the deposition of carbon during the reduction of the iron oxide to iron, and therefore no carbon monoxide is formed when steam is passed over the heated iron to produce hydrogen.—F. Sp.

Alkali-metal compounds [*sodium amide*]; *Process for the manufacture of* ——. E. A. Ashcroft, London. U.S. Pat. 1,197,329, Sept. 5, 1916. Date of appl., Mar. 12, 1912.

See Eng. Pat. 1002 of 1912; this J., 1913, 232.

Utilisation of Mond gas and recovery of by-products [*ammonium nitrate*] *therefrom.* Eng. Pat. 14,391. *See* IIa.

VIII.—GLASS; CERAMICS.

Refractive index and dispersion of glass in lenticular and other forms; A new method of measuring ——. R. W. Cheshire. Phil. Mag., 1916, **32**, 409—420.

The methods commonly used for accurately determining the refractive index of glass require the material to be in the form of a prism. When the glass is lenticular it is also possible to measure the focal length, the radii of curvature, and the axial thickness at the vertex, but with small lenses this method is not accurate beyond the third decimal place. A new method consists in immersing the glass in an aqueous solution of mercury potassium iodide, the refractive index of which is adjusted until it agrees with that of the test-piece, and then determining the refractive index of the liquid in a refractometer. The accuracy of this method is sufficient to give five significant figures. Light from a sodium flame illuminates a straight edge in a slit 1 mm. wide, an image of this edge being projected through a telescope objective into the plane of a second straight edge which is placed in front of an observing telescope. The glass to be tested and the immersion fluid are contained in a small rectangular glass cell having a carefully planed base plate, 2 mm. thick, made of extra dense flint glass for which $n_D = 1{\cdot}74$, and closed above by an air-tight plate to prevent evaporation and the formation of striæ. The cell is adjusted on the prism of a refractometer in the usual manner so that the refractive index of the liquid may be rapidly determined. The cell is placed between the objective and the observing telescope and the latter is focussed on the test-piece. If the refractive indices of the test-piece and the fluid differ, the image of the first straight edge will appear double, and on traversing the second straight edge slowly across the field of vision of the observing telescope the surface of the test-piece will gradually darken whilst the side facets and the rest of the cell will show up brightly. On continuing the movement of the straight edge, these facets will also begin to darken until the whole field is black. When the refractive indices of the liquid and the test-piece are identical, the movement of the straight edge will cause the whole field to darken simultaneously and uniformly.

It has not been found possible to determine the refractive indices of glass for lines other than the D (sodium) line with the same degree of accuracy, but good results may be obtained by using coloured filters for lines C and F, and a mercury vapour lamp or a cadmium arc for measurements of partial dispersions.—A. B. S.

Quartz glass apparatus for bacteriological and surgical work. T. Paul. Münch. med. Wochenschr., 1916, **63**, 1260. Chem.-Zeit., 1916, **40**, Rep., 318.

Pipettes, graduated flasks, and other measuring apparatus made of clear quartz glass are recommended particularly for bacteriological work and for the preparation of sterile solutions, as they may be rinsed and then immediately placed in a gas flame and sterilised. Quartz glass apparatus is also useful for storing metallic colloid suspensions which would be spoiled by withdrawing alkali from ordinary glass. For the production of specially pure distilled water a retort and condenser made of quartz glass are recommended. —A. B. S.

Patents.

Glass-melting receptacles. S. R. Scholes, Pittsburgh, Pa., U.S.A. Eng. Pat. 101,393, May 5, 1916. (Appl. No. 6490 of 1916.)

A glass-pot made of the customary mixture of raw clay and burned clay, with or without ground pot shell, and preferably containing about 1 % of alkali, is lined with a similar mixture containing 2 % of alkali, preferably in the form of felspar. —A. B. S.

Refractory articles: Manufacture of ——. T. B. Allen, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,197,327, Sept. 5, 1916. Date of appl., Nov. 29, 1913.

Refractory silicon carbide articles are manufactured by incorporating ferric chloride solution with a mixture of silicon carbide and clay, then shaping the article and firing at a temperature sufficient to decompose the ferric chloride. The resulting iron oxide is vitrified with the clay, at or adjacent to the surface.—B. N.

Refractory [*material*]; *Corrosion-resisting* ——. P. R. Hershman, Chicago, Ill. U.S. Pat. 1,198,033, Sept. 12, 1916. Date of appl., Aug. 9, 1915.

A refractory material which resists corrosion is made of aluminous material and carbon, the latter being in too small a proportion to convert the whole of the aluminium into carbide. The material is burned at a temperature sufficiently high to render it inert to hydrofluoric acid.—A. B. S.

Firebricks; Composition of matter for making ——. *Plastic composition* [*for sewer-pipe, tiles, etc.*]. E. V. Wagner, Scranton, Pa., Assignor to The Wagner Fire Brick Co., Helena, Mont. U.S. Pats. (A) 1,198,171 and (B) 1,198,172, Sept. 12, 1916. Date of appl., Jan. 8, 1916.

(A) A mixture of coal-ash 100 lb., magnesia 3 lb., water 2—2½ gallons, is used for making firebricks. (B) A mixture of coal-ash 0·98 cb.yd., crude fibrous asbestos 0·01 cb.yd., soluble sodium silicate 0·01 cb.yd., and water 30—35 galls. is mixed, moulded, and burned to form sewer-pipes, tiles, etc.—A. B. S.

IX.—BUILDING MATERIALS.

Ammonium salts; Use of solutions of —— for the treatment of wood. F. Moll. Z. angew. Chem., 1916, **29**, 339—341.

An outline, with lists of patents, is given of the different processes of treating wood with ammonium salt solutions. Their only value as preservative agents is to protect wood against fire; for this purpose the sulphate and phosphate are most frequently employed. Ammonia is also of value as a mordant for staining wood and for the extraction of resins. For other purposes the activity of ammonium salts is too slight to be of value.—C. A. M.

Patents.

Drying and extracting [*wood*]; *Process of* ——. D. B. Banks, Baltimore, Md. U.S. Pat. 1,197,097, Sept. 5, 1916. Date of appl., Apr. 19, 1915.

To separate liquids or fusible substances from cellular, fibrous, or porous substances, *e.g.* wood, the latter is heated in an enclosed shell with saturated steam to the boiling point of the liquids at the pressure of the steam, preferably in presence of substances which more readily absorb and radiate heat. The pressure and temperature of the steam is continuously lowered so as to produce internal evaporation in the cellular substances until the liquids have been expelled. The condensed products are removed from the shell, and the wood dried and seasoned by maintaining an atmosphere of superheated steam in contact with it.—W. F. F.

Wood; Process of treating and preserving ——. A. F. Barry, Kansas City, Mo. U.S. Pat. 1,197,997, Sept. 12, 1916. Date of appl., Apr. 19, 1915.

Case-hardened and non-porous wood is heated *in vacuo* and supplied with a predetermined amount of water vapour below 100° C. in such a manner that the vapour penetrates the wood uniformly without breaking the vacuum or "checking" the wood. The wood is then treated with a hot preserving oil and air admitted under pressure to distribute the oil through the wood.—A. B. S.

Wood; Impregnated —— and process of making the same. M. Landau, Berlin. U.S. Pat. 1,198,010, Sept. 12, 1916. Date of appl., Nov. 13, 1914.

Wood is impregnated with polynitrophenols in which the hydrogen of the phenol groups has been replaced by non-basic, non-aromatic organic groups.—A. B. S.

Manufacture of sulphuric acid [*and cement*]. U.S. Pat. 1,197,331. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron: Polymorphic transformations of pure ——. R. Ruer and F. Goerens. Ferrum, 1915, **13**, 1—6. J. Chem. Soc., 1916, **110**, ii., 483—484.

Electrolytic iron, containing only 0·009% of carbon, was used for the determinations, after being melted in a porcelain tube in nitrogen. By means of a platinum-wound electric resistance furnace, thickly insulated with asbestos, the rate of cooling over a given temperature interval was varied within wide limits. In order to prevent oxidation, the mass of iron was enclosed in a porcelain test-tube and covered with broken porcelain to the top of the tube, and a slow stream of nitrogen was introduced by means of a gas-tight joint. The iron was found to freeze at 1528° C., and to undergo the γ–δ-transformation at 1401°C. The temperature of the β–γ-equilibrium was 906° C., determined by comparing the heating and cooling curves at different rates. In the same way, the temperature of the α–β-equilibrium was determined to be 769° C. There was no evidence of a change between 1000 and 1200° C., the development of heat sometimes observed within that range being due to the presence of oxide.

Carbon steels: Determination of the α–β-transformation in pure —— by means of the thermal expansion. J. Driesen. Ferrum, 1915, **13**, 27—31. J. Chem. Soc., 1916, **110**, ii., 484.

On plotting the change of length for a given interval of temperature, $L_2—L_1/t_2—t_1$, against the temperature, characteristic curves are obtained which are well suited to exhibit any discontinuities which may present themselves in the expansion of a steel. All the steels examined, ranging from 0·05 to 1·45% C, give an almost horizontal line at low temperatures, followed by a rapid fall, which reaches a minimum at 745° C. This corresponds with the conversion of the pearlite into a solid solution. The steels containing less than 0·40% C then exhibit a well defined maximum at 765°—775°C., corresponding with the α–β-transformation. The maximum which follows indicates the beginning of the β–γ change. Steels containing more than 0·4% C give curves with only a single depression, due to the pearlite change.

Steel; Influence of some elements on the mechanical properties of ——. J. E. Stead. Iron and Steel Inst., Sep., 1916. [Advance proof.] 91 pages.

Influence of carbon. The results obtained by different investigators in determining the influence of varying amounts of carbon and of varying heat treatment on the mechanical properties of pure carbon steels are summarised. Comparison is difficult owing to the fact that in some cases the dimensions of the test-pieces submitted to tensile tests are not always given. It is suggested that when recording the elongation, the ratio of length to area should invariably accompany the figures, for without this the percentages of elongation are of little value. The yield point is often given as the elastic limit, yet the latter may be in some cases only half the former. When using the terms normalising or annealing, the temperature of heating and the time of cooling to below visible redness should be recorded. Neither term should be used without definition. After allowing for the influence of the small amount of carbon present in the purest commercial soft steels, it has been calculated that pure iron has the following properties:—elastic limit about 9 tons per sq. in.; maximum stress 17 tons per sq. in.; elongation (length/area = 8) 51%; reduction in area 84%. The effect of 0·1% C on very pure steels containing less than 0·9% C, with only small amounts of manganese and silicon, and in the normalised condition, appears to be:—yield point increased 1·68 tons per sq. in.; maximum stress increased 3·89 tons per sq. in.: elongation reduced 4·35%; reduction of area reduced 7·40%. In the manufacture of ship and boiler plates the carbon must be higher in the thicker plates to get the same static tests, since the more work, and the lower the finishing temperature, the higher will be the tenacity. *Normalising.* When steel is heated to definite temperatures well above all critical points, the carbon and iron become perfectly interdiffused. If then the steel cools down from the maximum temperature to below redness (say 450° C.) in not more than sixteen and not less than eight minutes it may be regarded as normalised. Published results lead to the conclusion that when small pieces of steel are normalised by heating just up to 870° C. and 950° C., and then cooled in air to about 400° C. in ten minutes, high yield point and tenacity are obtained without material reduction in the ductility. In normalising large steel castings it is the general practice to heat to about 900° C., but it is clear that the tests of small pieces of steel cast in connection with large castings will not indicate the properties of the larger mass. To obtain the best static mechanical properties it is not sufficient to heat a steel to just above the point at which cooling records and the microscope indicate the interdiffusion of carbon and iron to be apparently complete, but the temperature must be raised at least 50° C. beyond that point. *Hardening and tempering.* The best all round results obtained by Brinell with Swedish steels containing 0·18 to 0·44% C were got by quenching from 1000° C. in water at 20° C., and afterwards tempering at 650° C. A steel with 0·65% C gave the best results by quenching at 850° C. in oil. There would be great danger of water-cracking if large masses were quenched from 1000° C. in water; oil quenching at 1000° C. for low carbon steels, and 850° C. for steels with 0·3 to 0·65% C, followed by tempering, would be safer, and it is probable that better results would be given by quenching from 900° C. For low carbon steels with 0·2 to 0·4% C, it is safe to heat to, but not soak at, 900° to 950° C. before quenching and tempering, and to heat to gradually lower temperatures as the carbon rises. When hardening plain carbon steels for cutting purposes, the quenching temperature should never exceed a few degrees above the critical point Ac 1-2-3, that is, about 730° C. For hardening razors and fine cutting tools, the theoretical point to which they should be heated is 735° to 740° C., but in practice it is found safer to exceed this, though it is not usual to heat such material above 760° C. Carbon tool steels if quenched from 900°—1000° C. would be useless for cutting purposes, and would have a glaring coarse fracture when broken, and be exceedingly fragile, yet steels with 0·6 to 1% C give good mechanical results if hardened at 1000° C. and afterwards tempered at 550° C. Tests have shown that steels normalised at temperatures that give the finest structure have a lower yield point than steels that are normalised at much higher temperatures and which have a coarser structure. The temperatures suitable for hardening and refining are, therefore, lower than those best for normalising, and for hardening and tempering. Curves are given showing the temperatures to which, theoretically, in the author's opinion, pure carbon steels should be heated (1) to obtain the finest structure and for hardening tools, and (2), when heated for oil hardening and tempering to get the best mechanical properties. *Influence of phosphorus.* The effect of phosphorus, within certain limits, appears to be comparable with that of carbon, but the effect of carbon is the greater in reducing the ductility. The effect of 0·1% P as determined by Stead and d'Amico respectively is :—yield point raised 2·5 and 2·3 tons; maximum stress raised 2·4 and 4·1 tons; elongation reduced 0·7 and 1·36%; reduction reduced 1·5 and 3·8%. A certain amount of carbon (about 0·25 to 0·35%), when present in steel containing 0·2 to 0·5% P, causes the steel in setting to be much more finely crystalline than when phosphorus is absent, but the reverse is the case when little or no carbon is present. In the forged steels the crystalline structure is usually the finer in the phosphoretted steel. There is no reliable record showing that sound steel rails containing from 0·07 to 0·09% P break on the track more frequently than those containing less phosphorus. Phosphoretic rails undoubtedly resist wear better than the similar rails with less phosphorus present. Phosphoretic steel is most useful in small amount in tin-plate bars, as it prevents the sheets sticking together during rolling, and it is used in larger quantity in low carbon steel for bicycle parts. It confers on steel the important property of giving clean and bright surfaces when turned in the lathe, and moreover increases the elastic limit and tenacity. The quantity required to give good machining property is usually from 0·13 to 0·20%. Phosphorus alloyed with iron makes the metal less liable to corrode, and in that respect is useful. Probably the great variations in the mechanical properties of phosphoretic material can be explained by the difference in structure, for it has been proved that the same steel or iron can be made very brittle or comparatively tough according to whether the structure has been made fine or coarse. It is much more important to have a fine structure in phosphoretic material than it is in ordinary steel low in phosphorus. *Phosphorus in wrought iron.* Although wrought iron containing 0·4 to 0·5% P is liable to develop dangerous crystallisation if highly heated, and in the neighbourhood of welds, the presence of 0·10 to 0·15% P does not lead to that result. The best Yorkshire and Staffordshire irons contain phosphorus between these lower limits, and for structural purposes are superior to the best Swedish wrought irons, as the phosphorus in the former raises the elastic limit and makes the iron more easy to weld, and gives a higher yield point and tenacity. Carbon being always low, the phosphorus takes its place in conferring on the iron these useful properties. When the phosphorus reaches 0·4 to 0·5% the iron becomes brittle, and it is impossible to refine the coarse crystalline structure by heat treatment. Refining of the iron can only be effected by forging. *Influence of sulphur and manganese.* Sulphide of iron is deadly in its effect upon steel, whilst sulphide of manganese is comparatively harmless. The latter is exactly equivalent to the cinder in wrought iron, and in consequence steels containing it bend to a much greater extent in the direction of rolling than at right angles to that direction. The bad character of sulphur was earned in the early days of steel making owing to the difficulty of getting a sufficient quantity of manganese into the steel without unduly raising the carbon. In a most exhaustive series of tests made by Brinell a steel with 0·15% S gave the best impact tests, better far than a similar steel containing only 0·015% S. A steel containing 0·5% S and 1% Mn rolled and worked perfectly. When steel becomes stressed transversely to the rolling direction in use, the sulphur should be low, but when it is stressed in line with the rolling direction, as in rails and axles, and for material that has to be submitted to sudden shock, sulphur is not a disadvantage. Steel high in sulphur resembles wrought iron and is more or less fibrous. The more sulphurous a steel, other conditions being constant, the more rapidly is it attacked by acid solvents, owing to the great solubility of the manganese sulphide. After the threads of the latter are dissolved away, the acid attacks the walls of the holes so produced. The so-called porosity test, in which cross-sections of steel are immersed in acid for a given time, is a suitable one for roughly detecting sulphur, but not porosity. It is possible that high sulphur may be conducive to increased corrosion by the oxidation of the manganese sulphide to oxides of manganese and sulphuric acid, the acid formed then attacking the iron. *Influence of silicon.* The effect of silicon up to about 0·7% is not very pronounced either one way or the other, and it is doubtful whether any difference could be detected in steels varying in silicon between 0·05 and 0·30%. Silicon produces soundness in cast steel and on that account is now largely used. Owing to its use, also, basic open-hearth steel now approaches more nearly in good general properties to acid open-hearth steel than before silicon was added. Silicon up to 1·75% increases the yield point and tensile strength, and does not impair the ductility, but beyond that point increase of tenacity is only obtained with a serious loss of ductility. *Influence* *of copper.* The evidence is overwhelming that small quantities of copper, say about 0·5 %, have little or no material influence on the mechanical properties of steel. What small effect copper has is in its favour. It raises the yield point and tensile strength and has little effect on the ductility. Some of the finest tool steel ever made contained 0·2 % Cu. Even small quantities of copper make steel more resistant to acid corrosion, and there is much evidence that copper in steel sheets preserves them from general corrosion. *Influence of tin.* Sensible quantities of tin increase the hardness of steel when heated and also increase the yield point and maximum stress of the cold metal, but have not nearly so great an effect as carbon and phosphorus. It is doubtful whether 0·05 % Sn would have any material influence on the properties of structural steel. Detinned scrap should not contain more than 0·5 % Sn as a maximum. Results of tests show that tin in sensible quantity must be avoided, as it tends to make steel very difficult to roll, and hard and stiff when in the heated state. A bibliography is appended.—T. St.

[*Steel.*] *Pearlite ; Notes on* ——. H. M. Howe and A. G. Levy. Iron and Steel Inst., Sept., 1916. [Advance proof.] 23 pages.

Test-pieces of a steel containing C 0·92, Si 0·14, Mn 0·123, P 0·009, S 0·011 % were heated to a predetermined temperature, usually 800° or 900° C., and cooled immediately at a predetermined rate, which varied from case to case from that of a greatly retarded furnace-cooling to that of quenching in cold water. The effects of these variations on the position, length, and rise of Ar 1, and on the properties and microstructure of the steel were studied. Hastening the cooling lowers that part of the Ar 1 retardation at which the heat evolution is fastest, from the equilibrium position of about 725° C. at least to 625° C. if not to 530° C. Raising the initial temperature from 800° to 900° C. lowers Ar 1 slightly, about 5° C. Hastening the cooling at first increases the rise of temperature in Ar l, but later lessens it. Thus with very slow cooling and consequently an extremely long Ar 1, the rise of temperature is either *nil* or at most 1° or 2° C. ; when Ar 1 is shortened to about 5 minutes, a rise of as much as 4° C. may occur ; with further acceleration of cooling, as in retarded air-cooling, the rise of temperature may reach 18° C., and finally with still further acceleration, as when cooling in a blast of air or in water, the rise decreases in turn to *nil.* On the whole, for a given rate of cooling, the rise of temperature is greater when cooling from 900° C. than from 800° C. These variations are explained by the higher temperature and longer period of the initial heating tending to impair and destroy the existing transformation-starting nuclei, and by the undercooling brought about by quick cooling. Moreover, the faster the temperature is falling, the farther will it have fallen (after the transformation has begun) when the spread of the transformation has reached such a degree that the heat generated is sufficient measurably to retard the cooling. The greater the undercooling below Ac1, the greater is the impulse to transform from the high to the low-temperature state ; hence the greater is the number of points or nuclei at which this tendency is so strong that they start transforming, and hence (1) the faster does the transformation occur, and (2) the greater is the tendency to raise the existing temperature towards Ac1. When, however, the faster heat evolution is brought about by more rapid cooling, the more rapid external heat absorption which this in turn implies, tends to counteract the raising of the temperature. The following stages in the progressive change in the microstructure brought about by changing the rate of cooling may, it is considered, be recognised with advantage :—martensite, troostite, osmondite, sorbite, sorbitic pearlite, sub-lamellar pearlite, lamellar pearlite, reefy pearlite, beaded pearlite, and granular pearlite. The authors propose to restrict "sorbite" to structures irresoluble under a magnification of 500 diameters, and to those in which the transformation is complete, so that no allotropic iron or hardening carbon is present. The grounds on which the suggested nomenclature is based are discussed. The rate of cooling from 650° C. down does not affect the microstructure or the tensile properties unless the cooling as far as 650° C. has been at least relatively rapid. With very slow cooling to 650° C. the opportunity for coalescence is so great that the additional opportunity afforded by very slow cooling below 650° C. is inappreciable, but with quick cooling above 650° C., followed by slow cooling, the additional opportunity for coalescence causes a measureable softening. The formation of lamellar pearlite is caused by an intermediate rate of cooling, slow enough to permit the lamellæ to form, yet not so slow as to allow them in turn to granulate. The rates of cooling which give and preserve lamellar pearlite are much greater when the preliminary temperature is 800° C., (20 seconds duration Ar 1), than when it is 900° C. (11 to 18 minutes for Ar 1). Lamellar pearlite formed on cooling from 900° C. is coarser and more stable than that formed by cooling from 800° C. The microstructure is in all cases determined by the last heating and cooling past Ar 1. Every increment of the rate of cooling increases the strength and lessens the ductility. Unless the rate of cooling is rather rapid, the tensile strength of specimens cooled from 800° C. is far less than that of those cooled from 900° C. This probably results from the greater instability of the pearlite produced on cooling from 800° C., "divorce" beginning when Ar1 lasts 35 seconds and being almost complete when it lasts 80 seconds. Specimens cooled from 800° C. are far more ductile than those cooled from 900° C. and their proportional limit is not deficient as is their tensile strength. These effects are referred provisionally to the finer structure of the former specimens. It is probable that long exposure to 800° C. would lead to the structural stability conferred by a brief exposure to 900° C.—T. St.

Manganese [*in steel*]; *Rapid determination of* ——. E. Szász. Chem.-Zeit., 1916, **40**, 810—811.

For the determination of manganese in steel the method of Meineke has almost fallen into disuse, yet in spite of the large number of reagents and vessels required, it is extremely simple in operation, and gives a result in 12—15 mins., which is sharp and accurate and unaffected by other metals present in the steel, with the exception of cobalt. The steel is dissolved rapidly in a mixture of nitric and sulphuric acids, chromic acid is added, a suspension of zinc oxide in barium chloride solution is added to the diluted solution, and an aliquot portion of the filtered liquid taken. In a separate vessel some zinc chloride solution and a calculated excess of standard permanganate are measured out and the portion of the filtrate from the steel poured in so that the permanganate is in excess throughout ; the mixture is made up to a known volume and another aliquot portion filtered off. This filtrate is added to a measured excess of standardised antimony chloride solution in presence of hydrochloric acid ; the permanganate is thus discharged, and the excess of antimony is determined by titration with permanganate. A correction has to be determined and applied to correct for the consumption of permanganate by the filter paper during filtration.—J. F. B.

Platinum and illuminating gas. F. Mylius and C. Hüttner. Z. anorg. Chem., 1916, **95**, 257—283. Z. angew. Chem., 1916, **29**, Ref., 396.

COAL gas has an injurious action on commercial sheet platinum even at 600° C., a sooty layer containing metal being formed. If the carbon be removed from this layer by combustion, the metal is left behind in a porous form. Synthetic illuminating gas (a mixture of methane, ethylene, carbon monoxide, and hydrogen) has no action on sheet platinum or platiniridium at 600° C. The injurious action of coal gas is due to carbon bisulphide which combines with platinum metals to form unstable compounds. The formation of the sooty layer on platinum in heated coal gas is greatly influenced by impurities in the platinum, especially iron and rhodium, and may be used as a qualitative test to distinguish pure and impure platinum; with rhodium interaction with the coal gas begins at about 100° C. Luminous flames act in a similar manner to heated coal gas, but flames with an abundant supply of air have only a slight injurious action, the only appreciable effect, in the case of pure platinum, being a slight volatilisation of the metal. To minimise corrosion of platinum vessels heated in gas flames, a high sulphur content in the gas must be avoided and the flame must be provided with an abundant supply of air. (See also this J., 1915, 853; 1916, 740.)—A. S.

Blendes; The roasting of ——. M. V. M. de Lummen. Chem. Trade J., 1916, **59**, 261—262. (See also this J., 1916, 425.)

THE relative merits of the Delplace, Hegeler, and Spirlet furnaces for roasting blende are considered, and the following particulars given of the plant required for roasting 40 tons of Australian concentrates per 24 hrs. by each system, and of the respective operating costs. The prices given for the installations are based on those ruling before the war; and the operating costs on wages at 5s. per man per day, fuel at 10s. per ton, power at 0·7d. per horsepower-hour, and an allowance of 15% for depreciation and interest on capital. *Delplace:* Cost of 3 batteries of furnaces (14 tons per day each), including buildings, accessories, and royalty, £9000. Labour, 50 men and 2 foremen. Fuel consumption, 12% of the weight of raw ore. Power, nil. Total cost of roasting per ton of ore, 10s. 3½d. *Hegeler:* Minimum cost of furnace, including £3000 for building and accessories, £15,000. Labour, 20 men and 2 foremen. Fuel consumption, 30%. Power, 35 H.P. Total cost of roasting per ton of ore, 12s. 3½d. *Spirlet:* Cost of 9 furnaces (5 tons each), including royalty and £2000 for building and accessories, £13,520. Labour, 16 men and 2 foremen. Fuel consumption, 10%. Power, 16 H.P. Total cost of roasting per ton of ore, 8s. 6½d.—W. E. F. P.

Brass containing 61 *and* 62·5% *of copper; Annealing of arsenical* ——. *A study of the structure and properties developed by varying the rate of cooling within the transformation range.* C. H. Mathewson and E. M. Thalheimer. Inst. of Metals, Sep., 1916. [Advance proof.] 48 pages.

TESTS were made for the purpose of selecting a brass mixture based on the use of copper containing about 0·3% As, and of specifying forms of heat treatment which would give satisfaction in the manufacture of heavy tube. The process was to involve hot-rolling a thick cake to a circular disc about one-half inch thick, annealing and then cupping the disc, after which tube was produced by a number of closing in and drawing operations, each preceded by annealing treatment. The mixture selected contained 62·5% Cu, and therefore not more than 0·16% As. Results of tests are given showing the properties of brass containing (1), 62·5% Cu and only 0·024% As, (2), 62·5% Cu and 0·12% As, and (3), 61% Cu and 0·139% As, after different forms of heat treatment. After annealing and quenching the first two alloys at a variety of temperatures between 450° and 750° C., greater elongation and greater strength were consistently obtained in the case of the arsenical brass. After annealing and quenching at 550° C., the temperature which developed maximum values of elongation and minimum values of tensile strength in both cases, the arsenical brass possessed an elongation of 77·5% on 2 inches, and a tensile strength of 49,300 lb. per sq. in., while the non-arsenical metal possessed an elongation of 74·25%, and a tensile strength of 48,300 lb. The ductility of the arsenical brass was more adversely affected by annealing at high temperatures followed by immediate cooling at a quenching rate, but a perfect recovery of ductility took place if the cooling was reasonably slow, even when slow cooling was superseded by quenching at a dull red heat. The arsenical alloy with 61% Cu gave lower elongation and higher tensile strength throughout than that with 62·5% Cu and 0·12% As. The results are considered to show that the arsenical metal is likely to afford a better combination of strength and ductility than metal made from electrolytic copper, when both are properly annealed, and that arsenical brass of this type will meet severe hot- and cold-working requirements. To obtain the most favourable conditions for cold-working a brass with 61% Cu, annealing, if conducted at temperatures above moderate red heat, should be followed by at least a moderately slow rate of cooling, say 20° C. per minute, and slow cooling should be continued to a temperature not far above 450° C. For a metal with 62 to 63% Cu, emphasis should be laid on very slow cooling; for example, a 5° rate is far more satisfactory than a 20° rate, and in such case the metal should be allowed to cool normally to about 550° C., when it may be quenched in a stream of water. For a rate of cooling in excess of 20° C. per minute, it is advantageous to allow such cooling to proceed unchecked to 450° C., or even a lower temperature.—T. ST.

Nickel ores; Occurrence and utilisation of ——. Bull. Imp. Inst., 1916, **14**, 228—253.

THE chief nickel minerals occurring in commercial nickel ores are briefly described, and statistics given of the production, during recent years, of ore and matte in Canada, New Caledonia, and Norway, the chief producing countries. Thus, in 1911 the quantity of copper-nickel ore mined in Canada was 612,511 short tons, of which 610,834 was smelted, with the production of 32,607 short tons of matte valued at £1,030,332 and containing 8966 and 17,049 short tons of copper and nickel respectively; while out of 1,364,048 short tons of ore mined in 1915, 1,272,283 was smelted, producing 67,703 short tons of matte valued at £2,156,738 and containing 19,608 and 34,039 short tons of copper and nickel respectively. The matte, etc., exported from Canada to the United Kingdom and the United States in 1911 contained 2512 and 13,798 short tons of nickel, respectively, the corresponding figures for 1915 being 6874 and 26,331 short tons. The quantity of nickel ore produced in New Caledonia increased from 150,005 metric tons in 1911 to 172,365 in 1914; the exports in 1911 being 147,060 metric tons of ore, valued at £176,472, and 3839 of matte valued at £107,492, and the exports in 1914, 94,151 metric tons of ore and 5364 of matte valued at £109,219 and £128,736, respectively. The quantity of nickel ore produced in Norway increased from 5770 metric tons in 1909 to 49,990 in 1913. Geological and other particulars are given of the occurrence of nickel ores in Canada, United States, Cuba, United Kingdom, Austria-Hungary, Germany, Italy, Norway, Russia, Spain, Sweden, Switzerland, Union of South Africa, Nyasaland, Madagascar, Tasmania, New South Wales, New Caledonia, and India. Nickel is used chiefly in the form of alloys, of which the most important is nickel steel; the latter (2·5—3·5 % Ni) having a much higher elastic limit and greater tensile strength than ordinary steel, and on this account being employed extensively in bridge building, naval and military armaments, etc. The strongest of the nickel steels contains 13 % Ni and is so hard as to be unmachinable. Nickel is also used in conjunction with chromium for the manufacture of special steels which, for the same strength, are more cheaply produced than nickel steels. In this connection, the ore mined at Mayari, in Cuba, is of special interest; by direct smelting, this ore yields a crude iron (containing 1·4 % Ni and over 2·5 % Cr) from which nickel-chromium steel is obtained. Other useful alloys are "invar," a nickel steel (Ni 36, C 0·2 %) having a guaranteed coefficient of expansion as low as 0·0000008; "platinite," a similar steel (Ni 46, C 0·15 %) having about the same coefficient of expansion as glass and therefore used for fusing into the latter in place of platinum; the Cu-Zn-Ni alloys variously known as German silver, Nevada silver, etc.; Monel metal (Ni about 70, Cu about 30 %) obtained by the direct smelting of copper-nickel matte; "constantan" (Ni 40, Cu 60 %) and "manganin" (Ni 12, Cu 84, Mn 4 %) used for electrical resistances; and cupro-nickel (Cu 85, Ni 15 %) used in the United States for making bullet jackets. Vessels of pure nickel are used for laboratory purposes, and a considerable amount of nickel is employed in the form of nickel sulphate for electroplating. Pure nickel and nickel bronze are also used for coinage, and it has been estimated that, up to the end of 1912, 909,167,567 coins of pure nickel and 4,543,799,571 coins of nickel bronze (25 % Ni) had been issued.—W. E. F. P.

Tungsten deposits in California. U.S. Comm. Rept., Sept. 11, 1916.

The tungsten deposits discovered in California in 1913 have recently commenced to yield considerable quantities of ore. The deposits are 8 miles west of Bishop, Inyo County. The mineral has been found in a belt 15 miles long, the lode in some places reaching a width of 60 feet. The ore bodies consist of scheelite associated mainly with garnet, epidote, and quartz.

Antimony trisulphide and the products obtained from it by roasting; Quantitative analysis of ——. F. von Bacho. Monatsh. Chem., 1916, 37, 85—117. J. Chem. Soc., 1916, **110**, ii., 496—497.

For the estimation of sulphur in antimony trisulphide, the substance is decomposed by boiling with 25 % hydrochloric acid in an atmosphere of hydrogen and the hydrogen sulphide evolved absorbed by a 3—4 % solution of sodium hydroxide. All the solutions should be air-free, and the alkaline sulphide solution should be added slowly, with continuous stirring, to an acidified solution of iodine, the strength of which should not exceed N/100. The bromate and iodine methods for the estimation of antimony give consistent results, but in both cases the quantities found by experiment are about 1 % smaller than the theoretical amounts. This is in agreement with previous analytical experience, and since both methods yield results in agreement with theory if the older value of 122·0 is taken for the atomic weight of antimony, it is suggested that the atomic weight of antimony should be redetermined.

The product obtained by roasting antimony trisulphide is said to contain antimony tetroxide. In presence of this oxide, low values are obtained when the sulphide is estimated by the method described above, and this is attributed to the oxidation of the hydrogen sulphide by the antimony tetroxide. Satisfactory results may be obtained if the substance is boiled with 25 % potassium hydroxide, and the solution reduced by the addition of metallic aluminium, when the antimony is precipitated. The hydrogen sulphide is then liberated by the addition of acid and absorbed in 3—1 % sodium hydroxide solution.

According to Rose, the tetroxide may be estimated by heating with excess of antimony trisulphide in an inert atmosphere, when sulphur dioxide is set free according to the equation $Sb_2S_3+9Sb_2O_4=10Sb_2O_3+3SO_2$. Experiments made by the author with mixtures of the trisulphide and the tetroxide which were heated in a current of carbon dioxide gave much larger quantities of sulphur dioxide than correspond with this equation. Further investigation has shown that the carbon dioxide is acted on by antimony trisulphide at a dull red heat with the formation of sulphur dioxide, carbon monoxide, and carbon oxysulphide. This reaction precludes the possibility of estimating the higher oxides of antimony by fusion with the trisulphide in an atmosphere of carbon dioxide. Since it has also been found that sulphur dioxide is formed by the interaction of the trioxide with the trisulphide in an inert atmosphere, it follows that the liberation of sulphur dioxide cannot even be used as a qualitative test for the presence of higher oxides in the products obtained in the roasting process.

Coal; Use of powdered —— in metallurgical processes; a discussion of the engineering principles involved. C. J. Gadd. J. Franklin Inst., 1916, **182**, 323—352.

Dried powdered coal can be substituted economically and efficiently for producer and oil gas in heating puddling, heating, and open-hearth furnaces, with or without regenerative chambers. Only the best bituminous coals, high in volatile matter, and low in sulphur and ash are desirable. Coal used in heating and puddling furnaces should closely approximate to the composition:—volatile matter not under 30·00 %, fixed carbon not under 50·00, moisture not over 1·25, ash not over 9·50, sulphur not over 1·00 %; that for open-hearth furnaces to the composition:—volatile matter not under 36·00 %, fixed carbon not under 52·00, moisture not over 1·25, ash not over 6·00, sulphur not over 1·00 %. The dryer generally used for preparing coal before pulverising is of the revolving cylinder type, externally heated. To obtain high efficiency of combustion the coal should be powdered so that 95 % will pass a 100-mesh sieve, and 83 % a 200-mesh sieve. After pulverising, the moisture in the fuel should not exceed 0·75 %. The whole system from the dryer to the furnace should be dust-proof, and the greatest care should be taken to prevent leakage. Powdered coal in storage, containing about 0·75 % of moisture and 1 % of sulphur, will invariably fire within six days. To meet ideal conditions, powdered coal should be kept in motion. The burners are operated under either low or high pressure. Low-pressure burners are used with an air blast varying from 2 to 8 oz.; high-pressure burners are used with compressed air varying from 40 to 100 lb. pressure. The low-pressure burners give a short flame, as the fuel burns almost the instant it leaves the burner; the high-pressure type produces a long flame through progressive combustion, and can be used only where the form of the furnace and the character of the work demand that an elongated cutting flame be developed in close proximity to the work done. The latter method is adapted to open-hearth furnace practice and ore nodulising. The results are equally good whether the powdered coal is ejected from the burner at 1500 or 25,000 feet per minute. To ensure success the coal must be ground as finely as possible and fed to the furnace at an uniform rate, and the furnace must be so designed that complete combustion may take place while the coal is in suspension. In puddling furnaces the use of powdered coal has shown an average saving of about 30 to 36%, and in heating furnaces 15 to 25%. For every pound of coal fired, the waste-heat boilers show an evaporation of from 7 to 8 lb. of water. Details are given of plant comprising coarse coal storage, drying, pulverising, and conveying equipment, and different types of feeders and burners are described. The design of typical furnaces heated by powdered coal is shown by sectional drawings.—T. ST.

Determination of zinc by Schaffner's method. Patek. *See* XXIII.

PATENTS.

Iron alloy rich in phosphorus; Process of producing an —— from inferior finery-slag. F. von Holt, Osnabrück, Germany. U.S. Pat. 1,196,185, Aug. 29, 1916. Date of appl., June 26, 1916.

IRON slag containing 1—6% P, with or without manganese, is mixed with coal and the mixture "burned" in a gas generator at a temperature sufficient to effect combination between the basic constituents of the slag and the silicates present in the coal ash.—W. E. F. P.

Iron and steel [articles]; Method of changing the composition of ——. B. Ford, Philadelphia, Pa. U.S. Pat. 1,196,757, Sept. 5, 1916. Date of appl., Jan. 27, 1914.

THE article is immersed in a suitable medium heated externally to a temperature below its decomposing point, and an electric current is passed through the article to heat it and decompose the medium locally and permit its absorption by the metal.—W. F. F.

[Chromium-steel.] Cutlery. H. Brearley, Sheffield. U.S. Pat. 1,197,256, Sept. 5, 1916. Date of appl., Mar. 6, 1916.

A HARDENED, tempered, and polished cutlery blade is composed of a ferrous alloy containing Cr 13·0%, Mn 0·30%, and C 0·30%, free from microscopically distinguishable free carbides. —W. F. F.

Mild steel, steel, or copper; Deoxidation of ——. H. König, Crefeld. Ger. Pat. 293,470, Oct. 11, 1913. Addition to Ger. Pat. 290,309.

THE process described in the chief patent (this J., 1916, 544) is modified in that the carbon anode is raised somewhat above the surface of the molten metal, so that an arc is formed, and substances which combine with oxygen, *e.g.*, carbon, silicon, titanium, molybdenum, are added to the molten metal.—A. S

Furnace; [Zinc] smelling ——. E. Ruck, Swansea. Eng. Pat. 8265, June 3, 1915.

To allow the front ends of the retorts in the second and succeeding tiers of a regenerative gas-heated furnace for smelting zinc ores to be sufficiently heated, secondary gas and air supply conduits with suitable delivery outlets are provided in, for example, the front wall of the furnace structure. The mouths of the retorts are fixed close to the front wall of the furnace to facilitate charging and emptying.—T. ST.

Furnace for metallurgical purposes, e.g., for the recovery of zinc. Coswiger Braunkohlen-Werke Ges.m.b.H., Coswig. Ger. Pat. 293,344, Feb. 16, 1915.

THE furnace is in the form of a shaft composed of three parts, viz., a lower reduction chamber, an intermediate preheating chamber, and an upper feed chamber. A condensing chamber, with packing similar to that in a regenerator chamber, surrounds the shaft at about the level of the preheating chamber. The mixture of zinc vapour and carbon monoxide evolved in the reduction chamber is drawn by a fan or the like through the preheating chamber into the condenser, which is kept at about 500° C., so that the zinc is condensed in the liquid form. The carbon monoxide is drawn from the condenser by the fan and forced into the lower end of the feed chamber and escapes through an outlet at the top of the latter. By this method of working, the charge is preheated to about 500° C. in the feed chamber and to 900° C. in the preheating chamber, the reduction chamber being heated electrically or otherwise to 1200°—1300° C.—A. S.

Ores; Process for agglomerating ——. F. Krupp Akt.-Ges. Grusonwerk, Magdeburg-Buckau, Germany. Eng. Pat. 10,418, July 17, 1915. Under Int. Conv., July 18, 1914.

THE ore-outlet end of a rotary furnace is constricted, and the narrow part made of such a length that the heating gases, which are led in centrally at a sufficiently high velocity at this end, pass through the sintering zone in a gradually expanding current without impinging directly on the furnace walls, and when, finally, they strike the latter, their temperature is so far reduced that there is no danger of a deposit being formed.—T. ST.

Roasting and sintering ores; Apparatus for [continuously] ——. J. Gayley, Assignor to American Ore Reclamation Co., New York. U.S. Pat. 1,197,199, Sept. 5, 1916. Date of appl., May 6, 1916.

THE material is fed from a hopper on to a set of grate bars moving continuously over the open top of the heating chamber. The grate bars are supported on pallets which are carried by wheels running on track bars. The joint between the pallets and the top of the chamber is maintained air-tight by flat plates or curtains resting on the sides of the chamber and sliding in vertical grooves in the pallets.—W. F. F.

Nickel ores; Process for desulphurising, reducing, and refining ——. L. P. Burrows, Ottawa, Canada. Eng. Pat. 12,358, Aug. 27, 1915.

THE powdered (40-mesh) ore, *e.g.*, Sudbury ore—contained in a revolving drum or digester, supported on hollow trunnions and enclosed in a furnace casing—is subjected to the action of the gases produced by heating suddenly-expanded, dry steam to a high temperature; atmospheric oxygen is excluded from the drum during operation. Substances yielding chlorine or nitrogen by reaction with the ore under the conditions of treatment may be added to the latter as "fluxes." The volatile products of the reaction are recovered in a series of closed precipitation chambers, the non-volatile residue of reduced and refined nickel ore being removed periodically from the digester. —W. E. F. P.

Tungsten; Production of —— from scheelite. J. C. Butterfield, London, and A. Ashworth, Bury. Eng. Pat. 16,562, Nov. 23, 1915.

SCHEELITE (calcium tungstate) is finely ground, briquetted with 12 to 13% of charcoal, and heated in a graphite crucible to 1100° or 1200° C. for 4 or 5 hours. The cold mass is crushed to pass through a 30- or 40-mesh sieve, and then fed on to a shaking or percussive dressing table, whereby the metallic tungsten is separated. The tungsten powder thus obtained may be washed with dilute hydrochloric acid to remove any remaining lime, when, after being washed free from acid, it is ready for the steel maker.—T. ST.

Tungsten powder; Producing —— [electrolytically]. F. G. Keyes and R. B. Brownlee, Assignors to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,196,699, Aug. 29, 1916. Date of appl., Feb. 17, 1915.

Fused sodium tungstate is contained in a crucible, and a porous cup is partly immersed in the fused material, so that the material enters the cup to substantially the level of the material in the crucible. An anode and cathode dip respectively into the fused material in the crucible and cup. —B. N.

Quicksilver [mercury]; Apparatus for recovering —— from its ore. W. H. Landers, New Almaden, Cal., Assignor to Pacific Foundry Co., San Francisco, Cal. U.S. Pat. 1,195,236, Aug. 22, 1916. Date of appl., Mar. 29, 1916.

The apparatus comprises a roasting furnace, an outlet pipe from the furnace extending downwards into a dust-settling chamber, a pipe leading from the upper part of the latter to a condenser, and a pipe leading from the condenser to a stack. The cooling medium, after circulating around the condenser, is led to the stack to increase the draught through the apparatus. The temperature in the dust-settling chamber is kept sufficiently high to prevent condensation of mercury therein.—A. S.

Metals; Process for lead-plating ——. J. C. McClintock and R. J. Shoemaker, Topeka, Kans. U.S. Pat. 1,195,376, Aug. 22, 1916. Date of appl., June 26, 1915.

After treatment with hydrochloric acid to remove superficial oxides, the metal (still retaining a film of acid) is immersed in molten zinc chloride until it has attained the temperature of the latter, and then in molten lead. The bath of zinc chloride is supported on the bath of lead, both being maintained at 640°—680° F. (338°—360° C.), and the plated metal is withdrawn from the lead bath without further contact with the zinc chloride. —W. E. F. P.

Acid and insoluble metallic compounds; Method of making ——. [Precipitation of copper.] G. D. Van Arsdale, New York. U.S. Pat. 1,195,421, Aug. 22, 1916. Date of appl., June 25, 1914.

Copper is precipitated from a chloride solution, and free acid simultaneously produced, by treating the solution with sulphur dioxide and then bringing it in contact with metallic iron.—A. S.

Metals [copper]; Method of extracting —— from their ores. Process of making a leaching solution for extraction of metals from their ores. H. B. Slater, Los Angeles, Cal. U.S. Pats. (A) 1,195,616 and (B) 1,195,617, Aug. 22, 1916. Dates of appl., Sept. 2, 1913, and July 28, 1915.

(A) The ore is leached with a solution containing sodium chloride, ferric chloride, and hypochlorous acid, and the solution treated with sodium hydroxide to precipitate excess of iron. Copper is then recovered from the filtrate by precipitation, after which the ferric hydroxide previously removed is returned to the liquid and the mixture treated with free chlorine to regenerate the original solvent. (B) The solvent is prepared (or regenerated) by simultaneously electrolysing a solution of ferrous and sodium chlorides in the anode compartment, and a solution of sodium chloride in the cathode compartment of an electrolytic cell. The compartments are separated by a diaphragm sufficiently permeable to allow the cathode products to diffuse into the anode compartment, the electrolysis being continued until all the ferrous chloride is oxidised and sufficient chlorine liberated to produce free hypochlorous acid in the liquid. —W. E. F. P.

[Roasting] furnace. Metallurgical furnace. U. Wedge, Ardmore, Pa., Assignor to The Furnace Patent Co., Philadelphia, Pa. U.S. Pats. (A) 1,195,424 and (B) 1,195,125, Aug. 22, 1916. Dates of appl., Jan. 20, 1910, and June 21, 1911. Both renewed Jan. 20, 1916.

(A) In a multiple-hearth roasting furnace, some of the chambers are arranged for direct heating and others for muffle heating. A regulated supply of a reagent is delivered from a mechanical conveyor to the material in the muffle chambers. The material passes from the direct-heated chambers to the muffle chambers through passages sealed against the flow of gas, and air is supplied to and gases withdrawn from each chamber independently. The air supplied to the chambers in which the material is treated with a reagent is preheated in a chamber formed in one of the hearths in the upper portion of the furnace. (B) In a multiple-hearth furnace in which the material passes downwards from one hearth to the next, heating chambers are arranged in combination with the upper series of hearths so as to muffle the treating chambers above these hearths. Products of combustion from an outside source are supplied to the heating chambers and thence pass first into heating chambers below the hearths and then directly into the treating chambers above the lower series of hearths.—A. S.

[Metallurgical] heating furnace; Coal-burning ——. E. C. Walker and A. S. Moses, Assignors to G. M. Illges, St. Louis, Mo. U.S. Pat. 1,196,726, Aug. 29, 1916. Date of appl., June 11, 1913.

The fuel is burnt in a vertical shaft tapering at the bottom and is supported by a ram extending across the bottom of the shaft. The ram is movable vertically and horizontally to stoke and purge the fuel bed.—A. S.

Metal from ores; [Electrically] securing ——. J. H. Reid, Newark, N.J. U.S. Pat. 1,195,607, Aug. 22, 1916. Date of appl., Jan. 13, 1914.

The ore is supplied to an electric arc produced between depending iron electrodes. The alloy of iron with the metal of the ore thus produced, is treated with a metal of relatively low melting point, immiscible with iron and having a greater affinity for the metal of the ore, and the latter is subsequently recovered from the metal vehicle or carrier.—B. N.

Carnotite sandstone; Process of concentrating ——. H. N. McCoy, Chicago, Ill. U.S. Pat. 1,195,698, Aug. 22, 1916. Date of appl., Feb. 12, 1916.

The incrustation of carnotite is removed from the sand grains by a process of attrition in water, the radium-bearing slimes thus liberated being either separated as such or subjected to acid treatment for the recovery of radium.—W. E. F. P.

Soldering cast-iron, mild steel, aluminium, and the like; Composition of matter for ——. W. A. Day, Bellingham, Wash. U.S. Pat. 1,195,955, Aug. 22, 1916. Date of appl., Mar. 8, 1916.

An alloy composed of lead 1, tin 1, and zinc 2 parts by weight.—W. E. F. P.

Soldering metals; Method of ——. L. M. Klauber, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,196,118, Aug. 29, 1916. Date of appl., Apr. 1, 1910.

An acidified solution of a mercuric salt is applied to the surface or surfaces to be soldered, in order to deposit mercury thereon, and the amalgamated metal is immersed in molten solder heated to a temperature sufficiently high to expel the mercury. —A. S.

Centrifugal apparatus: High-temperature —— [for separating metals, mattes, or speisses from their accompanying slags]. W. B. Wescott, Assignor to Kalmus, Comstock, and Wescott, Inc., Boston, Mass. U.S. Pat. 1,196,829, Sept. 5, 1916. Date of appl., Mar. 19, 1914.

The apparatus comprises a crucible rotating on a vertical axis and lined internally with refractory material. An inlet pipe at the top is cooled externally by a jacket and lined internally with electrically non-conducting refractory material having a heating coil embedded in it. The pipe has a removable delivery spout which delivers the material to be treated towards the top of the walls of the crucible. The crucible is provided with an outlet at the bottom.—W. F. F.

Metals; Method of reducing —— [by electrolysis]. J. McNitt, Perth Amboy, N.J., Assignor to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,197,137, Sept. 5, 1916. Date of appl., Jan. 2, 1913.

The electrolyte is fused in a furnace under pressure of an inert gas, and the pressure is further increased by the gas generated by the electrolytic action. The boiling point of the metal is thus raised, and the temperature is kept below the boiling point of the electrolyte at atmospheric pressure.—W.F.F.

Coating wire and the like; Means for —— I. Hall, Birmingham. Eng. Pats. 13,224, Sept. 16, and 14,870, Oct. 20, 1915, and 101,170, Sept. 16, 1915 (Appl. No. 10,822 of 1916).

Separating oiled concentrates from the gangue of ores; Apparatus for ——. R. T. Mishler, Pomona, Cal. U.S. Pat. 1,197,843, Sept. 12, 1916. Date of appl., Sept. 13, 1915.

Plating metals; Process of ——. W. E. Watkins, New York, Assignor to The Metals Plating Co. U.S. Pat. 1,197,693, Sept. 12, 1916. Date of appl., Aug. 21, 1913.

See Eng. Pat. 18,932 of 1914; this J., 1916, 53.

Zinc solutions; Treatment of —— for the recovery of the metal therefrom. R. Lance, Paris. U.S. Pat. 1,198,241, Sept. 12, 1916. Date of appl., June 24, 1914.

See Fr. Pat. 463,614 of 1912; this J., 1914, 421.

Nickel ores: Desulphurisation, reduction, and refining of ——. L. P. Burrows. Fr. Pat. 479,606, Aug. 27, 1915.

See Eng. Pat. 12,358 of 1915; preceding.

XI.—ELECTRO-CHEMISTRY.

Gas mixtures; Separation of —— under the influence of a direct current. F. Skaupy. Ber. Deut. physik. Ges., 1916, **18**, 230—232. J. Chem. Soc., 1916, **110**, ii., 469.

When a fairly strong current is passed through a discharge tube containing neon mixed with about 10 % of argon, the anode end of the tube shows the neon spectrum and the cathode end the argon spectrum. Mixtures of helium and argon behave similarly, and the separation of gases under the influence of a direct current appears to be a general phenomenon. If the mixture is supplied at the middle of the discharge tube and the gases in the neighbourhood of the electrodes are removed, it is possible to effect a separation of the inert gases. When mercury or other vapours are mixed with the inert gases and subjected to the discharge, the active gases always move to the cathode. The observed behaviour is apparently determined by the magnitude of the ionisation potential. A low value of the ionisation potential results in the production of large quantities of positive ions, whilst such ions may not be found at all when the ionisation potential has a larger value. The positive ions move to the cathode, and under the influence of the difference of gas pressure the unchanged molecules are constrained to move in the opposite direction. In consequence of the above described effects, it follows that gases or vapours (for example, salt vapour) introduced into a discharge tube containing inert gases through which a direct current is passing will only produce a satisfactory emissive effect if they are introduced at the anode.

Flame electrolytes; Validity of Faraday's law for ——. Faraday's law and the electrolytic separation of copper from flames. B. Thieme. Ber. Deut. physikal. Ges., 1916, **18**, 187—194, 221—229. J. Chem. Soc., 1916, **110**, ii., 469.

The quantity of carbon deposited by the passage of a current through a hydrocarbon flame has been measured. The best results are obtained when the air supply is only just sufficient to prevent the separation of soot. The quantity of electrolytically deposited carbon is in fair agreement with the requirements of Faraday's law if the carbon atoms are supposed to carry a single unit of charge. From similar experiments made with a flame sprayed with a solution of copper sulphate, it is found that copper is deposited by an electric current passed through the flame in quantities consonant with Faraday's law.

Patents.

Primary galvanic battery cells with zinc anodes and alkaline electrolyte; Method for producing ——. J. N. Brönsted, and Hellesens Enke and V. Ludvigsen, Copenhagen. Eng. Pat. 16,471, Nov. 22, 1915.

An alkali zincate is added to the electrolyte in the proportion of 2 to 8 equivalents of zincate to 100 equivalents of alkali, before finishing or finally closing the cell.—W. F. F.

Galvanic cell. A. Heil, Frankfort, Germany, Assignor to C. Hubert and S. Stern, New York. U.S. Pat. 1,195,677, Aug. 22, 1916. Date of appl., Dec. 24, 1913.

The cell is composed of positive and negative elements and a depolarising mass composed of an intimate mixture of a deep black hydrate of manganese dioxide, mercuric oxide, and carbon, together with an alkaline electrolyte.—B. N.

Furnaces; Apparatus for preventing sintering in electric ——. E. S. Berglund, Trollhättan, Sweden. U.S. Pat. 1,196,202, Aug. 29, 1916. Date of appl., Apr. 21, 1915.

The charge is fed by gravitation through a feed shaft having a smaller cross-sectional area than that of the furnace chamber, and an auxiliary charge is fed mechanically into the chamber, at a point immediately below the opening of the feed shaft. Motion is thereby imparted to the charge in the chamber, in addition to the natural descending motion through the feed shaft.—B. N.

Furnace; Electrical ——. A. Eimer, New York. U.S. Pat. 1,197,275, Sept. 5, 1916. Date of appl., July 18, 1914.

A muffle furnace is provided with interchangeable electrical heating members, which are reversible in order that either surface may be presented to the furnace interior, and the members are provided with interlocking edges for their engagement in either position. Each member is provided with a series of parallel exposed grooves on one side to contain a resistance conductor, with inset notches alternating at opposite ends between adjacent grooves to carry the conductor from one groove to another, and the opposite side is provided with a smooth " conductor covering heating surface."—B. N.

Insulating compound; Chlorinated ——. J. W. Aylsworth, East Orange, N.J., Assignor to Halogen Products Co., Glen Ridge, N.J. U.S. Pat. 1,196,505, Aug. 29, 1916. Date of appl., Nov. 1, 1913.

A small proportion of a basic oxide is added to a mixture of solid chloronaphthalenes, the chlorine content of which is at least equal to that of trichloronaphthalene, in order to break up unstable addition products, and the resultant product is distilled in the presence of the basic oxide. Hydrochloric acid is eliminated from the composition, and the unstable products, from which hydrochloric acid might be evolved by subsequent heating of the composition to its boiling point, are also decomposed and eliminated.—B. N.

Electric furnaces. J. L. Dixon, Detroit, Mich. U.S. Pats. 1,197,458 and 1,197,459, Sept. 5, 1916. Date of appl., Apr. 10, 1916.

See Eng. Pats. 4742, 8513, 16,263, and 17,909 of 1914; this J., 1915, 233.

Electrolytic process for the extraction of cobalt oxides. U.S. Pat. 1,195,211. *See* VII.

Manufacture of hydrogen peroxide. U.S. Pat. 1,195,560. *See* VII.

Process of extracting alkali-metal compounds. U.S. Pat. 1,197,556. *See* VII.

XII.—FATS; OILS; WAXES.

Vegetable oils; New sources of ——. Z. angew. Chem., 1916, **29**, 337—338.

Asparagus seeds yielded, on extraction, 12% of oil. They should also be suitable for fodder. *Cherrystone oil*:—Large quantities of the waste stones are obtainable from the manufacturers of cherry liqueurs in S. Germany. *Lime tree fruit* contained 9·4% of oil, while *elm-tree fruit* yielded 9 to 14% of oil. The oils from these and other seeds had the following characters:—

	Asparagus seed oil.	Lime tree oil.	Maple fruit, *Acer pseudo-platanus.*	Maple fruit, *Acer platanoides.*	Pear pip oil.	Apple pip oil.	Canary seed oil, *Phalaris canariensis.*	Elm oil, *Ulmus Campestris.*	Elm oil, *U. Campestris* 1916.
Acid value	6·5	12·2	13·8	22·5	2·3	2·9	20·8	31·5	8·3
Saponif. value	193·4	195·2	179·8	157·0	197·5	189·5	184	272	224·5
Iodine value	140	126·0	93	100	126·5	119·8	115·5	20·5	28·8
Unsaponifiable %	0·96	1·5	6·95	8·72	0·5	1·2	1·5	10·8	8·7
Neutralisation value of fatty acids	200	198·5	—	183·0	203	195·5	203	273·5	264
M.pt. of fatty acids	fluid	fluid	about 25° C.	fluid	fluid	fluid	about 25° C.	37° C.	fluid
Iodine value of fatty acids	142·2	128·0	—	99·2	128·9	129·5	126·3	25·1	31·4
Refraction at 25° C.	73·75	71·3	62·4 at 40° C.	71 at 40° C.	70·65	70·55	68·7	39·2 at 40° C.	39·7

—C. A. M.

Japanese seal oil. M. Tsujimoto. Kōgyō-Kwagaku Zasshi, 1916, **19**, 715—722.

A sample of seal oil from Sakhalin remained clear at 0° C., but solidified to a viscous mass at − 10° C. When heated in a thin layer for 1½ hours at 100° C. it became very viscous. It could be readily refined by means of Kambara earth. It had the following characters:—Sp.gr. at 15°/4° C., 0·9264; acid value, 3·13; saponif. value, 190·61; iodine value (Wijs), 154·58; $n_D^{20} = 1·4795$; unsaponif. matter, 0·38%; oxidised acids, 0·37%; m.pt. of fatty acids, mostly liquid at 23° C.; insoluble bromides of fatty acids (70·16% Br), 38·34%. The oil is thus very similar to European seal oil and Japanese northern fur seal oil. The liquid fatty acids were hydrogenated in the presence of platinum black, and the resulting solid fatty acids were fractionally precipitated with magnesium acetate. Fractions melting at about 55° C. and having neutralisation values of 208 to 211 were obtained. Apparently these were mixtures of palmitic and stearic acids. Another portion of the liquid fatty acids was esterified, and the methyl esters were fractionally distilled under a pressure of 15 mm. The first fraction had saponif. value, 204·42 and iodine value 107·63. From these results the conclusion is drawn that the fatty acids of Japanese seal oil contain about 15% of an unsaturated acid lower in the series than oleic acid. This may be physetoleic acid or palmitoleic acid. The solid fatty acids consisted, in the main, of palmitic acid.—C. A. M.

Liver oils of sun-fish and Chimæra phantasma. M. Tsujimoto. Kōgyō-Kwagaku Zasshi, 1916, **19**, 723—727.

Sun-fish liver oil:—A sample of the liver of the sun-fish or "head-fish," *Mola mola*, L., yielded 362 grms. per kilo. of an orange-red oil, with a peculiar fishy odour and a very unpleasant taste. It deposited a large quantity of "stearine" at the ordinary temperature. When refined with Kambara earth it became light yellowish-brown and coloured the earth dark green. It had the following characters: Sp.gr. at 15°/4° C., 0·9252; acid value, 8·19; saponif. value, 180·17; iodine value (Wijs), 151·77; $n_D^{20} = 1·4786$; unsaponif. matter, 3·20%; m.pt. of fatty acids, 32° C.; insoluble bromides of fatty acids (69·1% Br), 13·48%. The unsaponifiable matter contained cholesterol and probably higher alcohols. No hydrocarbons such as are present in shark-liver oils (this J., 1916, 609) were found. *Liver oil of Chimæra phantasma*:—Oil is sometimes prepared as a commercial product from the liver of this fish, which is known as the "rat-fish." A liver weighing 380 grms. yielded 220 grms. of an orange-yellow oil, which deposited a considerable amount of "stearine." It had a peculiar odour and unpleasant taste, and gave the following results:—Sp.gr. at 15°/4° C., 0·9161; acid value, 0·4; saponif. value, 172·79; iodine value (Wijs) 113·02; $n_D^{20} = 1·4728$; unsaponif. matter, 8·52%; m.pt. of fatty acids, 30°—31° C.; neutralisation value, 193·88; bromides of fatty acids (69·27% Br), 22·40%. The oil resembled certain shark-liver oils. The unsaponifiable matter was a yellow liquid containing cholesterol but no hydrocarbons.
—C. A. M.

Glycerol in fatty oils; Determination of —— *by means of sodium glycerate.* H. Bull. Chem.-Zeit., 1916, **40**, 690.

Free fatty acids are first removed as soap by diluting 10 grms. of the oil with light petroleum spirit to 100 c.c. in a cylinder, adding 10 c.c. of a solution made by mixing 20 c.c. of 50% caustic potash solution with 240 c.c. of glycerin and 240 c.c. of water, mixing the solutions by inverting the cylinder several times, and allowing to stand overnight. The resulting soap solution thereby separates completely, leaving a clear supernatant liquid which is free from water. Thirty c.c. of the upper layer is transferred by means of a pipette to a 50 c.c. tube (2 cm. in width). 2 or 3 c.c. of 2-*N* sodium ethoxide (prepared by dissolving 23 grms. of sodium in absolute alcohol and diluting with alcohol to 500 c.c.) is added, the mixture made up to the 50 c.c. mark with light petroleum spirit, and the whole mixed and allowed to stand for some hours, so that the precipitated monosodium glycerate may settle. The excess of alkali in 25 c.c. of the clear solution is then titrated with *N*/10 hydrochloric acid, in presence of phenolphthalein and at least as much neutral alcohol as *N*/10 acid used, whilst the residue in the tube is mixed, transferred to a flask, the tube rinsed twice with 10 c.c. of alcohol, and the whole titrated at once with acid, preferably adding 5 c.c. of *N*/2 hydrochloric acid and then finishing with *N*/10 acid as before. The difference between the volumes of acid (reckoned as *N*/10) used in the two titrations, multiplied by the factor 0·0092, gives the weight of glycerol in 3 grms. of oil. The end-point of the titration is sharp, and the method is said to be both simple and accurate.—F. SODN.

Fats; Hydrogenation of —— in presence of metallic nickel and nickel oxides. W. Normann. Chem. Zeit., 1916, **40**, 757—759.

ERDMANN (this J., 1915, 969) found that hydrogenation of fats was effected more rapidly in presence of unreduced nickel oxide than in that of the nickel previously reduced therefrom, whereas the author's experiments gave different results, nickel oxide acting catalytically only after its reduction to metallic form (this J., 1915, 237). Comparative experiments with different oxides of nickel and the powdered metal reduced from them have shown that the activity of the various catalysts varies with the physical form of the powders. In the case of some of them it was not possible to effect serviceable hydrogenation of the oil. In all cases, however, the action of the metal catalysts was superior to that of the oxides. Certain impurities in commercial oxides appear to have a very unfavourable effect upon the hydrogenation, whereas the same impurities have little or no effect upon the metal catalysts previously reduced from the oxides. A slight addition of hydrochloric acid had no effect on the oxide catalyst but had a stimulating effect on a metal catalyst; further additions had an injurious action on the oxide catalyst, and reduced the activity of the metal catalyst to its original degree. Sodium chloride behaved in an analogous manner. Sulphuric acid in small quantities promoted the activity of both oxide and metal catalysts; in larger proportion it had little effect upon the metal, but destroyed the increased activity of the oxide. The hydrogenation of oils may be effected as a technical process by means of metallic nickel without any carrier.—C. A. M.

Phytosterol: Marcusson-Schilling's modification of Bömer's method for the detection of —— by precipitation with digitonin. A. Olig. Z. Unters. Nahr. Genussm., 1914, **28**, 129—138. J. Chem. Soc., 1916, **110**, ii., 199. (Compare this J., 1913, 1118.)

RESULTS of analyses of numerous mixtures of animal and vegetable fats showed that the melting point of the acetate, after the first or second crystallisation, almost always indicated whether phytosteryl acetate was present with the cholesteryl acetate. The presence of paraffin and of certain waxy or resinous constituents of shea and mowrah fats did not interfere with the test. In most cases it is sufficient to precipitate the cholesterol and phytosterol with digitonin directly from the fat; previous saponification of the fat and precipitation with digitonin from the fatty acids is necessary only when direct precipitation from the fat yields an inconclusive result, but this seldom occurs in practice.

Phytosterol in vegetable fats; Determination of ——. M. Klostermann and H. Opitz. Z. Unters. Nahr. Genussm., 1914, **28**, 138—145. J. Chem. Soc., 1916, **110**, ii., 499.

THE quantity of phytosterol in vegetable oils varies from 0·133% in the case of olive oil to 0·549% in sesamé oil; in many of the vegetable oils a large proportion of the phytosterol is present in the form of its ester. In the detection of vegetable oils in animal fats it is therefore advisable to saponify the fat before the phytosterol and cholesterol are precipitated with digitonin, since the latter precipitates the free alcohols only. It is pointed out that the quantity of phytosterol in a vegetable oil depends on the method by which the oil has been obtained from the seeds, etc.

Detection of tallow and hydrogenated fats in butter fat. Amberger. *See* XIXA.

Hydnocarpus venenata, Gaertner; false chaulmoogra. Brill. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Colophony and abietic acid. G. Cohn. Chem.-Zeit., 1916, **40**, 791—792.

COLOPHONY when treated with strong ammonia is converted into a brown gelatinous mass, which dries to a solid resin readily soluble in water. The solution behaves in exactly the same way as that of the ammonium salts of artificial resin acids (this J., 1916, 1025). It precipitates basic dyestuffs on the addition of acetic acid, and gives precipitates with alkaloids (morphine, etc.). The pale green copper salt is readily soluble in ether, whilst it is practically insoluble in methyl alcohol and in an excess of ammonia solution. By treatment with ether it may be separated from another salt which is present in a proportion varying with the origin and age of the colophony, and which when decomposed with hydrochloric acid yields an amorphous resin acid. On evaporating the ethereal solution copper abietate is left. This is not decomposed by hydrochloric acid, even on heating for a short time, but is readily decomposed by the acid when ether is also present. Bases such as ammonia, piperidine, etc., act upon colophony in the presence of water, producing a gel, the consistency of which depends upon the proportion of base. An excess of base liquefies the gel. Pure abietic acid may be rapidly prepared by gently heating 50 parts of white colophony with a mixture of 50 parts of pure methyl alcohol and 6 to 7 parts of strong sulphuric acid on the water-bath, with frequent shaking and stirring, until a crystalline mass is obtained. This is cooled, drained, triturated with cold methyl alcohol, and again separated. The resulting abietic acid melts at 156° to 162° C., and may be further purified by recrystallisation from methyl alcohol. It behaves towards ammonia like colophony. On adding ammonia to its solution in oil of turpentine the ammonium salt crystallises, whilst the oil is gradually gelatinised. It gives precipitates with basic dyestuffs in the same way as the artificial resin acids. A sample of the pure acid heated at 160° to 170° C. left, on cooling, a fused mass, which showed no tendency to re-crystallisation. Its sp.gr. was 1·072 (that of the original

white colophony being 1·08), and it behaved towards ammonia, methyl alcohol, and strong sulphuric acid in the same way as natural colophony. By heating the fused abietic acid to about 200° C. a yellow colophony (sp.gr. 1·07) was obtained. There was no loss in weight during either heating, so that no anhydride formation could have occurred. These results indicate that natural colophony must be regarded as a more or less impure vitreous modification of abietic acid.
—C. A. M.

Rosin: The Liebermann-Storch colour test for ——. P. E. Jameson. J. Ind. Eng. Chem., 1916, **8**, 855.

Kauri resin, like colophony, gives a deep violet-red colour changing to brown with the Liebermann-Storch reagent; the colour is most intense with varieties having a milky core surrounded by a nearly transparent shell, whilst in the varieties known as "Swamp" or "Brown Kauri," the colour is, to a great extent, masked by impurities. Following are the reactions given by some of the chief varnish resins with the Liebermann-Storch reagent:—amber and East India and black dammar resins, deep wine red changing to brown; Manila, pontianac, and Borneo resins, dark-brown; Batavia and Singapore dammar resins (recent), deep wine red colour which does not change on standing. Some specimens of Manila resin give a reaction similar to that of rosin. Contrary to the usual statements in text-books, cholesterol does not give a violet colour, but a deep blue colour, quickly changing to green.—A.S.

Patents.

Phenols and formaldehyde: Condensation product of —— and process of making same. J. W. Aylsworth, East Orange, N.J., Assignor to Condensite Company of America, Bloomfield, N.J. U.S. Pat. 1,197,171, Sept. 5, 1916. Date of appl., June 16, 1915.

Phenol is caused to interact with a compound containing a reactive methylene group, in proportions suitable to form an infusible product, under the influence of sulphuric or other mineral acid, and when the reaction is partially complete, a substance, such as barium carbonate, is added, which is capable of forming an insoluble, electrically insulating salt with the mineral acid, the quantity used being at least sufficient to combine with the whole of the acid present in the mass.
—J. F. B.

Phenols and formaldehyde: Condensation product of ——. T. S. Wennagel, Hamburg, Assignor to Naamlooze Vennootschap Hollandsche Proteine Maatschappij, Amsterdam. U.S. Pat. 1,197,316, Sept. 5, 1916. Date of appl., July 30, 1915.

A mixture of phenol, aldehydes, and fatty or oily triglycerides, with or without a quantity of resin preferably equal to the fatty or oily substances, is treated with double the amount of alkali required for the saponification of the triglycerides and of the resin, if present; the water is distilled off, and the mass cast into moulds.—J. F. B.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Vulcanised rubber waste: Process for the partial separation of the combined sulphur in ——. W. Esch, Hamburg. Ger. Pat. 293,496, Nov. 7, 1912.

The scrap rubber is treated with alkali to remove free sulphur, then dissolved in a phenolic solvent and the solution emulsified with the aid of an alkali. The emulsion is filtered, if necessary, and heated with a metal (zinc or aluminium) capable of liberating hydrogen from alkalis; part of the sulphur combined with the rubber is thus converted into hydrogen sulphide and the rubber is depolymerised. The emulsion is then treated with carbon dioxide, allowed to settle, and the supernatant solution of depolymerised rubber removed. The solvent is distilled off with steam under diminished pressure, and the residue is dried, mixed with a polymerising agent, *e.g.*, about 5% of sodium, heated for about two days at 80° C., washed, and dried.—A. S.

Process of treating textile materials [with rubber] and the article produced thereby. Eng. Pat. 101,318. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Skin; Biochemical studies of ——. G. J. Rosenthal. J. Amer. Leather Chem. Assoc., 1916, **11**, 463—495.

An account of the chemistry of skin is followed by a description of experiments made on dogskin, calfskin, and kid and cabretta skins, in order to ascertain what chemical changes take place during the usual processes preliminary to tanning. A dogskin was cut into pieces corresponding to butt, shoulder, and bellies, and the pieces dried *in vacuo* for eight hours at 55°—60° C. The skin was then ground to powder. Small samples were treated with 10% brine at 37° C. until no further amount of coagulable protein could be obtained. The residue was washed, and extracted under toluol with half-saturated lime water to remove mucins. Elastin was removed by subsequent alkaline tryptic digestion, and the residue from this treatment was digested in a 0·2% hydrochloric acid solution of pepsin to remove collagen. The final residue was taken as keratin. This process was carried out with fresh dogskin, and in the case of calfskin with (1) fresh skin, (2) skin after 42 hours' soaking, (3) and (4) skin after 24 and 66 hours' liming, (5) after 120 hours' liming, then unhairing and washing, and (6) after bating. The composition of both dogskin and calfskin was found to vary considerably in different portions of the skin. During the soaking to bating processes it was found that the content in coagulable protein steadily rises, elastin disappears during bating after a gradual decrease during liming, and both mucin and keratin are lost during liming. It is noticeable that there is much more mucin in the butt of calfskin than in the shoulder or belly. Other experiments showed that the ash content of the skin rose to a maximum at stage (4) and then decreased almost to its original value. The experiments on kid and cabretta skins gave very similar results. Sections of skin were cut at the above-mentioned stages and showed very distinct changes. In the case of calfskin the outer horny layer was affected by the soaking, the cell boundaries disappearing; during liming the entire epithelial layer is destroyed and the connective tissue loses its fibrillary structure; after bating, the corium alone is left, with an occasional strand of connective tissue. Photographs of the sections are included in the paper, and a bibliography is appended.—F. C. T.

Leather; [Determination of] total sulphates in ——. L. E. Levi and A. C. Orthmann. J. Amer. Leather Chem. Assoc., 1916, **11**, 496—498.

Leather from which fat has been extracted is oxidised with a mixture of chromic and hydrochloric acids, and sulphates are estimated in the solution. The method is accurate and rapid.
—F. C. T.

Leathers; Wear resistance of sole ——. L. Balderston. J. Amer. Leather Chem. Assoc., 1916, **11**, 498—500.

FURTHER experiments were carried out as previously described (this J., 1916, 935), except that the amount of friction was reduced, and the speed increased. It was found that the grain side of leather offers more resistance than the flesh side.—F. C. T.

Chrome tanning liquors; Determination of the basicity of ——. W. Appelius and R. Schmidt. Ledertechn. Runds., 1916, **8**, 85—86. Z. angew. Chem., 1916, **29**, Ref., 339.

To determine the acid combined with chromium, the diluted solution is boiled with finely-divided cupric oxide, whereby the chromium is precipitated and a quantity of copper corresponding to the acid combined with chromium is dissolved; the dissolved copper is determined by the iodide method. The quantity of dissolved copper for 100 grms. Cr_2O_3 is termed the "copper value," and the authors have constructed a table from which the basicity corresponding to a given "copper value" may be read directly.—A. S.

PATENTS.

Hides; Process for removing hair from ——. G. Maag, New York. U.S. Pat. 1,197,519, Sept. 5, 1916. Date of appl., Aug. 26, 1912; renewed Nov. 6, 1915.

THE hides are agitated at 95° F. (35° C.) with a solution containing 10 % of their weight of sodium sulphide at a density of about 1·5° B. (sp.gr. 1·004).—J. F. B.

Condensation products [*tanning agents*] *from α- or β-naphthylaminemono- or disulphonic acids or mixtures of these acids, and formaldehyde; Preparation of* ——. Deutsch-Koloniale Gerb- und Farbstoff-Ges. m. b. H., Karlsruhe. Ger. Pat. 293,041, June 20, 1913.

SOLUBLE tanning agents are obtained by condensing formaldehyde with α- or β-naphthylamine-mono- or disulphonic acids or their salts, or mixtures of these acids or salts, in presence of a quantity of concentrated sulphuric acid equal to from three to five times the quantity of the naphthylamine derivative. The products, unlike those described in Eng. Pat. 4648 of 1911 (this J., 1912, 325), do not contain sulphur.—A. S.

Condensation products [*tanning agents*] *from α- or β-naphthol or their sulphonic acids; Preparation of* ——. Deutsch-Koloniale Gerb- und Farbstoff-Ges. m. b. H., Karlsruhe. Ger. Pats. (A) 293,042, June 22, 1913, and (B) 293,693, Oct. 1, 1913.

(A) SOLUBLE products which precipitate gelatin from neutral solutions and even from solutions containing sodium carbonate, are obtained by heating α- or β-naphthol mixed with the calculated quantity or a slight excess of concentrated sulphuric acid, or α- or β-naphtholsulphonic acids or their salts, alone or mixed with a small quantity of concentrated sulphuric acid, for a long time above 100° C., or by treating naphtholsulphonic acids with phosphorus oxychloride or analogous condensing agents at lower temperatures (up to 100° C.), in some cases with addition of small quantities of concentrated sulphuric acid, and with exclusion of air or in a vacuum. (B) Products less soluble than those described above, but very effective as gelatin precipitants, are obtained by heating naphtholsulphonic acids with excess of phosphorus oxychloride at a high temperature. —A. S.

Method of waterproofing the soles of footwear. Eng. Pat. 12,839. *See* V.

XVI.—SOILS; FERTILISERS.

Soil: Influence of barnyard [*farmyard*] *manure and water upon the bacterial activities of the* ——. J. E. Greaves and E. G. Carter. J. Agric. Res., 1916, **6**, 889—926.

THE effects of measured quantities of farmyard manure and of irrigation water upon the bacterial activities of a light calcareous soil (Greenville Experiment Farm, Utah) were determined when the soil was potted and kept fallow, when fallowed under field conditions, and when it was under corn (maize) in the open. The bacterial numbers were estimated by counting the colonies which developed on a modified agar medium, the ammonifying power was determined by mixing 2 grms. of dried blood with 100-grm. portions of the soil, incubating for 4 days, adding 250 c.c. of water, distilling off the ammonia with 2 grms. of magnesium oxide, and collecting it in $N/10$ sulphuric acid. The nitrifying power was found in a similar way except that the incubation period was 21 days, and, in addition to the water, 2 grms. of powdered lime was added and the whole shaken in a machine for 10 minutes, after which the nitrates in the clear liquid were determined by the aluminium reduction method. The nitrogen-fixing power was found by placing 5-grm. portions of the soil into 100 c.c. of Ashby's solution, incubating for 18 days, and then determining the total nitrogen by Kjeldahl's method. In the pot experiments, the manure was applied at the rates of 5, 10, 15, 20, and 25 tons per acre, and the moisture content was kept at 12·5, 15, 17·5, 20, and 22·5 % by weight. The bacterial numbers were not greatly affected by the changing conditions, but from 10 tons of manure upwards they increased regularly. The optimum moisture content was 12·5 %. The average temperatures of the manured and unmanured soils were practically the same, but soil containing 12·5 % of moisture averaged 1° C. higher than soil with 22·5 %. The ammonifying power was much influenced by changes in the manurial and water contents; it increased regularly with the amount of dung applied and the greatest increase per ton of manure was observed in the soil receiving 5 tons. Ammonification was accelerated as the water applied increased up to 20 %, and the greatest effect was noted when the water was increased from 12·5 to 15 %. Increase of manure, even up to 25 tons, greatly increased the amount of nitrification, which attained a maximum with 17·5 % of water. The greatest increase per unit of manure took place with the smallest application. Although the nitrogen-fixing power was but little affected, it increased regularly up to 10 tons of manure per acre, and then decreased; it also increased with the amount of irrigation water added. There was no evidence of denitrification. The plots (24 × 7 ft.) of fallow field soil were treated with 5 and 15 tons of manure per acre, and with 5, 10, 20, 30, and 40 inches of water at intervals between May and November, in addition to a rainfall of about 5 inches. The bacteria were at a maximum in the plot receiving 15 tons of manure, and their number increased up to 20 inches of added water, the gain being most marked in the soil containing the most manure. Taking the ammonifying power of the unmanured and unirrigated plots as 100 %, 5 tons of manure gave 147 %, and 15 tons of 188 %; 10 inches of water 147 %, 20 inches 108 %, 30 inches 103 %, and 40 inches 108 %. The greatest depressing effect of large quantities of water was observed with 15 tons of manure. Nitrification was stimulated by increasing the manurial dressing, but depressed by increasing the water supply. In the field experiments on cropped plots, the bacterial population behaved similarly to that on the fallow land, but the number

was always lower. Ammonifying power increased with the amount of manure and also with the water supply up to 30 inches; it was depressed in the soil receiving 40 inches of water, and particularly in presence of 15 tons of manure. The nitrifying power was slightly less than in the fallow plots, but here again it appreciated with increasing manurial dressings; it also increased greatly with the amount of water added up to 30 inches, especially on the plots receiving 15 tons of manure. In general, the results showed that the crop-producing property of a soil is closely connected with its bacterial activities, particularly with its ammonifying and nitrifying powers.
—E. H. T.

Soil: Bacteriological studies of a —— subjected to different systems of cropping for twenty-five years. P. L. Gainey and W. M. Gibbs. J. Agric. Res., 1916, **6**, 953—975.

The bacterial activities of the Putnam silt loam soil belonging to the Missouri Experiment Station formed the subject of investigation during 1913 and 1914. The cropping systems adopted on the 1/10 acre plots were: a 6-year rotation of corn (maize), oats, wheat, clover, timothy, timothy; continuous maize, continuous wheat, and continuous timothy. Some of the plots received stable manure at the rate of 7 tons per acre, and two plots (continuous wheat and rotation) were dressed with sodium nitrate, potassium chloride, and superphosphate. Analytical determinations were made of the moisture content of the soils, of the water-holding capacity, and of the ammonifying and nitrifying action on the nitrogen of sterile cotton-seed meal. The bacterial counts, which were made on Temple's agar, disclosed marked differences between the various plots. In the absence of manure or fertiliser, the order was, timothy (greatest number), rotation, maize, wheat, the last two being nearly equal; but in the presence of manure the order was nearly reversed, *viz.*, maize, wheat, timothy, rotation, the two first responding in a marked degree. The different cropping systems had no appreciable effect on the ammonifying powers of the soil, and there was no correlation between the latter and the bacterial counts. The reverse held good with the nitrifying powers. Continuous maize and wheat produced a low oxidising power in the absence of manure or fertiliser, but this power was considerably increased when these amendments were present, particularly with the manure. The percentage increases in the nitrifying powers due to the application of organic manure in 1914 were: maize 217, wheat 150, timothy 47, and rotation 28; and the increases following the application of chemicals were: wheat 103, rotation 30. The increases were very much smaller when calcium carbonate was added to the test samples, and the lowest increases were observed when both carbonate and soil amendment were present together. The effect of the addition of calcium carbonate in largely eliminating the differences in nitrate formation within the soil itself, could not be correlated with its effect on the lime requirement.—E. H. T.

Sodium salts in the soil: Effect on plant growth of ——. F. B. Headley, E. W. Curtis, and C. S. Scofield. J. Agric. Res., 1916, **6**, 857—869.

In connection with an attempt to reclaim a tract of salt land in Nevada, experiments were made to determine the limits of tolerance of wheat seedlings to the carbonate, bicarbonate, chloride, and sulphate of sodium. The plants were grown from seed in a fairly rich sandy loam soil contained in glass tumblers. It was found that only a fraction of the added salts could be recovered from the soil by digestion with water, and that the limit of tolerance was better determined by the amount of salt thus recovered, and by the amount left in the soil solution, than by the quantity added. Sodium chloride was absorbed by the soil much less readily than either the carbonate or the sulphate, and the absorption of carbonate was greater in a rich loam soil than in a sandy soil. The carbonate and bicarbonate are mutually interchangeable in the soil, and the toxicity of these salts is conditioned solely by the amount of base that enters the soil solution. The quantity of recoverable salt which prevented germination was: for the carbonates, 0·13% of the dry weight of the soil; for the chloride, 0·52%; for the sulphate, 0·56%; and the amounts which reduced by one-half the growth of the seedlings were 0·04%, 0·16%, and 0·35% respectively.—E. H. T.

Superphosphates: Technological-chemical research on ——. U. Pratolongo. Annali Chim. Appl., 1916, **6**, 59—112.

Many samples of superphosphate were examined by the author chemically and with the petrographic microscope, and experiments were made on the conditions of equilibrium of the system, lime, phosphoric acid, and water at 75° C. and at 100° C., and on the influence of various factors on the physical properties of superphosphate. Contrary to the view generally accepted, the calcium sulphate present in superphosphate prepared from mineral phosphates usually exists mainly or entirely as anhydrite; only in rare instances is it present chiefly or solely as the dihydrate. In bone superphosphate, on the other hand, usually prepared with a restricted quantity of sulphuric acid, the dihydrate is present more frequently. Mono- and di-calcium phosphates occur usually only in the hydrated form, but the anhydrous salts are also sometimes present. The physical properties of superphosphate depend chiefly on the amount of the liquid phase which is always present. For analytical purposes the liquid phase is defined as the sum of the free water and the free phosphoric acid. To determine these the superphosphate is extracted with cold 95% alcohol, and the residue is washed with a little ether, dried for 1 hour at 80° C., and weighed; the loss of weight corresponds to the free water plus free phosphoric acid. In the alcoholic solution, after dilution with water, the phosphoric acid is determined either volumetrically or gravimetrically. Results obtained with numerous commercial samples of superphosphate indicate that in general the best products in regard to dryness and friability are those in which the liquid phase is less than 15%; products containing 15—18% of liquid phase are still dry and friable, those containing 18—25% are slightly moist and cake when compressed, whilst those containing more than 25% of liquid phase are moist and readily cake. In the technical preparation of superphosphate the first stage consists in the reaction of sulphuric acid with part of the tricalcium phosphate to form calcium sulphate and phosphoric acid. In the second phase the free phosphoric acid reacts with a further quantity of the tricalcium phosphate; this reaction proceeds with appreciable velocity only above 50°—60° C., and with sufficient velocity for technical purposes only at 70°—80° C. As the temperature of reaction increases, the amounts of free water and of free phosphoric acid in the product also increase; hence attempts to improve the physical characters of superphosphate by increasing the temperature of reaction are irrational. The best results will be obtained when the reaction temperature is from 80°—100° C., and as the quantity and concentration of the sulphuric acid used in practice may be regarded as fixed, the aim should be to maintain the desired temperature by variation of other factors, such as the dissipation of heat during the process, the total mass of the system, the duration of the mixing process, and the quantity of water evaporated, *e.g.*, by ventilation of the superphosphate dens.—A. S.

Phosphates; Causes that influence the solubility in citric acid of sparingly soluble ——. A. Aita. Annali Chim. Appl., 1916, **6**, 119—131.

EXPERIMENTS on lines similar to those described previously (this J., 1916, 974) showed that the solubility of the phosphoric acid of mineral phosphates in 2% citric acid is diminished in presence of sodium silicate or magnesium silicate, but increases in presence of ferrous sulphate or manganous sulphate in proportion to the concentration of the latter. In presence of ferric sulphate, ferric chloride, or aluminium sulphate, the solubility increases more rapidly than the concentration of the added salts. In explanation of this it is considered that in addition to the effect of the salts on the equilibrium between phosphoric acid and citric acid, to which the action of ferrous and manganous salts is due, ferric ions and aluminium ions form complex citrophosphates. In basic slag there are present secondary constituents which on the one hand diminish the citric acid solubility, *e.g.*, lime, silicates, etc., and others, such as sulphates, aluminium, and iron, which increase the solubility. It is considered that the phosphoric acid of basic slag is present as tricalcium phosphate and that its relatively high solubility in citric acid is due principally to the effect of the aluminium and ferric ions present. From this it follows that the difference in price between the phosphoric acid of basic slag and of mineral phosphates is not justified and that the Wagner citric acid test cannot be considered satisfactory as it does not take into account the influence of secondary constituents on the solubility of the phosphoric acid. (See also Robertson, this J., 1914, 9; 1916, 217; Collins and Hall, this J., 1915, 526.)—A. S.

Basic slag; The citric solubility of ——. J. Board Agric., 1916, **23**, 540—549.

FROM 1911 to 1913, experiments were conducted at five German experimental stations in order to study the relation between soil fertility and the content of total phosphoric acid and of citric soluble phosphoric acid in basic slag. At Bremen, pot experiments on mustard and rye, grown in sandy and "low" moor soils, showed that the manurial value of the slag was different for different soils, but that the citric solubility test gave a very fair indication of it, provided that the fineness did not fall below certain limits. In the Bromberg experiments, mustard and oats followed by mustard were grown in a loam very deficient in phosphoric acid. It was found that the fertilising value of the slag depended not only upon the total P_2O_5-content but was intimately connected with the citric solubility. The results at Halle, where rye, oats, and mustard were grown in a soil of 90% sand and 10% loam, indicated that the crop yields were independent of the fineness and alkalinity of the slags, but were probably influenced by the citric solubility. The Harleshausen tests gave unfavourable results, probably owing to the nature of the soils used. At Möckern, barley and peas were grown in a quartz soil, with and without added lime or gypsum, and in a sand containing a little lime but no humus. The crops of total dry matter showed that the citric acid test was a better index of manurial value than the total P_2O_5-content. The manurial effects varied most with the cultivation and the experimental conditions, but to a lesser extent with the nature of the soil and the crop. The general conclusion reached was that there were no grounds for altering the usual methods of evaluating basic slags.—E. H. T.

Calcium cyanamide; Analysis of crude ——. E. Truninger. Schweiz. Ver. anal. Chem., May 26 and 27, 1916. Chem.-Zeit., 1916, **40**, 812—813. (See also this J., 1916, 617.)

A SLIGHT alteration is to be made in the method previously described: the cyanamide should be precipitated with neutral silver nitrate and the ammonia added afterwards. For the present, the dicyandiamide may be determined indirectly by the simultaneous precipitation of cyanamide and dicyandiamide with silver nitrate and 2% potassium hydroxide solution and subsequent determination of the nitrogen in the precipitate by Kjeldahl's method. The determination of urea has not been deeply studied because it is not yet certain whether that substance is present. Caro's method (this J., 1911, 23) could not give accurate results, because the prolonged heating with alkali to drive off the ammonia would cause losses not only of dicyandiamide but also of urea if present. Determinations of the insoluble nitrogen in the residue from the extraction of the crude material with water and dilute nitric acid showed an average of 1%; in a few cases 2% was found. Agricultural experiments with calcium cyanamide on oats confirmed its favourable effects; with the exception of a single sample rich in dicyandiamide, an increased yield was recorded. The injurious influence of considerable quantities of this substance was shown at an early stage but could be largely inhibited by the simultaneous application of a readily assimilable nitrogen compound. In considering the unfavourable influence of the dicyandiamide, its great stability in the soil must be taken into account; nitrification had not taken place after a period of two months. Secondary ill-effects were observed in the case of oats even in the second year; on the other hand calcium cyanamide which had lain for a long time on the moist ground had lost much of its valuable properties. Vegetation experiments with urea and urea nitrate showed excellent results with oats. With winter wheat a top dressing of calcium cyanamide and urea showed the great value of urea used in this form.—J. F. B.

"*Marine kainit.*" U.S. Com. Rep., Sept. 23, 1916.

A POTASH fertiliser, called "marine kainit," and containing about 12% of potash, is now being produced in Spain from the mother liquors from the manufacture of sea-salt. After a preliminary evaporation of the liquors to remove a part of the salts, the residual liquor is evaporated to dryness. The product is said to be superior in many respects to ordinary kainit, particularly on account of its hygroscopic properties.

PATENTS.

Fertiliser; An improved —— [*from activated sewage sludge*]. G. J. Fowler and G. Mumford, Manchester. Eng. Pat. 8397, June 7, 1915.

THE solid residue obtained from sludge from sewage purified by forcing air through it, is heated and dried at a temperature not exceeding 100° C. as a rule, and then rendered bacterially active by the addition of about 5—10% of its bulk of fresh activated sludge. Alternatively, the heating may be carried out at 60°—70° C. for from 12 to 48 hours, in which case the contained moulds, seeds, etc., are killed, but sufficient beneficent bacteria are left to revivify the fertiliser and cause it to become bacterially active in a short time. (See this J., 1916, 552, 617.)—E. H. T.

Fertilisers; Manufacture of ——. D. Shields, Edgeworth, Pa. U.S. Pat. 1,196,889, Sept. 5, 1916. Date of appl., Mar. 11, 1916.

FINELY divided coal is mixed with "subterranean salt water," the mixture heated, the coal, impregnated with salts, is incorporated with at least an equal quantity of finely divided clay, and the product allowed to age.—F. Sodn.

Fertiliser formed by the addition of ammonium sulphate and acid phosphate to calcium cyanamide, and process of making same. F. S. Washburn, Nashville, Tenn., Assignor to American Cyanamid Co. U.S. Pat. 1,196,910, Sept. 5, 1916. Date of appl., Nov. 17, 1914.

Commercial calcium cyanamide is mixed with ammonium sulphate and sufficient acid fertiliser material, *e.g.*, acid phosphate, added to prevent the escape of ammonia.—F. Sodn.

Feldspar, feldspathic rock and other potash-bearing silicate rocks ; Process for treating —— for use as a fertilizer, or for further treatment by weak acids for the recovery of potash and alumina. C. W. Drury, Kingston, Ontario. Eng. Pat. 15,432, Nov. 2, 1915. Under Int. Conv., Dec. 28, 1911.

See U.S. Pat. 1,150,815 of 1915 ; this J., 1915, 973.

Citrate-soluble phosphate ; Manufacture of ——. S. B. Newberry, Cleveland, Ohio, U.S.A. Eng. Pat. 16,558, Nov. 23, 1915.

See U.S. Pats. 1,162,802 and 1,162,944 of 1915 ; this J., 1916, 133. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 13,890, 13,891, 19,044, and 19,045 of 1911.)

XVII.—SUGARS ; STARCHES ; GUMS.

Cane sugar factory : Relative purity of raw and clarified juices and of syrups in the ——. H. Pellet. Int. Sugar J., 1916, **18**, 420—421.

During evaporation of clarified juices there is no destruction of reducing sugars but rather a slight increase, especially during any stoppage or diminution in the rate of operating. The syrup rarely retains the purity of the clarified juice : for a satisfactory comparison it is necessary to take numerous and regular samples and bring the syrup to the same dilution as the juice before analysis.—J. H. L.

Sugars ; Precipitation of reducing —— by basic lead acetate. N. Deerr. Int. Sugar J., 1916, **18**, 402—404.

Statements in a recent paper by Davis (this J., 1916, 203) led the author to make the experiments described, which show that when basic lead acetate is added to a solution of invert sugar containing sodium sulphate, a considerable proportion of the sugar, in some cases more than one-half, is carried down with the lead precipitate, and addition of an excess of sodium sulphate does not redissolve it. The sugar thus removed from solution can be quantitatively recovered by treating the precipitate with dilute sulphuric acid, the reducing powers of this acid extract and of the original filtrate from the lead precipitate being together equal to that of the invert sugar solution employed. Conversion of reducing sugars into glutose, as suggested by Davis, may possibly occur on prolonged exposure to basic lead acetate even at low temperatures, but in the author's experiments prolonged exposure was avoided.—J. H. L.

Pentoses ; Total destruction of —— during alcoholic fermentation. [*Analysis of molasses.*] H. Pellet. Comptes rend., 1916, **163**, 274—276. (See also Cross and Tollens, this J., 1912, 198.)

In the fermentation of mixtures of arabinose or xylose with fermentable sugars, a considerable part or even the whole of the pentose may be decomposed in the course of a few days if only a small amount of yeast is present. When it is desired to eliminate the other sugars completely in order to determine the pentose by copper-reduction, a relatively large amount of yeast should be used so that fermentation is completed before the pentose is appreciably attacked. The author found, for example, that if 1 litre of a solution containing 100 grms. of beet molasses and 1 or 2 grms. of arabinose, is fermented with 50 grms. of ordinary pressed yeast, fermentation is practically complete in 24 hours without any decomposition of pentose, but after 48 hours no pentose remains. In the case of cane molasses, which ferments more rapidly than beet molasses, some destruction of pentose occurs even within 24 hours, and it is advisable to stop the fermentation after 6 or 12 hours, while the liquid still contains a little unfermented sugar. The composition of the fermenting liquid, especially as regards fermentable sugars, seems to influence very considerably the rate of destruction of pentoses by yeast. Applying these observations to the analysis of molasses, the author found that beet molasses contains no appreciable quantity of pentoses, and cane molasses contains a reducing substance (probably the glutose of van Ekenstein) which, unlike pentoses, is not fermentable under any conditions.—J. H. L.

Action of X-rays on iodine and starch iodide in aqueous media. Bordier. *See* VII.

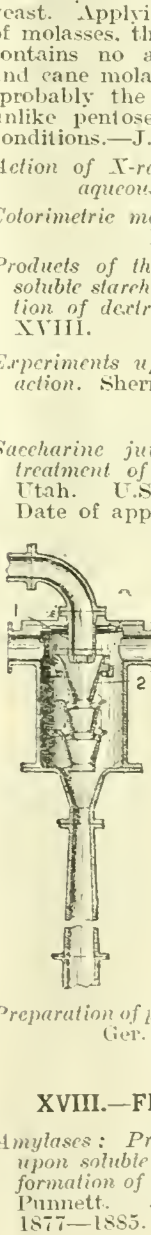
Colorimetric method for detection of potato starch. Blunck. *See* XIXa.

Products of the action of certain amylases upon soluble starch, with special reference to the formation of dextrose. Sherman and Punnett. *See* XVIII.

Experiments upon starch as substrate for enzyme action. Sherman and Baker. *See* XVIII.

Patents.

Saccharine juices : Apparatus for the gaseous treatment of ——. N. A. Lockwood, Ogden, Utah. U.S. Pat. 1,195,041, Aug. 15, 1916. Date of appl., Feb. 9, 1916.



The juice enters a closed receptacle forming a gas chamber provided with an inlet for the treating gas and means for receiving and conveying the incoming liquid and gas, including a hollow truncated inverted cone, 2, and a juice injector, 1, directly discharging into the cone and provided with a nozzle end having a number of tapering jet orifices formed so as to direct the injected juice in the form of a wall of jets having a central open zone.—J. F. B.

Preparation of phosphoric acid esters of carbohydrates. Ger. Pat. 292,817. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

Amylases : Products of the action of certain —— upon soluble starch, with special reference to the formation of dextrose. H. C. Sherman and P. W. Punnett. J. Amer. Chem. Soc., 1916, **38**, 1877—1885.

Both pancreatic and malt amylases, even when highly purified, may produce small quantities of dextrose in the hydrolysis of starch, but under the conditions which obtain in the determination of diastatic power the dextrose formed is not sufficient to affect the results appreciably. Takadiastase, purified beyond the commercial condition, forms rather larger quantities of dextrose than the other amylases. In the hydrolysis of soluble starch with any of the three kinds of amylase, at 10° C., considerable amounts of dextrin remain even after 40—50 times as long as is required for the disappearance of the starch-iodine reaction, and about 1 % of the "soluble" starch is left as a very finely divided insoluble residue difficult to filter.—J. H. L.

Starch as substrate for enzyme action: Experiments upon ——. H. C. Sherman and J. C. Baker. J. Amer. Chem. Soc., 1916, **38**, 1885—1901.

The authors studied the action of different amylases on the two constituents of starch, α-amylose (amylopectin) and β-amylose, separated from each other by centrifuging potato-starch paste containing a trace of sodium chloride. The conversions were carried out at 40° C. and continued for 24 hours, low concentrations of enzyme being employed. Pancreatic amylase, both in commercial and in highly purified form, produced maltose more rapidly from β- than from α-amylose, and in both cases the substrate ceased to give the iodine reaction when about 35—50 % of the theoretical quantity of maltose had been formed. The amylase of *Aspergillus oryzæ* (purified takadiastase) hydrolysed Lintner's soluble starch, starch gelatinised in an autoclave, and α-amylose, at about equal rates; it hydrolysed β-amylose somewhat more rapidly but its action was not so well sustained as that of other amylases. The iodine reaction was lost when only 20—30 % of the theoretical amount of maltose had been formed. Purified malt amylase produced maltose more rapidly from α- than from β-amylose during the earlier stages, but the rate of production from the former soon fell off whilst that from the latter was remarkably well sustained. The iodine test gave negative results only when 65—80 % of the theoretical amount of maltose had been formed, in the case of Lintner's soluble starch, autoclaved starch, or α-amylose, and only when 85—95 % had been formed in the case of β-amylose. The "delayed iodine end-point" appears to be characteristic of conversions effected by purified malt amylase, whether upon α- or β-amylose. With β-amylose as substrate, the amylase of *Aspergillus oryzæ* catalyses the earlier stages of conversion more than the later stages; the converse applies to malt amylase, whilst pancreatic amylase is intermediate. With α-amylose all the amylases show a more pronounced catalytic effect in the earlier than in the later stages. Starch pastes made at low temperatures (65°—80° C.), autoclaved starch, and Lintner's soluble starch, all resemble α- rather than β-amylose in their behaviour as substrate towards all three amylases, doubtless because α-amylose is the chief component of all these forms of starch. —J. H. L.

Yeast fermentation: Influence of catalysts (alkaloids, dyes, etc.) on ——. R. Somogyi. Int. Zeits. Phys.-Chem. Biol., 1916, 2, 416—429. J. Chem. Soc., 1916, **110**, i., 619—620.

Small amounts of quinine and atropine accelerate the growth of yeast, whilst larger quantities inhibit it. With cocaine and pilocarpine, on the contrary, small amounts inhibit whilst larger quantities have an accelerating influence on the fermentation (compare Traube and Onodera, this J., 1915, 510). Basic dyes, such as Malachite Green and Methylene Blue, exert a toxic action on the yeast-cells when present in moderate concentration. When, however, only a trace of Methylene Blue is added, the activity of the yeast appears to be enhanced and fermentation is accelerated. Most of the acid dyes examined did not materially influence the rate of fermentation even when present in considerable amounts.

Sulphur in wine: States of combination of —— and their determination. W. I. Baragiola and O. Schuppli. Z. Unters. Nahr. Genussm., 1915, **29**, 193—221. J. Chem. Soc., 1916, **110**, ii., 488.

Sulphur occurs in wine principally as inorganic and organic sulphates; free and combined sulphurous acid, and "neutral" sulphur (sometimes called protein sulphur), are also present. A small quantity of free sulphur (partly colloidal) is found in some wines. Inorganic sulphuric acid is estimated by precipitation in the cold with barium chloride in an atmosphere of carbon dioxide; the organic sulphuric acid is estimated by heating the filtrate from the barium sulphate precipitate. Von der Heide's method (see this J., 1911, 566) is trustworthy for the estimation of the total sulphuric acid. The total sulphurous acid is estimated by distillation in the presence of phosphoric acid, whilst Mathieu and Billon's method (this J., 1902, 1247) may be used for the estimation of the combined sulphurous acid. For the estimation of total sulphur the wine is treated with sodium carbonate and hydrogen peroxide, evaporated to dryness, the residue mixed with potassium nitrate, and ignited; the sulphate in the ash is then estimated gravimetrically. "Neutral" sulphur is estimated by boiling the wine with hydrochloric acid to expel sulphur dioxide, precipitating the sulphuric acid with barium chloride, oxidising the filtrate from the barium sulphate with nitric acid, and precipitating the resulting sulphuric acid with barium chloride.

Methyl alcohol; Detection of —— by Denigès' method. E. Salkowski. Z. Unters. Nahr. Genussm., 1914, **28**, 225—236. J. Chem. Soc., 1916, **110**, ii., 198.

It has been found that many different alcoholic liquids yield a distillate which gives a reaction indicating the presence of methyl alcohol when tested by Denigès' method (this J., 1910, 585). Even when the distillate has been re-distilled before being tested, the result is not conclusive. A feeble reaction may be due to the presence of glycerol, but a strong reaction may be taken as indicating the presence of methyl alcohol, though confirmatory tests should always be applied.

Fermentation lactic acid: A study of the stereoisomerism of a ——. S. J. Thomas. J. Ind. Eng. Chem., 1916, **8**, 821—823.

Matzoon is an Armenian soured milk product prepared from cow's milk by the aid of a "starter" containing a bacillus of the *B. bulgaricus* group, resembling *B. caucasicus* (Flugge). *Streptococcus kefir*, Kuntze (a member of the *Str. lebenis* group), and *Saccharomyces kefir*. The lactic acid produced by Matzoon in a synthetic culture medium was found to be optically inactive but could be resolved into the active modifications by fractional crystallisation of the strychnine salts.—A. S.

Total destruction of pentoses during alcoholic fermentation. Pellet. *See* XVII.

Biochemical synthesis of α-propyl-d-galactoside by means of an enzyme contained in air-dried bottom-fermentation beer yeast. Bourquelot and Aubry. *See* XX.

Patent.

Preparation of phosphoric acid esters of carbohydrates. Ger. Pat. 292,817. *See* XX.

XIXa.—FOODS.

Butter ; Progressive oxidation of cold-storage ——. D. C. Dyer. J. Agric. Res., 1916, **6**, 927—951.

The air contained in various samples of cold-storage butter was extracted and the carbon dioxide and oxygen contents determined, and at the same time the chemical characters of the extracted butter fats were in many cases also determined. The butter samples were placed in special tubes (9 × 1¾ in.) with widened necks to carry a rubber bung fitted with a glass stop-cock, and the space between the butter and the bung was filled with pure paraffin oil. The air contained in a pasteurised sweet-cream butter containing bacteria and prepared from cream of acidity 0·11 % (as lactic acid), underwent little or no change during 6 months at 0° F. (−18° C.), nor did the butter-milk made from the same cream. The composition of the air in the butter changed considerably when the temperature was 32° F. (0° C.), the oxygen diminishing and the carbon dioxide increasing progressively, and at room temperature this change was more marked. The air enclosed in butter made from sweet cream of acidity 0·25 %, and churned immediately after the addition of 15 % of a commercial starter, remained unchanged for 7 months at 0° F., but that from similar butter prepared with the addition of lactic acid suffered a progressive loss of both oxygen and carbon dioxide, the decreases being accentuated at 32° F., and the taste becoming unpleasant after 3 months. Butter-milk, from butter prepared similarly, lost all its enclosed oxygen in 26 days when it was exposed to a very large and confined surface of air ; the carbon dioxide rose from 2·37 % to 34 % in the same time, but thereafter began to diminish. To investigate the oxidation of pure butter fat, the latter was separated and washed practically free from non-fatty constituents, and then stored for several months at 0° F. The samples showed no deterioration even after 18 months, and the chemical analyses, performed after 4 months, showed that no oxidation had occurred. The confined air, however, showed a slight progressive increase of carbon dioxide, which bore no relation to the oxygen content. Stored at 32° F., and exposed to a large surface of air, the fat underwent a slight oxidation. To ascertain if the changes in whole butter were due to its non-fatty constituents, samples made from pasteurised cream and ripened with a pure culture were (a) washed until the wash water was just clear, (b) more thoroughly washed, and (c) left unwashed. The keeping qualities at 0° F. of the two former were the same, as were also the chemical characters of the butter fats, and hence no chemical changes had occurred. The carbon dioxide enclosed in (a) decreased greatly in the second to third month, and then the decreased percentage remained fairly constant : that in (b) rose to a maximum after 3 months and then remained constant. In both samples, the oxygen content was different at each stage but it diminished regularly in both. Sample (c) was prepared similarly but from a different lot of cream, and it contained more buttermilk. Although the fat did not change during storage at 0° F. for 6 months, the confined air became very different from that in (a) and (b) : the carbon dioxide was at a maximum after 3 months, when a characteristic "off flavour" developed, and after 8 months the oxygen content was reduced nearly to zero. The general conclusions arrived at were : Undesirable flavours in cold-storage butter are not due to oxidation of fat, but to a chemical change in one or more of the non-fatty ingredients ; the extent of the change is proportional to the acidity of the cream from which the butter was made : the amount of confined carbon dioxide is probably related to the quantity of buttermilk present, and this amount may increase to a maximum and then decrease progressively.—E. H. T.

Tallow and hydrogenated fats in butter fat : Detection of ——. K. Amberger. Z. Unters. Nahr. Genussm., 1916, **31**, 297—308. Z. angew. Chem., 1916, **29**, Ref., 111.

The method depends upon the different solubility in ether of the glycerides of butter fat and of fats containing tristearin or β-palmitodistearin. 31 grms. of the clear melted fat at 40°—50° C. is placed in a warm 400 c.c. flask, which is then filled with ether, closed with a cork, shaken vigorously, and placed in a water-bath. After 1 hour it is again shaken, replaced in the water-bath for another hour, and shaken again. If there is no appreciable precipitate the butter fat contains less than 12 % of tallow or the like. If a precipitate is present, it is collected on a filter, washed with 3—4 c.c. of ether containing 20 % of alcohol, and weighed ; if the weight amounts to 0·4 grm. or more the butter-fat is adulterated with a considerable proportion (15 % or more) of tallow or the like.—A. S.

Rennet ; Experiments on the preparation of home made ——. A. Todd and E. C. V. Cornish. J. Board Agric., 1916, **23**, 549—555.

The rennet prepared from the dried vells of calves was of no practical value, but that made from fresh vells, although only half as active as the commercial extract, was of good quality and could be kept in good condition for at least six weeks in presence of a preservative. After splitting and emptying the vells, the skins were trimmed and washed well with cold water. They were then put into brine containing boric acid, and after 3 weeks' immersion (for vells from milk-fed calves) were transferred with the liquid on to cheese-cloths, which were pressed by hand and drained for several hours. The vells were then removed, the cloths pressed in a root press, and the liquid filtered several times through cotton wool. Apparently there was no advantage to be gained by using vells from very young calves, or by using sand, kieselguhr, or other filtering medium in addition to or in place of cotton wool. Prepared as above, the cost per gallon was about 6s. at current prices : that of commercial rennet is about 28s. It is not known if the coagulating property of the extract is due to rennet or to pepsin.—E.H.T.

Potato starch : Colorimetric method for the detection of ——. G. Blunck. Z. Unters. Nahr. Genussm., 1915, **29**, 246—247. J. Chem. Soc., 1916, **110**, ii., 509.

The presence of potato starch in flour may be detected by treating a portion of the latter on a microscope slide with a drop of water, drying it, adding a drop of a solution of the dyestuff, "metachrome red G Agfa," washing off the excess of dyestuff, and then examining the slide under the microscope. Potato starch and cell tissues are coloured a bright golden yellow, whilst cereal starches are not coloured. The dye solution is prepared by cooling a solution of the substance in 30 % alcohol, saturated at the boiling point, filtering, and diluting the filtrate with one-quarter of its volume of water. In presence of acids the dye colours wheat starch as well as potato starch ; hence in applying the test to bread, it is necessary to treat a small quantity of the crumb with dilute alkali solution, and then wash it thoroughly, before adding the dye.

Soya beans : Salicylic acid reaction of ——. H. C. Brill. Philippine J. Sci., 1916, **11**, 81—89.

Some varieties of soya beans, particularly those grown in Japan, contain a substance which is soluble in alcohol and ether, volatile in steam, crystallisable, and yields a violet coloration with ferric chloride in acid solution. The substance, which is probably Brand's maltol (this J., 1894, 896; 1895, 378), does not give a reaction with Jorissen's test for salicylic acid (a red coloration when the solution is heated with potassium nitrite, acetic acid, and a trace of copper sulphate). It appears to be formed by enzymic action in the beans. (See also Sherman, this J., 1910, 230; Backe, *ibid.*, 417, 970.)—W. P. S.

Tin in canned foods. W. D. Bigelow. J. Ind. Eng. Chem., 1916, **8**, 813—815.

The tin present in canned foods is largely and sometimes chiefly present in an insoluble form. Apparently the organic acids present in the foods dissolve tin from the container, and the tin compounds are subsequently hydrolysed in contact with the food, with separation of the tin in an insoluble form and liberation of acid. The hydrolysis is greater with non-acid or slightly acid foods than with acid fruits, but in both cases a considerable proportion of the soluble tin salts is carried within the solid particles of food before being hydrolysed. The proportions of tin (mgrms. Sn per kilo.) in the liquor and in the drained solids of various kinds of canned foods was found to be as follows:—cranberries, 33, 254; raspberries, 39, 294; cherries, 52, 163; peaches, 86, 251; pears, 99, 151; plums, 43, 180; shrimps, 67, 381; spinach, 35, 131; asparagus, 200—252, 322—554; Lima beans, 40—46, 99—254; string beans, 63—132; 169—658; wax beans, 39—88, 143—616. The relative proportion of the tin in the drained solids increases with the age of the sample. (Compare Buchanan and Schryver, this J., 1909, 322.)—A. S.

Ipel, a coffee substitute: Leucæna glauca (Linnæus) Bentham. H. C. Brill. Philippine J. Sci., 1916, **11**(A), 101—104.

Ipel-ipel is a leguminous shrub growing widely in the Philippine Islands, the seeds of which are used there as a substitute for coffee. The roasted and ground seeds and their infusion have an aroma like that of coffee. The infusion appears brown by direct light and has a deep green fluorescence by reflected light. It gives a violet colour but no precipitate with ferric chloride, and reduces Fehling's solution after first acidifying with hydrochloric acid. The addition of copper acetate produces a green colour and a greenish-brown gelatinous precipitate, and lead acetate produces a yellow gelatinous precipitate. The infusion is slightly acid to litmus and gelatinises albumin. The specific gravity of a 10% decoction is 1·0068 and the content of dissolved solids 24·4%. Analyses of the raw and roasted seeds gave respectively: Moisture 11·80 and 8·13, fat 8·68 and 6·95, nitrogen 6·42 and 5·21, sucrose traces, nitrogen-free material other than fibre 9·78 and 16·11, crude fibre 22·29 and 22·18, ash 4·20 and 4·37%. The constants of the oil from the raw and roasted seeds are: $n_D = 1·467$ and 1·469, saponification value 196·2 and 190·7.—J. H. J.

Study of the stereoisomerism of a fermentation lactic acid. Thomas. *See* XVIII.

Patents.

Foods; Method of canning ——. F. Hugh, New York. Eng. Pat. 12,410, Aug. 30, 1915. Under Int. Conv., Sept. 30, 1914.

Foods such as fruits, vegetables, meat, and fish, are placed in bags made of waterproof paper, which are loosely closed with wooden clamps. The filled bags are then placed in tins, water is added to fill the space between the bag and the tin, and the whole is subjected to a sterilising operation, during which the wooden clamps swell and close the bags tightly; the tins are then sealed hermetically. The paper prevents the food coming into contact with the metal.—W. P. S.

Food for the feeding of agricultural stock; A milk-like ——. W. J. Melhuish, Poole, Dorset. Eng. Pat. 101,264, Apr. 25, 1916. (Appl. No. 5911 of 1916.)

To make 10 galls. of food, 8 galls. of water is heated to boiling in a jacketed pan, 2 galls. of lime water is poured in, and the source of heat removed. Then 160 grains of potassium or sodium phosphate is added and 16 lb. of pea nuts which have been coarsely ground is stirred in, with 100 grains of calcium chloride and 5 lb. of malted dextrin or other sweetening agent. About 200 grains of sodium bicarbonate, 250 grains of magnesium carbonate, and 100 minims of 50% butyric acid are also added. The pan is covered and the contents kept stirred for 20 mins., after which they are poured on to a cloth filter, and 20 grains of ammonium carbonate is stirred into the filtrate. When the temperature has fallen to blood heat, 120 grains of citric acid is added and the food stirred. Instead of pea nuts, any other starchless legume containing an edible oil may be used. The nuts may be blanched before use. To increase the amount of solid matter in the food, a portion, or the whole, of the insoluble matter of the nuts may be left in.—J. H. J.

Pasteurisation [of milk]; Process of ——. F. A. Haines, Assignor to D. C. Kerckhoff, St. Louis, Mo. U.S. Pat. 1,196,357, Aug. 29, 1916. Date of appl., Dec. 4, 1915.

Milk at 40° F. (4·5° C.) is passed through a coil at 185° F. (85° C.), whereby it is heated to 160° F. (71° C.) and remains at that temperature for ½—1 hr. It is then passed to a primary cooler where its temperature is rapidly reduced to 140° F. (60° C.) and where it remains for 20—30 mins., after which it is cooled further.—J. H. J.

Milk; Method of preserving ——. J. W. Davies, Boston, Mass. U.S. Pat. 1,197,270, Sept. 5, 1916. Date of appl., Jan. 24, 1916.

The milk is pasteurised at a temperature sufficiently high to destroy bacteria, without changing the condition of the milk constituents, and is then transferred to containers whilst at substantially the same temperature. The milk is transferred to a hot room, kept at a permanent preservative temperature, between 140° and 152° F. (60° and 66° C.), whereby bacterial development is prevented, so that the milk may be maintained in stable condition for long periods of time.—B. N.

Preserving fruit-juices. C. E. Burke, Berkeley, and D. E. Fogg, Oakland, Cal. U.S. Pat. 1,197,412, Sept. 5, 1916. Date of appl., Oct. 3, 1914.

Fruit-juices are clarified by treatment with "pith extract of a citrus fruit pith," together with a reagent promoting the coagulation of such extract.—B. N.

XIXb.—WATER PURIFICATION; SANITATION.

Swimming pools; Chemical purification of ——. G. W. Heise and R. H. Aguilar. Philippine J. Sci., 1916, **11**(A), 105—122.

Experiments were made with copper sulphate and bleaching powder at swimming baths at Manila supplied with a river water which was impure and turbid from finely-divided clay, and which possessed a high degree of bicarbonate alkalinity. Copper sulphate added to the clean water in the bath failed to keep down the number of bacteria. Bleaching powder also failed when added in one large dose to the clean water, the body secretions, particularly sweat, consuming a large amount of the chlorine added and preventing sterilisation. When bleaching powder was added daily in the amount of 0·5 part of available chlorine per million parts of water, the number of bacteria was kept below 200 per c.c., and *B. coli* was absent. The water could be kept fit for use for one and two weeks. No great change was produced in the chemical quality of the water as regards turbidity and oxygen absorption. The temperature of the water was 27°—30° C. One bath was in the open air and exposed to sunlight; the water in this bath consumed the available chlorine much more rapidly than the water in the indoor baths. The best chemical tests to judge the quality of the water were determinations of the free chlorine and of the consumption of free chlorine. The oxygen absorption test at the end of each week was proportional to the number of bathers.—J. H. J.

Antiseptics: Comparative action of —— on pus and on pure cultures. A. Lumière. Comptes rend., 1916, **163**, 309—311.

The author studied the relative resistance to disinfection of pus from a shell-wound, containing white *Staphylococci* and broth cultures of the same organism. The antiseptics employed were phenol, hermophenyl (mercuri-phenoldisulphonate of sodium), and sodium hypochlorite, as representing respectively the groups of phenolic, metallic, and oxidising antiseptics. It was found that under the conditions of the experiments (action for 2 hours at 38° C.), the amount of hypochlorite required to sterilise pus was about 12 times as much as was required for an equal volume of broth culture. Hermophenyl and phenol showed far less difference of activity in the two media. The reduced bactericidal action of hypochlorite in pus is attributed to combination with organic matter; toxins present are oxidised and rendered innocuous to a greater extent by this antiseptic than by those of the phenolic and metallic groups. The experiments indicate that in the treatment of suppurating wounds with hypochlorite, relatively strong solutions should be used.—J. H. L.

Patents.

Water and other liquids; Treatment of ——. S. H. Menzies, London. Eng. Pat. 13,087, Sept. 13, 1915.

The reagent by which the water is to be treated is supplied by means of a small pump, preferably of a positive type, which has a by-pass between the suction and the delivery, so that on opening the valve on the by-pass, the delivery of the pump is reduced to an extent depending upon the degree of opening. This pump is mounted upon the same spindle as the main pump by which the water to be treated is passed through the treatment plant. The main pump delivers into a pressure tank, of such size that the water remains in contact with the reagent for the desired length of time. Into the outlet pipe from this tank, another small pump of the above type may deliver a determined quantity of another reagent, such as a de-chlorinating reagent.—J. H. J.

Water; Treatment of —— for softening, purifying, and like purposes. H. J. Magrath, London. Eng. Pat. 17,133, Dec. 6, 1915.

A rectangular tank has a shallow layer of gravel on the bottom, over which is a deep layer of permutit or other base-exchanging material. The water enters by a valve, worked by a ball float, in the side of the tank, above the permutit, and stands at a level a little above the valve. It leaves by a three-way tap at the bottom. To regenerate the material a solution of salt is poured in at the top of the tank and allowed to trickle out through the cock at the bottom. Alternatively, the tank may be filled with salt solution by upward displacement, a pipe being provided passing from the top of the tank to the bottom and along the floor, the portion along the floor being perforated and connected with a socket leading to the exit tap.—J. H. J.

Water-purifying apparatus. M. F. Newman, Oakmont, Assignor to W. B. Scaife and Sons Co., Pittsburgh, Pa. U.S. Pat. 1,195,391, Aug. 22, 1916. Date of appl., May 12, 1916.

The apparatus consists of a treatment and settling tank, a gravity filter, and a purified water reservoir which is placed at a higher level than the filter. The inflow to the filter is controlled by a float valve operated by the level of the water over the filter, and the outflow from the filter is controlled by a float valve in the reservoir operated by the level of the water therein. The float operating the inlet valve is provided with a device for closing the outlet valve at a regulated minimum water-level in the filter. A system of pipes and valves is provided for washing the filter by a reverse flow of the purified water through the filter.—J. H. J.

Water-purifying apparatus. A. van Vloten, Denver, Colo. U.S. Pat. 1,195,537, Aug. 22, 1916. Date of appl., June 2, 1915.

The apparatus consists of a precipitation tank, having at its lower end a funnel-shaped mixing compartment. The water and chemicals are supplied to the mixing compartment under pressure, and pass upwards between the edge of a conical baffle-plate and the side of the tank. Above the mixing compartment is an annulus of inverted V cross-section, spaced from the side of the tank, around which the upward flow of the liquids takes place. The upper portion of the tank is cylindrical and acts as a settling compartment. The top of the tank is closed and carries the exit pipe.—J. H. J.

Water; Process of purifying ——. C. P. Hoover, Columbus, Ohio. U.S. Pat. 1,197,123, Sept. 5, 1916. Date of appl., July 11, 1916.

Bauxite is treated with sulphuric acid in such proportion as to form a mixture containing basic aluminium sulphate, sulphuric acid, and the insoluble impurities of the bauxite. Water is added, and the resulting mixture is added to the water to be purified, thus forming aluminium hydroxide. This is settled with the entrapped impurities and the initial impurities of the bauxite, and the purified water drawn off for use.—B. N.

Sterilisation of liquids. M. von Recklinghausen, A. Helbronner, and V. Henri, Paris, Assignors to The R.U.V. Co., Inc., New York. U.S. Pat. 1,196,481, Aug. 29, 1916. Date of appl., Dec. 21, 1912.

The sterilising apparatus comprises a vapour electric lamp consisting of an enlarged non-luminous portion at one end, containing both electrodes, and a narrow luminous portion. The lamp is placed in the side of a sterilising chamber, so that the narrow portion projects into a tube in the chamber; the non-luminous part of the tube remains outside the chamber.—J. H. J.

Insecticides or plant washes. G. J. Lemmens, Wateringbury, and P. J. Fryer, Tonbridge, Kent. Eng. Pat. 101,308, Feb. 25, 1916. (Appl. No. 2856 of 1916.)

The plant wash comprises two solutions. One is prepared from resin soap, which is rendered completely soluble by the addition of 15% of alcohol to the heated soap, or 75% of alcohol to the cold soap. Instead of alcohol, 30% of soap may be used, which, when added to the heated resin soap, produces a clear, non-setting liquid. This solution is added to the water with which the second solution is to be diluted, in order to soften it. The second solution is the insecticide proper, and is made with soap as a basis.—J. H. J.

Nicotine solutions [dipping baths]: Method of testing ——. R. G. Mewborne and H. K. McConnell, Assignors to The Kentucky Tobacco Product Co., Louisville, Ky. U.S. Pat. 1,197,142, Sept. 5, 1916. Date of appl., May 18, 1915.

The nicotine content of dipping baths is determined by directly titrating a test portion of the solution, purified to remove interfering matter, with a standard solution of silicotungstic acid, in the presence of a suitable excess of mineral acid, but in the absence of an indicator.—B. N.

Water; Purification of ——. H. Kriegsheim, Berlin, Assignor to The Permutit Co., New York. U.S. Pat. 1,197,610, Sept. 12, 1916. Date of appl., Aug. 11, 1914.

See Eng. Pat. 17,191 of 1914: this J., 1915, 885.

An improved fertiliser [from activated sewage sludge]. Eng. Pat. 8397. *See* XVI.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Digitalis group: Chemical constitution and pharmacological action of substances of the ——. W. Straub. Biochem. Zeits., 1916, **25**, 132—144. J. Chem. Soc., 1916, **110**, i., 618.

The lethal doses of the various glucosides of the digitalis group and their "genins" on frogs was determined, and also their relative actions in certain cases on the isolated hearts. The lethal doses are given in the following table, the results being expressed in grms. of drug per grm. of body-weight:—

Digitoxin	0·0000036	Digitoxigenin	0·000006
K strophanthin	0·00000075	Strophanthidin	0·0000025
Cymarin	0·0000008	Cymarigenin	0·0000025

Digitalin and digitalenin were not sufficiently soluble for determinations of toxicity to be made. The glucosides are therefore more toxic than their genins. The toxicities of cymarin, cymarigenin (identical with strophanthidin), and cymaric acid, of which the chemical relationships to one another were determined by Windaus (this J., 1915, 851), were found to be 0·0000008, 0·0000025, and 0·00042 (in the same units). The benzoate of cymarigenin has a toxicity represented by the number 0·000025. No conclusions are drawn as to the relationship between chemical constitution and pharmacological action.

Rhamnus barks; Analysis of ——. O. Tunmann. Apoth.-Zeit., 1915, **30**, 642. J. Chem. Soc., 1916, **110**, ii., 501.

The red-coloured foam which is obtained when drugs containing anthraquinones are shaken with sodium hydroxide solution (compare this J., 1916, 906) is probably due to the presence of chrysophanol: the latter is present, therefore, in *Rhamnus carniolicus* as well as in *R. catharticus*, and the reaction simply serves to distinguish these from the American rhamnus bark, *R. purshiana*. Tschirch's colorimetric method indicates that the quantities of anthraquinone derivatives in *R. frangulus* and in *R. purshiana* have a ratio of 4 : 1, whilst according to the author's gravimetric method (this J., 1916, 273) the ratio between the two respective quantities is 3 or 2·5 : 1.

Vanilla beans; Effect of curing on the aromatic constituents of ——. F. Rabak. J. Ind. Eng. Chem., 1916, **8**, 815—821.

Laboratory experiments were made on the effect on vanilla beans of different methods of curing. Twelve lots of beans were used, of which six were cured at the ordinary temperature and six in a water-oven at 40—60 C. Of each set of six, one lot was cured without any preliminary treatment and the others were first immersed, for the periods mentioned, three times successively in water at different temperatures, viz., for 30 secs. at intervals of 1 min. at 40° C., for 20 secs. at intervals of 1 min. at 60° C., and for 10 secs. at intervals of ½ min. at 80°, 90°, and 100° C. respectively. Extracts were prepared from the cured beans to afford a better basis for comparison. It was found that extracts prepared from beans cured at the ordinary temperature were superior in colour, odour, and taste to those prepared from beans cured at a higher temperature. The extracts in most cases were richer in vanilla resins and colouring matter than commercial extracts. In the preparation of the extracts a considerable proportion of the resins remained undissolved when the solvent had a lower alcohol concentration than 65 %. It is concluded that the commercial curing process might with advantage be considerably shortened and simplified, and in order to produce uniformity in the composition of vanilla extracts it is recommended that the green beans be imported, and cured under uniform conditions. The best results appear to be obtained by curing at the ordinary temperature, either without previous treatment or after treatment with water at temperatures up to 90° C. for a short period. —A. S.

Deodar tree wood; [Constituents of the] volatile oil of Indian ——. O. D. Roberts. Chem. Soc. Trans., 1916, **109**, 791—796.

Two samples of the volatile oil from the wood of Indian deodar tree (*Cedrus deodara*, Lond.; *C. libani*, Barr.) were of reddish-brown colour and characteristic balsamic odour and had the following constants: sp.gr. at 15° C., 0·9549 and 0·9756; α_D^{22} (100 mm. tube) $= +52°16'$ and $+34° 6'$; $n_D^{20} = 1·5195$ and 1·5225; acid value, 5·6 and 4·5; ester value, 19·3 and 4·9; ester value after acetylation, 30·8 and 34·1. The oil contains about 2 % of a ketone, $C_9H_{14}O$, probably *p*-methyl-Δ^3-tetrahydroacetophenone, giving a semicarbazone, m.pt. 163°—164° C., which on decomposition with dilute sulphuric acid and distillation with steam yields *p*-tolylmethylketone; about 0·07 % to 0·4 % of an unidentified phenol giving a blood-red coloration with ferric chloride and forming a benzoyl derivative, m.pt. 70° C.; 3 % to 12 % of the esters of hexoic, heptoic, and stearic acids; 50 % to 70 % of sesquiterpenes of variable rotation, together with sesquiterpene alcohols associated with high boiling, viscous decomposition products.—T. C.

Hydnocarpus venenata, Gaertner: False chaulmoogra. H. C. Brill. Philippine J. Sci., 1916, 11, 75—80.

The kernels obtained from the seeds of *H. venenata* yielded, by expression, 51·2 % of a greenish-yellow oil having the following characters:—sp. gr. at 30 C., 0·9175; m.pt., 19°—20° C.; $[\alpha]_D = +52·03°$; $n_D^{30} = 1·4770$; saponif. value, 200·3; acid value, 4·1; iodine value, 99·1. It contains a cyanogenetic glucoside, chaulmoogric acid, and hydnocarpic acid. The oil closely resembles true chaulmoogra oil obtained from *Taraktogenos Kurzii*, and also the oils obtained from *H. Wightiana* and *H. anthelmintica* (see this J., 1904, 669; 1905, 711). Since the chemical constituents are identical, it is probable that chaulmoogra and hydnocarpus oils would have the same physiological properties; gynocardia oil, which is optically inactive, might be different, depending on whether the physiological activity is due to the unsaturated acids present in the chaulmoogra and hydnocarpus oils or to the glucoside present in all the seeds.—W. P. S.

Thymol from Monarda punctata. E. M. Holmes. Perf. and Essent. Oil Rec., 1916, **7**, 311—312.

Experiments have been made in the United States (Dept. Agric. Bull. No. 372) on the cultivation and exploitation of *Monarda punctata* as a source of thymol, this plant being considered more suited to the particular circumstances than the Indian plant "Ajowan" (*Carum copticum*) which serves as the raw material for the extraction of thymol in Germany. The seeds of Monarda used for the experiments gave rise to two varieties of plants: dark plants with more serrate leaves and a pronounced red coloration in stems and branches, and light green plants with larger leaves, practically free from red coloration. The average yields of oil were 0·40 % from the dark plants testing 66 % of phenols, and 0·42 % from the light plants testing 69 % of phenols. The light plants also produced more leaves. Cultivation of this type in subsequent years showed in some crops an increased yield of oil up to 0·41 %, and phenol contents up to 72—74 %. Particulars of cultivation are given. The best results were obtained on rich, well drained sandy loam underlain with marl or calcareous clay at a depth of 2—3 ft.: the plant requires a good supply of lime. Cutting should be performed in the flower-bud stage and the herb taken to the distillery without drying. The distillation water, relatively rich in phenols, is reserved and added to the next batch of herb for distillation. The crude oil contains a small quantity of carvacrol and some cymene and, in the manufacture of thymol, the crude product is fractionated. The thymol is separated from the fraction boiling between 215° and 240° C., a crystal of thymol being added to induce crystallisation. With systematic working of the fractions, a commercial yield of 66·3 % of white crystallised thymol is obtained. It is calculated that from a first year's crop, 20 lb. of oil per acre may be expected and from subsequent crops 30 lb. or even 40 lb. of oil per acre. The expenses of cultivation are estimated at $23 per acre for the first year and $19 for subsequent years: replanting will not be required oftener than once in five years. The average profit over a period of five years is estimated at $16 per acre.—J. F. B.

Vitamines: Chemistry of the ——. R. R. Williams. Philippine J. Sci., 1916, **11**, 49—57.

The following method was employed for obtaining "vitamine" from rice polishings. Twenty-five kilos. of the polishings was macerated with alcohol containing hydrochloric acid, the liquid then pressed out, concentrated at a low temperature under reduced pressure, and the aqueous portion separated from the layer of fat. This aqueous portion was treated with phosphotungstic acid, the precipitate collected, washed with dilute sulphuric acid, air-dried, mixed with excess of barium hydroxide, and the mixture extracted with water: the extract was freed from barium and sulphuric acid, neutralised with nitric acid, concentrated under reduced pressure, and then treated with silver nitrate. The precipitated purine bases were separated, the solution treated with a further quantity of silver nitrate and an amount of barium hydroxide sufficient to produce a permanent precipitate; the latter was collected, decomposed with hydrogen sulphide, the silver sulphide separated, barium present was removed as sulphate, and the solution then concentrated and treated with twice its volume of alcohol. A precipitate formed which had slight curative properties when administered to fowls suffering from beri-beri: it contained a considerable quantity of nicotinic acid. The solution from this precipitate was evaporated over sulphuric acid at ordinary pressure: a small quantity of crystals formed on the surface of the liquid, the yield being about 35 mgrms. These crystals had m.pt. 223° C., and had pronounced curative powers. About 0·2 grm. of amorphous material, having curative powers, also separated as the liquid was concentrated; when the latter was evaporated completely, a film weighing 0·25 grm. was obtained which had moderate curative powers. The effects of nicotinic acid and its derivatives on neuritic fowls were also determined. Nicotinic acid, trigonellin, and *p*-hydroxynicotinic acid effected little improvement; the hydrochloride of the methyl ester of nicotinic acid produced a marked but temporary improvement.—W. P. S.

a-Propyl-d-galactoside; Biochemical synthesis of —— by means of an enzyme contained in air-dried bottom-fermentation beer yeast. E. Bourquelot and A. Aubry. Comptes rend., 1916, **163**, 312—315. (See this J., 1915, 159.)

Three litres of solution, containing 30 grms. of galactose, 750 grms. of propyl alcohol, and 600 c.c. of maceration juice from bottom-fermentation yeast, yielded after 8 months at the ordinary temperature, 2·1 grms. of crystalline *a*-propylgalactoside.—J. H. L.

Alkylamines: Preparation of ——. H. Krause. Chem.-Zeit., 1916, **40**, 810.

Having recently devised a practical process for the preparation of the nitroparaffins, the author has studied the reduction of these bodies to alkylamines by iron and hydrochloric acid by a process similar to that employed in the manufacture of aniline. It is known that the reduction of nitrobenzene may be effected with only $\frac{1}{40}$ of the theoretical quantity of hydrochloric acid and that the mixture remains acid throughout, owing to the weakly basic character of the aniline. The alkylamines are stronger bases, and when working with a fractional proportion of hydrochloric acid ($\frac{1}{36}$ of the theoretical) at 50°—60° C., the acid reaction soon disappears and ferrous hydroxide is precipitated, becoming oxidised later to the ferric condition. The liquid acquires an increasingly alkaline reaction and an ammoniacal odour. Thus the reduction of the nitroparaffins proceeds in an alkaline medium but less energetically than at first, and since the liquid contains no trace of iron salt in solution it is inferred that the reduction is effected by the nascent hydrogen produced by the action of the amine hydrochloride on the metallic iron, analogous to the action of ammonium chloride. This view is supported by the fact that iron and water alone have no action on the nitroparaffins, but if a little alkylamine hydrochloride be added, reduction sets in. The reduction of nitromethane with iron and $\frac{1}{36}$ of the theoretical quantity of hydrochloric acid for 6 hours gave a yield of 75 % of the calculated quantity of amine; in 3 hours the yield was only 58 %. The reduction, however, proceeds more energetically and completely when a larger proportion of acid is employed: for instance, with 1·5 mol. of acid to 1 mol. of nitromethane (theoretical proportion 7 : 1) the reduction is practically complete after 1 hour at 70° C. and the yield of methylamine is nearly quantitative: the reduction of nitroethane under similar conditions requires a longer time but the yield is practically as good.—J. F. B.

Ether for anæsthesia: Determination of small amounts of alcohol and water in ——. E. Mallinckrodt, jun., and A. D. Alt. J. Ind. Eng. Chem., 1916, 8, 807—812.

To determine water, the ether is dehydrated with a known weight of anhydrous potassium carbonate.

If alcohol also is present, some is retained by the potassium carbonate and vitiates the results, but it can be removed by washing two or three times with pure anhydrous ether before drying and re-weighing. If the specific gravity of the ether after dehydration with potassium carbonate be determined, the alcohol content can be read directly from a curve. A curve is given for the values at 25° on the hydrogen scale. It is nearly a straight line; the average values for pure anhydrous ether and for ether containing 3% of alcohol are 0·70987 and 0·71301 respectively. Five samples of commercial anæsthesia ether gave the following results:—

	1	2	3	4	5
Water, %	1·08	1·21	0·12	0·36	0·26
Alcohol, %	1·42	0·85	0·12	4·25	0·32

Alcohol had probably been added to sample No. 4. It is questionable whether ether complying strictly with the requirements of the U.S. Pharmacopœia (that it shall consist of 96% of ethyl oxide and 4% of alcohol containing a little water) can be made by the usual distillation process.—A. S.

Linseed mucilage as protective colloid. Colloidal gold. A. Gutbier, J. Huber, and E. Kuhn. Kolloid-Zeits., 1916, **18**, 201—210, 263—273. Z. angew. Chem., 1916, **29**, Ref., 109.

The mucilage is prepared by shaking linseed for 1 day at the ordinary temperature with water saturated with chloroform, and filtering through flannel and glass-wool. The substance may be purified by treating the solution with twice its quantity of absolute alcohol, dissolving the precipitate in water saturated with chloroform, and dialysing. Stable colloidal gold solutions were prepared by reducing gold chloride with hydrazine hydrate, formaldehyde, sodium hydrosulphite, or phenylhydrazonium chloride in presence of linseed mucilage. To obtain solid products from the colloidal gold solutions it was necessary to evaporate *in vacuo* over concentrated sulphuric acid, as only incomplete precipitation took place on addition of strong alcohol.—A. S.

Identification of phenols by the spectroscope. Gsell. *See* III.

Quartz glass apparatus for bacteriological and surgical work. Paul. *See* VIII.

Influence of catalysts (alkaloids, dyes, etc.) on yeast-fermentation. Somogyi. *See* XVIII.

Detection of methyl alcohol. Salkowski. *See* XVIII.

Titrimetric studies. [*Titration of hydrogen peroxide and diethylbarbituric acid.*] Enell. *See* XXIII.

Patents.

Hog cholera serum globulin; Preparations of ——, and process of producing same. P. M. Justice, London. From H. K. Mulford Co., Philadelphia, U.S.A. Eng. Pat. 101,275, May 31, 1916 (Appl. No. 7735 of 1916). Addition to Eng. Pat. 6604, May 3, 1915 (this J., 1916, 653).

The process described in the principal patent is modified by treating the hog cholera antitoxin with a reagent other than one which forms an insoluble hydroxide, *e.g.*, ammonium sulphate, so that the resulting mixture contains about 25% of the reagent, adding kieselguhr or other inert silicious earth, and filtering the mixture under pressure. The percentage of the reagent in the filtrate, which contains the hog cholera antibodies and globulins, and serum albumin, is then increased to about 50%, which causes precipitation of the globulin and hog cholera antibodies. These are separated by filtration from the serum albumin, which is discarded. The precipitate is freed from excess of the reagent by pressure, and may be dried, dialysed, or dissolved and sterilised by filtration.
—F. Sp.

Amyl acetate: Process of making ——. H. Essex and B. T. Brooks, Assignors to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,197,019, Sept. 5, 1916. Date of appl., Dec. 8, 1915.

Pentyl chloride, or the monohalogen derivative of a gasoline fraction of b.pt. 25°—45° C., is heated under pressure in a rotary container with an alkali salt of an organic acid, *e.g.*, an acetate, so that the mixture is forcibly agitated during heating.
—J. F. B.

Phosphoric acid esters of carbohydrates; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 292,817, Feb. 26, 1915.

In the preparation of phosphoric acid esters from fermentable carbohydrates and inorganic phosphates by the action of yeast enzymes (see Fr. Pat. 458,096 of 1913; this J., 1913, 1031), it is customary to heat the mixture in order to destroy the enzyme when the ester formation is complete. This method has the disadvantage that part of the ester is thereby decomposed, so that on subsequently treating with a calcium salt, the calcium salt of the ester is contaminated with calcium phosphate. According to the present patent the enzymic activity is destroyed by addition of tannic acid, which also precipitates proteins. A higher yield of the ester is obtained, and the product is purer than that obtained by the older method.—A. S.

Halogenhydroxyquinolines; Preparation of derivatives [metallic lakes] of ——. Soc. Chem. Ind. in Basle. Ger. Pat. 292,819, Nov. 22, 1913.

Metallic lakes, *e.g.*, the calcium, zinc, and cerium lakes, of halogenhydroxyquinolines are prepared by precipitation methods, in presence of suitable carriers if so desired. The method is especially suitable for the preparation of antiseptic dressings (bolus, kieselguhr, or the like impregnated with the lakes mentioned) for the dry treatment of wounds.
—A. S.

4-Hydroxypiperidine and its N-alkyl derivatives; Preparation of derivatives [esters] of ——. B. Emmert, Würzburg. Ger. Pat. 292,846, Dec. 8, 1914.

Organic acid esters of 4-hydroxypiperidine and its N-alkyl derivatives are prepared by the usual methods. They are of value as local anæsthetics and as mydriatics. Examples mentioned are the benzoic and *p*-toluic esters of 4-hydroxypiperidine, and the *o*- and *p*-toluic and *p*-nitrobenzoic esters of N-methyl-4-hydroxypiperidine.—A. S.

Alkali-acetones and hydroxyisopropyl derivatives of hydrocarbons: Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,059, July 11, 1914.

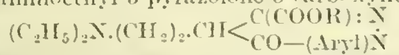
Alkali-acetones are obtained by the action of diacetonealcohol or triacetonealcohol on potassium or sodium or an alkali amide below 0° C. The alkali-acetones may be used for the preparation of hydroxyisopropyl derivatives of hydrocarbons or their derivatives, as described in Ger. Pat. 280,226 and Fr. Pat. 474,745 (this J., 1915, 378, 1116), or the two processes may be combined in a single operation.—A. S.

Acetaldehyde from acetylene; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,070, Apr. 21, 1914. Addition to Ger. Pat. 292,818.

Metallic mercury in presence of dilute acid is used instead of the mercuric salt specified in the chief patent (see U.S. Pats. 1,151,928 and 1,151,929 of 1915; this J., 1915, 1031).—A. S.

Alkyl esters of 1-aryl-4-diethylaminoethyl-5-pyrazolone-3-carboxylic acid; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,287, May 12, 1915.

The hitherto unknown alkyl esters of 1-aryl-4-diethylaminoethyl-5-pyrazolone-3-carboxylic acid,



$$(C_2H_5)_2N.(CH_2)_2.CH{<}\begin{matrix}C(COOR):N\\ CO—(Aryl)\dot{N}\end{matrix}$$

have been found to possess pronounced anæsthetic properties. They are obtained by treating esters of 1-aryl-5-pyrazolone-3-carboxylic acid, preferably in the form of their alkali salts, with halogenethyldiethylamines.—A. S.

Aluminium alkyloxides; Preparation of ——. Farbwerke vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,613, Dec. 24, 1913. Addition to Ger. Pat. 286,596 (this J., 1915, 1168).

The higher homologues of ethyl alcohol are caused to interact with metallic aluminium in presence of a very small quantity of a mercuric salt. The reaction may be started with a portion of the aluminium and the remainder added at intervals. The aluminium alkyloxides are soluble in the alcohols from which they are derived and may be recovered in a pure condition by crystallising or by distilling off the alcohol.—A. S.

Mercury chloroaminoglycerol compound; Preparation of a ——. B. Börner, Hanover. Ger. Pat. 293,692, Mar. 14, 1913.

A solution of mercuric chloride in glycerol is precipitated with ammonia in presence of water, or freshly-precipitated hydrous mercuric aminochloride (infusible white precipitate) is treated with glycerol, with or without the aid of pressure and heat. The product is soluble in weak acids, such as butyric acid, has no irritant action on the skin, and, in the form of ointment, is of value for the treatment of syphilis.—A. S.

Hog-cholera serum globulin; Process of producing ——. J. Reichel, Assignor to H. K. Mulford Co., Philadelphia, Pa. U.S. Pat. 1,197,150, Sept. 5, 1916. Date of appl., May 27, 1915.

See Eng. Pat. 101,275 of 1916; preceding.

Method of testing nicotine solutions. U.S. Pat. 1,197,142. *See* XIXb.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Photographic images; Process for the simultaneous toning and fixing of silver ——. A. Spitzer and L. Wilhelm, Vösendorf, Austria. Ger. Pat. 292,352, May 7, 1914.

Tellurous or telluric acid or their salts, especially the sodium salts, are used in admixture with sodium or ammonium thiosulphate, etc., for the preparation of combined toning and fixing baths. —A. S.

Photographic materials (plates, films, paper, etc.) with addition of a dye by which the light-sensitiveness is reduced. G. W. A. Sosna and J. E. Biedebach, Bremen. Ger. Pat. 292,723, July 20, 1915. Addition to Ger. Pat. 288,328.

In addition to the dyestuffs mentioned in the chief patent (this J., 1916, 386), a substance, such as phenolphthalein, is used which has no effect on the emulsion, but combines with a constituent of the developer, *e.g.*, the alkali, to form a coloured compound which protects the emulsion from the action of diffused daylight during development. —A. S.

Multicoloured screens for colour photography; Production of ——. C. Schleussner A.-G., Frankfort. Ger. Pat. 293,001, Oct. 15, 1914.

The screen is prepared with the aid of particles of a colloidal substance stained in different colours, and the particles are subsequently caused to coalesce by exposure to the vapour of a suitable swelling agent.—A. S.

XXII.—EXPLOSIVES; MATCHES.

Explosives in coal mines. Order of Sept. 21, 1916.

Two explosives, of the composition given below, have been added to the list of "Permitted Explosives":—

Ingredients.	Parts by weight.			
	Super-Cliffite No. 1.		Super-Cliffite No. 2.	
	Not more than	Not less than	Not more than	Not less than
Nitroglycerin ...	10·5	8·5	10·5	8·5
Nitrocotton	0·75	0·25	0·75	0·25
Ammonium nitrate	60	57	60·5	57·5
Sodium chloride	16	14	20·5	18·5
Ammonium oxalate	11	9	6	4
Wood meal (dried at 100° C.) ..	6·5	4·5	6·5	4·5
Moisture	2·5	0·5	2·5	0·5

The usual restrictions as to packing, etc., are included. Four ounces of either of the above explosives gave a swing of 2·53 in. to the ballistic pendulum, compared with a swing of 3·27 in. given by four ounces of gelignite containing 60% of nitroglycerin.

Patent.

Match making machinery. A. Kelley, Wilmington, Del., U.S.A. Eng. Pat. 13,378, Sept. 20, 1915.

XXIII.—ANALYSIS.

Hydrocyanic acid; Investigation of the chief methods of detecting ——. G. Anderson. Z. anal. Chem., 1916, 55, 459—468.

The relative delicacy of the principal tests for hydrocyanic acid was determined on 10 c.c. portions of solutions of 98·5% potassium cyanide. With a 0·01% solution (0·000393 grm. CN), a N/20 solution of silver nitrate and 20% nitric acid still produced a precipitate; the limit was reached with a 0·0001% solution (1 pt. HCN in 245,000), when the turbidity was visible only when viewed through a column 12 cm. high against black paper. In this test, it is advantageous to use an excess of silver nitrate. In the Prussian blue test, a precipitate was obtained with a 0·01% solution, but only a coloration at greater dilutions. The most dilute solution which gave the test was 0·001% (1 pt. HCN in 24,500). The conversion of cyanide into ferrocyanide is probably incomplete. The identification as ferric thiocyanate is possible with a 0·0001% solution. The test was performed by adding 3 drops of ammonium sulphide and 2 drops of N/1 caustic soda to 10 c.c. of the cyanide solution, evaporating to dryness on the water-bath, dissolving the residue in water and 3 drops of N/1 hydrochloric acid, and adding 5 drops of a 1% ferric chloride solution. The addition of a 15% caustic potash solution and a few c.c. of a cold saturated solution of picric acid, produces a red coloration, but the limit is reached with a 0·01% solution of cyanide. The test is uncertain and is not recommended. The presence of hydrocyanic acid is indicated by the production of a blue colour on paper steeped in a 4% guaiacum tincture and 0·25% copper sulphate solution, or, better, in the liquid itself: but a 3% solution of guaiaconic acid and a 1 : 1000 copper sulphate solution is to be preferred. The weakest solution that gave the reaction was a 0·00001% solution (1 pt. HCN in 2,450,000). Certain other substances, *e.g.*, ammonia and cigar smoke, however, produce the same effect.—E. H. T.

Soap as indicator in volumetric analysis. [*Titration of solutions of colouring matters.*] J. F. Sacher. Seifenfabrikant, 1916, **36**, 289—290. Z. angew. Chem., 1916, **29**, Ref., 329.

In the acidimetric or alkalimetric titration of solutions of colouring matters and the like, where the use of ordinary indicators is unsatisfactory, good results may be obtained by using soap solution as indicator. The soap solution is prepared by saponifying linseed oil with excess of potassium hydroxide solution and exactly neutralising with dilute acid: 1 c.c. of soap solution is used for 100 c.c. of the solution to be titrated. It is stated that the production of a turbidity in presence of free acid and disappearance of the turbidity in presence of free alkali are sufficiently sharp and rapid even at the ordinary temperature and in artificial light.—A. S.

Titrimetric studies. [*Titration of hydrogen peroxide, diethylbarbituric acid, and hydrogen sulphide.*] H. Enell. Z. anal. Chem., 1916, **55**, 452—459.

When titrating in presence of hydrogen peroxide, iodo-eosin or dimethylaminoazobenzene are more satisfactory indicators than phenolphthalein. Titrations of commercial hydrogen peroxide with *N*/10 potassium hydroxide gave a considerably higher result with the latter indicator than with the two former: the sample contained hydrochloric acid, and probably phosphoric acid and citrophene (triphenetidine citrate). Iodo-eosin, in presence of ether, is a most sensitive indicator and its use should be extended: the error caused by the loss of a little material when the bottle is opened after shaking can be obviated by using a rubber bung. It is excellently adapted for the titration of diethylbarbituric acid (veronal) with caustic soda, whereby the stable monosodium salt is formed. In the estimation of hydrogen sulphide with silver nitrate, some of the silver sulphide formed remains in colloidal solution and obscures the end-point of the subsequent titration with thiocyanate solution in presence of ammonium iron alum. This can be counteracted by adding *N*/10 sodium chloride solution, in amount about equal to that of silver nitrate solution, and filtering through cotton wool, allowance being made in the calculation for the amount so added. The presence of glycerol in an aqueous solution of hydrogen sulphide was found greatly to increase its keeping quality, thus confirming an old observation of Lepage (1867). The stability of the solution is increased to a small extent by adding 50% or 90% alcohol, and to a greater degree by adding ether. The solubility of hydrogen sulphide, in vols. per unit volume of solution, was found to be 2·6 for water, 1·87 for glycerol and water (1 : 1), 2·9 for 50%, 8·26 for 90% alcohol, and 14·46 for ether.—E. H. T.

Calcium in presence of strontium and barium; Detection of ——. P. N. Raikow. Chem.-Zeit., 1916, **40**, 781.

The material (0·5—1 grm.), as alkaline-earth carbonate, is heated for a few minutes in an open porcelain crucible over a Teclu burner, the product stirred, when cold, with a few c.c. of water, the mixture filtered, and the filtrate tested with phenolphthalein. An alkaline reaction indicates the presence of calcium. Under the conditions specified, strontium and barium carbonates are not altered, but calcium carbonate is readily decomposed, as little as 0·2% being detected with ease.—F. Sodn.

Zinc: Determination of —— by Schaffner's method. J. Patek. Z. anal. Chem., 1916, **55**, 427—452.

Various objections to the Schaffner method of zinc determination (Nissenson, this J., 1896, 52; Greenwood and Brislee, this J., 1909, 1138) were examined experimentally and disproved. Thus it was shown that it is not necessary that the standard zinc solution and the solution to be determined should contain the same amount of zinc; that the quantities of ammonia present in the two zinc solutions immediately before titration vary only within narrow limits; and that the maximum amount of ammonia present is much less than the quantity which adversely affects the analytical result. Further, the accuracy of the method is not influenced by the use of different acids in varying concentrations to dissolve the ore or the pure metal, nor by varying the kind of oxidising agent employed. Results are affected neither by the nature nor by the amount of the ammonium salt present. Lastly, Decker's contention (this J., 1906, 911) that freshly precipitated zinc sulphide interacts with ammonium salts in neutral or ammoniacal solution, could not be confirmed.—E. H. T.

Molybdic acid and ammonium nitrate: Recovery of —— from the residues from phosphoric acid determinations. A. Grete. Schweiz. Ver. anal. Chem., May 26 and 27, 1916. Chem.-Zeit., 1916, **40**, 813.

The residues from the gravimetric and volumetric processes contain, besides nitric acid, quantities of other acids, such as sulphuric acid, and salts of iron, aluminium, calcium, magnesium, and alkali metals. For the treatment of the residues, 40 litres of the acid liquid is neutralised with ammonia and re-acidified with 10 litres more of the residual liquors. The liquid is heated, and decanted from the yellow precipitate which forms: the sulphuric acid is precipitated by barium nitrate and the liquid made alkaline with ammonia and ammonium carbonate. The ferric hydroxide and alkaline earths are thus separated and the liquid then contains only small quantities of molybdic acid and the alkali salts as impurities. If the molybdic acid must be separated, yellow ammonium sulphide is added in not too large excess to the warm liquid until a dark reddish-yellow colour is produced. After cooling, dilute nitric acid is added carefully until a dark brown precipitate of molybdenum sulphide settles out from a perfectly colourless solution on stirring. The filtrate is then evaporated and ammonium nitrate is recovered by crystallisation. The last mother liquors, which are dark in colour and contaminated with alkali salts, may be used as a fertiliser. If the crystals of ammonium nitrate are to be used again for phosphoric acid determinations, it is not necessary to separate the molybdic acid by ammonium sulphide, but the final mother liquors should be so treated.—J. F. B.

Use of ammonium nitrate in determining the calorific power of lignites. Salvadori. *See* IIa.

Colorimetric determination of acetylene. Schulze. *See* IIa.

Identification of phenols by the spectroscope. Gsell. *See* III.

A new method of measuring the refractive index and dispersion of glass. Cheshire. *See* VIII.

Quartz glass apparatus for bacteriological and surgical work. Paul. *See* VIII.

Rapid method for the determination of manganese [in steel]. Szász. *See* X.

Platinum and illuminating gas. Mylius and Hüttner. *See* X.

Quantitative analysis of antimony trisulphide and the products obtained from it by roasting. Von Bacho. *See* X.

Determination of glycerol in fatty oils by means of sodium glycerate. Bull. *See* XII.

Marcusson-Schilling's modification of Bömer's method for the detection of phytosterol by precipitation with digitonin. Olig. *See* XII.

Determination of phytosterol in vegetable fats. Klostermann and Opitz. *See* XII.

The Liebermann-Storch colour test for rosin. Jameson. *See* XIII.

Determination of total sulphates in leather. Levi and Orthmann. *See* XV.

Determination of the basicity of chrome tanning liquors. Appelius and Schmidt. *See* XV.

Precipitation of reducing sugars by basic lead acetate. Deerr. *See* XVII.

Total destruction of pentoses during alcoholic fermentation. [*Analysis of molasses.*] Pellet. *See* XVII.

States of combination of sulphur in wine and their determination. Baragiola and Schuppli. *See* XVIII.

Detection of methyl alcohol. Salkowski. *See* XVIII.

Detection of tallow and hydrogenated fats in butter fat. Amberger. *See* XIXA.

Colorimetric method for detection of potato starch. Blunck. *See* XIXA.

Salicylic acid reaction of soya beans. Brill. *See* XIXA.

Analysis of Rhamnus barks. Tunmann. *See* XX.

Determination of small amounts of alcohol and water in ether for anæsthesia. Mallinckrodt and Alt. *See* XX.

PATENTS.

Pyrometer-scale. G. A. Shook, Urbana, Ill., Assignor to Scientific Materials Co., Pittsburgh, Pa. U.S. Pat. 1,196,306, Aug. 29, 1916. Date of appl., Oct. 2, 1913.

A TOTAL radiation pyrometer has a scale calibrated to represent true temperatures, based on the formula, log. $T = \log. T_0 - k$, in which T represents the true and T_0 the black-body temperature of the hot body, and k a constant depending upon the material of which the hot body is composed. —W. E. F. P.

Temperature of incandescent bodies; Apparatus for observing chemical processes and for determining the ——. Ströhlein und Co. Ges.m.b.H., Düsseldorf. Ger. Pat. 293,668, May 26, 1915.

A TUBE connected at one end with the apparatus in which the substance to be examined is heated, is closed at the other end by a lens. At this latter end the tube is connected with one limb of an inclined V-shaped tube, the other limb of which is provided with a lens and a coloured disc and is connected with the tube of an optical pyrometer. The light rays from the object under examination are reflected into the pyrometer tube by a mirror placed in the angle of the V-tube.—A. S.

Method of testing nicotine solutions [dipping baths]. U.S. Pat. 1,197,112. *See* XIXB.

Trade Report.

Chemical industries of Switzerland and the war. Chem.-Zeit., 1916, 40, 745—747.

THE industries of Switzerland have suffered principally through withdrawal of labour on mobilisation and difficulty in importing raw materials. The Swiss exports for 1915 reached a total value of 1670 mill. frcs., as against 1186 mill. frcs. for 1914; the imports (value 1680 mill. frcs.) were lower than in 1914. In the heavy chemical section, the works at Uetikon is the only one concerned in the manufacture of acids, using imported pyrites, and the supply of vitriol has been inadequate. As regards soda ash, the scarcity of imported supplies has stimulated the erection of a large new works at Zurzach. The most pressing scarcity has been felt in nitrogenous fertilisers; Chili saltpetre is unobtainable and the production of ammonium sulphate very inadequate, in spite of the stoppage of the exportation of ammonia liquor. Most of the glass factories are shut down, but the Monthey works reopened at the end of 1914 and is probably accumulating stock. The fine chemical industry is much hampered through lack of materials. There is a strong demand but exports are prohibited, except where ample supplies are demonstrated. The transport difficulties through the port of Genoa are extremely great, prices are very high, and the supply of materials is obtained entirely from Entente and a few neutral countries. In the electrochemical section conditions are more satisfactory. The carbide factories continue to work, with selling prices about 20% above normal. Calcium cyanamide, carborundum, and abrasite are being manufactured for export. The manufacture of chlorates is hampered by the German prohibition of the export of potassium chloride. The electrolytic caustic soda industry is unaffected by the war and the sale of bleaching powder has considerably increased. The manufacture of nitric acid from the air is greatly stimulated and a certain amount is available for export at double the normal price. The aluminium and iron-alloy industries are stimulated by strong demand and high prices, but greatly hampered by the difficulty of importing raw materials. The dyestuff industry has had to cope with great difficulties in connection with labour and materials. There are no coke ovens in Switzerland and the coal-tar products procurable have only been those which could be spared by belligerent countries, chiefly England, after the satisfaction of the explosives' demand; there is only one sulphuric acid works, but recently there has been Government encouragement for the scheme for the erection of a common acid plant for the dyestuff factories. Nitrites, nitric acid, caustic soda, and chlorine are plentiful. The Swiss dyestuffs factories have had to supply the requirements of the home consumers, who formerly dealt almost entirely with Germany and who are now busy with foreign orders; nevertheless a considerable quantity has been exported under Government supervision in return for raw materials allowed to come in; the price of aniline oil has risen to 10 times the normal. The Swiss silk-dyeing industry is suffering severely through scarcity of vegetable dyestuffs, particularly ogwood : stocks are nearly exhausted and supplies non-existent, since England and America absorb the whole production. The mechanical wood pulp mills complain of weak demand ; the demand for cellulose is very keen but the production is hampered through scarcity of chemicals and transport difficulties. The paper industry is oppressed by general troubles. The market for industrial explosives is weak ; the match factories are overburdened with demands but experience great scarcity of materials ; prices have risen 50 %. Imports generally are supervised by organisations acting on behalf of both groups of belligerents. Whereas the German organisation is said to be working smoothly and satisfactorily, the Entente trust is having considerable trouble and friction, particularly over the question of cotton goods and the general difficulties connected with transport through France and Genoa.—J. F. B.

Electro- and organic-chemical industries of Russia.
Chem. Trade J., 1916, **59**, 263—264.

Owing chiefly to lack of raw material, cheap sources of electrical energy, and available capital, Russia has been hitherto mainly dependent on foreign countries for electrochemical products. For the economic production of calcium nitrate, aluminium, ferrosilicon (50 % Si), caustic soda, sodium chlorate, mercury fulminate, calcium carbide, and electrolytic copper in Russia at the average prices ruling in 1913 (viz. about 12s., 85s., 41s., 18s., 70s., 59s., 26s., and 91s. per cwt., respectively) the cost of electrical energy per kilowatt-hour should not exceed 0·06d., 0·15d., 0·16d., 0·4d., 0·62d., 0·7d., 1·15d., and 1·25d., respectively ; while for purely electrochemical uses the maximum cost should be from 0·025 to 0·125d. per kilowatt-hour. By erecting power stations at centres where coal and peat are abundant, utilising the waterfalls in Finland, the Urals, and the Caucasus, and imposing very high protective duties, it is hoped to give the necessary impulse and ensure the development of Russian electrical and electrochemical industries.

Until the outbreak of war, the Russian chemical and pharmaceutical market was mainly dependent on German imports. To remedy this situation and create an independent Russian industry, the Association for the Development of the Chemical and Pharmaceutical Industries in Russia was founded at Moscow, and commenced operations in Sept., 1914. Since that date many pharmaceutical and other products have been manufactured under the auspices of the Association ; among these may be mentioned chloroform, caffeine, atropine, iodine and iodine products, citric acid, derivatives of creosote and guaiacol, acetylsalicylic acid, pyramidon, salol, formalin, hydrogen peroxide, mercury salts, sodium salicylate, β-naphthol, anisol, various alkaloids, sulphuric ether, acetic anhydride, ethyl chloride, "terpineol hydrate," and lanoline. Similar efforts in the domain of industrial chemical products are being made by the Association des Proprietaires d'Usines et des Industriels de la Russie, and the Association des Fabricants de Cotonnades, the latter being specially concerned in extending and bringing up to date the country's colour works. Independently of this, the principal textile manufacturers of Moscow have decided to establish a works for the production of coal-tar colours and the necessary intermediate products, and to place the construction and management of the works under Swiss control ; it is certain that Russia possesses an adequate supply of primary materials, particularly coal-tar, for the colour industry. The large quantities of indigo (13,000 cwt. in 1913), mineral pigments, tanning materials, etc., annually imported before the war have now sensibly diminished owing to domestic production ; while the export of glycerin (over 30,000 cwt. in 1914) has entirely ceased, owing to the home demand. The wood-distillation industry formerly flourished when the sale of methyl alcohol was profitable, but was adversely affected by competition with denatured alcohol ; the position has been somewhat modified since the war, owing to the increased demand for pyroligneous acid and acetone. Wood tar and turpentine are mainly produced in the Perm district, where 100 plants are in operation ; the Ural district possesses only two wood-distilling works, both of which produce pyroligneous acid and methyl alcohol. The match industry of Russia is conducted in 114 factories which, in 1914, produced 4,000,000 cases of 1000 boxes, of which 800,000 cases (about 78,000 cwt.) were exported.—W. E. F. P.

Prohibited exports. Order in Council, Sept. 29, 1916.

The following alterations have been made in the Proclamation of May 10, 1916 (see this J., 1916, 620) :—

Headings deleted. [1]Iron and steel plates and sheets. [2]Steel, and steel articles containing chrome, cobalt, nickel, or vanadium. [2]Goods made wholly or partly of rubber, gutta-percha, or balata.

New headings : [2]Molybdic acid and its salts. [2]Gauze made of copper or its alloys. [3]Matches. [1]Steel articles containing chrome, cobalt, nickel, or vanadium. [1]Iron and steel plates and sheets except when made from crucible cast steel or from carbon steel not made in the United Kingdom by the Siemens or Bessemer processes, provided such crucible or carbon steel does not contain more than 5 % of chrome, cobalt, nickel, or vanadium. [2]Goods made wholly or partly of rubber, gutta-percha, or balata (except rubber hose covered with steel wire). [1]Rubber hose covered with steel wire.

Note : The exportation of the goods mentioned above is prohibited as follows :—Goods marked [1], to all destinations. Goods marked [2], to all ports and destinations abroad other than ports and destinations in British Possessions and Protectorates. Goods marked [3], to all destinations in foreign countries in Europe and on the Mediterranean and Black Seas, other than France and French Posessions, Russia, Italy and Italian Possessions, Spain, and Portugal, and to all ports in any such foreign countries, and to all Russian Baltic ports.

Prohibited imports. Royal Proclamation, Oct. 3, 1916.

The importation of aluminium powder, and of manufactures of bone, horn, ivory, and celluloid is prohibited (except under licence).

Contraband of war. Royal Proclamation, Oct. 3, 1916.

The following are made absolute contraband :—Insulating materials (raw and manufactured), fatty acids, cadmium, cadmium alloys, and cadmium ore, albumin, waxes of all kinds. Yeast is added to the list of conditional contraband.

France : Prohibited exports.

The exportation from France of the following has been prohibited :—Arsenical ores, asphalts, bitumens, and pitch, bituminous limestone, borax, boric acid and other boron compounds, chromic acid, chromates and bichromates, fatty acids, felspar, formic ether, glues of all kinds and substances used for preparing them (casein, egg albumin, serum albumin, dried blood, dextrin and soluble starches, gelatin, glue and size, scraps of skin and leather, animal waste), halogen compounds of carbon, chlorides of metals and metalloids, sodium, spermaceti, varnish.

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THE VOLUMETRIC DETERMINATION OF TIN.

BY R. L. HALLETT.

(Abstract.)

In this paper the aim has been to present the different volumetric methods which have been advanced for the determination of tin, pointing out the advantages and disadvantages of each.

Some of the references most often quoted in this article are :—

A. H. Low, " Technical Methods of Ore Analysis," Fourth Edition.

J. W. Mellor, " Quantitative Inorganic Analysis," 1913 Edition.

L. Parry, " Assay of Tin and Antimony," Second Edition.

Tin is one of the elements for which volumetric methods seem to be specially advantageous because many other elements interfere with the gravimetric methods for its determination.

Nearly all of the proposed volumetric methods for tin which have proved satisfactory require a hydrochloric acid solution. When possible the finely-ground sample is dissolved directly in hydrochloric acid ; in some cases the addition of a small quantity of potassium chlorate, antimony chloride, or platinic chloride, or the presence of a piece of platinum foil, accelerates solution. In the analysis of materials containing sulphides or certain alloys, a mixture of hydrochloric and nitric acids may be used, followed by treatment with sulphuric acid and then with hydrochloric acid. Silicious products frequently respond to treatment with hydrofluoric acid.[1]

Samples containing insoluble tin oxide may be reduced by treatment with zinc in boiling dilute hydrochloric acid.[2] The oxide may also be reduced by heating in a current of hydrogen or coal gas,[3,4] following treatment with nitric acid. Heating with metallic zinc to a high temperature may also be employed in certain cases.[5]

For the decomposition of insoluble silicates, fusion with alkali carbonates is effective. Practically all silicates are decomposed by this process, but it cannot be used with spinel.[6] The method is not suitable for use with samples containing insoluble tin oxide, and if sulphides or salts of tin soluble in acids are present they must be removed before the fusion process is applied. The addition of 10% of borax to the alkali carbonate accelerates the decomposition in some instances.[7] Addition of sulphur to the alkali carbonates has also been proposed,[8] but the method does not appear to possess any advantages.

Fusion with potassium cyanide has been suggested for the reduction of tin oxide,[9] but though the results are fairly concordant, they are generally lower than those obtained by other methods.[10]

Acid-insoluble residues may be decomposed by fusion with sodium or potassium hydroxide,[11] the melt being subsequently dissolved in hydrochloric acid. This method is perhaps the most useful of the fusion processes, since it is applicable to almost all products and generally requires only a very simple preliminary acid treatment. An iron crucible is the most suitable for use with this process.[12]

Sodium peroxide may also be used for the fusion process,[13] but it corrodes the crucibles very rapidly, and generally its disadvantages more than offset the extra speed gained by its use. The addition of organic matter to the peroxide, to furnish the necessary heat for the reaction, has been suggested[14] as a means of preventing the corrosion. Quieter fusion results if zinc sulphide,[15] iron sulphide, or potassium persulphate[16] is added to the peroxide.

Sintering with zinc oxide has been proposed by J. J. Beringer [17] for the decomposition of insoluble tin oxide, which is thus converted into zinc stannate soluble in hydrochloric acid. H. W. Hutchin[18] has suggested the use of calcium oxide or carbonate in place of zinc oxide ; in this case calcium stannate is produced, the action being more complete than when zinc oxide is used.

Volumetric methods.

Of the various volumetric methods which may be used for the determination of the tin, nearly all of those which have met with any degree of success depend upon the oxidation of stannous to stannic chloride, generally in hydrochloric acid solution. Only three exceptions need be noted, first the titration of stannic chloride with potassium ferrocyanide; second the solution of metallic tin in ferric chloride followed by the titration of the ferrous chloride produced with potassium permanganate or potassium bichromate; and third the oxidation of sodium stannite to stannate with iodine, which is really the oxidation of stannous chloride in alkaline solution. Methods one and two are unsatisfactory, are hardly ever used, and will not be further discussed. Method three will be described in detail.

Among the methods which depend on the oxidation of stannous to stannic chloride, the following may be mentioned :—

Titration with ferric chloride.—This method, which is known as Menes' method,[19] consists in oxidising the stannous chloride solution with a hydrochloric acid solution of ferric chloride :

$$2FeCl_3 + SnCl_2 = 2FeCl_2 + SnCl_4$$

One drop of the standard solution in excess gives a decided yellow colour to the previously colourless solution, provided it is hot and strongly acid[20]. The titration should be performed as rapidly as possible and by daylight or, in case of an emergency, by magnesium light, but never by electric light or gas. It has been shown[21] that if a blue Bunsen flame be examined by looking through the solution being titrated, it will appear to have a greenish colour as soon as a trace of ferric chloride is present. Other suggestions for more accurately determining the end point are the addition of a drop of potassium thiocyanate and titrating until a persistent red tint appears,[22] and the addition of potassium iodide and starch indicator and titrating to a permanent blue.[23]

The presence of chlorides of lead, zinc, aluminium, iron, cobalt, nickel, antimony, copper, and cadmium does not affect this titration, except that the presence of a large amount of ferrous chloride retards the finish and lessens the delicacy of the end point. Cobalt and nickel give highly coloured solutions which mask the end point to some extent. Bismuth and mercury are reduced to the metallic state by stannous chloride and they should therefore be removed from the solution, as ferric chloride acts on them in this condition. As metallic antimony, copper, and arsenic and tungstic oxide would be precipitated during the reduction of the tin and would be attacked by hot ferric chloride in acid solution, they must also be removed.

The most successful manner of carrying out this method is said[24] to consist in dissolving the metallic tin in hydrochloric acid in a non-oxidising atmosphere and rapidly titrating the solution so produced. The solution should be titrated at the boiling point and its volume kept between 150 c.c. and 200 c.c. Precipitated antimony, arsenic, and copper must not be present during the titration.[25]

If it is desired to separate from cobalt, nickel, iron, and phosphorus, the tin, antimony, arsenic, copper, mercury, bismuth, and some lead and cadmium are separated as sulphides with hydrogen sulphide. The sulphides are dissolved in hydrochloric acid and potassium chlorate and the solution reduced by heating with iron wire, when arsenic, antimony, copper, bismuth, and mercury are precipitated in the metallic state. The solution must be strongly acid to prevent the precipitation of oxychloride of tin. The precipitate is filtered off and the filtrate neutralised with strip zinc, which precipitates metallic tin and lead. The solution is decanted off after testing for tin, and the metallic tin, lead, and excess of zinc are dissolved in the same flask in 180 c.c. of strong hydrochloric acid and this solution containing all the tin is brought to the boiling point. The flask is fitted with a rubber stopper and Bunsen valve to prevent the back flow of air into the flask. A small piece of zinc is added to keep a reducing atmosphere in the flask until the liquid clears and boils. When all the tin and this excess of zinc are dissolved and the solution is at the boiling point, it is rapidly titrated with the standard ferric chloride solution, which is standardised with pure metallic tin.

Owing to the difficulty of determining the end point, Lowenthal[26] adds an excess of ferric chloride and then titrates the ferrous chloride produced with standard potassium permanganate solution. This seems to be a desirable modification, but adds to the length of the method and makes the removal of interfering elements even more necessary.

It has been suggested that a more satisfactory end point, for the ferric chloride titration, may be obtained by using an indicator containing hydriodic acid, cuprous iodide, potassium iodide, and starch solution.

Direct titration of stannous chloride with potassium permanganate or potassium bichromate.—This method[27] gives a correct determination of the tin only when all the tin is in the reduced form and there are no other elements present which are oxidised by the standard solution. Because so many other elements interfere, this method in its simpler form has very limited application and if the interfering elements are separated, it becomes too complicated to be useful.

Titration of stannous chloride with iodine in alkaline solution.—In this method, known as Lenssen's,[28] the tin is brought into hydrochloric acid solution and one or two grams of Rochelle salt added together with an excess of sodium bicarbonate. If enough tartrate is present, the solution will be clear. The cold solution is then titrated with $N/10$ iodine. The method has been almost entirely superseded by the titration with iodine in acid solution.

Titration of stannous chloride in cold hydrochloric acid solution with standard iodine. This is called the Pearce-Low[29] method, and is one of the simplest, shortest, and most accurate for the volumetric estimation of tin. It depends on the oxidation of stannous chloride in cold hydrochloric acid by iodine to stannic chloride according to the equation:

$$SnCl_2 + 2HCl + I_2 = SnCl_4 + 2HI.$$

Starch solution is used as indicator. A small amount of sulphuric acid is not objectionable, but nitric acid and nitrates must not be present.

In the final hydrochloric acid solution, the tin will usually be found in the stannic condition and must be reduced to the stannous condition before titration. This reduction is usually accomplished in one of four ways, by the use of iron in the form of rods, nickel or aluminium in the form of sheets, or strips, or finely powdered antimony. Only pure soft iron may be used. If carbon is present in the iron, it will generally cause high results.

The use of aluminium renders this part of the method somewhat uncertain and makes it difficult to control the operation. The principal objection to the use of antimony is that the presence of so much finely powdered material in the solution obscures the end point. The only objection to nickel is the light green colour given the solution, but this does not affect the sensitiveness of the end point if the concentration of nickel salts is only that derived from the metal used for the reduction.

The reduction and titration are best performed in an atmosphere of carbon dioxide and in a solution containing not less than 25%, nor more than 40% by volume of free strong hydrochloric acid, and the temperature of the solution to be titrated should not exceed 22° C.

One-half to two grms. of the sample (depending on the percentage of tin) is first brought into hydrochloric acid solution. The solution is transferred to a 12-oz. wide-mouth conical flask, enough strong hydrochloric acid is added to make a total of 50 c.c. of free strong hydrochloric acid present, and the solution is diluted to 200 c.c. with water. A nickel coil is prepared by rolling 6 sq. in. of heavy sheet nickel (4 in. long and 1½ in. wide) into a loose roll of such a size that it may be easily inserted into the flask. A narrow strip of nickel is left attached to one side of the coil long enough to reach above the top of the flask. This coil is placed in the flask containing the tin solution, the nickel strip is bent over the edge and the flask is covered with a small watch glass. The solution is heated to boiling and gentle ebullition is maintained for thirty minutes after all the iron, which may be present, is reduced. This is indicated by the yellow colour of the solution changing to a pale green. Thirty minutes is more time than is necessary for the complete reduction of the stannic chloride from 0·5 grm. of tin oxide, and if complete reduction does not result in that length of time, either the nickel coil is too small or the nickel is inactive, due to impurities, and should be discarded and replaced by pure nickel.

It has been stated as an objection to this method, that it is impossible to tell when the reduction of the tin is complete and that the operator may titrate the solution before the tin is all in the lower form. The author has found that larger amounts of tin than would ever be taken as a sample are entirely reduced long before the expiration of the time allowed for the reduction, and no trouble need be experienced from this cause.

The solution in the flask is cooled in an atmosphere of carbon dioxide generated by adding two ½-in. cubes of crystalline marble to the solution. The nickel coil is then removed and is washed with cold hydrochloric acid solution (1 of strong acid to 3 of water) as it is withdrawn from the flask. A small amount of starch solution[31] is then added and the solution titrated at once with standard iodine.

The standard iodine solution most convenient for this titration is prepared by dissolving 10·7 grms. of iodine in 50 c.c. of water containing 20 grms. of potassium iodide in solution, and making up to one litre with water. When a half-gram sample is taken for analysis, 1 c.c. of this solution will equal 1% of tin. It may be standardised against tin or arsenious oxide.[30]

Few of the elements which are ordinarily found in materials to be analysed for tin interfere with this method. Nickel, cobalt, manganese, molybdenum, uranium, chromium, aluminium, zinc, lead, calcium, magnesium, sulphates, phosphates, bromides, iodides, and fluorides have no effect[32] unless present in so large amount that their colour masks that of the indicator. Arsenious and antimonious compounds in weak acid solution consume iodine, but in a hydrochloric acid solution ot the strength used in this method, they have no effect.[33]

If 0·1 grm. or more of antimony is present in the solution, the nickel coil will precipitate metallic antimony in a very slimy condition which does not settle and obscures the end point. This may be prevented by using a solution containing more hydrochloric acid. If therefore the sample taken contains 0·1 grm. or more of antimony, the solution is made up to contain 75 c.c. of free strong hydrochloric acid instead of 50 c.c. in 200 c.c. of volume, before reduction. If this is done the precipitation of slimy antimony will be prevented and no trouble will be experienced. If the antimony content is not known and the slimy antimony begins to precipitate during the reduction, an additional 25 c.c. of strong hydrochloric acid may be added, which will generally cause the antimony to dissolve and prevent further precipitation. If the precipitated antimony does not dissolve, another sample can be treated, adding more hydrochloric acid before reduction.

Copper in small amounts has no effect on the method, but if 0·05 grm. or more is present in the solution, it will be incompletely precipitated during the reduction, the titration will consume more iodine than is required by the tin, cuprous iodide will be precipitated, and the results will be erratic and high.

If copper is present in the sample in large enough amount to interfere, it must first be removed by treatment with nitric acid.[34]

Bismuth is precipitated in the metallic form during the reduction with nickel. In this form it is said to consume iodine[35] slowly but the action is very slight, and unless present in large amount, its effect is negligible. If it is desired to remove it, the metallic precipitate may be filtered and the filtrate again reduced and finished as usual.

Tungsten is reduced by the nickel coil to a lower state of oxidation, with the formation of a blue precipitate, said to be W_2O_5.[36] This is said[37] to be slowly oxidised by iodine, thus giving high results, but the oxidation is not proportional to the amount of tungsten present. Tungsten in amounts usually met with does not interfere to any extent, and its effect is only noticeable when it is present in large quantity. In case it should be desirable to separate the tungsten, the blue oxide may be filtered off with the precipitated bismuth, the solution afterwards being again reduced and titrated.

Titanic chloride is reduced to titanous chloride by the nickel coil. In the Pearce-Low method, titanium alone or with iron is said to consume no iodine,[38] but in the presence of tin, large amounts of titanium will consume iodine, giving high results. The error caused by titanium seems to be approximately a constant one and is independent of the amount of titanium present. Titanium may best be removed by converting the tin to insoluble oxide by evaporation with nitric acid and then fusing for 5 minutes with potassium bisulphate. The melt is dissolved in water and sulphuric acid and filtered.

If titanium and tungsten are both present, the tungsten will remain with the tin after filtering the extracted melt of the bisulphate fusion. The tungsten may be removed from this residue by heating with ammonium carbonate solution, in which the tin is insoluble.

The removal of titanium as volatile fluoride by evaporation with hydrofluoric acid is not complete if the titanium is in the form of ilmenite, the double oxide of titanium and iron.

Neither bismuth, tungsten, nor titanium, in any reasonable amount, such as is usually met with, interferes with the method, and may in general be neglected, especially if the titration is performed rapidly which, to a large extent, will eliminate secondary reactions. The interference of all of these metals is greatly increased by very slow and careful titration, which seems to accelerate their action and give them time seriously to affect the results. This is especially true of titanium, for bismuth and tungsten are not so active and as a rule need not be considered.[39]

Ferrous chloride is oxidised only by excess of iodine and no action takes place unless a very large amount of iodine is run in and allowed to stand. Its action is very slow even then, and the presence of iron does not affect the accuracy of this method.[40]

A tin determination may be run through and results obtained by this method in about one and a half hours and the method is accurate to about 0·1%.

FOOTNOTES.

[1] L. Parry, *loc. cit.*, pp.36 ; H. N. Warren, Chem. News, **67**, 16.

[2] J. S. C. Wells, Sch. of Mines Quart., **12**, 295.

[3] L. Parry, *loc. cit.*, pp. 34 ; J. W. Mellor, *loc. cit.*, p. 268 ; J. S. Wells, Sch. of Mines Quart., **12**, 295.

[4] W. Müller, Pogg. Ann., **107**, 136.

[5] T. Moore, Chem. News, **67**, 267.

[6] P. W. Shimer, J. Amer. Chem. Soc., **16**, 501.

[7] H. N. Warren, Chem. News, **62**, 216.

[8] J. W. Mellor, *loc. cit.*, p. 270; A. Froehde, Pogg. Ann. **119**, 317 ; E. Donath, Zeit. Anal. Chem., **19**, 23.

[9] J. W. Mellor, *loc. cit.*, p. 269; C. L. Bloxam, J. Chem. Soc., **18**, 97

[10] L. Parry, *loc. cit.*, p. 33.

[11] J. W. Mellor, *loc. cit.*, p. 266 ; A. H. Low, *loc. cit.*, p. 208; L. Parry, *loc. cit.*, p. 33 ; R. L. Hallett, Eng. and Min. J., **97**, 23.

[12] A. H. Low, *loc. cit.*, pp. 208, 211, 213 ; J. W. Mellor, *loc. cit.*, p. 266 ; R. L. Hallett, Eng. and Min. J., **97**, 23.

[13] J. W. Mellor, *loc. cit.*, pp. 266, 267.

[14] J. W. Mellor, *loc. cit.*, p. 267 ; S. W. Parr, J. Amer. Chem. Soc., **22**, 646.

[15] J. H. Walton and H. A. Scholz, Amer. Chem. J., **29**, 771.

[16] S. W. Parr, J. Amer. Chem. Soc., **24**, 167.

[17] H. W. Hutchin, Bull. Inst. Min. Met., Feb. 12, 1914.

[18] Ibid.

[19] L. Parry, *loc. cit.*, p. 20 ; J. W. Mellor, *loc. cit.*, p. 310.

[20] J. W. Mellor, *loc. cit.*, p. 310.

[21] F. H. Morgan, Jour. Anal. App. Chem., **2**, 169.

[22] J. W. Mellor, *loc. cit.*, p. 310.

[23] C. Victor, Chem.-Zeit., **29**, 179.

[24] L. Parry, *loc. cit.*, p. 20.

[25] Ibid., p. 33.

[26] J. Lõwenthal, J. prakt. Chem. (1), **76**, 484.

[27] F. Sutton, "Volumetric Analysis," 9th Ed., p. 347.

[28] Ibid., p. 346.

[29] A. H. Low, *loc. cit.*, p. 208 ; J. W. Mellor, *loc. cit.*, p. 311 ; L. Parry, *loc. cit.*, p. 37 ; F. Sutton, "Volumetric Analysis," 9th Ed., p. 346 ; R. L. Hallett, Eng. and Min. J., **97**, 23.

[30] A. H. Low, *loc. cit.*, p. 210.

[31] A. H. Low, *loc. cit.*, p. 81 ; J. W. Mellor, *loc. cit.*, p. 312.

[32] E. A. Wraight and P. L. Teed, Bull. Inst. Min. Met., Feb. 12, Ap. 9, 1914.

[33] A. H. Low, *loc. cit.*, p. 210.

[34] R. L. Hallett, Eng. and Min. J., **97**, 23.

[35] E. A. Wraight and P. L. Teed, *loc. cit.*

[36] Treadwell and Hall, "Qualitative Analysis," 1907 Ed., p. 441.

[37] Wraight and Teed, *loc. cit.*

[38] H. L. Sulman, Discussion of Paper by Wraight and Teed, *loc. cit.*

[39] Wraight and Teed, *loc. cit.*, Discussion.

[40] H. L. Sulman, Discussion of Paper by Wraight and Teed, *loc. cit.*

Communication.

NOTES ON SOME FATTY OILS.

BY SO UCHIDA.

Para rubber tree seed oil.

The oil is obtained from the seed of *Hevea braziliensis.* One litre of seed obtained from Singapore weighed on an average 364·1 grms. The kernel, which constitutes about 51·0 % of the seed, contains 52·19% of oil and 6·01% of water. When the kernel was pressed with a screw press, it furnished the following result :—Kernel, 1825 grms. First oil (cold drawn), 554 grms. Second oil (hot drawn), 46 grms. Total amount of oil, 600 grms. Percentage of oil obtained to the kernel, 32·88 %. The yield of oil obtained by pressing is poor.

The oil is a pale yellow liquid having an odour resembling that of linseed oil. In the winter months, it deposits a considerable amount of "stearine." With one drop of concentrated sulphuric acid, the oil assumes a reddish brown colour and after stirring it turns to brown. With nitric acid of sp. gr. 1·3, it assumes a yellow colour. When the oil is heated in a thin layer at 100° C. for 6 hours it dries to a soft film; on continuing the heating for 7 hours more the film remains soft. In the elaidin test no solidification is observed even after 48 hours' standing. The oil needs hardly any rectification, but to decolorise it completely it is best to filter it over 10% of its weight of Kambara earth or to shake it first with dilute sulphuric acid, followed by filtration over 5% of its weight of Kambara earth. It is a drying oil but exhibits weak drying power and in its general properties it resembles Inukaya seed oil. It can be used for the manufacture of paints, varnishes, boiled oil, and oil-cloth, as well as for soap-making.

The physical and chemical constants of the oil are as follows :—Sp. gr. (15° C.), 0·9239. Refractive index (27·5° C.), 1·4720. Butyro-refractometer reading (27·5° C.), 69·5. Acid value, 4·21. Saponification value, 191·9. Iodine value, 130·8 (Hübl's method). Ester value, 187·7. Reichert-Meissl value, 0·30. Hehner value, 95·37.

The mixed insoluble fatty acids are yellow and semi-solid and have the following constants :—Solidifying point, 27·0° C. Neutralisation value, 185·0. Mean molecular weight, 303·3. Iodine value, 116·5 (Hübl's method).

Shiromoji seed oil.

The oil is obtained from the seed of *Lindera triloba* BL., a plant belonging to the family of *Lauraceæ*. One litre of seeds obtained from Nagano prefecture weighed on an average 378·9 grms. The yellow kernel, which is found in the greyish brown husk, constitutes about 68·1% of the seed and contains 57·69% of oil and 3·34% of water. When the powdered kernel was pressed in a screw press, the following result was obtained :—Kernel, 3505 grms. First oil (cold drawn), 1034 grms. Second oil (hot drawn), 329 grms. Third oil (hot drawn), 223 grms. Total amount of oil 1586 grms. Percentage of oil obtained from the kernel, 45·26%. Thus one hectolitre of the seed will yield 10·9 kilos. of oil by pressing.

The oil is a pale yellow liquid at the ordinary temperature but solidifies in winter months to a hard white mass. It is odourless and has a pleasant taste. When one drop of concentrated sulphuric acid is added it assumes an orange colour. On being shaken with nitric acid of sp. gr. 1·3, it assumes a yellow colour. It yields no solid product in the elaidin test. The oil is non-drying and has the highest saponification value of all known natural oils. Its high saponification value as well as its low Hehner value indicate the presence of a considerable amount of lower fatty acids, while its low iodine value indicates that the oil is low in unsaturated fatty acids. The content of volatile fatty acids is small as judged from its low Reichert-Meissl value. The oil probably consists chiefly of laurin (saponification value 263·8). The cold drawn oil is pale yellow, but the hot drawn oil is somewhat darker. It can best be decolorised by filtering over 10% of its weight of natural absorbent earth or by shaking it first with dilute sulphuric acid, followed by filtration over 5% of its weight of natural absorbent earth. The oil is best suited for soap-making.

The physical and chemical constants of the oil are as follows :—Sp. gr. (15° C.), 0·9361. Refractive index (27·3° C.), 1·4732. Butyro-refractometer reading (27·3° C.), 40·2. Acid value, 0·63. Saponification value, 282·0. Iodine value (Hübl's method), 11·68. Ester value, 281·4. Reichert-Meissl value, 2·03. Hehner value, 85·72.

The mixed insoluble fatty acids form a reddish brown liquid and have the following characteristics :—Solidifying point, 14° C. Neutralisation value, 287·1. Mean molecular weight, 105·4. Iodine value (Hübl's method), 12·19.

Callophyllum oil.

Callophyllum oil is obtained from the seed of *Callophyllum inophyllum* L., a tree indigenous to Eastern Africa and Southern Asia. In Japan it grows in Formosa, in the Loochoo Islands, and in the Ogasawara Islands. The green nut is 2·5 to 3·0 cm. in diameter and becomes yellow on ripening. The round, pale yellow kernel which is found in a hard, thick wall is about 1·3 cm. in diameter and constitutes about 33·0% of the seed. One litre of the air-dried seed obtained from the Ogasawara Islands weighed on an average 400 grms.

The kernel, separated from the husk, was dried in the sun, crushed, steamed, and pressed with a screw press, when it gave the following result :—Kernel, 955 grms. First oil (hot drawn), 264 grms. Second oil (hot drawn), 44 grms. Third oil (hot drawn), 15 grms. Total, 323 grms. Percentage of oil pressed from the kernel, 33·83%. Hence one hectolitre of the seed will yield 4444 grms. of oil.

The oil thus obtained is a dark green, viscous liquid having a peculiar odour and contains a quantity of resin. In winter months it deposits "stearine" and becomes semi-solid. With one drop of concentrated sulphuric acid, the oil becomes reddish brown. On being shaken with nitric acid of sp.gr. 1·3, the oil assumes a brownish-red colour. In the elaidin test, it becomes a buttery mass after 2 hours. The dark green colour can be removed by shaking with dilute sulphuric acid but not with dilute sodium carbonate solution. It can be used for soap-making and also as an illuminant, but is unfit for edible purposes owing to its poisonous nature, especially when not rectified. It is a semi-drying oil and its high acid value is chiefly due to the presence of a considerable amount of resin.

The physical and chemical constants of the oil from Ogasawara Island are as follows :—Sp. gr. (15° C.), 0·9452. Refractive index (26·8° C.), 1·47925. Butyro-refractometer reading (26·8° C.), 81·6. Acid value, 45·95. Saponification value, 194·1. Iodine value, 95·49 (Hübl's method). Ester value, 148·1. Hehner value, 93·61. Reichert-Meissl value, 0·38.

The mixed insoluble fatty acids form a greenish brown soft mass and have the following characteristics :—Solidifying point, 28—29° C. Melting point, 37° C. Neutralisation value, 190·1. Mean molecular weight, 295·1. Iodine value, 95·4.

Hernandia seed oil.

The oil is obtained form the seed of *Hernandia peltata* Meisn., a tree indigenous to Eastern Africa and Southern Asia. The nut is round and green, but when it ripens a part of it becomes reddish. The flesh of the nut is thin while the kernel wall is thick; the kernel constitutes about 57% of the seed. A sample of oil was forwarded in 1914 from the Office of the Ogasawara Islands. The yield of oil by pressing was reported to be as follows, the press used being a primitive one :—

Kernel, 26,250 grms. First oil (hot drawn), 6832 grms. Second oil (hot drawn), 2063 grms. Total amount of oil, 8895 grms. Percentage of oil obtained from the kernel, 33·89 %.

The oil is a reddish brown liquid and has a characteristic odour. It deposits "stearine" in winter months. With one drop of concentrated sulphuric acid, it becomes reddish brown. With nitric acid of sp. gr. 1·4, it assumes a red colour. When it is heated in a thin layer at 100° C. for six hours it dries to a soft film, which remains soft and brittle after heating for a further 7 hours. The oil can best be rectified by shaking with dilute sulphuric acid or by treating with 4 % of its weight of 50 % solution of caustic alkali. It is a drying oil but its drying properties are rather weak, and the amount of free acid is considerable, as the acid value indicates. It can be used for the manufacture of soaps, boiled oil, and rubber substitute, and also for illuminating purposes.

The constants of the oil are as follows:—Sp. gr. (15° C.), 0·9380. Refractive index (27·2° C.), 1·47735. Butyro-refractometer reading (27·2° C.), 78·3. Acid value, 7·39. Saponification value, 195·7. Iodine value (Hübl's method), 126·1. Ester value, 188·3. Reichert-Meissl value, 1·77. Hehner value, 93·17.

The mixed insoluble fatty acids form a dark green liquid and have the following constants:—Begins to become turbid at 12—13° C. Neutralisation value, 185·7. Mean molecular weight, 302·1. Iodine value, 130·0.

Hakuunboku seed oil.

The oil is obtained from the seed of *Styrax obassia* S et Z. The seed, which ripens in September, is much like an acorn in shape and is about 1 cm. long. One litre of the seed (without cups) weighs 500 grms. on an average. The pale yellow kernel, found in the brown hard husk, constitutes about 48·6 % of the seed, and contains 43·71 % of oil and 5·45 % of water. The seed separated from the husks was crushed and expressed first cold and then hot, when it furnished the following figures:—Kernel, 1518 grms. First oil (cold drawn), 434 grms. Second oil (hot drawn), 29 grms. Total oil, 463 grms. Percentage of oil on kernel, 30·51 %. Thus one hectolitre of the seed will yield 7491 grms. of oil.

The cold drawn oil is a pale brownish yellow liquid and remains liquid even in winter months, but the second hot expressed oil is darker in colour and deposits "stearine" on long standing at the ordinary temperature. With one drop of concentrated sulphuric acid, the oil becomes brownish red and on stirring becomes brown. When shaken with nitric acid of sp. gr. 1·3, it turns greenish red. In the elaidin test, no solidification is observed after 5 hours; at the end of 72 hours only a small deposit of buttery consistency is deposited. When heated at 100° C. in a thin layer for 14 hours, it becomes more viscous but does not dry. It can be rectified by filtering over 10 % of its weight of natural absorbent earth or by treating with 2 % of its weight of caustic alkali as a 50 % solution. It is a semi-drying oil and its high Reichert-Meissl value indicates the presence of a considerable amount of volatile fatty acids such as butyric acid. In general properties it closely resembles Yego (*Styrax japonica*) seed oil.

The physical and chemical constants of the oil are as follows:—Sp. gr. (15° C.), 0·9610. Refractive index (27·5° C.), 1·48925. Butyro-refractometer reading (27·5° C.), 99·5. Acid value, 1·73. Saponification value 181·8. Iodine value (Hübl's method), 115·4. Ester value, 180·1. Reichert-Meissl value, 16·45. Hehner value, 92·94.

The mixed insoluble fatty acids form a yellowish liquid depositing a large amount of a white substance solid at the ordinary temperature, and have the following characteristics:—Begins to become turbid at 11—13·5° C. Neutralisation value, 166·1. Iodine value, 111·7. Mean molecular weight, 337·8.

Akebi seed oil.

The oil is obtained from the seed of *Akebia quinata*, Dcne., a climbing shrub indigenous to Japan. The fruit, which is the same size and shape as an European pear, is at first green but becomes partly reddish on ripening. It contains numerous black seeds 0·5 cm. long. One litre of the air-dried seed weighs 600 grms. on the average. The seed being small it was very difficult to separate the kernel from its shell, so the whole seed was crushed and subsequently pressed with a screw press first cold and then hot. The result was as follows:—Seed, 5388 grms. First oil (cold drawn), 721 grms. Second and third oils (hot drawn), 232 grms. Total 953 grms. Percentage of oil obtained to the seed, 17·69 %. Hence one hectolitre of the seed will yield about 10.609 grms. of oil.

The oil is a pale yellowish brown liquid having a characteristic odour and deposits a considerable amount of "stearine" in winter months; the second and the third oils almost solidify at 12—13°C. With one drop of concentrated sulphuric acid the oil assumes a greenish yellow colour, and on stirring a cochineal red colour. On being shaken with nitric acid, sp. gr. 1·3, it assumes a yellow colour with reddish tints. In the elaidin test, it gives a very soft buttery mass after five hours, the consistency remaining the same even after 72 hours.

This oil is non-drying and its most prominent characteristic is its extraordinarily high Reichert-Meissl value—the highest of any vegetable fatty oil. It also has a high acid value. Thus it contains a considerable amount of lower volatile fatty acids such as butyric acid. The oil can be decolorised by filtering over 10 % of its weight of Kambara earth or by shaking with dilute sulphuric acid. It can be utilised for the preparation of soap and Turkey red oil as well as for edible and burning purposes.

The physical and chemical constants of the oil are as follows:—Sp. gr. (15° C.), 0·9340. Refractive index (27·5° C.), 1·46145. Butyro-refractometer reading (27·5° C.), 53·2. Acid value, 25·45. Saponification value, 246·4. Iodine value, 78·38. Ester value, 221·0. Reichert-Meissl value, 39·76. Hehner value, 85·80.

The mixed insoluble fatty acids form a pale greenish solid, becoming pale yellow on long standing. They have the following characteristics:—Solidifying point, 31° C. M. pt., 38—39°C. Neutralisation value, 191·7. Mean mol. wt., 292·7. Iodine value, 77·78.

Kuromoji seed oil.

The oil is obtained from the seed of *Lindera serica* BL, a small tree belonging to the family of *Lauracea*. The seed is round, 0·5—0·7 cm. in diameter, and one litre of the seed weighs about 492 grms. on an average. The yellow kernel, which is found in a black brown husk, constitutes about 63·3 % of the seed and contains 69·60 % of oil and 3·25 % of water. The kernel roughly separated from the husks—the complete separation is very difficult—was crushed, then steamed and subsequently pressed with a screw press while still warm. 905 grms. of kernels yielded 340 grms. of first oil (hot drawn). 165 grms. of second oil (hot drawn), and 20 grms. of third oil (hot drawn). Total amount of oil, 525 grms. Percentage, 58·02 %. One hectolitre of seed will thus yield about 18,045 grms. of oil.

The oil is a yellowish brown liquid having an aromatic odour, and does not solidify even in winter. When one drop of concentrated sulphuric acid is added to 20 drops of oil placed on a white porcelain plate, it assumes an orange-brown colour. With nitric of sp. gr. 1·3, the oil becomes yellowish red. In the elaidin test it remains liquid even after 48 hours' standing; only a small deposit of buttery consistency was found. It is non-drying and its high saponification value as well as its low Hehner value indicate the presence of a considerable quantity of the lower fatty acids, while its low iodine value indicates that the content of unsaturated fatty acids is low. Again the content of volatile acids is low as indicated by its low Reichert-Meissl value. Complete decoloration of the oil is difficult, but when it is treated with 1% of caustic alkali as a 50% solution and then filtered over 10% of its weight of Kambara earth, it is fairly well decolorised. The oil can best find application in soap-making.

The physical and chemical constants of the oil are as follows:—Sp. gr. 30°/30° C., 0·9401. Refractive index (27·0° C.), 1·4680. Butyro-refractometer reading (27° C), 63·2. Acid value, 18·78. Saponification value, 255·6. Iodine value, 65·29 (Hübl). Ester value. 236·8. Reichert-Meissl value, 2·53. Hehner value. 86·22.

The mixed insoluble fatty acids are a dark brown liquid, having solidifying pt. 9·5° C., neutralisation value 262·0, mean mol. wt. 214·1, iodine value 37.

Aburachan seed oil.

The oil is obtained from the seed of *Lindera praecox*, a tree belonging to the family of *Lauracea*, growing in Shikoku, Kyushu, and Honshu, Japan. The seed is round, 1·0—1·3 cm. in diameter, and contains a pale yellow kernel in a reddish brown husk. One litre of the air-dried seed obtained from Nagano prefecture weighs on an average 432·3 grms. The kernel, constituting 80·7% of the seed, contains 29·44% of oil and 7·35% of water. The oil was prepared by steaming and pressing the powdered kernel. The result was as follows:—Kernel, 6348 grms. First oil (hot drawn), 790 grms. Second oil (hot drawn), 161 grms. Third oil (hot drawn), 150 grms. Fourth oil (hot drawn), 52 grms. Total, 1153 grms. =18·17% of the kernel. Hence one hectolitre of the seed will yield about 6341 grms. of oil by pressing.

The oil is a dark brown liquid possessing a somewhat aromatic odour. It solidifies in winter. When one drop of concentrated sulphuric acid is added to 20 drops of oil a brownish red liquid is produced. With nitric acid, sp. gr. 1·3, it becomes red. In the elaidin test, it remains liquid even after 72 hours, at the end of which time only a minute quantity of buttery consistency is formed. This oil is non-drying and its saponification value exceeds that of coconut oil, indicating the presence of a large amount of lower fatty acids. The amount of volatile fatty acids is small as shown by its low Reichert-Meissl value.

The oil can best be purified by filtering over 10% of its weight of Kambara earth or by shaking with dilute sulphuric acid.

The physical and chemical constants of the hot drawn oil from Shinano province seeds are:—Sp.gr. (15° C.), 0·9348. Refractive index (27° C.), 1·4550. Butyro-refractometer reading (27° C.), 43·6. Acid value, 2·60. Saponification value, 273·6. Iodine value, (Hübl), 20·53. Ester value, 271·0. Hehner value, 89·21. Reichert-Meissl value, 1·39.

The mixed insoluble fatty acids, which are liquid and reddish brown, have solidifying pt. 13° C., neutralisation value 277·2, mean mol. wt. 202·4, iodine value 18·28.

Magnolia fruit oil.

The oil is obtained from the fruit of *Magnolia hypoleuca* S. et Z., a large tree growing in Shikoku, Kyushu, and Honshu, Japan. The fruit is red, ellipsoidal, and 1·0—1·3 cm. long. The pale yellow flesh is thick and rich in oil. The black kernel is 0·7—0·9 cm. long and has very thick and hard walls. One litre of the fruit weighs 637 grms. on an average. The flesh and the kernel (kernel wall and kernel) are in the ratio of 45 : 55. The kernel separated from its wall contains 59·60% of oil and 4·69% of water. The fruit of *Magnolia hypoleuca*, without separating its seed and flesh, was crushed and pressed with a screw press, when 4055 grms. of the fruit yielded 1270 grms. of first oil (cold drawn), 217 grms. of second oil (hot drawn), and 74 grms. of third oil (hot drawn); total 1561 grms. =31·51%. One hectolitre of the seed will thus yield about 20·6 kilos. of oil.

The oil thus obtained is dark brown with purple tints, and is very difficult to decolorise. It is viscous and deposits a considerable amount of "stearine" even at the ordinary temperature on long standing. Twenty drops of the oil placed on a white porcelain plate and treated with one drop of concentrated sulphuric acid, assumes a greenish yellow colour which on stirring turns to greenish brown. On shaking with nitric acid of sp. gr. 1·3 it becomes a reddish brown colour. In the elaidin test it deposits a considerable amount of a buttery mass after 5 hours' standing, and after 48 hours the whole mass becomes soft and of buttery consistency. When heated to 100° C. in a thin layer for 14 hours it becomes more viscous but does not dry. It is semi-drying and its somewhat high acid value indicates the presence of free acid in considerable quantity. The oil can be used for soap-making and also as a burning oil.

The physical and chemical constants are as follows:—Sp. gr. (15° C.), 0·9315. Refractive index (26·8° C.), 1·4739. Butyro-refractometer reading (26·8° C.), 72·5. Acid value, 13·43. Saponification value, 224·4. Iodine value, 109·2. Ester value, 211·0. Reichert-Meissl value, 4·93. Hehner value, 93·11.

The mixed insoluble fatty acids are a soft solid of dark brown colour, and have the following characteristics:—M. pt., 35°—35·5° C. Solidifying pt., 28°—28·5° C. Neutralisation value, 201·9. Mean mol. wt., 277·9. Iodine value, 99·66.

Magnolia flesh oil.

The flesh of the magnolia fruit was separated and pressed with a screw press. 1480 grms. yielded 394 grms. of first oil (cold drawn), 129 grms. of second and third oil (hot drawn). Total, 523 grms. = 35·34%.

The oil is dark brown and deposits a large amount of "stearine" in winter months and becomes viscous. The colour can easily be removed by treating first with 2% of caustic alkali as 50% solution, followed by the filtration over 10% of Kambara earth.

The oil gives a green coloration with concentrated sulphuric acid and a yellow colour with nitric acid of sp. gr. 1·3. In the elaidin test it becomes turbid after 5 hours and then separates into two layers, liquid and solid; finally at the end of 72 hours the whole mass becomes buttery. When heated in a thin layer at 100° C. for 14 hours it shows no tendency to dry. It contains a considerable amount of free acid, and can be used as the raw material for soap and rubber substitute, but as it is very difficult to separate the flesh and the kernel, it is not likely to be of any technical importance.

The physical constants of the oil are:—Sp. gr. (15° C.), 0·9239. Refractive index (27° C.), 1·4693. Butyro-refractometer reading (27° C.), 65·3. Acid value, 13·59. Saponification value, 205·0. Iodine value, 89·53. Ester value, 104·4. Reichert-Meissl value, 4·67. Hehner value, 94·83.

The mixed insoluble fatty acids are solid and pale brown and have :—M. pt., 36·5° C. Solidif. pt., 32°—32·5° C. Neutralisation value, 205·1. Mean mol. wt., 273·5. Iodine value, 86·16.

Magnolia seed oil.

As the wall of the kernel is very thick and hard, the seed was crushed whole, sifted with a winnowing basket to separate any coarse wall pieces, and subsequently steamed and pressed with a screw press. The yield of the oil was very poor as it was absorbed by the pieces of kernel wall. 3180 grms. of seed yielded 246 grms. of oil or 7·74 %.

The oil is a dark brown liquid and is exceedingly difficult to decolorise. It does not solidify even in winter months. Treated with nitric acid it becomes reddish brown. In the elaidin test, no solidification is observed after two hours ; at the end of 72 hours a small deposit of buttery consistency is formed. When it is spread in a thin layer and heated at 100° C., it dries after 11 hours. It is a non-drying oil but exhibits weak drying properties. It can be used for the manufacture of soap and boiled oil, but as it is not profitable to press the oil separately from the flesh and the seed it is not likely to acquire any technical importance.

The constants of the oil are as follows :—Sp. gr. (15° C.), 0·9288. Refractive index (27° C.), 1·4754. Butyro-refractometer reading (27° C.), 75·0. Acid value, 6·69. Saponification value, 207·4. Iodine value, 124·5. Ester value, 250·7. Reichert-Meissl value, 0·17. Hehner value, 96·54.

The mixed insoluble fatty acids form a brownish black liquid, which begins to become turbid at 17·5°—17·0° C., and has neutralisation value 193·7, mean mol. wt. 289·6, iodine value 125·5.

Tea seed oil.

This oil is obtained from the seed of the ordinary tea plant, *Thea chinensis*, a shrub largely cultivated in the provinces of Musashi, Suruga, Ise, Yamashiro, and Omi for the manufacture of tea ; it also grows wild extensively in Shikoku and Kyushu. In some parts of these districts, the tea plant grows abundantly as undergrowth of the forest. The seed is round, about 1 cm. in diameter, and contains a yellowish white kernel in a blackish brown husk. One litre of the air-dried seed of wild tea plant obtained from Tosa province weighed 380 grms. on the average. The kernel, which constitutes 65·3 % of the seed, contains 27·62 % of oil and 10·25 % of water. The kernel was ground to a coarse meal, then steamed and subsequently pressed while still warm with a screw press. 3384 grms. of the kernels yielded 498 grms. of first oil (hot drawn), 102 grms. of second oil (hot drawn), and 14 grms. of third oil (hot drawn). Total, 612 grms., or 18·09 % of the weight of the kernel. One hectolitre of the seed will hence yield about 4488 grms. of oil by pressing.

The oil is a pale brown liquid having a peculiar odour, and deposits a large amount of " stearine " in winter. With concentrated sulphuric acid an indigo blue coloration is produced which becomes greenish brown on stirring. On shaking with nitric acid, sp. gr. 1·3, a pale blue colour is produced. In the elaidin test it became turbid and very viscous after 5 hours, owing to the production of solid matter, and after standing for 24 hours the whole mass assumed a buttery consistency.

This oil is non-drying and in its general properties resembles Sazanqua (*Thea sazanqua*) seed oil. The best way to rectify the oil is to filter it over 10 % of its weight of Kambara earth, or it may first be shaken with dilute sulphuric acid and then filtered over 5 % of its weight of Kambara earth. It can be used for soap-making and also for lubricating and burning.

The constants of the pressed oil from Tosa province seed are as follows :—Sp. gr. (30°/30° C.) 0·9126. Refractive index (27·6° C.), 1·4669. Butyro-refractometer reading (27·6° C.), 61·6. Acid value, 4·12. Saponification value, 193·8. Iodine value, 86·20 (Hübl). Ester value, 189·7 Hehner value, 95·76. Reichert-Meissl value, 0·10.

The mixed insoluble fatty acids form a pale green, soft solid and have the following characteristes :—Solidif. pt., 25·5° C. Neutralisation value, 190·5 Mean mol. wt., 294·5. Iodine value (Hübl), 80·79.

London Chamber of Commerce.

Special Meeting of Chemical Section, held at the Chamber House, 79, Cannon Street, E.C., on October 27, 1916.

MR. THOMAS TYRER IN THE CHAIR.

The SECRETARY read the notice convening the meeting, the object of which was to consider the general policy of the chemical and allied industries on practical questions arising during and after the War, and what concerted action may be desirable in the common interest.

The CHAIRMAN said that the present definition of trade as mere " buying and selling " was misleading, and the conditions which prevailed to-day were insane. There was little or no consideration for others and an increasing tendency to cut-throat competition. They were told to co-operate and co-ordinate. Co-ordination must involve cooperation, but co-operation did not involve coordination. Under co-ordination what would become of the small man in face of the position in which the great men and the great combinations in the last few years had placed him ? It was a question as to what combination of the two forms, co-operation and co-ordination, would be the wiser course. In the chemical trade there had been suffering and inconvenience, and after the war the ill feeling, " envy, hatred, and malice," which grew out of it, and the uncharitableness which would necessarily follow, would exist in greater force. There was no sign that any condition of rivalry would be ameliorated, but the contrary, and men who had been free-traders, and who were prepared to show that the commercial success of this country was based upon a system of free trade, were face to face with the success and the competition of a great, able, and determined nation, and it was now a question whether the almost sacrosanct idea or fetish of free trade would be sufficient. It had not done everything in the past, and it had produced a state of things to which, in his opinion, much of the ignorance and *laissez faire* of to-day was due. His personal view was that the trade ought not to be placed in the position of being constantly faced with the mailed fist of a determined, but not industrially demented, nation. The British would require to make the best use of those qualities of forethought, intelligence, industry, and endurance, which they undoubtedly possessed, but which had been allowed to become rusty as a consequence of opulent facilities. He, personally, deplored that British Dyes Limited had been subsidised by the Government, which logically meant that every one who had a " good thing " ought also to be subsidised.

The pressure of war and the necessity for increasing our output had revealed in Great Britain resources in scientific knowledge and engineering which we little thought we possessed. They should drop subsidies, drop prejudices and conceits, and call in men who could give the right kind of advice. Amongst the greatest hindrances to progress were not the want of knowledge and material, or lack of men, but the want of sane legislation and co-operation. To begin with, the whole condition of the railway service, and the management of labour, and much more, was wrong, for instance, primary and secondary education, but he could not see on the part of the Government true discrimination. The virtual preference accorded to German competitors before the War should be destroyed. It was not protective tariffs alone that would protect or save any trade. Let them put all their brains and energy into co-operative action.

Mr. E. A. B. HODGETTS, of Nobel's Explosives Co., Ltd., said that his Company had not suffered much from enemy competition in the United Kingdom, although they had from the dumping of goods in Australia. There was a great deal to be said in regard to the freight question in this country, but he was not prepared to say what alterations were necessary; the subject was covered by serious complications.

Mr. E. J. BOAKE (Boake, Roberts and Co.) said that across the North Sea organised co-ordination of science and industry with practically unlimited capital were prepared to fight British manufacturers, who were presided over by a Government which knew nothing and cared less about their destiny. The position seemed hopeless. What was needed was direct representation in the House of Commons as a big trade organisation. Was it unreasonable that the greatest key industry in this country should be directly represented in the House of Commons where such questions as railway rates, the Consular Service, and tariffs would have to be dealt with. The Chemical Section had expressed its views very strongly in favour of tariffs to enable them to trade on level terms. If there were no tariffs, what was to become of the quantities of chemicals now lying in Germany, which the Germans would desire to sell immediately after the War. Were we going to allow those goods to enter here? There was the question of the obliging foreign agent who established himself in London, from whom they had previously obtained chemicals of every conceivable kind. In exchange, however, those gentlemen acquired knowledge which it was not in British interests they should have.

Mr. G. H. WILKINSON, of the Wrekin Chemical Co., said that the question of tariffs had been considered by the British Wood Distillers' Association in Manchester a few weeks ago, when the opinion had been expressed that in a commodity like wood-charcoal, where British works are in a position to supply the entire needs of the home markets, a prohibitive duty of £5 per ton should be levied on charcoal coming into the United Kingdom from any source whatever. In the case of acetate of lime and wood spirits, the home manufacturers could not entirely supply the demand, but in view of the great importance of these articles in time of War, the Association had requested that the Government should take steps to foster and encourage home production so as to obtain the maximum production possible in this country.

The CHAIRMAN referred to the fact that no progress had been made in the alcohol question lately, owing to the inability to move the Government officials. He also referred to another good work, to which the Section had been accessory—namely, the transference of the manufacture of caffeine from the foreigner to Britain, by securing suitable denaturants of the raw material, which was retained here instead of going abroad.

Mr. R. PUGH, of the London Chemical Works, Ltd., said that the position of the manufacturers of salicylates was the same as that of the wood distillers. They were looking for some form of protection which would enable them to establish themselves on equal terms with their foreign competitors. They considered that they should be protected against unfair competition, by proper organisation, and he suggested that the Chemical Section of the Chamber should form a Committee with a view to ascertaining which industries in this country were capable of supplying the needs of Great Britain and the Colonies in various chemical manufactures.

Dr. M. O. FORSTER, F.R.S., expressed the view that the Government assistance to British Dyes Limited was a wise action, especially when they remembered that the German chemical industry had for years received financial assistance either direct from the German Government or from that Government through the German banks. It was just that early assistance in which Great Britain's fine chemical industry had been so lamentably lacking in the past. They had not been able to expend the necessary amount on research chemists, or in the long and patient investigation required, which would not bring in a return for perhaps five or ten years. He thought tariffs would have to be placed on certain articles, but they would have to ascertain the guiding principle which should control their incidence and administration. Where they had a material which would be produced in this country in the amount which was necessary for national requirements, then a tariff should be put on importation in order to assist British industry and to discourage importation. Where they had a material for which there was a practically unlimited demand, and where it would be to the advantage of the country to have a larger quantity than could possibly be produced in Great Britain, then it seemed to him it would be wiser not to place a duty on such an article, unless it was a question of discriminating between our friends and our enemies. It was in the matter of intermediates that Germany had scored.

So far as the re-establishment of the dye industry was concerned, it would take years to approach anywhere near the position which Germany had reached.

Finally, it would be necessary to reform, whatever else was reformed, our system of education, and insist that scientific study should have an equal chance with classical study.

Sir CHARLES BEDFORD, Secretary of the Association of British Chemical Manufacturers, referred to the amount of spade work necessary before his Association could seriously commence its work. They were proposing to form sectional committees which should study, in order of urgency, their requirements, and the requirements of the chemical industry as a whole. He agreed with Mr. Boake as to the necessity for direct representation of the industry in the House of Commons, but what they required now were practical propositions, as it was not likely within the period of the war that they would have such an alteration as would enable representatives of their own or other leading trades and industries to sit in the House of Commons. On the question of tariffs a protective duty by itself would not save an industry: organisation was required. One of the obstacles to be faced and got over was the individual jealousies which were manifest in regard to the immense amount of trade which was done by secret processes, and the subject of pooling was a very dangerous thing to face. The only remedy was to combine in formulating some method by which this difficulty could be got over.

In regard to tariffs the question was so infinitely complex that it would be almost impossible to deal with the subject, and the only solution would be a Standing Board for Tariffs, a Board on which would sit, side by side with the Government officials, accredited representatives of all the chief industries.

Mr. D. Lloyd Howard (Howards and Sons, Chairman of the Manufacturers' Sub-section) submitted that an important consideration in regard to the question before them was that the way lay not in one remedy, but in several. He was very glad to see that the question of tariffs and also differential tariffs against our enemies tended to become less and less a party question amongst business men. There were, of course, extreme fanatics on both sides who would not alter their views. Education, and more of it, was undoubtedly necessary. At the same time we had a great many very good chemists and practical men, who, with our curious national habit of self-depreciation, had not met with the support which they deserved. German-trained chemists included a vast number of mere hacks, only useful to those who are far-seeing and highly trained enough to make use of them.

On such a subject as the present there were a number of things to be taken into consideration, for instance, the operation of the patent laws, which gave a most unfair protection to the foreigner. If they were to examine a number of patents for German fine chemicals, they would find whole groups of compounds protected by a patent, which it was never the intention of the patentee to work, the idea being to prevent their use by other investigators.

There must be a more sympathetic attitude towards a production from the highest to the lowest, and the interests of the community must be more carefully studied and helped on by the Government.

Mr. C. A. Hill (British Drug Houses, Ltd., Chairman of the Druggists' Sub-section) said that the Germans had been very active in the past in getting into their hands the control of the supply of certain drugs, which were the only source of certain important chemicals, such as santonin, for which was secured the whole of the Russian supply of the raw material, wormseed.

Egyptian henbane, a source of atropine, was another of the German monopolies. That sort of thing must stop. Nobody was to blame except perhaps our own manufacturers. The time for quarrelling was past, and all our efforts should now be directed to securing co-operation between Government Departments like the Foreign Office, the Imperial Institute, and the fine chemical makers. He was sure that co-operation would lead to better results.

The Chairman reported that the Chamber's Special Committee on Trade after the War was preparing a third report on the measures to be taken to give full effect to the recommendations of the Economic Conference of the Allies, and particularly the question of commercial and industrial organisation and financial facilities. On this Committee all the Trade Sections of the Chamber were represented and the Report would be ready by the end of the year. The various Sub-sections of the Chemical Section would discuss points which affected them, and the Advisory or Emergency Committee of "Sub-sectional Chairmen" would always be ready to consider any recommendations or suggestions submitted.

It was moved from the Chair, seconded by Mr. Blagden, and agreed :—

"That the questions raised in the discussion at this meeting, as noted, be referred to the respective Sub-sections for consideration and such action as may be practicable."

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows :—

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French.—1 fr. 05 c. each, as follows : Patents dated 1902 to 1907 inclusive, Belin et Cie., 56, Rue Ferou 8. Paris (3e.); Patents from 1908 to date, L'Imprimerie Natinnale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL ; PLANT ; MACHINERY.

Acid-resisting iron apparatus ; Design of ——. N. Swindin. Chem. Trade J., 1916, 59, 323—324.

The general design of plant in which acid-resisting iron alloys are used is similar to that where steel is employed, except that due allowance is made for the greater liability of the alloys to fracture from the action of internal stresses. Unequal cooling being the chief source of trouble in this respect, the thickness of the castings should be as uniform as possible and the presence of relatively large masses of metal (*e.g.* at the junction of two or more walls of the apparatus) avoided. Although parts with flanges and ground or machined faces are obtainable and sometimes indispensable, plain spigot and socket joints should be used wherever possible ; pipe apparatus of the kind under discussion is seldom subjected to high pressures, and excellent cements to withstand every kind of acid liquid or gas are now available for making such joints quite tight. As in the case of other metals used for pans, etc., the most reliable form of casting for acid-resisting iron alloys is a hollow sphere or portion thereof ; flat surfaces should be avoided wherever possible, and if unavoidable should not be larger than 18 in. square. The very shallow pans used for concentration purposes are ribbed and corrugated, thus providing an increased surface for heat transmission and overcoming foundry troubles by breaking up flat surfaces. The advantages of the iron alloys over earthenware, etc., are most apparent in nitric acid plants, chiefly as regards the great reduction in size, and increase in efficiency, of the condensing apparatus. For denitrating sulphuric acid, towers made of iron alloys are very successful, but being slightly attacked by weak (although not by strong) sulphuric acid, cascade basins and pans of these alloys can only be employed in the lower part of the run it iron-free acid is required.—W. E. F. P.

Drying in the chemical industry ; Rational ——. R. W. Dinnendahl. Chem.-Zeit., 1916, 40, 845—846.

For drying chemical products economically it is important to remove as much of the water as possible from the moist material by mechanical means before applying heat to evaporate the remainder. Two patented devices for removing moisture in continuous operation are described. The first is a rotating vacuum filter consisting of a circular revolving table, the surface of which is divided radially into a suitable number of cells.

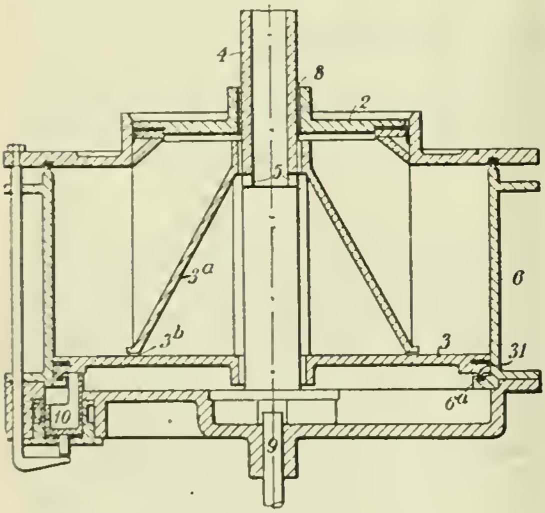
The cells are filled with interchangeable filter frames and connected underneath with a wet air pump. The material to be drained is fed continuously from a hopper on to the filter frames covered with cloth, and spreads itself out into a layer of uniform thickness, being immediately subjected to the suction of the vacuum pump below the frames. As the table rotates, the vacuum is finally broken and the solid material removed by automatic means, assisted if necessary by the application of compressed air in the zone of the discharge operation. Between the removal zone and the feed-zone an arrangement is placed for cleaning the filter frames. The second apparatus is an automatic filter press for dealing with mixtures containing less than 90% of water. It consists of a cylinder with reciprocating piston which exerts a pressure on the introduced material, regulated by an adjustable cover on the pressure tube which forms an extension of the cylinder. During the backward stroke of the piston the cylinder is charged with material from a hopper; in the forward stroke this material is pushed up into the pressure tube where it is subjected to a gradually increasing pressure with every stroke of the piston, falling out at the end in a solid form on to a conveyor.—J. F. B.

Utilisation of Etna lava in the chemical industry. Pagliani. *See* VII.

Patents.

Separation of solid substances from liquids; Centrifugal machines for the ——. R. A. Sturgeon, Llangollen, Wales. Eng. Pat. 7019, May 10, 1915.

In apparatus of the type described in Eng. Pat. 24,038 of 1913 (this J., 1915, 263), liquid is admitted by the hollow shaft, 4, and passes by the openings, 3^b, in the rotating member, 2, 3^a, 3, to the outer casing, 6, and finally escapes by the outlet, 8, which is nearer to the axis than in the former patent, thus reducing the outflow velocity and consequently the power used. An additional joint between the fixed and rotating parts may be formed by the rib, 31, and the flange, 6^a. The pressure liquid admitted by the pipe, 9, to lift the plate, 3, and allow the discharge of solid matter as in the former patent, may escape tangentially by a valve, 10, in a direction opposite to that of rotation.—W. F. F.



Drying, heating, cooling, or ventilating: Apparatus for ——. T. G. Marlow, Streatham, and The Pulsometer Engineering Co., Ltd., Reading. Eng. Pat. 12,988, Sept. 10, 1915.

The movement of the gas or air through the apparatus described in Eng. Pat. 16,299 of 1911 (this J., 1912, 909) is regulated, or the direction is reversed, by a rotary controller driven by a variable speed motor and a double-valve reversing device.—W. H. C.

Chemical reactions; Receptacles for carrying out ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. Eng. Pat. 100,447, May 5, 1916. Under Int. Conv., May 12, 1915. (Appl. No. 6496 of 1916.)

In a receptacle having a discharge pipe at the bottom provided with a sluice valve and an inlet for steam between the valve and the outlet from the receptacle, an additional hand-operated valve is provided to close the outlet from the receptacle so that the pipe may be cleared by steam. The crust at the bottom of the receptacle may be pushed up and broken by raising the valve from its seating. The receptacle may be used in the production of ammonia from calcium cyanamide. —W. F. F.

Constant discharge of a liquid or the like; Means and apparatus for keeping a ——. F. Danesi, Rome. Eng. Pat. 101,386, Apr. 6, 1916. (Appl. No. 5049 of 1916.)

A constant flow from a tank in which the level of the liquid varies, is maintained by means of a siphon which is supported by a frame and float, so that the level of the discharge orifice of the siphon is always the same distance below the level of the surface of the liquid.—W. H. C.

Classifier. H. B. Hallowell, Worcester, Mass. U.S. Pat. 1,197,622, Sept. 12, 1916. Date of appl., Mar. 10, 1915.

The material is fed continuously into the upper part of a vertical chamber and is subjected to intermittent upward blasts of air introduced at the lower part of the chamber. The air separates the finer particles and carries them through an outlet situated above the lower end of the feed pipe, into a bag chamber which retains the solid particles.—W. H. C.

Filter, and filtering process. A. E. Krause, Jersey City, N.J. U.S. Pat. 1,198,039, Sept. 12, 1916. Date of appl., Aug. 26, 1914.

A composite filter comprises a first section consisting of a layer of carbonaceous flue dust having an acid reaction and selective oil-removing properties, and a second section formed of serpentine asbestos which is capable of neutralising acid, and also has oil-removing properties.—W. H. C.

Filtering apparatus. O. J. Salisbury, Salt Lake City, Utah. U.S. Pat. 1,198,282, Sept. 12, 1916. Date of appl., Dec. 9, 1915.

The filtering agent is enclosed in a casing formed of two similar sections suspended by hinges along the upper longitudinal joint so that they can be moved outwards in unison. The filtering agent is lowered while the sections are being opened and raised while they are being closed again.—W. H. C.

Evaporation of liquids giving off noxious gases. J. O. Lundberg, Flateby, Norway. U.S. Pat. 1,198,245, Sep. 12, 1916. Date of appl., July 31, 1915.

Evaporation is effected in several stages, in the first of which steam is the heating agent, while in the remainder the vapour from the preceding stage heats the liquid residue from the preceding stage. The vapour from the last stage is utilised to evaporate water condensed from the steam used as heating agent in the first stage.—W. F. F.

Liquids : Method of treating —— with gases. C. S. Bradley, New York. U.S. Pat. 1,198,519, Sept. 19, 1916. Date of appl., Dec. 18, 1913.

A liquid is treated with a gas, *e.g.*, for oxidising, by running it into a vessel and bubbling gas through it at such a rate that only the foam overflows into a second vessel, where it is re-liquefied and treated again in the same way.—W. F. F.

Crushing mill : Vertical ——. T. J. Sturtevant, Wellesley, Mass., Assignor to Sturtevant Mill Co. U.S. Pat. 1,198,597, Sept. 19, 1916. Date of appl., June 24, 1916.

In a vertical crushing mill, the step bearing of the vertical shaft is formed in a spider frame which is bolted by means of lugs to a flange on the base of the casing. The frame is adjusted in height by interposing washers of varying thickness. The shaft is driven by bevel gearing, and all parts except the shaft are removable through the bottom of the casing.—W. F. F.

[Nickel] catalysts ; Process of regenerating ——. N. Sulzberger, New York. U.S. Pat. 1,199,032, Sept. 19, 1916. Date of appl., Mar. 20, 1916.

A catalyst containing nickel associated with silica is regenerated by dissolving the nickel in an acid and the silica in an alkali, mixing the solutions to precipitate nickel silicate, and reducing the precipitate to render it catalytically active.
—W. F. F.

Evaporating apparatus. P. Kestner. Fr. Pat. 478,684, May 14, 1915. Under Int. Conv., May 16, 1914.

See Eng. Pat. 12,124 of 1914 ; this J., 1915, 823.

Catalysts. O.D.Lucas. Fr.Pat.478,739,May 18, 1915.

See Eng. Pat. 5847 of 1914 ; this J., 1915, 784.

Combined apparatus for ventilating, steaming, fire extinguishing, gas-freeing, and sounding of tanks or vessels containing oil, petroleum spirit, or other inflammable liquids. Eng. Pat. 14,331. *See* IIa.

Apparatus for drying vapour, particularly in connection with benzol and other stills. Eng. Pat. 17,568. *See* III.

Evaporation of waste liquors, especially waste liquors from the sulphite- and sulphate-cellulose processes. Ger. Pat. 293,394. *See* V.

Condensers [for nitric acid]. Eng. Pat. 101,307. *See* VII.

Kilns. U.S. Pats. 1,199,015 and 1,199,016. *See* VIII.

Rotary vacuum-filter. U.S. Pat. 1,198,880. *See* X.

IIa.—FUEL ; GAS ; MINERAL OILS AND WAXES.

Dissolved acetylene ; Committee on ——.

The Home Secretary has appointed a Committee to consider the existing regulations in regard to cylinders of dissolved acetylene compressed into a porous substance, and to suggest amendments to these regulations where it appears desirable. The Committee consists of Major A. M. Cooper-Key, C.B. (Chairman), Eng.-Captain C. W. J. Bearblock, R.N., Prof. C. V. Boys, F.R.S., Major T. H. Crozier, Mr. W. S. Smith, and Dr. T. E. Stanton, F.R.S. Major Crozier is to be the Secretary of the Committee, and all communications should be addressed to him at the Home Office.

Coal-dust explosions ; Influence of incombustible substances on ——. A. S. Blatchford. Trans. N. Eng. Inst. Min. and Mech. Eng., 1916, 46, 235—251.

The author gives results of experimental work on the quenching effect of different substances. Explosions with different mixtures were carried out in a strong spherical glass vessel of a capacity of about 120 cubic inches. The impulse of the explosion acts on a pendulum, the stationary position of the latter indicating a quenched explosion. Average results of experiments on four coals are given below, the figures indicating the least percentage of material in a mixture which prevents an explosion. Glauber's salt $(6H_2O)$ 8, sodium bicarbonate 8, soda-crystals $(5H_2O)$ 10, anhydrous sodium carbonate 12, magnesia alba 19, magnesia 28, gypsum 30, Chance mud 35, ground shale 40, quicklime 48, boiler-ashes 53. The author suggests that the liberation of carbon dioxide from a quenching material has but small influence on the explosive character of a mixture, and that the specific heat of the quenching substance may be an important factor in its efficiency. He states that the effect of a quenching material is probably due to the rate of heat-absorption over a particular range of temperature, and suggests that the explanation of the quenching action should be sought in the physical rather than in the chemical properties of the materials.—J. E. C.

Peat powder as locomotive fuel. Engineering, 1916, 102, 387.

Peat powder was blown into the fire-box of a locomotive by compressed air, and ignited by a small coal fire. Heating values of peat powder and coal averaged 7920 B.Th.U. and 13,030 B.Th.U. respectively. The steam was superheated to a higher degree with peat powder than with coal, owing to the longer flame produced. Comparative tests showed an evaporation of 4·71 kilos. and 6·81 kilos. of water per kilo. of peat powder and coal respectively.—J. E. C.

Coal tar pitch ; Transport of hot, fluid —— in tank-wagons for briquette manufacture. Z. angew. Chem., 1916, 29, 549.

A briquette factory at a Silesian colliery proposes to obtain a supply of pitch direct from a neighbouring coal-tar distillery in a fluid form transported in tank-wagons. The system has already been in operation at Bochum, where the wagons holding 15 tons are charged with pitch from the retorts at 250° C. ; in this case the distance on rail is 4 km. and the time between filling and emptying 7 hours ; the fluid pitch is readily discharged by compressed air. This system is intended to work in conjunction with the Fohr-Kleinschmidt method of briquetting. The pitch is heated to 130°—170° C. to bring it to a mobile condition and then sprayed by a steam-heated atomiser, worked with steam or compressed air, into a mixing drum where the pitch spray solidifies whilst still in the air to an extremely fine soot-like dust. Under the slow rotation of the drum and the action of suitable elevating and transporting arrangements, an intimate mixture of the coal dust and binder is produced, which is then passed to a kneading apparatus with superheated steam and finally pressed into briquettes at 50°—80° C. By this process the proportion of pitch in the briquettes is reduced by fully 1% (on an average percentage of 7) and the costs of manufacture are further decreased by the tank-wagon system of transport. The tank-wagons can be emptied in 15 mins. and the necessity of handling, breaking, and melting the pitch is avoided.—J. F. B.

Blast-furnace gas: New application of ——. W. Zimmermann. Stahl u. Eisen, 1916, **36**, 573—581. Z. angew. Chem., 1916, **29**, Ref., 415.

THE blast-furnace gas is introduced into coke-ovens above the coke; it reacts with the hot coke-oven gas yielding a gas containing less carbon dioxide and nitrogen and more light and heavy hydrocarbons, and hence possessing a higher calorific value, than the so-called mixed gas prepared by mixing together cold coke-oven gas and blast-furnace gas; the increase of calorific value amounts to from 8 to 13·6%. In addition the yield of ammonia is increased by about 25%, owing to the cooling effect produced in the coke-ovens by the introduction of blast-furnace gas. —A. S.

Petroleum; Action of aluminium chloride on ——. A. Pictet and I. Lerczynska. Bull. Soc. Chim., 1916, **19**, 326—334. (See also McAfee; this J., 1915, 1002.)

ANHYDROUS aluminium chloride dissolves in the higher fractions (b.pt. above 140° C.) from petroleum to a brown solution, which on distillation yields as first fraction (b.pt. 40°—140° C.) a product possessing all the properties of light petroleum spirit (benzine). A suitable amount of aluminium chloride is 10% of the weight of the petroleum. The yield of petroleum spirit depends only on the source of the petroleum (see table), and not on the rate of distillation or pressure, and the product is not altered by a further treatment with aluminium chloride. Calcium, zinc, chromium, copper, mercuric, and silicon chlorides are without action on petroleum; ferrous and ferric chloride have an incomplete action at a higher temperature. The petroleum spirit produced by the action of aluminium chloride is a colourless, non-fluorescent liquid (sp.gr. 0·72) with a pleasant ethereal odour; it consists of saturated hydrocarbons, and is free from chlorine and sulphur.

Fractions from treated product.

		40°—140° C.	140°—180° C.	180°—360° C.	Residue.
		%	%	%	%
Illuminating oils.	Galician	50	10	28—29	11—12
	Austrian	46·5	10	26·5	16
	American	30	20	38	12
	Baku	40	16	25	18
Lubricating oils.	Austrian	20	52	15	13
	American	17·5	22·5	34	25
	Baku	31·5	12	56	
Vaseline		21·5	35	38·5	
Paraffin (Galician)		35	13	52	
Vacuum tar * (up to 200° C.)		15	30	55	

* See this J., 1913, 1098; 1914, 70; 1915, 163, 604.

—F. W. A.

Gasoline, unsaturated and aromatic hydrocarbons; Effect of aluminium chloride upon a naphthene base oil in the formation of ——. G. Egloff and R. J. Moore. Met. and Chem. Eng., 1916, **15**, 340—350.

A NAPHTHENE base oil, having a sp.gr. of 0·878 at 15·5° C. and an initial b.pt. of 175° C., was fractionated by steam, direct, and vacuum distillation, and a series of six fractions obtained amounting together to about 28% by volume of the original oil; 300 c.c. of each fraction was placed, with 10% of its weight of aluminium chloride, in a 500 c.c. Kjeldahl flask having a 24 in. Liebig condenser attached, and maintained at below 100° C. for 12 hrs., during which time any newly-formed hydrocarbons boiling below this temperature were removed from the sphere of the reaction. The residue in the flask and the distillate recovered were treated separately with a 10% solution of sodium hydroxide, filtered, washed, and dried with calcium chloride, then mixed together and the volume of the converted oil determined. Each fraction of the series was also analysed, before and after conversion, by means of fractional distillation, sulphonation, nitration, and determination of sp.gr. and refractive index. For the latter purpose, fractionation was first effected in a 300 c.c. round-bottomed flask provided with a Glinsky still head, in which the fractions to 95°, 95°—120°, and 120°—150° C. (for benzene, toluene, and xylene, respectively) were thrice run; and then by simple distillation of the residue in a standard 200 c.c. Engler flask, from which fractions were collected at intervals of 25° C. until cracking of the residuum occurred. After treatment with aluminium chloride the six oils yielded from 21·3 to 60·2% of hydrocarbons boiling below the initial b.pts. of the originals, the maximum conversion being effected in the oil of highest b.pt.; the total oil recovered varied between, 60 and 79·3% of the original. In every case, the sp.gr. and refractive index of the recovered oil was lower than that of the starting oil, the greatest change being observed in the highest boiling oil, the sp.gr. of which was thus reduced from 0·849 to 0·774. The recovered oils yielded from 23·5 to 47·3% of gasoline (sp.gr. 0·726 to 0·801), equivalent to from 18·4 to 32·1% of the original oils, the maximum conversion being effected in the oil of highest b.pt., which also yielded the gasoline of lowest sp.gr. The highest proportions of toluene and xylene were found in the oil recovered from the starting oil of lowest b.pt., and that of benzene from the product of the next oil in the series; on the basis of the original oils, maxima of 1·11, 2·35, and 7·80% were obtained for benzene, toluene, and xylene, respectively. The percentages of unsaturated hydrocarbons and of hydrocarbons capable of being nitrated were usually higher in the original than in the converted oils for the same distillation cuts. The original oils contained large quantities of hydrocarbons capable of being nitrated, 54·9% being found in the distillation cut between 150° and 175° C. In every case the proportion of stable hydrocarbons remaining after sulphonation and nitration was greater in the converted than in the original oil.—W. E. F. P.

Naphthene base oil: Thermal and pressure decomposition of a —— *in the gas phase.* G. Egloff, T. J. Twomey, and R. J. Moore. Met. and Chem. Eng., 1916, **15**, 387—393.

THE decomposition products, viz., gasoline, unsaturated compounds, benzene, toluene, and xylene, formed from two naphthene base oils at 550°, 600°, 650°, and 700° C., with pressures of one and eleven atmospheres, have been studied. Although similar as regards distillation and specific gravity, the two oils gave widely different percentage yields of the above products under the same conditions of temperature and pressure, the results emphasising the importance of the character of the starting oil used in cracking, when yields of certain hydrocarbons are desired in maximum quantity. Increase in temperature and pressure increased the decomposition and the specific gravity of the oils obtained, but at the same temperatures an increase of pressure to 11 atmospheres gave a lower percentage yield of recovered oil. The maximum percentages by volume of aromatic hydrocarbons were 14·1%, made up of benzene (2·6%), toluene (1·7%), and xylene (6·8%), at

650° C. and atmospheric pressure, and 18·2%, made up of benzene (7·2%), toluene (5·9%), and xylene (5·1%), at 650° C. and eleven atmospheres. The maximum percentage yield of gasoline at 650° C. and atmospheric pressure was 19·3%, and at 600° C. and 11 atmospheres, 26·2%. Up to 150° C., the percentages of olefines and unsaturated compounds, in the gasoline cut, ranged between 8·6 and 42·3%, increase of pressure decreasing the formation. The percentage of oil decomposed—forming carbon and gas—increased with increase of temperature and pressure, varying from a minimum of 10% at 550° C. and 1 atmosphere to a maximum of 69·3% at 700° C. and 11 atmospheres.—B. N.

Natural asphalts; Chemical composition of ——. J. Marcusson. Z. angew. Chem., 1916, 29, 346—348, 349—351.

THE following method of analysis is a development of that devised by Richardson (this J., 1913, 646):—*Free acids*:—Five grms. of the bitumen is dissolved in 25 c.c. of benzene, and the solution treated with 200 c.c. of neutral alcohol, which precipitates most of the neutral constituents. The solution is decanted and titrated with $N/10$ alcoholic sodium hydroxide solution, with phenolphthalein as indicator. It is then diluted with an equal volume of water, and unsaponified substances are extracted by shaking with benzene, after which it is evaporated on the water-bath and the acids liberated by means of a mineral acid. They consist of brown resinous masses, which are sparingly soluble in petroleum spirit, fairly soluble in benzene, and almost completely soluble in chloroform. *Acid anhydrides*:—The unsaponified portion is united to the pitch-like substances precipitated by alcohol from the original benzene solution, and saponified with $N/1$-alcoholic potassium hydroxide solution in presence of benzene, and the resulting acids are liberated as described above. *Asphaltenes*:—All constituents which have not reacted with alkali are dissolved in about 10 c.c. of benzene, and the solution poured into 200 c.c. of petroleum spirit boiling below 50° C. The precipitated dark brown powder is washed with petroleum spirit, dried, and weighed. *Unaltered oil*:—The petroleum spirit solution is concentrated to about 50 c.c., distributed on to about 25 grms. of fullers' earth in a Soxhlet thimble, and extracted with petroleum spirit. The extract is evaporated and leaves a light coloured residue resembling a viscous mineral oil. *Petroleum resins*:—These are retained by the fullers' earth, from which they are subsequently extracted by means of chloroform. The following results were thus obtained with bitumens:

Bitumen from	Free asphaltogenic acids.	Inner anhydrides of acids.	Asphaltenes.	Petroleum resins.	Unaltered oily substances.
	%	%	%	%	%
Crude Trinidad asphalt	6·4	3·9	37·0	23·0	31·0
Refined Bermuda asphalt	3·5	2·0	35·3	14·4	39·6

Formation and composition of asphalt constituents:—(1) *Oily substances*:—These have a sp.gr. below 1, and show appreciable optical dextro-rotation. They consist, in the main, of a mixture of saturated and unsaturated hydrocarbons, and have iodine values similar to those of viscous mineral oils (*e.g.* 16·6 and 18·0, respectively, in the case of the oils from the Trinidad and Bermuda asphalts). They contain very little paraffin wax (usually less than 1%). (2) *Petroleum resins*:—These form the first stage in the conversion of petroleum hydrocarbons into asphaltenes. They are solid reddish-brown to brownish-black masses which melt below 100° C. They are soluble in petroleum spirit, chloroform, carbon bisulphide, and benzene, but, unlike light machine oils, are only sparingly soluble in hot or cold acetone. Their sp.gr. approximates to 1. When treated with fuming nitric acid they are converted into light brown nitro-acids, which are dissolved as salts by alcoholic potassium hydroxide solution. Sulphuric acid at 100° C. converts them into insoluble sulpho-compounds, whilst sulphuric acid and formaldehyde react with them to form sparingly soluble precipitates. When oxidised with potassium permanganate in pyridine solution they form solid acids, which give characteristic alkali salts. The iodine value is higher than that of mineral oils (*e.g.*, 33·7 in the case of the Trinidad asphalt resin). (3) *Asphaltenes*:—These may be formed by the action of oxygen or sulphur on petroleum resins, as well as by intra-molecular changes within the latter. When the resins are heated for some time at 120° C. they lose their solubility in petroleum spirit, become deep black, and are converted into asphaltenes. The sp.gr. of asphaltenes exceeds 1. They are nearly insoluble in alcohol and petroleum spirit and sparingly soluble in ether and acetone, but are completely soluble in benzene, chloroform, and carbon bisulphide. They are characterised by their high proportion of sulphur (*e.g.* 7 to 13%) in a form sensitive to light, under the influence of which the asphaltenes are converted into an insoluble modification. Their behaviour towards nitric and sulphuric acids, etc., is nearly the same as that of the resins, but they are less readily oxidised by potassium permanganate. They have high iodine values (*e.g.*, 40·2 and 27·8 in the case of the asphaltenes from Trinidad and Bermuda asphalts respectively). Nearly the whole of the halogen combines by addition and not by substitution. They contain considerable quantities of sulphides, and it is to these that the absorption of bromine and iodine is to be attributed. The asphaltenes and their parent resins appear to be saturated polycyclic compounds, which also contain sulphur or oxygen, either of which can replace the other. (4) *Asphaltogenic acids and their anhydrides*:—These acids are tar-like or resinous masses which are soluble in alcohol or chloroform, but are nearly insoluble in petroleum spirit. Their sp.gr. exceeds 1. They contain variable quantities of sulphur. Their sodium salts are sparingly soluble. When heated they are converted into anhydrides. The acids from Trinidad crude asphalt gave the following results, which are compared with those given by the acids obtained by heating Texas oil in the air:—

Acids from:	Solubility in petroleum spirit.	Acid value.	Saponification value.	Iodine value.	Sulphur.
					%
Trinidad crude asphalt	nearly insol.	98·5	120·4	22·4	3·1
Texas oil	nearly insol.	89·3	147·0	17·3	1·2

(See also this J., 1911, 480; 1914, 739.)—C. A. M.

Asphalt industry; Standards for products of the ——. J. Marcusson. Mitt. K. Materialprüf., 1916, 34, 40—55.

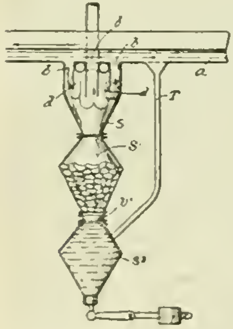
BY means of the analytical methods worked out by the author and others (this J., 1912, 63; 1913, 188, 223; 1914, 739; 1915, 1235) it is now possible to distinguish natural from artificial asphalts, to identify the various kinds of asphalts in mixtures, and, in many cases, to determine quantitatively natural asphalts in admixture with artificial products. As a preliminary to the establishment of standards for the products of the asphalt industry, the author gives a brief critical review of the specifications adopted by a number of municipal and other authorities and private consumers for various asphalt products. For the raw paper for the manufacture of roofing felt, the following standards have been fixed by the *Materialprüfungsamt* in conjunction with the *Verband deutscher Dachpappenfabriken.* (1) For the preparation of the paper, rags, fibrous textile waste, and waste paper may be used, but direct addition of wood pulp, straw pulp, peat, sawdust, and mineral loading materials is forbidden. (2) The paper must not yield more than 12 % of ash. (3) Moisture content of air-dry paper must not exceed 12 %. (4) Paper which when immersed in anthracene oil absorbs less than 120 % must be considered unsatisfactory. (5) Paper of normal thickness (at least 400 grms. per sq. m.) must have a breaking weight (for a strip 15 mm. wide) in the longitudinal direction of at least 3 kilos.—A. S.

Heat treatment of brass in neutral and reducing atmospheres. Use of coal gas. White and Standerline. *See* X.

Patents.

Coal and other minerals; Apparatus for washing ——. P. Habets, Montegnée, and A. France, Liege, Belgium. U.S. Pat. 1,197,932, Sept. 12, 1916. Date of appl., Feb. 9, 1914.

Coal is carried along a horizontal channel, *a*, by a stream of water and falls through slots into vertical passages, *b*, in a washing chamber, *s*. Water from an independent supply enters by other passages, *d*, and circulates upwards through the passages, *b*. Mineral matter collects in the chamber, s^1, which is provided with a valve, v^1, communicating with a trap, s^2, which is connected by a pipe, T, with the channel, *a*.—W. F. F.



Coal, ore, etc.; Apparatus for separating ——. F. Pardee, Hazleton, Pa. U.S. Pat. 1,197,946, Sept. 12, 1916. Date of appl., May 2, 1913.

Water enters tangentially into the top of a separating vessel of inverted conical shape. The heavier material passes through an outlet at the bottom into a receiving and settling chamber, while the lighter material is withdrawn upwards by suction through a vertical pipe extending nearly to the bottom of the separating vessel. Water is separated from the solid material in both cases and returned to the separating chamber.—W. F. F.

Pitch; Utilisation of —— *as a fuel.* G. H. H. Bölling, Christiania. Eng. Pat. 101,444, Apr. 5, 1916. (Appl. No. 5029 of 1916.) Under Int. Conv., Mar. 25, 1916.

Pitch is melted by means of a steam coil and introduced, through heated pipes, into the furnace where it is atomised by a jet of steam or air. The steam jackets, pipes, and valves are arranged so that any incrustation can be removed.—J. E. C.

Coal and the like; Presses for agglomerating ——. H. Steven, Gilly, Belgium. Eng. Pat. 2500, Jan. 30, 1914. Under Int. Conv., Jan. 31, 1913.

In a modification of the moulding press described in Eng. Pat. 228 of 1914 (see Fr. Pat. 466,420; this J., 1914, 635) in which the material is subjected to four successive compressions in the same mould carried by a rotary mould table, the first and last compressions are effected by cams or the like, and the second and third by hydraulic presses. The cams are carried by one shaft and the mould plate and hydraulic control valves are operated by another shaft, both shafts being driven simultaneously from the same source. Means are provided for compensating for leakage of liquid in the hydraulic system at the end of each backward stroke of the hydraulic pistons.—W. F. F.

Briquettes of anthracite, coke, lignite, [wood charcoal,] etc.; Manufacture of smokeless ——. A. Exbrayat. Second Addition, dated June 20, 1914, to Fr. Pat. 470,949, June 28, 1913 (this J., 1915, 215; 1916, 33).

In the manufacture of briquettes such as those described in the principal patent and first addition thereto, the caustic soda and silicates of aluminium and calcium are replaced by hydraulic lime.
—W. F. F.

Paper or other organic material; Process and apparatus for making briquettes from ——. A. Specken. Fr. Pat. 479,162, Apr. 3, 1915. Under Int. Conv. (in the name of F. Isler), Oct. 19, 1914.

The apparatus consists of a vat above which is mounted a cylindrical envelope containing a perforated cylinder fitting loosely therein and a piston capable of being pressed into the cylinder by means of an overhead lever. The paper is worked up into a pulp with water in the vat and mixed with other waste materials such as charcoal, wood waste, or rags; the pulp is charged into the perforated cylinder and pressed into a briquette while the water drains back into the vat.—J. F. B.

Chequer bricks used in the chequering chambers of carburetted water-gas plants or coke-oven chambers. E. J. Davison, London, and C. P. Tooley, Leeds. Eng. Pat. 16,634, Nov. 25, 1915. (See also Eng. Pat. 745 of 1915; this J., 1916, 297.)

Chequer bricks are designed with alternate square pedestals and fine-edged bevelled recesses on their upper and lower surfaces; the pedestals on the upper surface are opposite to recesses on the lower surface. The bevel may be flat, convex, or concave.—J. E. C.

Coke ovens; Regenerative ——. British Coke Ovens, Ltd., and F. M. N. Schuster, London. Eng. Pat. 101,394, May 5, 1916. (Appl. No. 6512 of 1916.)

The bricks in the regenerator chamber are composed of a base portion with two parallel upstanding flanges spaced from the edges and from one another. The bricks are placed in layers slightly shorter than the width of the chamber, so that the bottom layer has one edge in contact with the side wall and each layer is slightly displaced relatively to the one below till the opposite wall is reached. The displacement of the next layers is in the opposite direction till the first wall is reached and so on. The gases are thus constrained to pass horizontally through a series of flues and then in the reverse direction through another series of flues and so on.—W. F. F.

Coke-ovens; Device for leading away noxious gases during the charging of ——. H. Koppers, Essen. Ger. Pat. 294,009, Apr. 10, 1915. Addition to Ger. Pat. 291,053 (this J., 1916, 683).

Grooves are formed in the walls of the oven just below the charging opening, so that annular channels are left open around the heaps of coal of sufficient size to accommodate the gas evolved during the charging operation and allow it to pass freely to the gas-outlet pipe.—A. S.

Gas manufacture; Automatic control of processes of ——. J. F. Simmance, London. Eng. Pat. 13,292, Sept. 17, 1915.

The invention comprises an apparatus for the automatic control of gas manufacture, consisting of a combination of a recording instrument indicating the variation of some physical property of the gas produced, with means whereby the governor valve is controlled by the travel of the pen or indicating part of the instrument.—J. E. C.

Coal; Method of carbonising ——. H. L. Doherty, New York. U.S. Pat. 1,197,804, Sept. 12, 1916. Date of appl., Mar. 21, 1913. Renewed Mar. 11, 1916.

Coal is moved downwards through a long vertical conduit, and preheated air is passed intermittently across it horizontally at its middle portion to maintain combustion at that point. Gas is withdrawn at the top, and part of it is burnt to preheat the air and part is admitted at the bottom of the fuel conduit and passed upwards. This gas is heated at the middle portion and thus preheats the descending fuel above, while the gas itself together with the distillation gas is cooled and withdrawn at the top.—W. F. F.

Gas producer. J. A. Herrick, Newark, N.J. U.S. Pat. 1,197,625, Sept. 12, 1916. Date of appl., Dec. 30, 1912.

An interior lining to a gas producer is supported by a ring in segments connected to the casing. The segments are hollow, with openings to the exterior of the casing, and a poker tube is attached to one of the segments.—J. E. C.

Gas producer. G. B. Cramp, Duluth, Minn., Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,198,010, Sept. 12, 1916. Date of appl., Jan. 10, 1914.

In a gas producer with a rotating ash support, automatic means are provided for delivering ashes at predetermined intervals and for varying the duration of such intervals.—J. E. C.

Gas producer. E. A. W. Jefferies, Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,198,037, Sept. 12, 1916. Date of appl., Aug. 6, 1913.

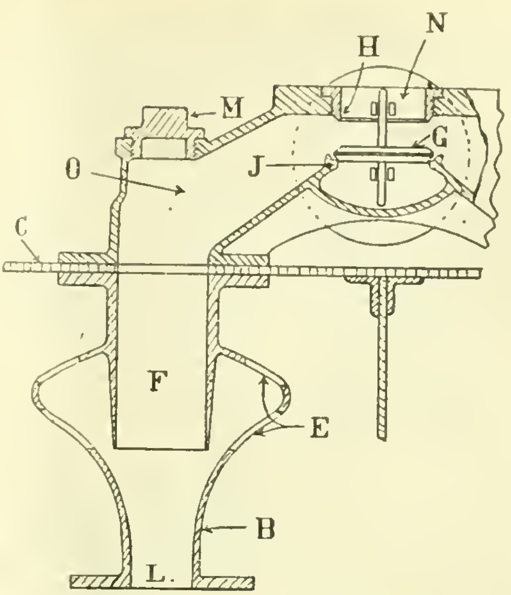
A gas producer is provided with a rotating ash support and a scraper which may be allowed to revolve with the ash support or held stationary by a stop.—J. E. C.

Gas generators; Regulation of air-blast in ——. C. H. Smoot, South Orange, N.J., Assignor to The Rateau Battu Smoot Co., New York. U.S. Pat. 1,198,162, Sept. 12, 1916. Date of appl., Oct. 19, 1915.

In a gas generating apparatus consisting of a generator and carburettor, a constant volume of air, at desired pressure, is delivered to the generator, regardless of the amount of air delivered to the carburettor. The volume is regulated by means of the difference in pressure in the air-delivery pipe proper and at the throat of a Venturi meter fitted in the delivery pipe.—J. E. C.

Tanks or vessels containing oil, petroleum spirit, or other inflammable liquids; Combined apparatus for ventilating, steaming, fire-extinguishing, gas-freeing and sounding of ——. T. A. Crompton, Ilford, Essex. Eng. Pat. 14,331, Oct. 11, 1915.

The apparatus is fitted to the cover, C, of the tank as shown, and an extension pipe is fitted to the opening, L. Gas given off from the liquid, or displaced in filling, passes through the openings, E, nozzle, F, pipe, O, and outlet, N. Air may enter in the reverse direction. The valve, G, is provided with two seatings, H, J, and rests normally on the lower seating by gravity. The tank may be steamed out when empty by admitting steam to the space below the valve, G, so as to raise it against the seating, H. For fire-extinguishing in the gas space, the steam circulates through the opening, E, the extension pipe from the opening, L, being sealed by the liquid. Soundings may be taken by unscrewing the plug, M. The part, B, F, may be used separately as a ventilating and gas-freeing apparatus.—W. F. F.



Light hydrocarbons; Manufacture of —— *from heavy hydrocarbons.* W. F. Rittman, New York. Eng. Pat. 9162, June 22, 1915. Under Int. Conv., Mar. 15, 1915.

Heavy hydrocarbons such as crude mineral oils, oil residues or their products, or liquid hydrocarbons obtained from shale, are supplied from a reservoir to the top of a vertical cylinder. The upper part of the cylinder contains refractory material such as metal balls carried on a perforated shelf. The oil is suddenly gasified and the gas passes to the lower cracking portion of the cylinder which is heated by passing an electric current through a surrounding coil. The temperature and pressure are maintained above 450° C. and 100 lb. per sq. in. respectively. The lighter hydrocarbons boiling below 30° C. tend to separate upwards and the heavier hydrocarbons downwards by gravity. The latter pass by an outlet at the bottom of the cracking chamber to a fractional condenser. (See also this J., 1916, 1003.)—W. F. F.

Hydrocarbons; Cracking of ——. G. P. Lewis, London. Eng. Pats. 12,188, Aug. 24, 1915, and 2509, Feb. 19, 1916.

Oil is heated in the lower part of a vertical cylindrical apparatus by an external steam or hot gas jacket and the vapour passes upwards into the cracking chamber which contains a set of baffle-plates and is heated externally by a steam or hot gas jacket, or internally by heating coils. The temperature of the heating medium varies from 400° C. to 500° C. and the pressure of the oil gas from 60—280 lb. per sq. in. The cracked vapour passes upwards to a tubular condenser cooled by water at about 150° C. The temperature of the water may be varied by a pressure control valve. The baffle-plates may be replaced by fragments of solid material which may be catalytic or impreg nated with catalytic material. The uncondensed gases or hydrogen or both may be re-introduced into the cracking chamber.—W. F. F.

Heavy oils, especially kerosene; Treatment of —— for their conversion into lighter oils. M. A. H. de Dampierre. Fr. Pat. 478,831, Feb. 22, 1915. Under Int. Conv., Apr. 16, 1914.

Heavy oils such as crude petroleum, kerosene, or petroleum residues, are vaporised, mixed with hydrogen, and passed through a tube containing a number of perforated nickel discs which act catalytically, and preferably also lined with nickel. The tube is cooled by water jackets, so that heavy oil is condensed and returned to the vaporising chamber, whilst the lighter vapour passes on to another condenser.—W. F. F.

Petroleum; Method of distilling ——. Standard Oil Co. Fr. Pat. 477,829, Feb. 27, 1915. Under Int. Conv., Apr. 20, 1914.

Petroleum or petroleum residuum is circulated by a pump in a closed circuit, from the bottom of a partly filled reservoir through a heated coil of small bore to the top of the reservoir. The vapour formed passes by another pipe from the top of the reservoir to a water-cooled condensing coil and thence to a receptacle. The pressure maintained in the system varies from 3 to 7 atmospheres, and the temperature from 340° C. to 450° C.—W. F. F.

Alcohol [and hydrocarbons]; Adapting —— for use with petrol motors. L. Rivière. First Addition, dated July 1, 1914, to Fr. Pat. 475,938, Mar. 20, 1914.

The calorific value of alcohol, its derivatives, and hydrocarbons such as benzol, is increased, and the fuel rendered suitable for use with internal combustion engines, by hydrogenation in contact with a catalyst such as reduced nickel. The process may be carried out in the apparatus described in Fr. Pat. 374,179 and the second Addition thereto (this J., 1907, 769; 1909, 317).—W. F. F.

Briquettes or agglomerated fuel; Manufacture of ——. Pure Coal Briquettes, Ltd. Fr. Pat. 478,872, June 1, 1915. Under Int. Conv., Oct. 7, 1914.

See Eng. Pat. 5018 of 1915; this J., 1916, 826.

Agglomerating process. [Manufacture of briquettes.] Pure Coal Briquettes, Ltd. Fr. Pat. 478,873, June 1, 1915. Under Int. Conv., Mar. 27, 1915.

See Eng. Pat. 5019 of 1915; this J., 1916, 592.

Fuel. Pure Coal Briquettes, Ltd. Fr. Pat. 478,874, June 1, 1915. Under Int. Conv., Mar. 27, 1915.

See Eng. Pat. 20,679 of 1914; this J., 1916, 297.

Coal gas plants; Method of operating ——. A. E. White, London. From Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 16,269, Nov. 18, 1915.

See U.S. Pat. 1,166,183 of 1915; this J., 1916, 245.

Carburetted hydrogen; Apparatus and process for the manufacture of ——. B. Van Steenbergh. Fr. Pat. 479,277, July 15, 1915.

See U.S. Pat. 1,124,361 of 1915; this J., 1915, 216.

Light hydrocarbons and analogous substances; Manufacture of ——. Synthetic Hydro-Carbon Co. Fr. Pat. 479,210, July 6, 1915. Under Int. Conv., Mar. 15, 1915.

See Eng. Pat. 9162 of 1915; preceding.

Structure for producing flameless catalytic combustion. U.S. Pat. 1,198,542. *See* IIb.

Manufacture of benzene, toluene, and other aromatic hydrocarbons from petroleum and other hydrocarbons. Eng. Pat. 9163. *See* III.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

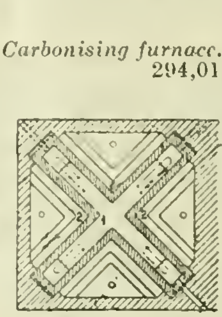
Coal and other hydrocarbons; Apparatus for treating ——. J. D. Scott, Detroit, Mich. U.S. Pat. 1,198,069, Sept. 12, 1916. Date of appl., Oct. 23, 1914.

The invention consists of a combination of a preliminary heating chamber, a vapour extracting chamber, and a cooling chamber, communicating with each other by sliding doors, and containing movable tray carriers.—J. E. C.

Wood; Apparatus for treating ——. W. M. Bashlin, Grove City, Pa. U.S. Pat. 1,198,990, Sept. 19, 1916. Date of appl., Mar. 29, 1912.

A retort for treating wood is heated externally by a steam jacket, and internally by a dry-steam coil. Perforated pipes are grouped around the coil for the distribution of steam or solvents. —J. E. C.

Carbonising furnace. E. Ziegler, Berlin. Ger. Pat. 294,015, Nov. 6, 1915.



In a vertical furnace with several carbonising chambers, for obtaining tar, gas, and coke from carbonaceous substances, the heating flues, 1, and the carbonising chambers, 2, have the form shown, in cross-section, in the figure.—A. S.

Combustion; Structure for producing flameless catalytic ——. C. K. Harding, Chicago, Ill. U.S. Pat. 1,198,542, Sept. 19, 1916. Date of appl., Mar. 18, 1912.

A substance for producing heat from gaseous fuels by catalytic combustion consists of a structure containing thorium oxide and radioactive uranium oxide.—J. E. C.

Flameless surface combustion of combustible gas; Process and apparatus for the ——. A. Adam. Fr. Pat. 477,958, July 9, 1914.

The porous material within which combustion takes place has two of its faces at right angles in communication with the gas and air conduits respectively, so that mixing takes place within the material only and lighting back is avoided. A layer of rare earth may be applied to or embedded in the face of the porous material for illuminating purposes. The invention may be applied to gas burners of the ordinary type, a diaphragm of porous material being placed in a mixing chamber at the junction of the gas and air pipes to prevent lighting back.—W. F. F.

Vapour electric apparatus [producing ultra-violet rays.] P. C. Hewitt, Ringwood Manor, N.J., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,197,629, Sept. 12, 1916. Date of appl., Sept. 19, 1912.

An apparatus for the production of ultra-violet rays is composed of an exhausted vessel containing an anode and a thallium cathode. Means are provided for starting the current and producing thallium vapour, the current then passing through the vapour from anode to cathode.—B. N.

Bituminous fuels; Process and apparatus for manufacture of various products from ——. R. Maclaurin. Fr. Pat. 479,110, June 25, 1915. Under Int. Conv., Oct. 28, 1913.

See Eng. Pat. 24,426 of 1913; this J., 1914, 1148.

Process of forming methyl alcohol and other compounds from waste [soda wood pulp] liquors containing organic matter. U.S. Pat. 1,197,983. *See* V.

III.—TAR AND TAR PRODUCTS.

Coal tar products; Census of ——.

On Nov. 1st the Ministry of Munitions announced that all persons engaged in the production, manufacture, purchase, sale, or distribution of any coal-tar or coke or their by-products (including in particular tar, carbolic crystals, benzol, toluol, ammoniacal liquor, and sulphate of ammonia) are required to furnish him with such particulars as to output, working of plant, cost of manufacture, sales, deliveries, stock in hand, purchases, and prices, at such intervals as may be required. Any particulars so furnished shall be verified and authenticated by the signature of the person required to furnish them, or, in the case of a company, by a responsible officer.

Transport of hot fluid coal tar pitch in tank-wagons for briquette manufacture. *See* IIa.

Effect of aluminium chloride upon a naphthene base oil in the formation of gasoline, unsaturated and aromatic hydrocarbons. Egloff and Moore. *See* IIa.

Thermal and pressure decomposition of a naphthene base oil in the gas phase. Egloff and others. *See* IIa.

Nitration of diethylbenzylamine. Noelting and Kregczy. *See* IV.

A modified chlorination process. [*Preparation of chloro-derivatives of benzene.*] Smythe. *See* XX.

Patents.

Benzene, toluene, and other aromatic hydrocarbons; Manufacture of —— *from petroleum and other hydrocarbons.* W. F. Rittman, New York. Eng. Pat. 9163, June 22, 1915. Under Int. Conv., Mar. 15, 1915.

Hydrocarbon oils are subjected to a temperature at which a sudden gasification occurs, and whilst in the gaseous condition are cracked at a temperature not less than 600° C., preferably 650°—800° C., and a pressure not less than 60 lb. per sq. in., preferably 250 lb. per sq. in.—J. E. C.

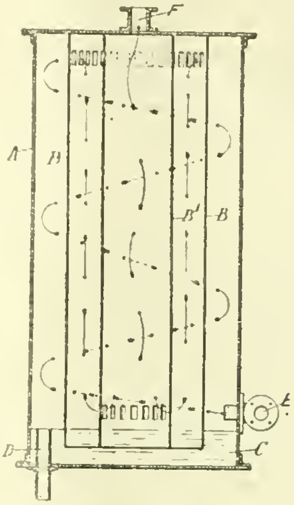
Xylene and other aromatic hydrocarbons; Treatment of —— *to obtain lower hydrocarbons of the same series.* Synthetic Hydro-Carbon Co. Fr. Pat. 479,786. Sept. 20, 1915. Under Int. Conv., July 7, 1915.

Xylene or other hydrocarbon is subjected, in the form of vapour, to a temperature not below 400° C. and a pressure not exceeding 200 lb. per sq. in. With higher temperatures (between 600° C. and 850° C.) a lower pressure, capable of being reduced to half an atmosphere, may be used. Under the latter conditions 30 % of toluene has been produced from xylene.—J. E. C.

Benzene, toluene, and other aromatic and analogous hydrocarbons; Manufacture of ——. Synthetic Hydro-Carbon Co. Fr. Pat. 479,211, July 6, 1915. Under Int. Conv., Mar. 15, 1915.

See Eng. Pat. 9163 of 1915; preceding.

Benzol and other stills; Apparatus for drying vapour, particularly in connection with ——. J. E. Mitchell and H. Morfey, Barnsley. Eng. Pat. 17,568, Dec. 16, 1915.



An apparatus for separating suspended particles of liquid from benzol and other vapours comprises a vessel, A, having a tangential inlet, E, with one or more concentric baffle-tubes, B, B¹, and a central outlet, F. The lower ends of the baffle-tubes are sealed at C in liquid to a depth controlled by an overflow pipe, D.—J. E. C.

Utilisation of pitch as fuel. Eng. Pat. 101,444. *See* IIa.

Fire- and water-proof composition and process of making same. U.S. Pat. 1,194,558. *See* IX.

Preparation of chlorine derivatives of organic substances. Fr. Pat. 479,645. *See* XX.

Nitration process. U.S. Pat. 1,198,129. *See* XXII.

IV.—COLOURING MATTERS AND DYES.

Diethylbenzylamine; Nitration of ——. E. Noelting and A. Kregczy. Bull. Soc. Chim., 1916, 19, 335—338.

Nitration of diethylbenzylamine in sulphuric acid solution gives a mixture containing 35—40 % of the *meta*-derivative (b.pt. 206°—208° C. at 42 mm.), 40—45 % of the *para*-derivative (b.pt. 219°—221° C. at 42 mm.), and 15—20 % of the *ortho*-derivative (b.pt. 175°—177° C. at 42 mm.) The isomerides may be separated by fractional crystallisation of their picrates from alcohol.—F. W. A.

Aminodiethylbenzylamines; Dyestuffs from ——. E. Noelting and A. Kregczy. Bull. Soc. Chim., 1916, 19, 338—341.

Aminodiethylbenzylamines are prepared by the reduction of the corresponding nitro-compounds (see above) with zinc or iron in acetic acid solution, and are colourless oils having the following b.pts. at 42 mm.: *ortho*, 153°—155° C.; *meta*, 167°—168° C.; *para*, 165°—166° C. On treatment with picryl chloride, the isomerides behave as substituted toluidines, and yield picryl derivatives, which, in addition to the acid properties of the products from toluidines, possess basic properties due to the substituent, and hence may be dyed on tanned cotton. Whereas the tolylated rhodamine from fluorescein chloride and toluidine is insoluble in water, the amino-alkylated derivative obtained by using aminodiethylbenzylamine is sufficiently soluble for dyeing silk, wool, and tannin-mordanted cotton, producing a redder shade of violet than the corresponding product from toluidine.—F. W. A.

Aminophenylarsinic acid; Dyestuffs from ——. E. Noelting. Bull. Soc. Chim., 1916, **19**, 341—343.

Azo dyestuffs derived from *p*-aminophenylarsinic acid and β-naphthol, its sulphonic acids, etc., may be dyed on mordants, *e.g.* chromium, iron, aluminium, titanium, tin, etc., giving yellow-orange, orange-red, red, to brown-red shades. Unmordanted wool gives yellow-orange to orange-red shades, browner dyeings resulting with chromed wool. The dyestuffs from *p*-aminophenylarsinic acid do not differ in shade from those of sulphanilic and *p*-aminobenzoic acid, but their affinity for mordants is much greater.—F. W. A.

1.3-*Dibromoanthraquinone.* F. Ullmann and O. Eiser. Ber., 1916, **49**, 2154—2169.

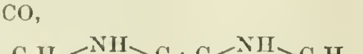
1.3-DIBROMOANTHRAQUINONE (m.pt. 210° C.) is obtained by removal of the amino-group from dibromo-1- or 2-aminoanthraquinone, preferably the latter. The bromine atom in the 1-position is readily replaced, *e.g.*, on boiling with aniline 3-bromo-1-anilinoanthraquinone is obtained, and on treatment with *p*-toluenesulphamide in amyl alcohol solution 3-bromo-1-*p*-toluenesulphamino-anthraquinone is produced, which gives 3-bromo-1-aminoanthraquinone (m.pt. 243° C.) on treatment with concentrated sulphuric acid. Anthranilic acid behaves similarly, giving 3-bromo-1-anthraquinonylanthranilic acid; this is readily converted into the corresponding acridone, which dyes bluer shades than the anthraquinoneacridone of Ullmann and Oechsner (Annalen, 1911, **381**, 1); the shade becomes redder and the affinity for the fibre greater on introducing another bromine atom. Both bromine atoms are replaceable at higher temperatures, *e.g.* potassium phenoxide gives 1.3-diphenoxyanthraquinone, and 1-aminoanthraquinone gives α.α′-dianthraquinonyl-1.3-diamino-anthraquinone. 1.3-Dibromo-2-aminoanthraquinone gives with *p*-tolylmercaptan 3-bromo-2-amino-1-anthraquinonyl-*p*-thiocresol. The bromine atom in 4-position is most active in 2.4-dibromo-1-aminoanthraquinone; on heating with aniline the 4-bromine atom is eliminated, giving 2-bromo-1-aminoanthraquinone.—F. W. A.

Sulphurylindigo and sulphurylisatin. Heterocyclic sulphones. V. M. Claass. Ber., 1916, **49**, 1880—1883. (Compare this J., 1916, 960.)

THE action of nitrous acid on sulphurylindoxyl (compare this J., 1916, 529) gives a 20% yield of a dinitrile and not an oxime. The main reaction taking place is the oxidation of the methylene group, resulting in the production of sulphuryl-isatin (I), and sulphurylindigo (II),

(I)

$$C_6H_4<\substack{NH\\SO_2}>CO,$$

(II) 

$$C_6H_4<\substack{NH\\SO_2}>C:C<\substack{NH\\SO_2}>C_6H_4.$$

If the reaction is carried out in an anhydrous medium, *e.g.* by passing nitrous acid into a warm benzene solution of sulphurylindoxyl, a 60% yield of pure sulphurylindigo is produced. In order to obtain the isatin, it is preferable to add nitrosulphurylindoxyl to 5% caustic soda solution, when a vigorous reaction occurs, the isatin afterwards being precipitated by addition of an acid; it is a brown powder, of m.pt. 150°—155° C., soluble in ammonia, sodium carbonate, and caustic soda solution, and readily soluble in alcohol and in acetic acid. Chromic acid in glacial acetic acid is a suitable oxidising agent for preparing sulphurylindigo; the indigo is obtained as a microcrystalline brown powder of m.pt. 106°—110° C., readily soluble in alcohol and in acetic acid, insoluble in water and in alkalis, which however decompose it on heating; it does not dye animal or vegetable fibres; hydrosulphite is without action on it. Oxidation of 2-bromosulphurylindoxyl with chromic acid gives α.α′-dibromosulphurylindigo (m.pt. 142°—143° C.).
—F. W. A.

PATENTS.

Anthracene dyestuffs: Manufacture of ——. [*Alkylated Pyrazole-anthrone Yellow.*] A. G. Bloxam, London. From Chem. Fabr. Griesheim-Elektron, Frankfurt, Germany. Eng. Pat. 14,103, Oct. 5, 1915.

PYRAZOLE-ANTHRONE Yellow (see Ger. Pat. 255,641; this J., 1913, 357) or a substitution product in the form of an alkali salt is treated with an alkylating or aralkylating agent. *Example:* One part of Pyrazole-anthrone Yellow, in the form of paste, is digested with 50% caustic potash solution until completely converted into the violet potassium salt, the solution diluted until it contains 3—5% caustic potash, and the salt drained as much as possible; the paste obtained is heated with one or two parts of benzyl chloride in a closed vessel at 100° C. for 3 hrs., and the product is diluted with alcohol, filtered, and the residue washed with alcohol. The mono-benzyl derivative produced gives with hydrosulphite a blue vat from which cotton is dyed scarlet shades. On heating 38 parts of the benzyl derivative, in the form of the dried potassium salt, with 120 parts of the methyl ester of toluene-*p*-sulphonic acid in an autoclave for 1 hr. at 120° C., with stirring, the benzylmethyl derivative is obtained; this product dyes cotton an excellent fast red.—F. W. A.

Acid wool [*azo*] *dyestuffs indifferent to copper; Manufacture of* ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,127, Oct. 26, 1915. Addition to Eng. Pat. 1611, Feb. 1, 1915.

THE copper compounds of the dyestuffs described in Eng. Pats. 1611 (this J., 1916, 301) and 12,249 of 1915 (this J., 1916, 922) are obtained direct by combining the *o*-diazo-phenol or -naphthol derivative with a suitable component in presence of copper or a copper compound. The combination generally occurs more readily under these conditions. *Example*: 24 grms. of copper sulphate crystals and 60 grms. of water are added with stirring to a concentrated solution of 25 grms. of 1.5-naphtholsulphonic acid sodium salt and 40 grms. of calcined sodium carbonate; the diazo-compound from 24 grms. of 1.2.4-aminonaphthol-sulphonic acid is added with stirring, the mixture is stirred for 24 hrs. at the ordinary temperature, and then heated gradually to 40° C. and maintained at that temperature until combination is complete; the excess of copper hydroxide is filtered off, and the copper compound salted out. The product dyes wool from an acid bath pure violet tints fast to light, washing, and alkali. Whereas an extremely small yield is obtained by combining 1.2.4-aminonaphtholsulphonic acid with 1.5-naphtholsulphonic acid by the usual methods, an approximately quantitative yield of the copper compound of the *o*-hydroxyazo dyestuff is obtained by the above method.—F. W. A.

o-Hydroxyazo dyestuffs; Manufacture of direct —— O. Imray, London. From Soc. Chem. Ind. in Basle, Switzerland. Eng. Pat. 101,601, Aug. 25, 1915. (Appl. No. 6871 of 1916.)

IN the manufacture of direct *o*-hydroxyazo-dyestuffs as described in Eng. Pat. 12,250 of 1915 (this J., 1916, 1008), at least one molecule of an *o*-hydroxydiazo derivative of the benzene or naphthalene series is substituted for the diazotised monoamine in preparing substantive tris- and polyazo dyestuffs from tetrazotised *p*- and *m*-diamines, suitable components, and diazotised monoamines. The most valuable dyestuffs are obtained by using 2-amino-5-naphthol-7-sulphonic or -1.7-disulphonic acids or their derivatives. In case the diamine is used together with a derivative of *o*-aminophenol or -naphthol and a derivative of 2-amino-5-naphthol-7-sulphonic acid, in addition to benzidine, tolidine, dianisidine, ethoxybenzidine, *p*-diaminostilbene-disulphonic acid and their substitution products, there may be used diaminodiphenyl ether, diaminodiphenylamine, *m*- or *p*-aminobenzoyl-*m*- or *p*-phenylenediamine, azoxyaniline, azoxytoluidine, *m*- or *p*-diaminodiphenylurea, or diaminodiphenylthiourea. In place of diazophenol derivatives the more easily coupling diazoacidylphenol derivatives may be used, the products being subsequently saponified. The new dyestuffs are suitable for dyeing cotton, wool, silk, straw, wood, paper, leather, etc., and for the production of lake pigments. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act of 1907, to Eng. Pat. 15,056 of 1892; this J., 1893, 753.)—F. W. A.

Indophenolic compounds and dyestuffs therefrom; Manufacture of ——. Claus and Co., Ltd., and E. Wray, Manchester. Eng. Pat. 101,433, Jan. 27, 1916. (Appl. No. 1317 of 1916.)

Carbazyl-N-acetic acid or its esters, obtained by condensing carbazole or an alkaline salt thereof with chloroacetic acid or ester, condenses with *p*-nitrosophenol, etc., in sulphuric acid medium to give indophenols. On treatment with sulphurising agents these indophenols or their leucocompounds yield dyestuffs which give blue dyeings on cotton, fast to washing, light, and bleaching, from a sulphide or hydrosulphite vat.—F. W. A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Filter paper with fine pores. J. Grossfeld. Z. angew. Chem., 1916, 29, 364.

A filter paper capable of retaining the finest precipitate of barium sulphate, etc., has its pores filled with purified kieselguhr (nearly pure silica). On igniting the paper, the mineral matter is left as a coherent pellicle.—C. A. M.

Paper specialities; Use of bark for ——. O. Kress. J. Ind. Eng. Chem., 1916, 8, 883—886.

Experiments have been made in the U.S. Forest Products Laboratory on the utilisation of spent an-bark and other waste bark as a filler in the nanufacture of various paper products. Satisfactory results have been obtained on a commercial scale with mixtures of 20—30% of spent hemlock ark and 70—80% of rag stock for the manufacture f roofing felt. The wet bark (35% of dry substance) is passed through a screen of ¾ in. mesh nto a chest from which it is pumped to the regulatng box of a Jordan beater, whence it passes to he rag beater chest. The mixture of bark and ags is treated in another Jordan beater and then asses to the machine chest. The felt is made on 72-in. machine with a 36-in. cylinder and 46 -ft. dryers. Promising results have also been btained with mixtures of 20% of unbleached ulphite pulp and 80% of spent hemlock or oak ark for the production of wall papers and fibre onduits. For the manufacture of wall board avourable results were obtained in laboratory ests with mixtures containing sulphite and "kraft" ulps and 80% of waste spruce and balsam bark btained in the drum barking of pulpwood, and lso with mixtures of 50% of bark and 50% of echanical wood pulp.—A. S.

Fireproof writing paper; Experimental notes on the preparation of ——. R. G. Myers. J. Ind. Eng. Chem., 1916, 8, 888—889.

The pulps used were made at 100° C. from chrysotile fibre together with white or lightly tinted precipitates of metallic compounds, and the papers were prepared by a method similar to that used in the manufacture of hand-made Japanese paper. The best papers in regard to tensile strength and closeness of texture were obtained from pulps containing precipitated hydroxides, arsenites, silicates, and tungstates. A paper prepared from a pulp containing a considerable excess of magnesium arsenite in an alkaline mixture was superior in tensile strength and closeness of texture to any of the commercial papers examined. The fire-resisting character of the papers was tested by exposure for 10 hours to a temperature varying from 900° to 1000° C., and it is concluded from the results "that no paper composed of incombustible substances containing molecular water is fireproof or can be made fireproof." Several of the samples, however, were not seriously impaired when exposed to dull red heat for an hour or so. For fireproof inks solutions of ferric, chromic, and cobaltous nitrates and chlorides gave good results. For use with inks other than those prepared with platinum compounds, an excess of acid oxides should be maintained in the paper.—A. S.

Standards for products of the asphalt industry. Marcusson. *See* IIa.

Patents.

Drying machine [for fabrics]. T Allsop and W W Sibson, Assignors to Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,198,377, Sept. 12, 1916. Date of appl., Apr. 1, 1915.

A rectangular chamber is divided by a vertical transverse partition into a heating and a drying compartment. The chamber has a flat roof except over the partition, where there is a peaked portion, the ridge of which is directly over the partition. A fan driven by a shaft which passes through the sloping sides of the peaked roof, is situated in the upper portion of the partition, which extends into the peaked roof. The drying compartment is provided with two superposed endless carriers, one of which has chain ways and tentering hooks for stretching fabric.—W. H. C.

Silk waste; Process for treating —— to separate the chrysalides and form a sheet or prepare for spinning. Schmid Frères. First Addition, dated Feb. 6, 1915, to Fr. Pat. 462,252, Sept. 6, 1913. Under Int. Conv., Mar. 14, 1914, and Jan. 28, 1915.

The silk waste may be treated with steam, superheated or not, instead of with soap froth, to render the sericin soluble. Waste which has been treated with steam, soap froth, or alkali is transported automatically on hurdles passing beneath sprays of water. The hurdles are then placed on supports attached to an oscillating shaft which imparts to them the shaking motion necessary to detach the chrysalides; or the waste may be beaten with brushes or brooms in special vessels containing water, so as to form sheets which are hung over movable sticks and worked about in water to remove the chrysalides. The sheets of waste are floated in a vat full of water and repeatedly raked from one end of the vat to the other to parallelise the fibres and divide them into tufts, which are rubbed across a fixed obstacle, then washed, drained, and dried.—J. F. B.

Flax and similar fibrous materials; Treatment of ——. The Fibres Extraction Proprietary, Ltd. Fr. Pat. 479,780, Sept. 20, 1915.

Flax, ramie, phormium, agave, or the like is packed in perforated wagons which are passed on rails through a series of three chambers. The first is provided with distributors of liquid at the top and of steam below, by means of which the material is washed with hot water in an atmosphere of steam. The second chamber has a pit below the level of the rails, provided with heating apparatus and a circulating and distributing system ; the material is boiled with a solution containing caustic soda and linseed oil, to which may be added soda ash and tallow. After leaving the second chamber the material is washed with water from a flexible pipe situated between the second and third chambers. In the third chamber, provided with a heating and ventilating system, the material is dried while still in the wagons.—J. F. B.

Carbonising wool ; Method of ——. I. Teller, Vienna. Ger. Pat. 293,884, Jan. 23, 1915.

After scouring, the wool is treated with a cold saturated solution of zinc chloride in concentrated hydrochloric acid.—A. S.

Paper making machines. C. E. Pope, Holyoke, Mass. U.S. Pats. (A) 1,197,855 and (B) 1,197,856, Sept. 12, 1916. Date of appl., Aug. 25, 1913.

(A) In a paper machine with moving wire, an endless felt passes round the upper couch roll in contact with the web of pulp carried by the wire ; the wire passes forward from the couch press to a guide roll which leads it back, and at a point between the couch press and the guide roll, where the underside of the wire is exposed, means are provided to press the felt against the web of pulp and to guide the latter with the felt away from the wire. (B) The means employed for directing the felt with the adherent web away from the wire may include a device for causing a pneumatic pressure acting through the wire toward the felt, for instance, a stationary suction box above the felt.—J. F. B.

Insulating material [from waste paper] and process for producing the same. G. W. W. Harden, Le Roy, Minn. U.S. Pat. 1,198,028, Sept. 12, 1916. Date of appl., Nov. 15, 1913.

Waste paper is reduced to a low grade paper pulp, and commingled and felted with long unground stems of raw whole straw in water. The materials are formed into a sheet and dried, the pulp serving as a binder to the straw and the latter as a reinforcement to the pulp and forming air cells in the sheet.—B. N.

Pulp for the manufacture of paper and other purposes ; Process and apparatus for obtaining ——. S. Milne. Fr. Pat. 478,063, Mar. 17, 1915. Under Int. Conv., Mar. 19, 1914.

Pulp prepared from esparto or other material in horizontal rotary digesters, is discharged into a receptacle provided with an agitator, and then passed to a squeezing and washing apparatus (see Eng. Pat. 6948 of 1914 ; this J., 1915, 488). It is then diluted, and passed through one or more screens to remove the coarser impurities, and subsequently bleached. The coarser fibrous material is passed through a refining apparatus before further treatment. The order of the various operations subsequent to digestion may be varied.

Methyl alcohol and other compounds from waste [soda wood pulp] liquors containing organic matter ; Process of forming ——. A. H. White, Ann Arbor, Mich. U.S. Pat. 1,197,983, Sept. 12, 1916. Date of appl., Nov. 29, 1915.

The concentrated liquor is fed gradually into a retort heated to 450° to 700° F. (about 230°—370° C.) where it spreads out into a thin layer and is rapidly subjected to destructive distillation with foaming and charring, filling the space with a porous black ash ; the rate of feed is regulated to maintain the vapour in the retort for from 5 to 150 seconds, varying according to the temperature and amount of contact substance acting as a catalyst, longer for low temperatures and shorter for highe temperatures.—J. F. B.

Evaporation of waste liquors, especially wast liquors from the sulphite- and sulphate-cellulos processes. E. Mürbe, Görlitz. Ger. Pat. 293,394, Jan. 21, 1914.

The waste liquor is sprayed under pressure into a chamber in which it comes in direct contact with hot waste gases from the boiler furnace. Further concentration is effected in the usua way in separate evaporating chambers.—A. S.

Flax and analogous materials ; Retting of —— M. A. Adam, W. J. Fernie, and The Fibre Corporation, Ltd Fr. Pat. 478,548, Apr. 29, 1915

See Eng. Pat. 745 of 1914 ; this J., 1915, 545.

Ungumming silk or silk wastes ; Process for —— Schmid Frères. Fr. Pat. 479,294, July 17, 1915 Under Int. Conv., Jan. 22, 1915.

See Eng. Pat. 100,029 of 1916 ; this J., 1916, 733

Cellulose ; Process for the electric treatment of —— A. L. C. Nodon, Bordeaux, France. U.S. Pat 1,198,867, Sept. 19, 1916. Date of appl., Feb. 28, 1913

See Fr. Pat. 453,111 of 1912 ; this J., 1913, 785

Cellulose esters ; Manufacture of ——. Soc. Chim Usines du Rhône. First Addition, dated June 3 1915 (under Int. Conv., June 12, 1914), to Fr Pat. 473,399, June 12, 1914.

See Eng. Pat. 8046 of 1915 ; this J., 1916, 39.

Insulating material [from Zostera marina fibre] and manufacture of the same. H. B. McFarlan and R. J. Shoemaker. Fr. Pat. 478,907, Jun 4, 1915.

See U.S. Pats. 1,146,189 and 1,146,190 of 1915 this J., 1915, 901.

Fireproofing fabrics or other porous or absorbe substances. T. J. I. Craig, and Whipp Bros. an Tod, Ltd. Fr. Pat. 477,857, Mar. 2, 1915. Unde Int. Conv., July 7, Aug. 7 and 25, and Dec. 2, 1914

See Eng. Pats, 16,153, 18,310, 19,041, and 23,42 of 1914 ; this J., 1915, 868.

Process and apparatus for making briquettes fro paper or other organic material. Fr. Pat. 479,16 *See* IIa.

Waterproofing the soles of footwear [with nitr cellulose, etc.]. Eng. Pat. 12,840. *See* XV.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Dyeing on tussah silk ; Black ——. R. N. Se J. Soc. Dyers and Col., 1916, **32**, 243—244.

Tussah silk is not attacked by caustic soda readily as ordinary silk, and in this respect mo closely resembles cotton ; it is, however, mo resistant to hydrochloric acid, and in this respe is more allied to wool. Towards colouring matte tussah silk behaves more like wool than li ordinary silk, *e.g.* it may be dyed with Prussi blue in the same manner as wool. Details a given for dyeing tussah silk with direct cott blacks, acid blacks, acid mordant blacks, sulph blacks, Aniline Black, and logwood.—F. W. A.

Aniline Black on wool; Production of ——. R. N. Sen. J Soc. Dyers and Col., 1916, 32, 244—245.

Wool is prepared by treatment with 6% potassium bichromate and 5% sulphuric acid at 60° C. for half-an-hour, squeezed, rinsed, and then dyed with Aniline Black, preferably twice by Green's air oxidation method, followed by chroming cold for 3 hrs. in a bath containing 4 grms. of potassium bichromate per litre.—F. W. A.

Dyeing wool with sulphur colours. R. N. Sen. J. Soc. Dyers and Col., 1916, 32, 245—246.

The glucose process for dyeing animal fibres with sulphur colours has been modified by substituting ammonium for sodium sulphate, omitting the sodium carbonate, and adding slowly a small amount of formic acid towards the end of the dyeing operation. The methods of Lodge and Evans (this J., 1916, 41) were improved by adding to (*a*) the sulphide bath a small amount of Turkey-red oil (to improve the penetration and depth of shade) and, towards the end of the dyeing operation, a small amount of formic acid, and (*b*) to the hydrosulphite vat, ammonium sulphate and Turkey-red oil. New methods are suggested in which sodium sulphide alone, or hydrosulphite and either sodium carbonate or ammonia, are used to dissolve the dyestuff, and ammonium sulphate and Turkey-red oil are added to the dye bath; good blacks are produced.—F. W. A.

Patents

Silk for weighting; Protective treatment of ——. Schadd and Korteling. Fr. Pat. 478,007, Mar. 12, 1915. Under Int. Conv., Nov. 6, 1914.

Silk is treated before, and if necessary up to, the end of the weighting operation, with organic compounds, particularly those containing nitrogen or sulphur, or both, which are more readily oxidisable than the fibroin and preferably those of which the primary oxidation products still have a reducing action and which yield nothing that can affect the feel or colour of the silk or give stains with metallic salts. *Example:* The silk is treated before or during the weighting operation with a solution containing 2% of sodium hippurate, calculated on the weight of the silk, then drained and loaded by any of the usual processes; hippuric acid is fixed in the fibre by treatment with hydrochloric acid.—J. F. B.

Dyeing rugs and like articles; Process for ——. W. E. Olson, Chicago, Ill. U.S. Pat. 1,198,373, Sept. 12, 1916. Date of appl., May 20, 1914.

Rugs are sprayed with a liquid dye uniformly or otherwise, the surface brushed to force the dye into the nap, the rugs dried, treated in a vapour bath to deposit a film of water on the surface, and finally the dye is fixed.—F. W. A.

Waterproofing of fabrics. A. Vincent and E. Pluszeski. Fr. Pat. 479,436, Dec. 2, 1914.

Textile material for military purposes, etc., is waterproofed by treatment for 8 mins. with the emulsion of calcium oleate, margarate, and stearate obtained from 100 grms. of fat, 900 grms. of benzine, 20 grms. of quicklime, and 80 grms. of water. The benzine is recovered during the drying process.—F. W. A.

Fireproofing and bleaching fabrics and analogous materials. T. J. I. Craig, and Whipp Bros. and Tod, Ltd. Fr. Pat. 479,086, June 23, 1915. Under Int.Conv.,Nov. 17, 1914, and Mar. 22,1915.

See Eng. Pats. 22,617 of 1914 and 4448 of 1915; this J., 1915, 1205.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphur, pyrites, and sulphuric acid in the United States. U.S. Geol. Survey, 1916.

The production of sulphur in the United States in 1915 showed a decrease over the previous year; actual figures are not given; 25,910 tons of sulphur was imported. The demand improved gradually as the year advanced, owing to the requirements of sulphuric acid manufacturers. Imports of pyrites amounted to 964,634 tons and production to 394,124 tons. Exports of sulphur fell from 98,163 tons in 1914 to 37,312 tons in 1915. In the sulphuric acid industry, until the middle of 1915 manufacturers were able to meet the demands made on them, but subsequently supplies have been inadequate and prices have consequently increased. The amounts of various strengths produced in the United States last year were: 50° B., 1,518,271 short tons; 60° B., 657,070 tons; 66° B., 1,019,024 tons; other grades, including stronger acid reported as oleum, 189,795 tons. The total, reduced to 50° B. acid, represents 3,868,152 tons, the value being $32,657,051. Copper and zinc smelters produced the equivalent of 1,056,830 short tons of 50° B. acid during the year, valued at $7,621,241.

Nitric acid: The Ostwald process of oxidising ammonia to ——. F. C. Zeisberg. Met. and Chem. Eng., 1916, 15, 299—304.

From a résumé of the information available (which is to be regarded with reserve) it is concluded that the Ostwald and similar processes for the manufacture of nitric acid by the catalytic oxidation of ammonia can hardly compete with the sodium nitrate or arc processes, the possible margin of profit being very small even when the price of ammonia is low. The process possesses the advantages of being continuous and capable of installation in small units; it also requires little power and relatively small absorption apparatus, the exit gases from the converters being several times as concentrated as those from any arc furnace. It is, however, only a step, not a complete process, and the plant would have to be located with respect to economy of freight on incoming supplies of ammonia liquor or cyanamide, and the cost of ammonia would have to be improbably low for profitable operation. On the basis of 85% and 97% yields for the Ostwald and sodium nitrate processes respectively, and with sodium nitrate and ammonia at the present prices, viz. 2·64 c. (1·32d.) and 13·25 c. (6·62d.) per lb., respectively, the cost of 93% nitric acid would be 5·471 c. (2·73d.) per lb. by the former and 5·5 c. (2·75d.) per lb. by the latter process; the corresponding costs with sodium nitrate at 1·5 c. (0·75d.) and ammonia at 7·5 c. (3·75d.) being 3·621 c. (1·81d.) and 3·88 c. (1·94d.) per lb. respectively. On the basis of equal yields (97%), nitric acid could be produced for about 0·5 c. (0·25d.) less per lb. by the Ostwald than by the sodium nitrate process; but according to the most trustworthy evidence, the conversion efficiency of the Ostwald process appears not to exceed 85%.—W. E. F. P.

Etna lava; Utilisation of —— in the chemical industry. S. Pagliani. Annali Chim. Appl., 1916, 6, 157—162.

Mount Etna lava has been used for some years with good results in an Italian works, for the construction of apparatus for the concentration of sulphuric acid, Glover and Gay Lussac towers, condensing towers for hydrochloric acid, and other plant in which Volvic lava or analogous material is usually employed. Not all specimens of the lava are suitable for such purposes, but large quantities of material of satisfactory quality are available in the quarries. Analyses of samples of the lava deposited at different epochs (from 122 B.C. to 1910) show that the maximum, minimum, and average values for the percentages of the various constituents are as follows:—SiO_2, 51·89, 46·25, 49·13; Al_2O_3, 22·67, 15·91, 19·84; Fe_2O_3, 19·32, 9·13, 11·47; CaO + MgO, 17·18, 11·60, 13·38; $Na_2O + K_2O$, 8·11, 2·12, 5·81%. The porosity of a sample of the lava, as measured by the weight of water absorbed per 100 parts of material, was found to be 0·18, as compared with 0·71 for granite. —A. S.

Lime: ferric oxide: Preliminary report on the system ——. R. B. Sosman and H. E. Merwin. J. Wash. Acad. Sci., 1916, **6**, 532—537.

The system CaO—Fe_2O_3 was investigated by means of thermal curves and by optical examination. The mixtures were melted down in platinum crucibles, then ground, and remelted for the determination of the thermal breaks. Temperatures up to 1250°—1450° C. were employed, the lower temperature with mixtures containing less than 50 molecular per cent. of CaO owing to the considerable dissociation of the ferric oxide at higher temperatures. Two binary compounds were found, CaO,Fe_2O_3, and $2CaO,Fe_2O_3$, and both appear to be dissociated at their melting points. $2CaO,Fe_2O_3$ gives black crystals; it is formed from a finely powdered mixture of calcium carbonate and ferric oxide at temperatures considerably below its liquefying point, which lies somewhat above 1385° C. The transition temperature at which it dissociates and is in equilibrium with CaO and liquid is 1436° C. Similarly it is in equilibrium with liquid and with CaO,Fe_2O_3 at 1216° C. This latter compound forms deep red or nearly black crystals. There is no optical evidence of solid solution of either $2CaO,Fe_2O_3$, or Fe_2O_3 in the compound. There is an eutectic at 1203° C. between CaO,Fe_2O_3 and Fe_2O_3 (hæmatite): the eutectic composition is between 10 and 25 molecular per cent. of CaO, probably nearer the latter. No evidence was found of a 3 : 1 compound analogous to tricalcium aluminate; samples of this composition all consisted of the above 2 : 1 compound and CaO.—G. F. M.

Cobalt aluminate, cobalt orthostannate, and Rinman's green; Formation of ——. J. A. Hedvall. Z. anorg. Chem., 1916, **96**, 71—74. Z. angew. Chem., 1916, **29**, Ref., 401. (See also this J., 1915, 1052.)

Interaction of cobalt oxide and alumina begins between 925° and 1025° C. and at a higher temperature the more slowly the mixture is heated. With a rate of heating such that interaction begins at 1025° C., the mixture must be heated at 1075°—1100° C. for 10 mins. to obtain complete conversion into the blue aluminate, CoO,Al_2O_3. When the green aluminate, $7CoO,5Al_2O_3$, is also formed, the reaction velocity is considerably retarded: the greenish-blue product is converted into the pure blue aluminate in about 20 mins. In presence of potassium chloride as flux, formation of CoO,Al_2O_3 takes place even at 776° C. (the melting point of the chloride).

When a mixture of cobalt oxide and stannic oxide is heated somewhat rapidly, interaction begins only at about 1000° C. even in presence of potassium chloride, and at about 1075° C. in the case of a mixture which has been heated previously. The formation of green cobalt orthostannate, Co_2SnO_4, proceeds with somewhat higher velocity than that of the blue aluminate.

The temperature of formation of Rinman's green from zinc oxide and CoO or Co_3O_4 is about 790°—800° C. In absence of potassium chloride the reaction is much slower than the formation of aluminate or stannate.—A. S.

Design of acid-resisting iron apparatus. Swindin. *See* I.

Exchange of bases by silicates. Exchange of alkalis and ammonium by hydrous aluminium-alkali silicates (permutites). Ramann and others. *See* XIXb.

Determination of sulphuric anhydride. Pierce *See* XXIII.

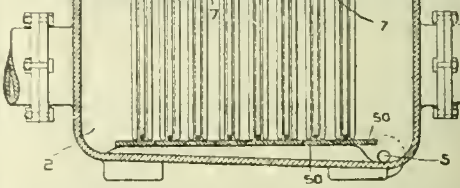
Use of titanium trichloride in volumetric analysis. Monnier. *See* XXIII.

Detection of small quantities of selenium and their distinction from arsenic. Meunier. *See* XXIII.

Patents.

Condensers [for nitric acid]. A. Hough, Dragon Station, Quebec. Eng. Pat. 101,307, Feb. 24, 1916. (Appl. No. 2792 of 1916.)

Nitric acid or other vapour is passed into a container, 2, of dish form, provided with a cover divided into a number of detachable parts, 7, and having a trapped outlet, 5, at the lower end of the inclined base. In the interior of the container is a series of vertical tubes, preferably of glass, of three-loop zig-zag shape, the ends of which protrude upwards through apertures in the cover in which they are fixed by cement, and which rest upon a false bottom, 50, situated near the base of the container. Water flows through these tubes in the opposite direction to the incoming vapour. The condenser units are connected to inlet and outlet headers by a series of nipples, fixed to the headers, and by flexible tubing, each nipple being provided with a controlling tap, 13.—E. H. T.



Nitric acid; Production of ——. H. D. Rankin. Fr. Pat. 479,492, Aug. 10, 1915.

See U.S. Pat. 1,150,786 of 1915; this J., 1915, 960. The electrical resistance of the mixture of oxygen and nitrogen may be diminished by addition of steam. The nitrogen oxides produced in the reaction chamber are cooled to prevent dissociation and decomposition, and are then led to a vessel containing a mixture of sulphuric acid and water, and air also is introduced into this vessel.

*Nitrogen oxides; **Manufacture** of* ——. J. Y. Johnson, London. From Badische Anilin u. Soda Fabr., Ludwigshafen, Germany Eng. Pat. 13,297, May 21, 1915. (See also Eng. Pats. 7651 and 13,298 of 1915; this J., 1916, 1015.)

The bismuth or bismuth oxide contained in the contact mass described in Eng. Pat. 13,818 of 1914 (this J., 1915, 799) may be replaced by tellurium or a tellurium compound, in an amount which may be varied within wide limits, and upon a carrier consisting of a noble metal or an indifferent substance. Thus the following may be used as contact masses at 700°—800° C.: Powdered firebrick soaked in a 10—20% solution of platinic chloride, and in a solution of about 10 % ammonium or sodium tellurite (either separately or mixed); a metal of the platinum group deposited on the carrier and then rendered active with a small amount of tellurium or one of its compounds; granular cupric oxide is soaked in a 5 % solution of ammonium tellurite and dried. (Reference is directed in pursuance of Sect. 8, Sub-sect. 2, of the Patents and Designs Act, 1907, to Eng. Pat. 2308 of 1914.)—E. H. T.

Sodium silicate; Soluble composition of ——, and process of preparing the same. L. B. Edgerton, Upland, Pa. U.S. Pat. 1,198,203, Sept. 12, 1916. Date of appl., Dec. 8, 1914.

A solution of sodium silicate is deprived of some of its water by injecting it, in a finely-divided form, into a large volume of dry air, moving in the same upward direction and heated to between 140° and 200° F. (60° and 92° C.).—E. H. T.

Alkali chlorides; Electrolysis of ——. R. van Hasselt, The Hague, Netherlands. Eng. Pat. 101,440, Mar. 21, 1916. (Appl. No. 4190 of 1916.)

A highly concentrated salt solution is circulated through the anode compartment, entering at a level a little above a horizontal diaphragm and leaving in a slightly impoverished condition at a higher level. It is then passed into a salt chamber, in which the liquid is kept alkaline, where it is heated to expel the chlorine and is re-saturated with salt. After filtering, the liquid is returned to the anode compartment, the velocity of flow and the composition of the fresh salt solution being regulated to compensate for the volume of liquid passing through the diaphragm. —B. N.

Cyanides and ammonia or its salts; Preparation of —— by the Marguerite and Sourdeval process. L. Petit Devaucelle and F. Bensa. Fr. Pat. 478,919, Sept. 9, 1914.

In the manufacture of cyanides by heating together a metallic oxide or carbonate and a carbonaceous material in the presence of nitrogen, a fairly pure salt or oxide of an alkali or alkaline-earth metal (*e.g.*, precipitated barium carbonate) is used; a carbon is selected, having a low ash content, *e.g.*, that obtained from tar, petroleum, anthracite, etc.; the mixture of salt or oxide and carbon is agglomerated preferably by admixture with 20 % of tar; the nitrogen used is also as pure as practicable. In the subsequent conversion of the cyanide into ammonia by the action of steam, the necessary reduction of temperature, previous to the reaction, is preferably produced by cooling the mass with a stream of cold air rather than by cooling the retort. By observing these precautions the cyanide reaction occurs at a lower temperature and a better yield is obtained in both processes at a lower cost of fuel and plant. —B. V. S.

Sodium carbonate; Rapid preparation of fine crystals of ——. R. Bernat. Fr. Pat. 479,545, Aug. 17, 1915.

A hot saturated solution of sodium carbonate is quickly cooled by causing it to flow over a shallow dish, cooled externally. The mixture of crystals and mother liquor is further cooled by the addition of powdered ice. The preliminary cooling with dishes may be omitted, more ice being then required. Very small, needle-shaped crystals are obtained, suitable for the preparation of washing powders, easily soluble in cold water.—B. V. S.

Caustic lime; Manufacture of ——. J. Mühlen, Wiesbaden. Ger. Pat. 293,825, Sept. 26, 1915.

Burnt lime is dry slaked, the pulverulent slaked lime is separated as one finished product, and the residue is mixed with fresh quicklime and finely ground to form a second finished product.—A. S.

Chlorine; Cheap process for the manufacture of ——. P. R. Falck. Fr. Pat. 479,196, July 5, 1915.

A hot saturated solution of sodium chlorate is dropped, a little at a time, into a hot solution of sodium bisulphate and chloride, the strength of this solution being such that no hydrochloric acid is evolved in the cold and only a little when heated to boiling point. A steady evolution of chlorine, free from oxides, is obtained. A part of the bisulphate and chlorate may be replaced by the nitric-sulphuric acid mixtures left from the manufacture of guncotton.—B. V. S.

Caustic alkalis, etc.: Electrolytic manufacture of ——. E. A. Ashcroft, London. U.S. Pat. 1,198,987, Sep. 19, 1916. Date of appl., Mar. 12, 1912.

See Eng. Pat. 1004 of 1912; this J., 1913, 199.

Nitrogen; Process for fixing —— by means of ferro-aluminium or other ferro-alloys. O. Serpek, Assignor to Soc. Gén. des Nitrures, Paris. U.S. Pat. 1,198,965, Sept. 19, 1916. Date of appl., Dec. 20, 1913.

See Eng. Pats. 27,030 and 27,971 of 1913; this J., 1914, 549, 961.

Cyanogen compounds; Manufacture of ——. Nitrogen Products Co. Fr. Pat. 477,918, Mar. 8, 1915.

See Eng. Pat. 2286 of 1915; this J., 1916, 422.

Receptacles for carrying out chemical reactions. Eng. Pat. 100,447. *See* I.

Kiln for lime, cement, and other similar materials. Fr. Pat. 478,401. *See* IX.

Preparation of base-exchanging substances. Fr. Pat. 479,152. *See* XIXb.

VIII.—GLASS; CERAMICS.

Patents.

Glass-drawing and blowing apparatus. A. E. White, London. From Window Glass Rotary Pot Co., Pittsburgh, Pa., U.S.A. Eng. Pat. 18,126, Dec. 29, 1915.

A glass-drawing or -blowing apparatus for producing window glass is arranged so that movement of the rotary hearth and the heating of the furnace are automatically controlled by mechanical and electrical means. The furnace has four stations, so arranged that whilst one pot is being filled with a charge of glass from a separate tank furnace at the first station, a glass cylinder is being withdrawn from another pot at the third. Between the first and second station the supply of gas or oil to the furnace is reduced so as to render the glass more viscous; and at the fourth station the pot and any surplus glass in it are re-heated so as to be ready to receive a fresh charge. By the motion of the rotary hearth, which is driven electrically, the pots are automatically taken to each station in turn. The rotary hearth also controls automatically the supply of air and fuel (oil or gas) to the several sections of the furnace, regulating the temperature of the glass at each station, and cutting off the heat when the hearth is in motion. The glass is drawn in the form of a cylinder by lowering a head or bait into the molten material and then raising it slowly, air being supplied automatically to expand the cylinder as it is formed by the rising bait. The diameter of the cylinder is kept uniform by manipulating the

speed of the motor. When of the proper size, the cylinder is moved automatically to the drawing station and is cut off by means of a series of gas jets arranged on the periphery of a steel ring.
—A. B. S.

Quartz glass or similar refractory glasses : Gas-tight sealing of wire in ——. E. Podszus, Neukölln. Ger. Pat. 293,963, Mar. 15, 1914. Addition to Ger. Pat. 290,606.

A quantity (1—2 %) of alkali or alkaline-earth, sufficient to dissolve the oxide on the surface of the wire, is added to the flux described in the chief patent (this J., 1916, 602). The alkali may be added in the form of orthoclase, a suitable flux being composed of silica 10, alumina 1, boric oxide 1, and orthoclase 2 parts.—A. S.

Refractory materials : Production of ——. P. R. Hershman, Chicago, Ill., Assignor to The Mineral Products Co., New York. U.S. Pat. 1,197,626, Sept. 12, 1916. Date of appl., Dec. 21, 1914. Renewed Feb. 4, 1916.

Briquettes, formed of a mixture of alumina with from 10—30 % of finely divided carbon, are heated slowly in a non-oxidising atmosphere consisting mainly of hydrocarbon gases until the mixture frits together.—W. H. C.

Pottery and like kilns ; Gas-fired ——. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 101,567, Jan. 9, 1916. (Appl. No. 874 of 1916.)

A rectangular down-draught kiln has a perforated floor at the bottom and another, hollow, perforated floor about midway of its height, for supporting the articles to be burned. It is heated by two sets of flat-flame gas-burners on opposite sides ; the flames from one set project upwards through side flues or "bags" to the top of the kiln, whilst the flames from the other set project horizontally into the space between the walls of the hollow floor, and pass downwards through the lower half of the kiln. Several kilns may be connected in series, and worked in pairs, so that the waste heat from one kiln may be used to dry the contents of another. Compressed air may be used to regulate the draught.—A. B. S.

Kilns. L. W. McArthur, Assignor to P. S. McKergow, Montreal. U.S. Pats. (a) 1,199,015 and (b) 1,199,016, Sept. 19, 1916. Dates of appl., Feb. 16 and May 1, 1916.

(a) A kiln for burning bricks is provided with a floor composed of layers of separate slabs arranged to form tortuous flues for the hot gases passing from a generator below into the heating chamber. The top of the kiln is open, but openings in the side walls near the top cause an outward draught into vertical flues in the walls which lead first downwards and then upwards into chimneys which form vertical continuations of the side walls. (b) In a kiln of the type described in (a), the openings in the side walls are wide and shallow, decreasing in width and increasing in depth from the inner side of the wall outwards. The flues are arranged in groups, each of which communicates with a separate chimney.—W. F. F.

Muffle-furnace for burning-in colours on glass, porcelain, etc. ; Gas-fired ——. S. Schieren, Cöln-Junkersdorf. Ger. Pat. 293,313, Feb. 9, 1913.

The furnace is so constructed that it can quickly be modified for rapid working. For this purpose the burners are mounted on a support so that they can be moved sideways and raised in the side flues to such a height that the heating gases circulate only around the upper part of the muffle chamber ; and the damper in the plate closing the bottom of the furnace chamber is opened, so that cool air can circulate in contact with the bottom of the muffle. The articles are placed on supporting plates in the muffle chamber and are heated from above in the upper part and cooled in the lower part.—A. S.

Supporting tiles, more especially whilst subjected to heat treatment. P. d'H. Dressler, London. Eng. Pat. 12,581, Sept. 1, 1915.

Kilns. L. W. McArthur and P. S. McKergow, Montreal. Eng. Pat. 101,583, Mar. 22, 1916. (Appl. No. 4265 of 1916.)

See U.S. Pat. 1,199,015 of 1916 ; preceding.

Chequer bricks used in the chequering chambers of carburetted water-gas plant or coke-oven chambers. Eng. Pat. 16,634. *See* IIa.

IX.—BUILDING MATERIALS.

Concrete ; Effect of prolonged keeping of —— *in a wet condition on its subsequent shrinkage on hardening in air.* M. Rudeloff. Mitt. K. Material-prüf., 1916, 34, 2—11.

Test-prisms of concrete were allowed to set : (1) continuously exposed to the air, (2) continuously under water, (3) exposed to air for varying periods and then immersed in water, and (4) immersed in water for varying periods and then exposed to the air. The experiments were made in 1912, and the detailed results were published in "*Heft 23 des deutschen Auschusses für Eisenbeton.*" Since 1912 the test-pieces have been kept exposed to the air in a dry cellar, and the changes in length have been again measured. Some of the results are summarised in the following table :—

Measurements in 1912.			Measurements in 1916.		
Conditions of setting.	Age of test-piece in days.	Change of length, % × 10⁴	Exposure to air since 1912, days.	Change of length, % × 10⁴. since 1912.	Change of length, % × 10⁴. total.
Exposed to air ..	196	—324	1372	+1	—323
Under water ..	196	+328	1365	—282	+46
168 days under water, after exposure to air for :					
3 days	171	+323	1409	—213	+110
7 days	175	+312	1411	—206	+106
14 days	182	+310	1411	—266	+35
21 days	189	+176	1111	—266	—90
exposed to air for 140 days after keeping under water for :					
3 days	144	—102	1378	—205	—307
7 days	148	—86	1378	—204	—290
28 days	169	—11	1378	—208	—219
90 days	231	+145	1378	—191	—46

—A. S.

Oak ; Ancient Irish ——. P. A. E. Richards. Analyst, 1916, 41, 303—304.

Stumps of ancient oak are found in various parts of Ireland buried in peat bogs and in sand and mud near the sea ; they probably date back to the Neolithic period and in some respects resemble the Russian oaks described previously by the author (this J., 1916, 738). The specimens examined had the following compositions :—

	Kerry	Roscommon		Sligo	Anna-gasan
	(black).	(black).	(grey).	(brown).	(tr.sea).
	%	%	%	%	%
Total mineral matter	2·31	1·46	1·09	0·28	6·33
Ether-alcohol extract	4·37	7·68	7·24	5·5	5·02
Water and total extractives	44·3	40·5	36·2	39·6	38·7
Cellulose	27·3	34·4	37·6	39·3	44·4
Lignin, etc.	28·4	25·1	26·2	21·1	15·9
The mineral matter contained—					
Fe_2O_3	62·70	33·90	25·80	3·95	0·37
Al_2O_3	trace	trace	trace	1·65	0·30
CaO	16·24	34·22	38·61	16·42	4·10
MgO	none	0·80	1·02	15·28	7·27
SiO_2	2·30	0·70	0·80	7·80	1·80
SO_3	5·83	4·65	3·42	30·80	14·58
Cl	1·10	trace	trace	0·70	38·20
CO_2	9·53	25·20	28·40	13·70	3·40
Na & K salts	3·30	traces	traces	11·70	68·20
Percentage of mineral matter soluble	13	8	6	56	90

—W. P. S.

Standards for products of the asphalt industry. Marcusson. *See* IIa.

Patents.

Metal coating upon cement-mortar, plaster-mortar, or gypsum-mortar, trass-mortar, and the like, with or without admixture of sand, granite, marble, and the like; Process for forming a——. L. A. and A. J. Sanders, Amsterdam. Eng. Pat. 14,226, Oct. 7, 1915.

Cementitious material or mortar is mixed with metal (*e.g.* iron filings) or metal ore (titanic iron sand), water, and sand, stone, or graphite. The paste thus produced is applied as a coating or moulded to the desired shape, and after it has hardened, a metal coating is formed on it by the application of a solution of a salt of a suitable metal. Thus, copper sulphate will react with the iron, and metallic copper will be precipitated. The metallic coating is stated to adhere well, and to be impermeable to water, oil, and benzene. —A. B. S.

Fire- and waterproof composition [for wood] and process of making same. J. V. Skoglund, New York. U.S. Pat. 1,194,558, Aug. 15, 1916. Date of appl., Aug. 15, 1913.

A composition suitable for coating porous materials such as balsa wood and other soft woods is made by mixing a brominated coal-tar hydrocarbon with a heavy hydrocarbon. *Example:*—Four parts of gas tar or "dead oil" is treated with 2 parts of bromine; when the reaction has subsided the product is melted with about 20 parts of pitch. The composition is applied in the fused condition to the articles to be coated. It does not sink into the pores and is inflammable only with difficulty.—J. F. B.

Kiln for lime, cement, and other similar materials. A. Anker. Fr. Pat. 478,401, July 30, 1914.

The material is caused to descend uniformly over the whole cross-section of the kiln by providing a discharge opening in the bottom, of the full cross-section. The material is removed in layers by an endless chain running over a flat plate and provided with transverse ribs projecting upwards. Alternatively the chain may run below a series of parallel bars on which the charge rests, projections carried by the chain extending upwards into the lowest layer of material. In each case the plane of discharge is slightly inclined downwards, or two such discharge conveyors may work outwards from the centre of the discharge opening.—W. F. F.

Artificial stone; Manufacture of —— from magnesia and a magnesium salt. E. Wallin, Hamburg-Seddel. Ger. Pat. 293,283, Mar. 12, 1914.

Magnesium nitrate or a mixture which yields magnesium nitrate by chemical interaction is used in the preparation of magnesian artificial stone. The materials may be mixed dry and water added when required for use.—A. S.

Lime-sand mortar; Method of improving ——. Mörtelwerk "Jolit" G.m.b.H., Berlin. Ger. Pat. 293,415, Aug. 17, 1913.

Dissolved or emulsified silicates are sprayed on to the finished mortar, whereby better results are obtained than when silicates are incorporated during the preparation of the mortar.—A. S.

Waterproof cement; Manufacture of ——. W. Giese, Cöthen. Ger. Pat. 293,715, Mar. 16, 1915.

Small quantities of alkali silicate and of a calcium compound, preferably the chloride or carbonate, are added during the grinding of the cement clinker The strength of the cement is not reduced as is the case when alkali silicate alone is added. —A. S.

Cement or hydraulic lime from calcium sulphate; Process of manufacturing ——. L. P. Basset, Montmorency, France. U.S. Pat. 1,198,816, Sept. 19, 1916. Date of appl., Dec. 17, 1912.

See Addition of Oct. 21, 1912, to Fr. Pat. 455,062 of 1912; this J., 1913, 945.

Cement or hydraulic lime from plaster; Process of manufacturing ——. L. P. Basset, Montmorency, France U.S. Pat. 1,198,817, Sept. 19, 1916. Date of appl., Nov. 25, 1913.

See Eng. Pat. 12,027 of 1912; this J., 1913, 793. Excess of calcium sulphate is used.

Manufacture of caustic lime. Ger. Pat. 293,825. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Blast-furnace slags; Properties of —— and methods employed for calculating the charges. M. A. Pawloff. Rev. Soc. Russe Métal., 1914, **1**, 652—679. Rev. Mét., 1916, **13**, Ext., 59—60.

In calculating the charge of a blast-furnace, the relation between the ore, the flux, and the fuel-ash, must be determined so that the quantity and composition of the slag may correspond to the kind of iron desired. The amount of slag is kept as low as possible, for reasons of economy, and the quality, as determined by the physical properties and chemical composition, is chosen to favour the reduction of the elements desired in the metal, whilst opposing the passage to the metal of objectionable substances. The fluidity of blast-furnace slags is almost entirely dependent on the relative proportions of $(SiO_2+Al_2O_3)$ and CaO. Normal slags in charcoal furnaces contain 65 to 69% $(SiO_2+Al_2O_3)$, and the ratio $\frac{SiO_2+Al_2O_3}{CaO}$ varies only from 2 to 1·5. When coke is used the proportion of lime must be increased on account of the sulphur. In these slags the ratio $\frac{SiO_2+Al_2O_3}{CaO}$ approaches unity, corresponding to 40—50% $(SiO_2+Al_2O_3)$, the average content of CaS being 5%. The second important physical property of slags is the heat required for melting. In charcoal furnaces the most fusible slags with a heat of fusion between 340 and 400 cals. per kilo. are chosen: in coke furnaces the degree of fusibility is generally within the limits 350 and 460 cals. Diagrams showing the degree of fusibility of slags with varying amounts of lime, alumina, and silica, are given, with additional lines for the ratios $\frac{SiO_2}{Al_2O_3}$ and $\frac{RO}{SiO_2}$. Slags having different chemical compositions may possess the required fluidity and degree of fusibility, and the composition selected will depend on the kind of iron desired. The proportion of sulphur retained by the slag depends on the proportion of lime (or of $CaO + MgO + MnO$). Silica does not exceed 38 % in the slags of modern coke blast-furnaces. Charcoal furnace slags are characterised by a smaller lime content, ore for these furnaces being desulphurised, when necessary, by preliminary roasting. The reduction of manganese also depends directly on the proportion of lime and magnesia in the slag, and to prevent the formation of infusible masses in the furnace, lime is often replaced by magnesia. In the manufacture of ferromanganese the slag may contain up to 12 % MgO, with 38—36 % CaO. The reduction of silica is, on the contrary, prevented by the presence of much lime and magnesia in the slag, and, other things being equal, the consumption of fuel required to cause the passage of a certain quantity of silicon into the iron is less as the amount of $(SiO_2 + Al_2O_3)$ in the slag is higher. With charcoal, the $(SiO_2 + Al_2O_3)$ may attain 70 % of the weight of the slag, but with coke, in view of the necessity of eliminating sulphur, the slag should not contain more than 45 to 50 % $(SiO_2 + Al_2O_3)$. Where high temperatures are employed, less lime is needed, as the sulphur is partly volatilised. The reduction of phosphorus is complete when the ratio $\frac{CaO}{SiO_2} = 1{\cdot}65$. The quantity of slag formed depends on local conditions. With charcoal, a minimum of 25 % of the weight of the iron may be attained; with coke, the proportion varies from a minimum of 40 % to a maximum of 150 %, the latter amount being formed in smelting Cleveland ores. The weight of coke required varies from 80 to 120 % of the weight of iron produced, and rises to 200 to 250 % for ferromanganese and ferrosilicon. The determination of the quantity of flux necessary for slagging the ash of the fuel and the gangue of the ore may be based on four different quantities:—(1) *The ratio of the oxygen of the silica to that of the base of the slag.* This method is only suitable for charcoal furnaces, the ash of the fuel taking no part in the action, and the ratio $\frac{SiO_2}{Al_2O_3}$ in the slag being given directly by the analysis of the ore. The most fusible and most acid slag being the most advantageous, and the ratio $\frac{SiO_2}{Al_2O_3}$ being known, a suitable degree of acidity may be obtained by reference to the diagrams. (2) *The ratio (by weight)* $\frac{SiO_2 + Al_2O_3}{RO}$. This ratio, proposed by Platz, is a better basis for calculating the charge than the former ratio. In coke furnaces its value is generally made $\frac{48}{52}$ for cast irons and $\frac{52}{48}$ for irons to be refined. An objection however to the use of a constant figure for this ratio is that the properties of slags may vary according to the relative proportions of SiO_2 and Al_2O_3. In charcoal furnaces the ratio $\frac{SiO_2 + Al_2O_3}{RO}$ is generally about $\frac{63}{37}$. As is shown in the diagrams, slags with 37 % CaO may vary largely as regards Al_2O_3 and SiO_2 without raising the heat of fusion above 360 cals., and with the ratio $\frac{63}{37}$ fusible slags are given for all values of $\frac{SiO_2}{Al_2O_3}$ between 1 and 30. (3) *The ratio (by weight)* $\frac{RO}{SiO_2}$. In this method alumina is considered as neutral. In coke furnaces the ratio varies from 1·65 for the most basic and least fusible slags, to 1·20 for the most fusible slags. The usual value is 1·4 to 1·5. This method is not suitable for calculating the charges of charcoal furnaces. (4) *The content in the slag of* SiO_2, CaO, $(SiO_2 + Al_2O_3)$, *or* RO. This method is equally suitable for coke and charcoal furnaces. The most suitable constituent to consider in both cases is $(SiO_2 + Al_2O_3)$.—T. ST.

Cast-iron; Corrosion of ——. O. Bauer and E. Wetzel. Mitt. K. Materialprüf., 1916, 34, 11—40.

CAST-IRON embedded in moist soil is subject to a peculiar form of corrosion, known as "graphitisation," "iron cancer," etc., in which it is converted locally into a soft, friable, grey mass (compare Steel, this J., 1910, 1141). The authors have investigated a number of cases of corrosion of this type and also made experiments with the object of producing similar effects in laboratory tests. Their results indicate that the fundamental condition for the production of corrosion of this kind is the presence of water in the liquid state. The phenomenon is usually associated with grey cast iron, but white cast iron may be corroded in a similar manner. The corrosion is accelerated by the application of an electric current, *e.g.* by stray currents in the soil, but also takes place, though much more slowly, in the absence of external electric currents. The oxidation products of the iron, in a spongy condition at first, are retained in place by the network of graphite in the case of grey cast iron, or of cementite in the case of white iron, and are gradually agglomerated to a more or less firm mass. In grey cast iron the corrosion appears always to proceed from the laminæ of graphite and gradually to spread outward.—A. S.

Steel: Elastic limit of ——. N. I. Belaiew and N. T. Goudtsow. Rev. Mét., 1916, 13, 116—148.

THE upper part of a 1000 kilo. ingot of Martin steel (C 0·34, Mn 0·60, Si 0·26, S 0·036, P 0·034 %) to the extent of 40 % of the length, the bottom 5 %, the outer surface, and the central core 101·6 mm. in diameter, were discarded, and the remaining steel, free from any possible variability in composition, was cut up into bars, which (some after forging) were then subjected to a variety of heat treatments, and tested mechanically. The steel gave one arrest, on heating, at 735° C., and two arrests on cooling, Ar 3—2 at 735° C., and Ar-1 at 690° C. Specimens of each bar were tested on different machines to make the results as independent as possible of the method of determination. *Effect of annealing temperature on the mechanical properties.* Under similar conditions of slow cooling, variation of the temperature of annealing within the limits 1100° and 850° C. had no influence on the mechanical properties. The progressive lowering of the annealing temperature from 850° to 740° C. lowered the tensile strength, and increased the elongation and reduction of area. Micrographic examination showed a transition from lamellar to stippled pearlite, characterised by a fine distribution of cementite in the ferrite. The ratio of the loads corresponding to the apparent elastic limit (yield point) and to the proportional elastic limit (maximum load up to which increase in length is proportional to the load) gave a constant value, the curves of the variations of these loads with annealing temperature being parallel. With the lowering of the annealing temperature from 850° to 740° C. the most marked variation was that of the reduction of area. *Effect of the reheating temperature after quenching at 760° C.* Raising the reheating temperature restored to the steel its initial mechanical properties. When quenched and reheated at 750° C. it had the same properties as when annealed at this temperature. The curve of reduction of area plotted against reheating temperatures gave a maximum at 650° C. The loads corresponding to the proportional and apparent elastic limits varied together with the reheating temperatures. The differences in the values of the critical points obtained in tensile tests on the same bar were greater as the reheating temperature was lower. Similar results were also obtained with a steel containing C 0·42, Mn 1·00, Si 0·35 %. The results showed that a medium carbon steel, after being annealed at above 850° C., acquires a granular structure, its tensile strength increases, and the reduction of area diminishes. Annealing at 740° C., on the contrary, renders the structure more homogeneous, lowers the tensile strength slightly, and increases the reduction of area considerably. Maximum stress and elastic limit (apparent and proportional) can only be considerably increased by quenching followed by reheating, the most favourable temperature for the latter being 650° C. Tests made to ascertain the effects on static tests of heterogeneity produced mechanically and by non-uniform heat treatment showed that the greater the heterogeneity, the lower were the loads corresponding to the elastic limits (proportional and apparent). Similar results were given by a eutectoid steel after being annealed at 1000° C., whereby coarsely lamellar pearlite was produced. The normal mechanical properties were only acquired when the pearlite had been brought into the granular condition, as by annealing at 740° C. The authors consider that the proportional elastic limit should not be used in specifications, as this value is largely affected by non-essential factors, and may thus give a false idea of the object tested. The clearest indications of the mechanical properties are given by a stress-strain diagram produced automatically, but failing the necessary apparatus, it is necessary and sufficient to determine the apparent elastic limit (the yield point).—T. St.

Cobalt and Fe_2Co; Magnetic properties of ——. H. T. Kalmus and K. B. Blake. Mines Branch, Dept. of Mines, Ottawa, Canada. 1916. No. 413. 18 pages. (See also this J., 1911, 261; 1915, 180, 619.)

The magnetic permeability and hysteresis loss of pure cobalt (99·6 % Co) were measured by the authors and others. The results obtained are given in a series of diagrams. Similar measurements were also made on the alloy Fe_2Co and comparisons made between the latter, pure iron, and commercial transformer steel. The alloy was brittle but fairly strong and could be readily forged. The ultimate strength after annealing—about the same as that of pure iron—was more than doubled by forging. Sound castings of the alloy were difficult to obtain, most of the castings prepared lacking cohesion, as indicated by micrographic examination. The alloy had a saturation value of magnetisation from 10 to 13 % higher than that of pure iron. The best castings (from melting in a vacuum) had a maximum permeability of about 13,000 at a density of 8000 gauss, which, although considerably lower than the corresponding value for pure iron, is much greater than that of standard transformer steel or other commercial materials. The permeability of the alloy in medium fields (50—200 gilberts per cm.) was approximately 25 % greater than that of pure iron or commercial grades of transformer steel or iron; the hysteresis loss at 10,000 gauss was considerably less than for the best grades of commercial transformer steel, and at 15,000 gauss about the same as for commercial iron at 10,000 gauss. The alloy should thus be of great value in parts of electromagnetic machinery where extreme magnetic densities are required.—W. E. F. P.

[*Silver.*] *Cupellation losses in assaying.* H. T. Mann and C. Y. Clayton. School of Mines and Metallurgy Bull., University of Missouri, Feb., 1916. 60 pages.

The following conclusions have been drawn from the results of more than 600 experiments. 1. *Losses due to composition of cupels.* A mixture of equal parts of bone-ash and cement gave trouble through spitting, and the beads did not break clean from the cupels. Cupels made of a cement base with bone-ash top were very satisfactory as regards silver losses, but the bond between the base and the top is very weak. The loss of silver was highest with cement cupels; the beads were held very firmly and had to be scraped. Morganite cupels showed the smallest silver losses; the beads separated very readily and clean, but below 850° C. they retained lead. Next to Morganite, Braunite cupels were best as regards losses, but spitting was very marked. The beads very easily removed, but below 800° C. they retained lead. A few figures showing the actual silver losses are tabulated below:—

Composition of cupel.	Cupellation temperature.	Silver loss, %.
	° C.	
Bone-ash	751	1·5
Bone-ash	855	4·8
Bone-ash	951	12·4
Bone-ash and cement (1 : 1) ..	751	2·2
Bone-ash and cement (1 : 1) ..	849	6·3
Bone-ash and cement (1 : 1) ..	951	13·2
Cement....................	751	3·0
Cement....................	851	9·2
Cement....................	959	19·4
Morganite	775	0·0
Morganite	851	0·6
Morganite	955	2·8
Braunite	755	0·4
Braunite	855	2·5
Braunite	951	5·2

2. *The effect of moisture, hardness, and surface condition* of the cupels on the loss was very small: with soft cupels slightly less time was required than with hard ones. 3. *Size of bone-ash.* Provided the bone ash was finer than 60-mesh, the size of the particles did not affect the losses. 4. *Composition of assay slag.* The chemical composition of the slag had very little effect upon the silver recovery so long as the charge for the assay was so proportioned that the ore was completely decomposed; a fluid slag was formed; the proper amount of "collector" was furnished at the proper time; and the lead button was free from objectionable impurities.—W. R. S.

[*Cyaniding silver ores.*] *The manganese-silver problem.* W. Neal. J. Chem. Met., and Min. Soc., S. Africa. 1916, 17, 9—18.

The ores from the El Favor Mine (State of Jalisco, Mexico) contain 3·5 % of manganese, chiefly as oxide, and 20 oz. of silver per ton, probably as proustite. Only the manganese present as oxide interferes with the cyanide process, silver occurring with manganese carbonate and silicate being generally readily soluble. In this case the extraction of silver by cyanide was 40—45 %, and many processes were tried experimentally in order to increase the yield. Concentration by gravity gave a product assaying 100 oz. per ton, but this only accounted for 18·8 % of the silver present. Magnetic separation on Wetherill machines removed the oxides of manganese, and the tailings were amenable to direct cyaniding. The magnetic fraction should yield most of its silver by chloridising roasting followed by leaching with cyanide or thiosulphate. Leaching the crude ore with cyanogen bromide was a failure. By roasting the ore for 15 minutes at 480° C. with 2½% of salt, and then treating with cyanide, a 76·7 to 82·3% extraction was obtained; 12½% of the silver was volatilised. Reducing roasting with powdered coal, followed by cyaniding gave a 75% extraction. Preliminary leaching with sulphuric acid and a reducing agent gave a product which, after cyaniding, contained less than 2 oz. per ton: ferrous sulphate was found to be very efficient and cheap, but oxalic acid proved too costly. Sulphurous acid gave such good results in the laboratory that it was decided to instal an experimental 5-ton plant at the mine as soon as conditions in Mexico make it possible to resume work. The silver refractory to cyanide was found to be equally so to flotation.—W. R. S.

Cyanide solutions: Electrolytic precipitation from ——. G. H. Clevenger. Eng. and Min. J., 1916, **102**, 579—582.

PRECIPITATION by electrolysis is less complete than by chemical methods, and it is found more economical to complete the precipitation in zinc boxes than to attempt complete precipitation by electrolysis. It is essential to subject the electrolyte to agitation or rapid movement. Peroxidised lead is the most satisfactory anode material (this J., 1915, 1095). Fused magnetite electrodes are fragile. The cathodes used are made of sheet lead, tin plate, or aluminium. The electrode surface is very large, necessitating unwieldy units as compared with zinc-boxes. The electrolyte is a poor conductor owing to the small proportion of dissolved salts: hence the electrodes must be placed close together, but less than 1½ in. space has not been found practicable. Electrolysis is most advantageous where there is a considerable bulk of metals to precipitate, where much copper is present, and where thiocyanate is formed during cyaniding, as this salt is then again converted into cyanide.—W. R. S.

Brass; Heat treatment of —— *in neutral and reducing atmospheres. Use of coal gas.* A. H. White and B. A. Standerline. Michigan Gas Assoc. J. Gas Lighting, 1916, **136**, 136—138.

SPIRALS of thin copper and brass foil were heated in neutral and reducing atmospheres in a muffle within which coal gas was burnt with an insufficient supply of air, the combustion being completed with additional air outside and around the muffle. To effect combustion, it was necessary to preheat the mixed gases by passing them through a previously heated chequer-work of refractory material (see also this J., 1915, 1094). Copper was not oxidised when heated to 1200° F. (650° C.) in a mixture of 3 vols. of air and 1 vol. of gas, but smaller proportions of air were necessary at higher temperatures. The volatilisation of zinc from brass was reduced to a minimum by rapid heating. The loss of zinc brought about by heating brass containing 70% Cu and 30% Zn almost at the melting point for an hour amounted to an elimination of zinc from a layer only 0·003 inch thick. With lower temperatures, more favourable results were obtained. Tests have only been made on the laboratory scale, but it is considered that with proper furnace design, the process should be successful for annealing brass on the large scale.—T. St.

Brass; Effect of corrosion on the ductility and strength of ——. P. D. Merica. U.S. Bureau of Standards. Met. and Chem. Eng., 1916, **15**, 321—324. (See also this J., 1915, 1057.)

THE strength and ductility of brass are known to be decreased as the result of corrosion (in ammonia solution) while under stress. In seeking an explanation of this, measurements were made of the electrolytic potential of brass, two similar electrodes of which, one under stress and the other not, were used in dilute solutions of copper and zinc sulphates under conditions precluding atmospheric oxidation of the alloy. Rods of α-brass (nominally Cu 67·5 and Zn 32·5%, but containing Pb 0·06 and Fe 0·02%), 0·25 in. in diameter, were employed after being annealed at 100° C. for 1 hr., cleaned by light rubbing with fine emery, and then etched with nitric acid. From the results obtained it is believed that an increase in e.m.f. of α-brass is caused by the application of tensile stress, the increase amounting to about 0·2 millivolt at 20,000 lb. per sq. in. (below the elastic limit) and to about 1 millivolt at 30,000 lb. per sq. in. (the yield point) of the alloy. On this basis it is suggested that, at the bottom of small furrows in the roughened (etched) surface of the alloy, the stress is greater than at ridges immediately adjacent, with the result that a galvanic couple is formed and that only the bottom of the furrow is corroded; in time a crack is produced, the furrow becoming narrower and sharper as it penetrates inwards, until the cross-section of the material is finally so reduced that fracture occurs.—W. E. F. P.

Brass: Physical tests on common —— *taken parallel and at right angles to the direction of rolling.* W. B. Price and P. Davidson. Amer. Inst. of Metals, Sept., 1916. [Advance proof.] 32 pages.

TESTS were made on specimens of brass (Cu 64·71, Zn 35·27, Fe 0·02%; Pb, *nil*) cut out respectively parallel and at right angles to the direction of rolling. Up to 35% reduction by rolling, the elongation for both directions was practically identical; with greater reduction, transverse specimens showed marked superiority, the effects of rolling becoming strongly evident under the microscope. The tensile strength was nearly the same up to about 50% reduction, beyond which the transverse specimens were again superior. The yield-point was practically the same for both specimens below 20% reduction. With greater reduction the yield point for the longitudinal specimens rose uniformly, until at 42% it was equal to the tensile strength. The yield points of the transverse specimens were more erratic. The longitudinal pieces showed greater reduction of area than the transverse specimens. Above 40% reduction, transverse specimens showed a shrinkage after heating to 300° C. and cooling, while the longitudinal specimens showed elongation.—W. R. S.

Aluminium bronze with 10% *aluminium: Thermal treatment of* ——. A. Portevin and G. Arnou. Rev. Mét., 1916, **13**, 101—115.

TWO bronzes containing respectively Cu 89·84, Al 9·95, Mn *nil*, Zn 0·11%, and Cu 88·80, Al 10·02, Mn 1·11, Zn 0·05%, having been rolled into plates 10 mm. thick, were heat-treated and then subjected to tensile, impact, and hardness tests, and micrographic examination. *The influence of the quenching temperature* was studied by heating specimens in a salt bath for 5 minutes at 500°, 600°, 700°, and 800° C. respectively, and quenching at these temperatures. Quenching at 500° C. did not affect the mechanical properties of the annealed metal (this accords with the fact that the eutectoid point lies between 550° and 600° C.); quenching at 600° and 700° C. raised the values of all the mechanical characteristics, but quenching at higher temperatures, whilst further increasing the tensile strength and hardness, caused a reduction in the elongation and resilience. *The influence of reheating after quenching at* 800° *C.* The specimens were heated at 800° C. for 10 minutes, quenched, and then reheated for 10 minutes at 400°, 500°, 600°, and 700° C. respectively. Annealing at 400° C. raised the hardness and tensile strength, and produced a slight corresponding diminution of the elongation and resilience. Annealing at 500° and 600° C. produced rapid changes in the mechanical properties, particularly in the case of the bronze with 1 % Mn. Annealing at about 600°—700° C. after quenching, produced a marked improvement in the mechanical properties, as compared with those of the completely annealed rolled metal (1½ hours at 750° C.). *Influence of reheating after quenching at 900° C.* The previous results were accentuated. The bronze with 1 % Mn, when annealed at 600° to 700° C. after quenching at 900° C., gave a higher tensile strength, twice the elongation, and four times the resilience of the fully annealed metal. The α-constituent disappeared with rising quenching temperature, until after quenching at 900° C. the alloy consisted wholly of a martensitic constituent. Reheating after quenching at 800° C. brought about the separation of the α-solid solution, in that the dimensions of the α-elements persisting after quenching were increased, and needles separated between these elements. On reheating after quenching at 900° C. the needles became more and more clearly defined and numerous as the reheating temperature was increased.—T. St.

Zinc bronze: 2Zn-10Sn-88Cu; Report on a series of comparative tests of —— standard test bars. C. P. Karr. Amer. Inst. of Metals, Sept., 1916. [Advance proof.] 12 pages. (See also this J., 1914, 1012.)

In order to obtain further information for framing specifications, tests were made on cast-to-size test bars cast by five foundries from ingots compounded by one of them. The specific gravity of the sand-cast metal averaged 8·50, that of chill-cast metal, 8·69. Re-melting did not materially alter the chemical composition. The results of the physical tests and the suggested standard for specifications are tabulated below.

		Tensile strength. Lb. per sq. in.	Elongation on 2 in.	Reduction of area.
			%	%
Virgin melt	....	39,200 ± 1960	13 ± 2·3	10 ± 3
Do.	chill-cast	44,100 ± 2900	28 ± 3	23·7 ± 1·3
Re-melted	sand-cast ..	35,300 ± 3500	10·5 ± 2·6	9·1 ± 2·8
Do.	chill-cast ..	44,300 ± 2900	24·6 ± 7·4	19·8 ± 7·4
Re-melted twice	sand-cast	37,900 ± 2600	10·5 ± 2·2	11·5 ± 3·2
	chill-cast	31,600 ± 3600	4 ± 0·7	6 ± 1·9
Suggested standard	sand-cast	33,000	10	9
	chill-cast	40,000	22	18

—W. R. S.

Copper-aluminium-iron alloys; Some ——. W. M. Corse and G. F. Comstock. Amer. Inst. of Metals, Sept., 1916. [Advance proof.] 16 pages.

The aluminium content of the alloys tested was 7—10 %, and the upper limit of the iron 8 %. With constant aluminium percentage there was always an increase in proportional limit, yield point, and tensile strength as the iron increased, with a less substantial decrease in elongation and reduction of area. With constant iron content, the proportional limit, yield point, and tensile strength increased with the aluminium, while elongation and reduction of area decreased. For a given strength, better ductility could be obtained with low aluminium and high iron than *vice-versa*. Above 4 % of iron the ultimate strength did not change much while the ductility fell decidedly. The best alloys for strength and ductility contained between 3 and 4 % of iron. Twelve photomicrographs are reproduced and described.
—W. R. S.

Metals; Rates of solution of —— in ferric salts and in chromic acid. R. G. van Name and D. U. Hill. Amer. J. Sci., 1916, 42, 301—332.

Measurements have been made of the rates at which different metals, such as cadmium, iron, nickel, tin, copper, silver, and zinc, react with the same oxidising solution in the presence of varying concentrations of free acid. The solutions used were (a) ferric sulphate and sulphuric acid, (b) ferric chloride and hydrochloric acid, and (c) chromic and sulphuric acids. When the acidity is sufficiently high, a number of metals give the same reaction velocity under like conditions, showing that diffusion is here the determining factor. With decreasing acidity such agreement tends to disappear, and the observed velocities then depend upon the nature of the metal, the order being approximately the same as in the electromotive series, and the velocity greater the more electro-positive the metal. The speed of the reaction in normal cases is proportional to the concentration of the oxidising agent, not only under conditions where different metals give the same rate, but also where the rate depends upon the specific nature of the metal. From these and related facts, the following conclusions have been drawn in normal cases, where the progress of the reaction is not interfered with by mechanical effects, such as the formation of insoluble coatings and the like. (1) The velocity of a reaction at the actual boundary surface between a solid and a liquid is not necessarily extremely rapid, even when there is no mechanical interference with its progress. (2) When a solid reacts with a dissolved reagent, and the reaction velocity at the boundary surface is limited, a balance is quickly established between the consumption and the supply (by diffusion) of the reagent, such that its concentration at the boundary, under otherwise constant conditions, is always proportional to its concentration in the solution. (3) The rate of the reaction at the boundary surface may in some cases be low enough, compared with the rate of the diffusion process, to be an important or even the predominant factor in determining the observed reaction velocity. A sound interpretation of the diffusion theory must take account of this possibility, which has heretofore been neglected.—B. N.

Board of Trade Committee on non-ferrous metal trades.

The President of the Board of Trade has appointed:—Sir Gerard Muntz, Bart. (chairman), Mr. C. L. Budd, Mr. Clive Cookson, Mr. C. W. Fielding, Lieut.-Col. A. J. Foster, Mr. A. W. Tait, and Mr. A. H. Wiggin, J.P., to be a Committee to consider the position after the War, especially in relation to international competition, of the lead, copper, tin, and such other of the non-ferrous metal trades as may be referred to the Committee, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The Secretary of the Committee is Mr. James F. Ronca, to whom all communications should be addressed at 7, Whitehall Gardens, S.W.

Oil-water emulsions; Surface tension of ——. A flotation theory. G. Belchic and R. O. Neal. Min. and Eng. World, 1916, 45, 487—489.

In investigating the assumption of various workers that oil reduces the surface tension of water and thus allows air bubbles to exist when they reach the surface of the water in the flotation machine, measurements were made of the surface tensions of oil and water emulsions prepared in a flotation machine of the Minerals Separation type, in which

1 to 5 grms. of 12 different oils and products were agitated for 7 mins. with 2000 grms. of neutral, acid, and alkaline water; the determinations were made by the capillary method. Although scarcely affected by the addition of sodium hydroxide (2 lb. per ton), the surface tension of neutral water, originally 89, was reduced to 60 by a similar proportion of sulphuric acid. Each of the oils also reduced the surface tension of neutral water, but no relation was found to exist between the amount of this reduction and the surface tension of the oil itself. The surface tension of acid water was either increased or decreased by the smaller additions of oil; but except in the case of olive oil, the larger additions caused a decrease in surface tension. The surface tension of alkaline water was increased by the larger quantities of certain oils, but generally unaffected by the smaller proportions. From the fact that the ability of the oils to produce a persistent bubble foam appeared to be independent of surface tension, it is concluded that, for flotation purposes, the foaming power of an oil is more important than its property of decreasing the surface tension of water.
—W. E. F. P.

Mineral output of British India in 1915. Board of Trade J., Oct. 26, 1916.

The Report for 1915 of the Chief Inspector of Mines in India contains the following particulars relative to the mineral output of British India last year:—There was a distinct advance in the output of coal, which amounted to 16,352,480 tons, an increase of 624,849 tons on the 1914 output. Of the 1915 total 95·93 per cent. was raised in Bengal and in Bihar and Orissa. The output of mica again decreased, and was the smallest since 1910, being only 24.063 cwt. as against 38.139 cwt. in 1914. Restrictions on export and the loss of the German market had an adverse effect on the sale of all grades of splittings. The chief demand was for good clear and part-stained block mica, for use, among other things, for the magnetos of aeroplanes. The trade in Madras mica was especially depressed. The manganese industry was very depressed during the first half of the year, and although there was a strong demand later, the shortage of tonnage prevented it from being fully met. The output of manganese was 378,172 tons, a decrease of 177,500 tons as compared with the 1914 production. The gold output of 1915 was 24,320 oz., as compared with 19,873 oz. in 1914. An output of 512 oz. silver is also reported from a gold mine; this is the first time that silver has figured in the records. The output of copper was 8010 tons, as compared with 4400 tons in 1914. During the greater part of the year the wolfram industry languished, but towards the close, efforts were successfully made to stimulate the production, resulting in a total output for the year of 39,432 cwt. as against 31,526 cwt. in 1914. There were increases in the output of bauxite, clay, fullers' earth, salt, magnesite, and galena, and decreases in iron, chromite, tin, steatite, samarskite, slate, and limestone. The limestone trade has suffered owing to building operations being reduced.

Mineral output of South Africa in 1915. Board of Trade J., Oct. 26, 1916.

According to the Report of the Government Mining Engineer, the total value of the mineral output of South Africa in 1915 is estimated at £43,531,000, a decrease of approximately £1,800,000 as compared with the value of the output in 1914. The decrease is more than accounted for by the decline of over £5,000,000 in the value of diamonds produced in 1915. The value of the gold output increased by nearly £3,000,000, whilst the value of copper, tin, and asbestos produced increased by approximately £400,000.

Design of acid-resisting iron apparatus. Swindin. *See* I.

New application of blast-furnace gas. Zimmermann. *See* IIa.

Patents.

Iron or steel: Apparatus for determining the "critical" or "conversion" point of samples of —— by measuring the electrical resistance of a test piece of such metal whilst heated to a high temperature. H. J. C. Simson, London. From P. Saldau, Petrograd. Eng. Pat. 12,993, Sept. 10, 1915.

A porcelain tube, fitted at both ends with detachable water-cooled extensions, is heated in an electric furnace, and a sample of iron or steel is held within the tube by a gripping device consisting of rods of nickel or nickel-chrome steel. The rods are suitably insulated and their ends, which extend from the tube, are water-cooled and connected with an electrical-resistance measuring apparatus. The temperature of the test specimen is measured by a thermo-couple. Means are provided for passing an inert gas through the tube, or for creating a vacuum therein. The varying resistance is plotted against temperature, the curve indicating by a modification of its shape the critical point of the sample.—T. St.

Steel: Process for casting —— in several layers. A. Rojekof, Bejitza, Russia. U.S. Pat. 1,197,859, Sept. 12, 1916. Date of appl., Aug. 12, 1911.

The mould is divided into two or more compartments by metal partitions which do not touch the walls of the mould. The partitions are made of such a thickness that they weld perfectly with the adjacent layers of molten steel, and are provided with means to facilitate their fusing with the steel. An ingot comprising different layers of steel is formed by charging the several compartments simultaneously with molten steel of different chemical composition.—T. St.

Heat treatment of iron and other metals by means of a reducing gas. Bunzlauer Werke Lengersdorff und Co., Bunzlau. Ger. Pat. 293,798, Oct. 20, 1915.

The metal is heated by means of a current of hot gas, the composition and temperature of which are controlled by addition of regulated quantities of cold gas produced in the same gas generator (see Fr. Pat. 422,699 of 1910; this J., 1911, 529).—A. S.

Furnace; Electric ——. Steel furnace. J. L. Dixon, Detroit, Mich. U.S. Pats. (a) 1,198,625 and (b) 1,198,626. Sept. 19, 1916. Dates of appl., (a) Apr. 10 and (b) July 15, 1916.

(a) The furnace is provided with a lower electrode and two or more groups of three upper electrodes, with main leads for supplying three-phase alternating current to transformers in groups of three, corresponding in number with the upper electrodes. One terminal of each secondary is connected to one of the upper electrodes, and the other secondary terminals are connected in common to the lower electrode. The primaries of one or more of the three-transformer groups are connected by conductors to the main leads in triangular fashion, and the remaining primary groups by conductors in star fashion. Two or more sets of multiple switches are arranged to reverse the terminal connections of one primary in each group connected in triangular fashion, with relation to two of the main leads, whilst also reversing the terminal connections of one primary in each star-connected group with respect to the interior or common connection of the star. (b) The upper electrodes are arranged in pairs in the furnace, which is provided also with a lower electrode, and three-phase alternating current is supplied from main leads to one or more transformers, the secondaries of which are connected so as to deliver two-phase currents to all but one pair of the upper electrodes. An additional transformer, delivering two-phase current from two secondaries, is connected with the main leads, with connections from the terminals of one of the secondaries to one of the remaining upper electrodes, and similar connections, arranged in two reversely-connected branches, between the terminals of the other secondary and the last upper electrode and the lower electrode respectively. Suitable switches are arranged in the two branches of the last-named connections to place the secondaries either in multiple arc or in series. —B. N.

Silvering and gilding metal articles; Preparations for ——. A. Dalby, London. Eng. Pats. 8866 and 8867, June 16, 1915.

Preparations for coating or plating metals such as iron, steel, copper, brass, or aluminium, are composed of equal parts of potassium iodide, potassium hydrogen tartrate, potassium cyanide, and the double cyanide of potassium and silver for silver plating or washing silver or silver-plated articles, or gold chloride for gilding or washing gold or gilded metals. One pint of distilled water is added to 8 oz. of the mixture, or the latter is made into a paste with 4 oz. of calcium carbonate and a few grains of calcium chloride.—B. N.

Metals; Production of granulated or finely divided ——. J. S. Remington, Grange-over-Sands. Eng. Pats. 13,958, Oct. 1, and 14,853, Oct. 20, 1915.

Molten metal is sucked up a tube from a crucible into an ejector by the action of a jet of steam, air, or gas, delivered under pressure (100 to 200 lb. per sq. in.) through a nozzle into the ejector. The jet picks up the molten metal and delivers it as a fine spray, the particles of which solidify as a granulated powder on coming into contact with the cool air. The gas or steam is strongly heated before coming into contact with the molten metal, by passing it through a coil contained in a hood just over the crucible, the hood serving also to exclude air from the crucible. The method is particularly applicable to the granulation of aluminium.—T. St.

Alloy. P. R. Kuehnrich, Sheffield. Eng. Pat. 14,939, Oct. 22, 1915.

A substitute for high-speed steel for making high-speed tools is composed of ferro-chrome (containing about 70% Cr and 4 to 6% C) 8, Ni 21, Si 1·7, Al 2·5 parts by weight. The base alloy of nickel, chromium, and silicon, is first melted, and the aluminium, ranging from 3 to 20% according to the hardness required, is then added. The molten alloy is cast into tools, which are ready for use, after grinding, without any additional heat treatment. Metals such as tungsten, vanadium, etc., in proportions up to about 1%, may be added to the base alloy, and the nickel may be wholly or partially replaced by cobalt.—T. St.

Radium; Process of treating ores containing ——. R. B. Moore, Denver, Colo., U.S.A. Eng. Pat. 16,228, Nov. 17, 1915.

The liquid obtained by leaching the ore (*e.g.* carnotite) with a hot solution of nitric acid containing a little hydrochloric acid, is nearly neutralised and then treated with barium chloride and sulphuric acid to obtain a precipitate of radium-barium sulphate.—W. E. F. P.

Ores; Process of treating ——. R. F. Bacon, Pittsburgh, Pa., Assignor to Metals Recovery Co. U.S. Pat. 1,197,589, Sept. 12, 1916. Date of appl., June 28, 1915.

To enable the constituents of non-sulphide ores to be separated from associated gangue and from each other, by flotation, the finely divided ore is subjected to the action of hydrogen sulphide in the presence of an excess of sulphur dioxide, to produce colloidal sulphur within the mixture and convert the metal compounds present into sulphides.—W. E. F. P.

[Copper-zinc] ores; Concentration of ——. R. F. Bacon, Pittsburgh, Pa., Assignor to Metals Recovery Co., New York. U.S. Pat. 1,197,590, Sept. 12, 1916. Date of appl., Nov. 10, 1915.

Non-sulphide ore containing metals forming sulphides soluble and insoluble in acid (*e.g.* zinc and copper, respectively), is treated with excess of acid, followed by hydrogen sulphide. The mixture is then subjected to a flotation process whereby a concentrate rich in acid-insoluble sulphides is obtained; the residual acid pulp is neutralised, treated with alkali sulphide, and then by flotation to recover the acid-soluble sulphides. Sulphide copper ore is partly roasted to convert the sulphides into compounds soluble in acid, then treated with acid and hydrogen sulphide in succession, and finally by flotation to recover the copper sulphide.—W. E. F. P.

Metal; Compound ——. B. E. Eldred, Assignor to General Electric Co., New York. U.S. Pat. 1,197,615, Sep. 12, 1916. Date of appl., Sep. 18, 1913.

A wire having as a whole a lower coefficient of expansion than platinum, is composed of a core of nickel steel, a layer of copper welded to the core, and an exterior sheath of platinum welded to the copper.—T. St.

Ferrous metals; Plating —— [*with copper*]. H. Eldridge, New York, Assignor to The Metals Plating Co. U.S. Pat. 1,197,616, Sept. 12, 1916. Date of appl., Apr. 3, 1913.

Ferrous metal is coated with cupric oxide and heated at substantially the melting point of the cupric oxide for about 4 to 10 seconds, until the iron reacts with the oxygen of the oxide. A substantially continuous coating of metallic copper in a weld-like union is thus formed. The iron oxide formed is superposed on the copper and is finally removed.—T. St.

Metals; Plating ——. W. E. Watkins, New York. U.S. Pats. (A) 1,197,694 and (B) 1,197,695, Sept. 12, 1916. Date of appl., Aug. 17, 1915. (See also Eng. Pat. 18,932 of 1914; this J., 1916, 53.)

(A) To plate iron or steel with copper, a coating consisting of a reducible compound of copper, a suitable reducing liquid vehicle, a finely divided solid reducing agent, and finely divided particles of copper, is applied, and the metal and coating are heated to so high a temperature and for so long as to form an adherent plating layer of copper. (B) Instead of the coating described in (A), a substantially homogeneous copper-plating suspension, comprising finely divided particles of copper, together with a suitable spreading vehicle of a reducing character, containing finely divided carbon in suspension, is used.—T. St.

[Gold and silver.] Precious metals from their ores; Method of extracting ——. T. B. Crowe, Victor, Assignor to The Portland Gold Mining Co., Colorado Springs, Colo. U.S. Pat. 1,198,011, Sept. 12, 1916. Date of appl., Mar. 2, 1915.

Air is blown continuously through a mixture of the finely divided ore and cyanide solution, the closed containing vessel having a relatively small air outlet so that the mixture is maintained under pressure.—W. E. F. P.

[*Gold and silver.*] *Precious metals from their ores; Process of extracting* ——. A. E. Vandercook, Alameda, Assignor to L. B. McMurtry, San Francisco, Cal. U.S. Pat. 1,198,086, Sept. 12, 1916. Date of appl., Oct. 24, 1914.

A mixture of the ground sulphide ore with alkali cyanide solution is caused to impinge repeatedly on a layer of mercury by which the larger metallic particles are amalgamated. The alkali sulphide formed is decomposed by the mercury-alkali cyanide produced in the solution, mercury sulphide being precipitated and the alkali cyanide regenerated. The precious metals are recovered by the usual methods from the cyanide solution and amalgam.—W. E. F. P.

Metals [*gold and silver*]; *Process and apparatus for extracting* —— *from their ores.* Koering Cyaniding Process Co. Fr. Pat. 479,683, Sept. 7, 1915.

Within a closed, horizontal, rotary cylinder a smaller perforated cylinder is fixed co-axially by means of channel irons which divide the annular space between the cylinders into longitudinal compartments. The perforated cylinder, into which the ore and solvent (cyanide solution) are charged, is lined inside with a refractory filtering medium in the form of slabs or tiles, the latter being maintained in position by angle irons disposed longitudinally so as to form a series of narrow shelves along the inside of the chamber, and "caulked" with strips of lime wood or other material adapted to expand when moistened. Means are provided for the admission of air and water or other liquid to the inner and outer cylinders, the arrangement being such that during rotation the solvent is caused to pass repeatedly through the ore and filtering medium in alternately opposite directions before discharge.
—W.E.F.P.

Arsenical material; Process of treating —— [*for the recovery of zinc*]. D. Anderson, jun., San Francisco, Cal. U.S. Pat. 1,198,095, Sept. 12, 1916. Date of appl., Feb. 7, 1914; renewed June 6, 1916.

Arsenical ore, flue-dust, etc., containing iron and zinc, is treated with rather more than sufficient sulphuric acid (or gases containing sulphur trioxide) to convert the bases present into normal sulphates, and the mixture evaporated to dryness and heated to expel arsenic. After being roasted at such a temperature that only a small proportion of the zinc is rendered insoluble, the residue is leached with water.—W. E. F. P.

Bearing material and process of producing the same. R. E. Rich, Chicago, Ill. U.S. Pat. 1,198,152, Sept. 12, 1916. Date of appl., Apr. 17, 1915.

Molten Babbit metal is incorporated with particles of graphite, the latter being heavily coated with lead and having a minimum sp. gr. of 6·8; the mixture is allowed to solidify.—W. E. F. P.

Copper-refining. U. A. Garred, New York. U.S. Pat. 1,198,434, Sept. 19, 1916. Date of appl., Apr. 26, 1916.

Copper is melted and "flapped" in a cupola wherein it is subjected to the action of flaming particles and highly heated products of combustion and air. The molten metal is partially "poled" by being passed over solid carbonaceous material, and is then conducted to a "poling furnace" where it is first blown with air to effect any desired oxidation, and finally with non-oxidising gas charged with finely divided carbon particles to complete the "poling." The molten "flapped" copper is received from the cupola into a tilting ladle, from which it is delivered alternately to two "poling furnaces" spaced apart.—T. St.

Brass and copper alloys; Process of making ——. G. H. Clamer, Philadelphia, Pa. U.S. Pat. 1,198,618, Sep. 19, 1916. Date of appl., Feb. 16, 1915.

The copper is melted, then introduced into an electric furnace, and the alloying materials added, a proper temperature being maintained during the addition to avoid volatilisation; the resulting alloy is finally brought to the proper casting temperature.—B. N.

Brass: Method of obtaining —— *directly by the use of low-grade zinc ores.* M. Pierron. Fr. Pat. 479,599, Aug. 26, 1915.

Finely-powdered low-grade oxidised zinc ore, etc., is heated, preferably in crucibles, with an excess of carbon and copper strips or turnings to 800°—950° C. for 6 to 10 hours, whereby the zinc vapour is absorbed by the copper, without fusion of the product. The copper may thus be converted into brass containing 10 to 20% Zn in one operation. By repeating the operation three or four times, the zinc content may be raised to 40—45%, but to obtain any given exact composition, it is necessary to melt the brass so formed, and make suitable additions of copper or zinc.—T. St.

Vacuum-filter; Rotary —— [*for use in treatment of ores*]. E. Wagner, New York. U.S. Pat. 1,198,880, Sep. 19, 1916. Date of appl., Mar. 13, 1913.

An apparatus for recovering values from ore solutions consists of a drum made up of two rotary rings, forming two independent compartments, and a number of independent and detachable filtering units attached to the periphery of the drum. Each unit consists of a pan with a grooved perforated bottom on which rests filtering material. Each pan communicates through perforations with both compartments, one of which is connected with a pressure system and the other with a suction system. Two valves are associated with each pan for controlling the communications with the two compartments, and means are provided for automatically actuating the valves during the rotation of the drum. The material to be filtered is fed into the pans from above as the drum rotates.—T. St.

Lead matte: Treating ——. U. Wedge, Ardmore, Pa. U.S. Pat. 1,198,882, Sept. 19, 1916. Date of appl., Jan. 29, 1913.

Lead matte is passed through a furnace of the superposed hearth type so arranged that the matte is first gently heated, and later, when a suitable proportion of the sulphur has been removed, strongly heated to complete the desired desulphurisation.—T. St.

Welding [; *Flux for* ——]. C. W. Phelps, Coupeville, Wash., Assignor to D. E. Richardson, Riverside, Wash. U.S. Pat. 1,199,020, Sept. 19, 1916. Date of appl., June 6, 1914.

A flux for welding and working iron and steel is composed of volcanic ash 9 parts, and sodium chloride 1 part.—W. F. F.

Zinc and lead; Condenser for vapours of ——. Soc. Anon. Métallurgique "Procédés de Laval." Fr. Pat. 478,942, June 7, 1915.

The bottom of a vertical condenser is closed by a conical member which forms part of a rotary, sand-sealed receiving chamber and supports one or more shaped but loosely-fitting blocks. By the grinding action set up between the blocks, the conical base, and the sides of the condenser on rotating the receiving chamber, the globules of metal percolating through the interstices between these members are caused to coalesce and the liquid metal to flow down the conical surface into the chamber beneath.—W. E. F. P.

[*Lead-zinc*] *ores; Process for the treatment of low-grade, complex* ——. H. E. L. Fiévet. Fr. Pat. 479,039, June 15, 1915.

Low-grade, complex ore not amenable to concentration by ordinary methods and containing, for example, lead, zinc, arsenic, antimony, and precious metals, is mixed with oxide and sulphide ores of iron and a little copper (ore or scrap), and the mixture smelted with iron slag, in a water-jacketed furnace, to produce a matte containing all the metals in question. The matte is tapped into a converter and "blown" in the presence of powdered coke to eliminate the more volatile metals, which are recovered as oxides or sulphates, in condensing chambers, and leave a matte rich in copper and containing the precious metals.—W. E. F. P.

Metal alloys; Fusion of ——. A. Hermansen. Fr. Pat. 479,757, Sept. 17, 1915.

In the manufacture of alloys (*e.g.* brass) composed of volatile and non-volatile metals, loss by volatilisation is prevented by melting the non-volatile constituents together at a higher temperature than usual and adding the volatile metals after the charge is removed from the furnace.—W. E. F. P.

Ores; Two-stage process for the treatment of ——. Westdeutsche Thomasphosphat-Werke Ges., Berlin. Ger. Pat. 294,119, May 20, 1914.

The ore is first smelted in an electric furnace, with exclusion of air, or in a reducing atmosphere, and the reduced material is separated from the slag and transferred to a fuel-fired furnace, reverberatory furnace, or converter for further treatment. —A. S.

Steel; Manufacture of —— *by the basic open-hearth process.* A. E. Davies, Bilston. U.S. Pat. 1,198,827, Sept. 19, 1916. Date of appl., Sept. 21, 1915.

See Eng. Pat. 20,582 of 1914; this J., 1915, 874.

Manganese-steel; Heat treatment of ——. Manganese Steel Rail Co. Fr. Pat. 477,880, Mar. 4, 1915. Under Int. Conv., Apr. 17, 1914.

See U.S. Pat. 1,123,003 of 1914; this J., 1915, 181.

Coatings of copper upon iron and steel; Process for obtaining adhesive ——. S. O. Cowper-Coles, London. U.S. Pat. 1,198,703, Sept. 19, 1916. Date of appl., Aug. 21, 1914.

See Eng. Pat. 25,393 of 1913; this J., 1914, 793.

Metals from their ores; Apparatus for the recovery of ——. Koering Cyaniding Process Co., and B. R. Koering, Detroit, Mich., U.S.A. Eng. Pat. 12,137, Aug. 23, 1915.

See U.S. Pat. 1,163,828 of 1915; this J., 1916, 184.

Roasted ores; Process and apparatus for the treatment of —— *with liquids.* A. Ramén. Fr. Pat. 477,906, Mar. 5, 1915. Under Int. Conv., Mar. 17, 1914.

See Eng. Pat. 15,254 of 1915; this J., 1915, 838.

Metallurgical furnaces. I. Hall. Fr. Pat. 478,158 Mar. 26, 1915. Under Int. Conv., Mar. 23, 1914

See Eng. Pat. 7238 of 1914; this J., 1915, 556.

Metals; Electrical deposition of —— *by fusion, and electrodes therefor.* Slaughter and Co., Ltd. Fr. Pat. 478,247, Apr. 3, 1915. Under Int. Conv., June 3, 1914.

See U.S. Pat. 1,141,390 of 1915; this J., 1915, 838.

Sulphide ores; Separation of mixed ——. Minerals Separation, Ltd. Fr. Pat. 478,478, Apr. 22, 1915. Under Int. Conv., May 1, 1914.

See Eng. Pat. 5650 of 1915; this J., 1916, 639.

Concentration of ores. Minerals Separation, Ltd. Fr. Pat. 479,719, Sept. 11, 1915. Under Int. Conv., Sept. 16, 1914.

See Eng. Pats. 19,855 and 19,856 of 1914; this J., 1916, 184.

Volatile metals, especially zinc; Manufacture and condensation of —— *in the electric furnace.* A./S. Metalforedling. Fr. Pat. 478,770, Jan. 27, 1915.

See Ger. Pats. 289,493, 290,499, 290,690, and 291,492 of 1914; this J., 1916, 427, 606, 695.

Ores; Process of smelting —— *and electric furnace therefor.* F. W. Highfield. Fr. Pat. 478,778, May 21, 1915.

See Eng. Pats. 4937 of 1914 and 2728 of 1915; this J., 1915, 720.

Metals from metalliferous materials; Extraction of ——. H. D. Rankin. Fr. Pat. 479,493, Aug. 10, 1915.

See U.S. Pat. 1,150,787 of 1915; this J., 1915, 968.

Protective coatings of alloys for metal articles, and process of applying the same. C. Mark. Fr. Pat. 479,509, Aug. 13, 1915.

See U.S. Pat. 1,155,317 of 1915; this J., 1915, 1151.

Process for forming a metal coating upon cement-mortar, plaster-mortar, or gypsum-mortar, trass-mortar and the like, with or without admixture of sand, granite, marble, and the like. Eng. Pat. 14,226. *See* IX.

Antimony compounds for treatment of parasites and parasitic diseases of plants [*and extraction of antimony from metallurgical products*]. Fr. Pat. 479,097. *See* XIXb.

XI.—ELECTRO-CHEMISTRY.

Lead accumulator; Theory of the ——. C. Féry. Jour. de Phys., 1916, 21. Amer. J. Sci., 1916, 42, 366—368.

The behaviour of the lead accumulator while discharging is stated to be similar to that of a primary cell, such as the manganese cell, with a solid depolariser, with the difference that the negative electrode gives rise to an insoluble salt. The theory of "double sulphating" is stated to be incorrect, and the reaction during normal discharge is given by the equations:—$Pb+H_2SO_4+Pb_3O_7=PbSO_4+H_2O+3PbO_2$, or $Pb+H_2SO_4+Pb_2O_5=PbSO_4+H_2O+2PbO_2$. These equations show a formation of 15 and 10·4 grms. of the higher oxide per ampère-hour respectively, and the best commercial tests have given 12 to 14 grms. for thin plates slowly discharged. The quantity of acid combined during the discharge is exactly one-half of the amount required by the theory of "double sulphating," and the variations in mass of the positive plate are very small and are in the opposite sense to those required by the theory. If the formula Pb_2O_5 is accepted, the mass of lead in the positive electrode must be exactly double that taking part in the reaction in the negative grid: the active material of the positive plate is reduced to lead peroxide during the discharge.—B. N.

Patents.

Electrolysers; Bi-polar electrode ——. G. G. Hepburn, Manchester. Eng. Pat. 12,730, Sept. 6, 1915.

The electrodes are suspended, face to face, by means of insulating collars on an insulating bolt, so as to form narrow vertical adjustable cells, open at the top and bottom, between the electrodes. These spaces are closed at the side by walls formed of insulating material fixed in vertical grooves in the electrodes. Portions of the upper part of each electrode are cut away, so that a trough is formed above each narrow cell. The lower end of each of the narrow cells is partially closed by a movable bar or wedge, and parallel grooves are cut in the electrodes on each side of these to prevent passage of the electrolyte from one cell to another. Electrolyte is delivered continuously to the upper troughs, and falls in sheets through the vertical cells for treatment.—B. N.

Electrolytic apparatus. W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,198,024, Sept. 12, 1916. Date of appl., Dec. 11, 1911; renewed May 11, 1916.

Horizontal cathodes are arranged within a tank containing the cathode electrolyte, and an anode bell, containing horizontal anodes and anode electrolyte, and closed below by a diaphragm, is suspended within the tank and oscillated by suitable means. Means are also provided for separately introducing and withdrawing the anode and cathode electrolytes, and for catching and removing the disintegrated anode material. A reagent is introduced into the anode bell to combine with the liberated anions, and the regenerated electrolyte is withdrawn through a flexible outlet attached to the anode bell and passing through the cathode electrolyte and the sides of the cathode tank.—B. N.

Furnace: Electric arc ——. C. O. A. Dövle, Notodden. Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,198,116, Sept. 12, 1916. Date of appl., Apr. 13, 1915.

A support, projecting inwards, is fixed to the wall of the furnace, and an adjustable electrode is mounted in the support, the electrode projecting through an aperture, in the wall, of larger diameter than the electrode. The aperture is surrounded by a collar, and a spherical cap is arranged to slide on the collar and electrode, and is pressed by a spring against the collar so as to form a gas-tight joint.—B. N.

Carbon articles; Method of [*electrically*] *heating* —— *in independent units.* J. W. Brown, Lakewood, Ohio. Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,198,616, Sept. 19, 1916. Date of appl., June 6, 1912.

The body portion of an electric resistance furnace is formed as a movable receptacle, which is removed from its position for charging and discharging, and is then replaced and connected to the electrodes. —B. N.

Electrodes for electric arc furnaces; Supports for ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 478,491, Apr. 23, 1915. Under Int. Conv., Apr. 30, 1914.

See U.S. Pat. 1,198,116 of 1916; preceding.

Electric arc furnaces. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 478,694, May 15, 1915. Under Int. Conv., May 19, 1914.

See U.S. Pat. 1,193,882 of 1916; this J., 1916, 971.

Insulating material [*from waste paper*] *and process for producing the same.* U.S. Pat. 1,198,028. *See* V.

Electrolysis of alkali chlorides. Eng. Pat. 101,440. *See* VII.

Electric furnace. U.S. Pat. 1,198,625. *See* X.

Electrically indicating the presence of saline, alkaline, and acid impurities in feed water used for steam generators and other purposes. Eng. Pat. 101,387. *See* XIXb.

XII.—FATS; OILS; WAXES.

Vegetable oils: New sources of ——. Z. angew. Chem., 1916, **29**, 363.

The proportion of oil (2½%) said to be obtainable from lime (linden) seeds (this J., 1916, 1069) has been under-estimated. Recent determinations gave 9·4% of oil, while very good seeds of *Tilia tomentosa* yielded 12·36% and those of *T. parvifolia* 20·36% on extraction. From the oil extracted from horse chestnuts up to about 80% of an edible oil, which resembles rape seed oil in composition, can be obtained. Official instructions have been issued in Germany that the fat must be extracted from these fruits before they are used for fodder. —C. A. M.

Oil extraction from olives: Utilisation of the residues of ——. H. Chevalier. Bull. de l'Agric., Tunis, 1915, **19**, 277—283. Bull. Agric. Intell., 1916, **7**, 591—592.

The *margines* of French olive growers is identical with the *amurca* of the ancient Latins, who used it as a fertiliser and insecticide. It is estimated that about 80,000 metric tons of this product is wasted yearly in France. Analysis by Bertainchand of a sample of margines of sp.gr. 1·150 gave the following results:—Mineral matter, 24·20; potash, 12·43; soda, 0·36; lime, 0·78; phosphoric acid, 0·39; chlorine, 2·52; and nitrogenous substances, 3·98 grms. per litre. The annual loss to the soil from this source would thus amount to 9800 tons of potash, 3200 tons of nitrogenous substances, 600 tons of lime, and 300 tons of phosphoric acid. It is suggested that this waste product should be used either in the form of a powder or a wash to destroy scale insects.—C. A. M.

Oil-seeds derived from American palms; Some new ——. G. T. Bray and F. L. Elliott. Analyst, 1916, **41**, 298—302.

Several specimens of oil seeds from South and Central America were examined at the Imperial Institute; the kernels of the seeds or nuts will possibly form valuable additions to the oil seeds now utilised as sources of edible fat. In the case of Babassu and Cohune nuts there is considerable difficulty in extracting the kernels from the nuts on account of the thick hard shells. About 1200 tons of Babassu kernels was exported during 1915. The composition of the kernels and the characters of the fats are given in the following table:—

	Attalea species.	*Attalea Cohune.*	*Astrocaryum* species. *A. vulgare.*		*Acrocomia* species.	*Acrocomia sclerocarpa.*	*Maximiliana regia.*
Popular or native names.	Bassoba, Babassu, Coco Babassu.	Cohune, Coyun, Cahoun.	Tucan.	Large Panama nuts.	Paraguay kernels.	Gru-gru kernels.	Cokerite kernels.
Origin.	Brazil.	British Honduras.	S. America.	S. America.	S. America.	W. Indies.	British Guiana.
Composition of kernels :—	%	%	%	%	%	%	%
Moisture	4·2	4·5	6·5	7·1	6·0	6·1	11·3
Oil	67·2	65·4—71·6	48·6	37·6	65·2	57·0	56·9
Characters of oil :—							
M. pt.	26° C.	22°—24° C.	30·5° C.	—	—	—	27° C.
Titre test	23° C.	19·7°—21° C.	27° C.	—	21° C.	21·5° C.	24·2° C.
Sp. gr. at 100°/15° C.	0·868	0·870	0·867	—	0·865	0·868	0·867
Acid value	5·5	1·2— 20·4	2·9	—	26·1	1·4	3·1
Saponif. value	249	252·4—256·5	249	250	247	254—255	253
Iodine value (Hübl, 17 hrs.)	15·6	11·0— 13·7	11·6	—	28·5	16·2—21·0	13·0
Reichert-Wollny value ..	5·8	6·8— 8·3	3·8	—	6·5	5·7— 6·8	3·0
Polenske value	10·2	12·5— 15·4	5·9	—	10·2	10·0—12·6	7·0
Unsaponifiable matter, %..	0·3	0·2— 0·3	0·3	—	0·3	0·4— 0·5	0·3

—W. P. S.

Shark liver oil : A highly unsaturated hydrocarbon in ——. M. Tsujimoto. J. Ind. Eng. Chem., 1916, 8, 889—896. (See also Mastbaum, this J., 1916, 316.)

The hydrocarbon, squalene, present in certain shark liver oils (this J., 1916, 609), could readily be prepared on a commercial scale in Japan by distilling oils containing it under reduced pressure or with superheated steam and then washing the distillate with alkali to remove free fatty acids. The hydrocarbon has $n_D^{20} = 1·4965$, and is readily soluble in ether, petroleum spirit, carbon tetrachloride, and acetone, and sparingly soluble in cold alcohol and glacial acetic acid. When mixed with 1% of cobalt resinate, it dried in about 10 days in winter to a colourless smooth film, firmer than films obtained from fatty oils. The product obtained by complete hydrogenation of squalene is an oil resembling "liquid paraffin," which sets to a transparent jelly at −80° C., and becomes mobile again at −35° C.—A. S.

Hydrogenation of fatty oils : Problem of catalyst poisons with reference to the ——. C. Ellis and A. A. Wells. J. Ind. Eng. Chem., 1916, 8, 886—888.

One of the chief difficulties in the hydrogenation of low-grade oils, such as fish and whale oils, is that the nickel catalyst is soon rendered inactive. In some cases the substance which affects the catalyst is absorbed or fixed by the latter, for if the inactive catalyst be removed, the hydrogenation can be readily completed with a fresh quantity of catalyst. Moreover in many cases oils can be purified by agitating with spent catalyst so that hydrogenation can subsequently be readily effected. Of various methods tried for removing the substance or substances which render the catalyst inactive, agitating and heating the oil with freshly precipitated copper hydroxide was found most effective, especially if preceded by treatment with caustic soda or sodium carbonate solution. Satisfactory results in this way were obtained with cod oil, menhaden oil, and herring oil. With dog-fish oil it was necessary to filter off the catalyst after a preliminary treatment, then add a mixture of finely-divided nickel-copper hydroxide, and again treat with hydrogen before satisfactory hardening could be effected.—A. S.

Arachidic acid [arachis oil] : Detection of ——. R. H. Kerr. J. Ind. Eng. Chem., 1916, 8, 904.

The presence of 5% of peanut (arachis) oil in olive oil, cottonseed oil, soya bean oil, and corn (maize) oil can be detected by the following method. 20 grms. of the oil is saponified with alcoholic potassium hydroxide, and the excess of alkali is neutralised with a 25% solution of acetic acid in 95% alcohol, in presence of phenolphthalein. The mixture is treated with 50 c.c. of a 5% solution of magnesium acetate in a mixture of equal parts of water and 95% alcohol, heated to boiling, cooled to the ordinary temperature, with occasional shaking, and then kept at 10°—15° C. until next day. The precipitate is filtered off, washed twice with 50% alcohol and three times with water, then treated, in the flask in which precipitation was effected, with 100 c.c. of hot water and sufficient dilute sulphuric acid to decompose the magnesium salts. The separated fatty acids, after washing with water, are dissolved in 90% alcohol, and arachidic acid separated by crystallisation.—A. S.

Marine animal oils in oils, fats, and soaps ; Detection of ——. J. Marcusson and H. von Huber. Mitt. K. Materialprüf., 1916, 34, 56—60.

Products such as "neutraline" prepared by heating marine animal oils in absence of air or in presence of an inert gas, do not respond to the octobromide test (Mitt. K. Materialprüf., 1911, 469), but give a positive result with Tortelli and Jaffe's colour reaction (this J., 1914, 1061 ; 1915, 1102). They are also characterised by high specific gravity (over 0·930) and high viscosity (from 31·7 to 49·5 Engler degrees at 20° C. in four samples examined). Certain other oils possess high specific gravity and high viscosity, but may be easily recognised, *e.g.*, castor oil by its solubility in alcohol and high acetyl value, "soluble castor oil" (blown castor oil) by yielding a considerable quantity of hydroxy-acids insoluble in petroleum spirit, and lithographic varnish and similar products prepared from linseed oil, by their odour and by the phytosteryl acetate test. Hydrogenated marine animal oils may be detected by examination of the unsaponifiable matter for the presence of octodecyl alcohol of m.pt. 60° C. (Marcusson and Meyerheim, this J., 1914, 491). Clupanodonic acid, the constituent of marine animal oils to which the octobromide reaction is due, is present in small quantities in some oils from terrestrial animals, but in cases where any doubt may arise, recourse may be had to quantitative determination of the amount of octobromide, and to determinations of the iodine values of the oil and of the liquid fatty acids.—A. S.

Suberogenic acids. [*Fatty acids from cork.*] F. Scurti and G. Tommasi. Gaz. Chim. Ital., 1916. **46**, II., 159—168.

The authors have shown previously (this J., 1913, 512) that the constituent of cork named fellonic acid by Kügler is really α-hydroxybehenic acid. Investigation of the suberinic and floionic acids of Gilson (La Cellule, VI., 1890, 63) has now shown that these are respectively ricinoleic acid or an isomer and a saturated tricarboxylic acid of the fatty series, $C_{22}H_{13}(COOH)_3$, m.pt. 121° C. Cork substance must therefore be regarded as a combination of cellulosic and hemicellulosic derivatives with products of the enzymic oxidation of fatty acids.—A. S.

Surface tension of oil-water emulsions. A flotation theory. Belchic and Neal. *See* X.

Detection of benzoic acid in [*edible*] *fats.* Stadlin. *See* XIXa.

Glycerin as medicine. See XX.

Catalytic hydrogenation of organic compounds with base metals at the ordinary temperature. Influence of contact poisons on hydrogenation. Kelber. *See* XX.

Patents.

Catalysts for hydrogenation processes, particularly for the hydrogenation of fatty acids and their esters: Preparation of ——. E. B. Higgins, Wallasey. Eng. Pat. 23,873, Oct. 21, 1913.

Fatty acid salts, such as the formates, of nickel, cobalt, iron, or copper, are heated until the mass blackens, preferably in a vessel from which the air has been expelled by means of nitrogen or other inert gas. The resulting product does not lose its catalytic activity on exposure to the air at ordinary temperatures.—C. A. M.

Cocoa [*cacao*] *butter and the like: Horizontal hydraulic presses for pressing out* ——. D. T. Hänel, Dresden, Germany. Eng. Pat. 13,188, Sept. 15, 1915.

A horizontal press constructed on the principle of the upright "pot press," contains a series of annular vessels or hollow pots, which are pressed forward by the piston until a cover plate comes against the end member of the series and closes it, after which the pressing is completed by the telescoping of the hollow pots and plungers in the column. The piston is then drawn back, and the pots are clamped in position whilst uncoupled from the succeeding press plungers, which, when now moved forward again, expel the press-cakes from the hollow vessels.—C. A. M.

Catalysts [*for hydrogenation of oils and fats*]. N. Sulzberger. Fr. Pat. 478,911, June 1, 1915. Under Int. Conv., Feb. 25 and June 9, 1914.

See U.S. Pat. 1,143,332 of 1915; this J., 1915, 822.

Process of regenerating [*nickel*] *catalysts.* U.S. Pat. 1,199,032. *See* I.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Paints; Effect of storage on mixed ——. E. E. Ware and R. E. Christman. J. Ind. Eng. Chem., 1916, 8, 879—883.

Mixed paints to which small quantities of water containing an emulsifying agent have been added to retard settling of the pigment, may deteriorate on prolonged storage owing to "skinning" or to "puttying." The former term is used here to denote the formation of an amorphous soapy layer between the settled pigment and the supernatant vehicle, and the latter, the gelatinisation of the whole of the paint to a soft, putty-like mass. Several samples of composite-base paints which had been kept for periods varying from two to eight years were examined. The amorphous layer in samples of paints in which "skinning" had occurred, was found to consist chiefly (*e.g.* to the extent of over 80%) of zinc soap, and its formation is due to combination of the oxides of the pigment with free fatty acids produced by the saponification of the oil of the vehicle by the aqueous emulsifying agent. When dissolved resinates formed from added "gloss oil" are present in sufficient quantity, the viscosity of the vehicle is increased to such a degree that the metallic soaps formed and the pigments are prevented from settling, and "livering" or "puttying" takes place. It is suggested that an aqueous emulsifying agent containing a substance which exerts no saponifying action on linseed oil should be used, or a non-aqueous protective colloid, such as aluminium palmitate or oleate, should be added to prevent settling of the pigment. The setting of mixed paints to a hard mass might be prevented by grinding the pigments in an oil of fairly high acid content or by adding the optimum amount of lead or zinc soap to the pigments ground in a neutral oil.—A. S.

Turpentine: Italian ——. *Oil of turpentine from Pinus pinea. L.* F. C. Palazzo. Annali Chim. Appl., 1916, 6, 135—153.

Turpentine has been collected and distilled on a small scale in Tuscany for the past five or six years, but the production of Italian oil of turpentine is negligible compared with the quantity (about 3000 metric tons per annum) imported, chiefly from the United States and France. Italian turpentine is obtained from *Pinus pinaster* (*P. maritima*) and from *P. pinea*, and the variable character of the product is due to the fact that the two kinds are distilled together indiscriminately, although they yield oils of entirely different characters. The author has examined samples of oil of turpentine distilled in the laboratory with steam at 2½—3 atm. pressure from specimens of the oleoresin of *P. pinea* collected under his personal supervision. The characters of the oil were: sp.gr. at 15° C., 0·8473—0·8507; $n_D^{20} = 1{\cdot}4731—1{\cdot}4737$; α_D (100 mm.) = −93·80° to −97·30°; flash point (Abel apparatus, with bath at 80° C.), 50°—51° C.; soluble in about 5 vols. of 90% alcohol. On fractional distillation the oil yielded 85—90%, distilling between 174° and 180° C., and this fraction was found to consist almost entirely of limonene. The pure limonene obtained from it by distilling in presence of sodium and again fractionating, had the characters: b.pt., 175°—176° C.; sp.gr. at 20°/15° C., 0·8432; $n_D^{20} = 1{\cdot}4720$; $\alpha_D^{20} = -120{\cdot}36$. It is urged that the production of oil of turpentine from *P. pinea* should be developed in Italy, as the oil, apart from the advantages it possesses in many respects over ordinary oil of turpentine, is of value as a commercial source of limonene, which is largely used in the manufacture of artificial essential oils and scented soaps and as a solvent in the varnish industry.—A. S.

Kauri-gum industry of New Zealand in 1915-16. Board of Trade J., Oct. 26, 1916.

The second annual Report of the Superintendent of the Kauri Gum Industry in New Zealand states that shortly after the declaration of war there was a decided slump in the industry, and in order to alleviate the depression the New Zealand Government passed an Act in 1914 which empowered the Minister of Land to buy and sell gum. The original intention was to advance up to 50% of the value of the gum on the basis of prices current on 1st July, 1914, and when the gum was sold to hand over to the producer the proceeds less the amount advanced and all charges incurred in connection with the handling of the gum. Later it was arranged to make a further advance of 20%, and finally, by an amending Act in 1915, the Minister was empowered to make purchases outright, the probability being that all future purchases will be so made. The Act of 1914 referred to above also authorised the Minister of Lands to employ workmen on the Crown gum lands. This was given effect to, and the system known as "face-digging" was put into operation. The special feature of "face-digging" is that while recovering gum from the surface of the ground the surface is levelled and made suitable for subsequent farming operations. Wherever it is practicable stumps are removed in the process of digging operations, as is also loose timber, for it is under the stumps that the large deposits of gum are often found. For the profitable carrying on of this work it will be necessary to obtain some mechanical appliance for dealing with the timber, not only in order to remove it from the ground, but also to facilitate its disposal. Much consideration has been given to the possibility of extracting gum from this timber Gum is also collected by tapping kauri trees. It is said that it is possible to bleed the kauri without doing any appreciable injury to the tree, and it is estimated that for every million feet of milling lumber in a forest a net annual revenue of £75 could be obtained by the tapping process. The fossil kauri gum when taken from the ground is scraped with a strong pocket knife in order to clean it. Some better method of cleaning is necessary, and a sand-blast apparatus of local invention seems to promise good results. An experimental plant equipped at Auckland proved successful, and a factory was afterwards erected in Dargaville to clean gum for the market. The quantity of gum exported in 1915 was 4575 tons, valued at £279,133, as compared with 8473 tons, valued at £497,444, in the previous year. From 1st January to 30th June in the current year, however, 2644 tons of gum, valued at £164,291, was exported. Latterly there was little or no demand for Government advances owing to the fact that local merchants were buying freely and at good prices. The United States not only takes by far the greatest proportion of the kauri-gum output of New Zealand, but also the most expensive grades. The gum exported to the United Kingdom includes a considerable proportion of low-grade chips and dust used in linoleum manufacture. Considerable attention has been directed lately to the question of the profitable utilisation of kauri-swamp peat by the extraction of oils and other valuable products, and two syndicates have carried out a large amount of preliminary investigation work in connection therewith.

Formation of cobalt aluminate, cobalt orthostannate, and Rinman's green. Hedvall. *See* VII.

PATENTS.

Paint for general purposes; Composition of matter to be used as a ——. N. B. Arnold, Brooklyn, N.Y., U.S.A. Eng. Pat. 101,365, Feb. 8, 1916. (Appl. No. 1860 of 1916.)

A PAINT which has good covering power and does not crack or peel when dry is obtained by incorporating zinc oxide (300 lb.) with silica (75 lb.) and linseed oil (9 galls.).—C. A. M.

Paint composition. B. T. Brooks and F. W. Padgett. Assignors to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,197,599, Sept. 12, 1916. Date of appl., Aug. 10, 1914.

THE pigment is incorporated with an unsaturated, non-saponifiable, non-volatile hydrocarbon which will yield a film on drying.—C. A. M.

Crayons, pencils, or masses; Phosphorescent or luminous ——. Self-luminous pencils or crayons. W. C. Horne, North Cheam. Eng. Pats. (A) 16,518 and (B) 16,519, Nov. 23, 1915.

(A) PHOSPHORESCENT calcium sulphide prepared as described in Eng. Pat. 805 of 1881, or commercial "luminous sulphide of calcium" is digested with a mixture of water and alcohol until the lime present is completely slaked. It is then incorporated with a mixture of soap with spermaceti, lanoline, or an oil such as castor or almond oil, with or without crystalline sodium phosphate, and the warm mass is moulded into crayons, which will remain permanently soft. The calcium sulphide may be replaced by phosphorescent zinc sulphide, which should be moistened with alcohol before compounding with the other ingredients. (B), Luminous pencils which do not require exposure to light are prepared by mixing a radioactive substance, such as commercial radium bromide (30 grains) with a "screen element" such as zinc sulphide or the like (90 grains), and incorporating the mixture with a fatty or soapy medium such as an alcoholic solution of pure potash soap or a chloroform solution of wax, or both; or the active ingredient may be mixed with gum, or with a finely powdered resin, and the mixture formed into a mass by pressure and heat.—C. A. M.

Mimeograph inks, and process of making same. R. Hochstetter. Assignor to The Ault and Wiborg Co., Cincinnati, Ohio. U.S. Pats. (A) 1,198,440, (B) 1,198,441, and (C) 1,198,442, Sept. 19, 1916. Date of appl., Feb. 4, 1914.

(A) A CARBON black pigment is ground with a mineral oil, with or without the addition of a small proportion of a blue pigment, and the mixture is incorporated with Turkey-red oil or other sulphonated oil. (B) A coloured pigment or lake colour is used instead of the black pigment specified in (A). (C) A dyestuff of the desired colour, or its base, is dissolved in alcohol, an acid capable of forming oil-soluble colours, and a small proportion of a solvent for basic aniline dyestuffs are added. The solution is ground with a mineral oil, with or without the addition of another pigment, and Turkey-red oil is added to the mixture.—C. A. M.

Wooden articles; Superficial finishing of ——. E. S. Buffum, Newton, Mass. U.S. Pat. 1,197,601, Sept. 12, 1916. Date of appl., Sept. 3, 1912.

THE surface is treated with melted rosin or other filling material until air and moisture have been expelled from the pores. The rosin is then allowed to harden, and the surface is coated with a phenol-resin varnish or other "convertible varnish," and, after drying, is heated at a temperature below the melting point of the rosin, until the resinous constituent of the varnish has become hardened.—C. A. M.

Clarifying agents from the nitro-derivatives of resins, balsams, or their constituents. C. Bauer. Ger. Pat. 292,542, Nov. 3, 1914.

NITRATED colophony, resin, balsam, etc., may be used for clarifying turbid aqueous liquids. The nitro-derivatives are ground very finely with a small quantity of water or dissolved in a solvent miscible with water, or in alkali hydroxide or carbonate solution, before being added to the solution to be clarified. When alkaline solutions are used, a precipitant, *e.g.* an acid, or a salt such as lead acetate or alum, is also added. When used for clarifying alimentary products, such as gelatin solutions, the nitro-derivatives must first be freed from bitter substances by dissolving in excess of alkali hydroxide or carbonate solution and heating until saponification begins. *Example:* A solution of 100 grms. of dextrin in 300 grms. of water is stirred in the cold with 5 c.c. of a solution containing 10% of nitrated resin and 90% of alcohol, filtered, and concentrated if necessary; the solution will remain clear.—F. W. A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Vulcanised rubber and the like; Process for regenerating ——. B. J. F. Varenhorst, The Hague, and J. G. Fol, Delft, Holland. U.S. Pat. 1,198,975, Sept. 19, 1916. Date of appl., May 4, 1914.

The material is finely divided, boiled in an alkaline solution, and heated, with constant agitation, in an atmosphere of an inert gas to a temperature close to but below the melting point.—C. A. M.

Rubber; Process for moulding vulcanised ——. J. D. Mundi. Fr. Pat. 479,543, Aug. 17, 1915. Under Int. Conv., Feb. 23, 1915.

Vulcanised rubber waste, broken up or powdered, with or without the addition of raw rubber, is submitted to high pressure and raised temperature whilst in moulds or suitable moulding machinery.—F. C. T.

Rubber and analogous substances; Treatment of ——. Rubber Regenerating Co. Fr. Pat. 479,785, Sept. 20, 1915.

See U.S. Pat. 1,158,843 of 1915; this J., 1915, 1261.

Vulcanised plastic material; Manufacture of articles of ——. Rubber Regenerating Co. Fr. Pat. 479,806, Sept. 22, 1915.

See U.S. Pat. 1,161,967 of 1915; this J., 1916, 130.

XV.—LEATHER; BONE; HORN; GLUE.

Tannin contents of some Queensland barks. J. C. Brünnich and A. T. Jefferis. (Queensl. Agric. J., 1916, **5**, 104—106. Bull. Agric. Intell., 1916, **7**, 687—688.

The authors have tested a number of barks from Queensland trees, some of which yield useful woods for the timber industry. Barks containing over 20% of tannin are capable of being exploited directly for tanning purposes; to this class belong: an undetermined species of acacia known as "black wattle," *Acacia implexa*, and the inside bark of *Eucalyptus Cloeziana* ("Gympie messmate") which constitutes about one-half the total bark thickness. Barks containing between 10 and 20% of tannin may be useful in certain circumstances and may be exploited for the manufacture of tanning extracts, particularly if derived from large timber trees. The more interesting of this class are: *Acacia harpophylla* ("Brigalow") containing 16%, which is widely distributed in the West and common on the prickly pear-infested lands; *Eucalyptus microcorys* ("Tallow wood"), with 17·66%, is a coastal tree but becoming rather scarce; *E. haemostoma* ("white" or "scrub gum") contains 11·97%, the wood is largely used for fencing and firewood; *E. Cloeziana* ("Gympie messmate"), which is fairly abundant in the neighbourhood of Gympie, is large and gives a useful hardwood; the entire bark contains 11·95% of tannin.—J. F. B.

Chestnut extract; Trading in ——. Board of Trade J., Oct. 26, 1916.

The Army Council have ordered that no person shall buy, sell, deal in, or make delivery of chestnut extract imported from any country other than an Allied country or dependencies thereof after Aug. 1st, 1916, except as authorised and permitted by or on behalf of the Director of Army Contracts.

[Tannery] lime liquors; Determination of sulphide in ——. H. G. Bennett. Collegium (London), 1916, 219—233. (See also this J., 1916, 479.)

The author recommends the addition of both ammonia and ammonium chloride to the $N/10$ zinc sulphate solution used for the titration of the sulphide as suggested by Blockey and Mehd (this J., 1912, 360; 1914, 269). The difficulties attending the use of a solution to which ammonia alone has been added, *i.e.* the precipitation of zinc hydroxide and the incomplete precipitation of zinc sulphide due to the formation of complex ions, are largely avoided, though the method is not suitable for liquors containing less than 0·1% of sodium sulphide. If the reagent is made up according to the author's prescription (Collegium, London, 1915, 314), an amount of liquor needing at least 3·5 c.c. of reagent should be used to ensure solution of zinc hydroxide initially precipitated by the lime. The copper sulphide precipitation method of McCandlish and Wilson (this J., 1914, 606) is criticised on account of the uncertain composition of the sulphide precipitate. As a rapid control method the liquor may be treated with excess of sodium arsenite solution, acidified, the arsenic sulphide and organic matter filtered off, and an aliquot portion of the filtrate titrated with iodine solution after adding excess of sodium bicarbonate.—F. C. T.

Use of bark for paper specialities. Kress. *See* V.

Patents.

Depilation or de-wooling of skins; Process for —— R. Vidal. First Addition, dated July 10, 1914, to Fr. Pat. 474,426, Nov. 27, 1913 (this J., 1915, 1105).

A tepid or cold solution of the preparation of castor oil and alkali sulphide described in the principal patent, acts as a swelling, degreasing, and unhairing agent on skins immersed in it or painted with it on the flesh.—F. C. T.

Waterproofing the soles of footwear [with nitrocellulose, etc.]. A. V. St. Armande, Nitshill, Scotland. Eng. Pat. 12,840, Sept. 8, 1915.

A mixture of nitrocellulose (which may be in the form of celluloid), nitrated castor or other oil, and a germicide such as β-naphthol, is applied to the leather or other fabric by painting on in solution or by fastening on as a solid layer or sheet. Pigments, dyes, etc., may be added to the material. —F. C. T.

Glue and other adhesives; Substitute for ——. V. G. Bloede, Catonsville, Md. U.S. Pat. 1,198,100, Sep. 12, 1916. Date of appl., Jan. 2, 1915.

A composition is claimed consisting of starch or hydrolysed starch, caustic alkali, and a lead compound.—F. C. T.

Casein masses; Process and apparatus for the manufacture of transparent horn-like ——. A. Bartels, Harburg, Germany. Eng. Pat. 13,203, Sept. 15, 1915.

Dry commercial casein is agitated with a solvent for fats, notably a mixture of alcohol with petroleum spirit or benzene, at a temperature above that of the atmosphere, and is then dried and treated in the usual manner. The casein may be introduced into a removable strainer drum, which rotates in a horizontal cylinder containing the solvent. After complete extraction of the fat, the solvent is drawn off, and the casein is heated in the same drum *in vacuo*.—C. A. M.

Casein made by the use of rennet. Soc. di Esportazione Polenghi-Lombardo, and E. Soncini. Fr. Pat. 478,290, Mar. 9, 1915. Under Int. Conv., Mar. 25, 1914.

Lactic ferment is added to milk, which, after a certain acidity has been attained, is coagulated at 40° C. by means of rennet. Casein so produced is soluble in acids and alkalis, and when in alkaline solution is not precipitated by calcium or barium hydroxide. It is also superior in binding power to ordinary casein.—F. C. T.

XVI.—SOILS; FERTILISERS.

a-Crotonic acid, a soil constituent. E. H. Walters and L. E. Wise. J. Agric. Res., 1916, **6**, 1043—1045.

A sample of infertile Susquehanna fine sandy loam soil from Texas was extracted with a 2% solution of sodium hydroxide for 24 hours. After acidifying and filtering, the liquid was extracted with ether, and the concentrated ethereal solution shaken with sodium bisulphite to remove aldehydes, etc. The bisulphite solution was then extracted repeatedly with ether, the combined extracts were evaporated, and the residue sublimed. The purified sublimate was identified as pure *a*-crotonic acid. The yield obtained was 94 mgrms. from 50 lb. of soil. It is suggested that the acid may be a decomposition product of cellulose, or it may result from the hydrolysis of allyl cyanide, a constituent of the essential oils from certain plants.—E. H. T.

Phosphoric acid; Effect of —— on the decomposition of sugar in the soil. S. Herke. Kiserletrigyi Kozlemények, 1915, **18**, 857—884. Bull. Agric. Intell., 1916, 7, 645—646.

The decomposition of sugar in soil, as measured by the amount of carbon dioxide liberated, is conditioned by the chemical nature of the soil and by the presence of certain nutritive salts. There appears to be a connection between such action on the part of phosphoric acid and the larger yields which it produces in manurial experiments. Experiments on oats and mustard demonstrated that increased crop yields and increased liberation of carbon dioxide advanced *pari passu*. The accelerating action of phosphoric acid on the decomposition of soil sugar is favourably influenced by calcium carbonate, by nitric nitrogen (0·05 grm. per kilo. of soil, applied as sodium nitrate), by ammonium sulphate (0·05 grm. nitrogen per kilo.) in certain soils, and by potassium sulphate in some cases. In general, the addition of nitrogenous and potassium compounds affects the action of the phosphoric acid in different ways in different soils, and a variation in the amount of one nutritive salt influences the action of the other.—E. H. T.

Bacterised peat ("humogen"); Experiments with ——. F. J. Chittenden. J. Roy. Hortic. Soc., 1915, **41**, 305—326. Bull. Agric. Intell., 1916, 7, 651—655.

Pot experiments with begonia plants (*Begonia semperflorens*) and with *Eupatorium adenophorum* grown in loam, in loam and raw peat, and in loam with bacterised peat, showed the fertilising power of the last named in an unmistakable manner. Similar tests on seedling tomatoes gave a like result; it was however remarked that the increased development was confined to the aerial parts of the plants. The difference between the loam series and the loam and raw peat series was very slight, and that between the bacterised and the raw peat was too great to be ascribed to difference in water-retaining capacity. The hypothesis that the treated peat contains "activators" is supported by the fact that large doses of it caused very little increase in growth but were not detrimental. Tomatoes were also grown in sand cultures and watered with extracts of bacterised peat, boiled peat, untreated peat, and with an ammoniacal extract of raw peat. None of the plants did well; those treated with the ammoniacal extract died within two days, and those that received the humogen grew to twice the size of the rest. Hence it is inferred that the particular virtue of this fertiliser lies in its water-soluble constituents. The results obtained in the field experiments were much less satisfactory. Radishes, turnips, and French beans were grown in a very sandy soil, and dressings of 2 tons per acre were used for both treated and untreated peat. There was no difference in the growth of the plants in either, or in the control plot. "Early White Stone" turnips were cultivated in plots receiving (*a*) no dressing, (*b*) humogen (1 ton per acre), and (*c*) the same plus 150 grms. of manganese sulphate. There was a slightly accelerated growth and a small increased yield in (*b*), but the increase was mostly in the leaves. In (*c*) the root and aerial development was balanced. The yield of dwarf French beans was 12% greater in soil dressed with humogen, and 3% greater in the same soil manured with untreated peat, than in the control plot. No visible effect attended the application of bacterised peat, at the rate of 3 tons per acre, on a grass plot measuring 10×60 ft. The effects of (1) humogen on turnips growing in a poor, unmanured soil was compared with those obtained by using (2) humogen and farmyard manure, (3) farmyard manure, (4) the same together with artificials, (5) no manure, (6) lime, (7) humogen and lime. Seven of the ten plots were watered artificially. The order of response for the roots only was: 7 (best), 5, 3, 2 and 4, 6, 1, and for the whole plants: 4, 7, 3, 2, 1, 6, 5. The watered plots as a whole did better than the unwatered, but in the latter the bacterised peat diminished the yield. Similar experiments performed in 1915 on radishes, grown under glass and in the open, and upon turnips, showed that as regards the weight of the roots, the effect of the fertiliser was negligible; it probably varies in composition. Twenty tons of farmyard manure costing £8 (delivered) is better value than 1 ton of bacterised peat at £10.—E. H. T.

Ammonia [in soil extracts]; Aeration method for [determination of] ——. B. S. Davisson, E. R. Allen, and B. M. Stubblefield. J. Ind. Eng. Chem., 1916, **8**, 896—899.

Experiments with ammonium sulphate solution, and with soil extracts, with and without addition of ammonium sulphate, showed that quantities of ammonia up to 24 mgrms. can be recovered quantitatively from 250 c.c. of solution by adding 0·5 grm. of magnesia and drawing air through at the rate of 1080 litres per hour for $2\frac{1}{2}$ hours. The ammonia cannot be absorbed completely from the air unless the latter is scrubbed well, for instance in a tower containing pieces of glass rod, as it passes through the absorbing acid.—A. S.

Utilisation of the residues of oil extraction from olives. Chevalier. *See* XII.

Exchange of bases by silicates. Exchange of alkalis and ammonium by hydrous aluminium-alkali silicates (permutites). Ramann and others. *See* XIXB.

PATENTS.

Bones: Process for pulverising — — for manure. C. Deguide. Fr. Pat. 478,792, May 25, 1915.

BONES either fresh or degelatinised are dried at a temperature not so high as to decompose organic matter, and subsequently reduced to very fine powder. A temperature of about 100° C. is suitable.—F. C. T.

Antimony compounds for the treatment of parasites and parasitic diseases of plants. Fr. Pat. 479,097. *See* XIXB.

XVII.—SUGARS; STARCHES; GUMS.

Sucrose: Constants of the quartz-wedge saccharimeter, and the specific rotation of ——. Part I. Constants for the 26-grm. normal weight. F. Bates and R. F. Jackson. U.S. Bureau of Standards. J. Wash. Acad. Sci., 1916, **6**, 25—31.

THE sucrose used was carefully purified, and dried by heating *in vacuo* at 50°—60° C. The absolute rotation of the sucrose solutions was measured with a large polarimeter having a silver scale reading to thousandths of a degree: the light source was the yellow-green line $\lambda = 5461$ A. from a quartz mercury-vapour lamp. In the saccharimetric tests, two different makes of instrument were used in each experiment, viz., a Bates saccharimeter, type Fric, and either a Schmidt and Haensch or a Julius Peters instrument, the mean value of the readings of the two instruments being taken as the true result. According to the mean value of the results of ten experiments, the solution of the normal weight of sucrose gave a rotation of but 99.89_5 "sugar degrees" when the saccharimeter was calibrated by means of the Herzfeld-Schönrock conversion factor, 34·657 (see this J., 1904, 561). Taking the actual reading of the normal sugar solution as 100°, the sugar values of the quartz plates used for calibrating the saccharimeters were re-calculated, and it was found that the true conversion factors are 34·620° for $\lambda = 5892.5$ and 40·690 for $\lambda = 5461$. For the normal sucrose solution the absolute rotations are 31·617° for $\lambda = 5892.5$ and 40·763° for $\lambda = 5461$. The rotary dispersion curves of the quartz plate and of the sucrose solution cross at about $\lambda = 0.585\mu$; the slight difference in the rotary dispersions causes differences in the saccharimetric readings when various light sources are used. It is computed that the thickness of the normal quartz plate is 1·5931—1·5910 mm. The values for the specific rotation of sucrose from the authors' data are $[\alpha]^{20}_{5892.5} = 66.529°$ and $[\alpha]^{20}_{5461} = 78.342°$.—A. S.

Dextrose: The saccharimetric normal weight and the specific rotation of ——. R. F. Jackson. U.S. Bureau of Standards. J. Wash. Acad. Sci., 1916, **6**, 530—531.

THE dextrose employed was prepared by repeated crystallisation from starch conversion products or invert sugar, and was finally dried at 60°—80° C. in a vacuum. The density of its aqueous solutions was found to correspond to the formula $D^{20°}_{4} = 0.9981 + 0.003788p + 0.00001412p^2$, where p is the percentage of anhydrous dextrose weighed in a vacuum. The formula is valid for values of p between 5 and 30. The normal weight of dextrose weighed in air with brass weights is 32·231 grms. This contained in 100 c.c. of solution produces a rotation of 100 on the scale of the quartz-wedge saccharimeter when the latter is controlled by the conversion factor determined by Bates and Jackson (see preceding abstract), viz. 34·620° for $\lambda = 5892.5$ or 40·690° for $\lambda = 5461$, or by the rotation of 26·0 grms. of sucrose in 100 c.c. of solution. Calibrated by the erroneous Herzfeld-Schönrock factor, 34·657°, the normal weight of dextrose is 32·261 grms. For solutions more dilute than normal, the rotations deviate from proportionality, and a small correction must be applied. The specific rotation, which is a function of the concentration of dextrose, is given by the formula $[\alpha]^{20°}_{5461} = 62.032 + 0.01257c$ where c is grams of anhydrous dextrose weighed *in vacuo* and contained in 100 c.c. of solution, or to the formula $[\alpha]^{20°}_{5461} = 62.032 + 0.0422p + 0.0001897p^2$, where p is the percentage of dextrose by weight *in vacuo*.—G. F. M.

Potato starch factories in Hungary; Waste waters from ——, their noxious action and purification. J. Halmi. Vizügyi Közlemények, 1916, **6**, 1—22. Bull. Agric. Intell., 1916, **7**, 736—738.

THE volume of waste waters from the starch factories amounts to 1·4—2·8 cub. ft. per cwt. of potatoes, according to the methods of manufacture; the working of the factories covers only 3 or 4 months in the winter, during which over $2\frac{1}{2}$ million cwt. of potatoes is worked up. A quantity of from 459,121 to 918,242 cub. ft. of waste water is thus discharged daily during the period of activity. Under these conditions the method of purification by irrigation was found too cumbersome, and has been abandoned in favour of a mechanical system. Good results have been obtained by a system based on the following principles: purification of the potato-washing waters by decantation; accumulation in special ditches of the noxious waste water obtained in the various manufacturing operations, and their emptying after fermentation. The innocuous water derived from the potato-washing, amounting to about one-third of the total, is run into a tank capable of holding the deposited solid matters collected during the whole season's working as well as the water passing through at a speed of 5 mm. per sec. The deposit generally amounts to 5% of the potatoes worked, *i.e.* about 25 cub. ft. per 10 ton wagon of potatoes. The tank is divided into sections for separate repairs and the outlet is protected by a wire sieve and boards to deflect floating matter. The noxious waters from the starch manufacture, amounting to two-thirds of the whole, are run over dyked areas of ground, with no outlet, to a depth of about 3 ft., and there left to ferment. The area required for small factories is about 5 acres and for large factories (20 wagons per day) 85 acres. Part of the water disappears by percolation and evaporation; the remainder requires about 4 months for fermentation before it is fit for release under the control of the authorities. The soil thus manured is suitable for cultivation.—J. F. B.

PATENTS.

Starch or its derivatives; Manufacture of ——. Anon. Borrás. Fr. Pat. 478,185, Mar. 27, 1915.

SEE Eng. Pat. 100,675 of 1916; this J., 1916, 860.

Clarifying agents from the nitro-derivatives of resins, balsams, or their constituents. Ger. Pat. 292,542. *See* XIII.

Substitute for glue and other adhesives. U.S. Pat. 1,198,100. *See* XV.

XVIII.—FERMENTATION INDUSTRIES.

Pentose or pentosans [in brewing materials]; Determination of —— by means of Fehling's solution. J. L. Baker and H. F. E. Hulton. Analyst, 1916, **41**, 294—297.

Eynon and Lane's modification of Flohil's method (see this J., 1912, 259) was applied to the determination of pentoses and pentosans in malt, barley, wort, beer, etc. The material was distilled in the usual way with hydrochloric acid (sp. gr 1·06) until all the furfural had passed over into the distillate; working with 2 grms. of material, or 30 c.c. of liquid samples, it was usually found that the whole of the furfural had distilled when about 300 c.c. of distillate had been collected, but the distillation was always continued until a drop of the distillate no longer gave a reaction with aniline acetate. The acidity of the distillate was determined by titrating 10 c.c. with $N/2$ sodium hydroxide solution and from this titration was calculated the amount of sodium chloride which would be present in an aliquot portion of the neutralised distillate (see below). An aliquot portion, say 50 to 70 c.c., of the distillate was then neutralised with concentrated sodium hydroxide solution, diluted to 80 c.c., mixed with 20 c.c. of Fehling's solution, and heated to boiling under a reflux condenser; the boiling was continued for exactly 35 mins., the cuprous oxide then collected and weighed, after oxidation, as cupric oxide. During the boiling, a piece of asbestos board was placed between the burner and the flask to prevent overheating of the sides of the flask. Three mgrms. of cupric oxide represents approximately 1 mgrm. of furfural; the ratio furfural copper varied from 0·3 to 0·32 (see Eynon and Lane, *loc. cit.*). The correction for the amount of cuprous oxide precipitated from Fehling's solution by sodium chloride was somewhat larger than mentioned by Eynon and Lane, especially with the larger quantities of sodium chloride, but it was found that the amount of cuprous oxide thus produced decreased considerably if, instead of boiling the mixture, the flask was immersed in a boiling water-bath. This alteration in the method is recommended since the furfural-copper value *per se* is not affected. The quantities of cupric oxide yielded by varying amounts of sodium chloride were as follows:—

Grms. sodium chloride.	Mgrms. CuO.		
	Eynon and Lane.	Baker and Hulton.	Boiling water-bath method.
0	6	9	2
7	11·3	12·5	3
10	13·0	20·0	4

It is probable that the production of large quantities of cuprous oxide when sodium chloride and Fehling's solution are boiled over a flame is due to the raising of the boiling point of the mixture. The authors also recommend the use of larger quantities of Fehling's solution and distillate, so that the weight of cupric oxide obtained is increased whilst the error is decreased. —W. P. S.

XIXa.—FOODS.

Milk; Resistance of non-sporing bacteria in —— to the action of heat. C. Gorini. Rend. Reale Inst. Lomb., 1915, **48**, 956—961. Bull. Agric. Intell., 1916, **7**, 740.

Although, as a general rule, the sporing bacteria are most resistant to heat, it has been found that milk which has turned sour after sterilisation at 100° C. contains non-sporing types. Investigation has shown that the protection afforded to these forms of bacteria is due to the formation of a covering of casein around the cells, owing probably to the biochemical or acid-producing action of the bacteria themselves. Experiments performed on cultures of these bacteria proved that it was not possible to reproduce the protective phenomena under artificial conditions.—J. F. B.

Citric acid in milk: Determination of ——. K. Rudolf. Arch. Chem. u. Micros., 1915, **8**, 129—133. Bull. Agric. Intell., 1916, **7**, 739. (See also this J., 1915, 971.)

Stahre's method for the determination of citric acid in wine may readily be applied to milk. 50 c.c. of milk is treated with 10 c.c. of sulphuric acid diluted with an equal volume of water; 2 c.c. of a 40% solution of potassium bromide is added and 20 c.c. of phosphotungstic acid solution; the mixture is made up to 200 c.c., shaken, and filtered. 150 c.c. of the filtrate is treated in an Erlenmeyer flask with 25 c.c. of freshly prepared saturated solution of hydrobromic acid, heated on a water-bath at 48°—50° C. for 5 mins., and 10 c.c. of 50% solution of potassium permanganate is gradually added with constant agitation. The remaining operations are the same as in the case of wine (*loc. cit.*). The amount of citric acid per 100 c.c. of milk is found by multiplying the weight of the pentabromoacetone by 1·215. Milk obtained direct from a healthy cow contained 0·1985 grm. of citric acid per 100 c.c. The milk contains more citric acid at the beginning of the milking than at the end. When ordinary milk is allowed to stand, the proportion of citric acid diminishes as curdling advances; completely sour milk contains none. Yoghurt is fairly rich in citric acid (0·1668 grm. per 100 c.c.), which does not decrease appreciably on standing.—J. F. B.

Fat content of dried whole milk: Determination of the ——. K. Mohs. Z. ges. Getreidew., 1916, **8**, 37—41. Z. angew. Chem., 1916, **29**, Ref., 411.

Samples of dried whole milk which have been kept for some time show an apparent reduction of fat content as determined by extraction with ether. This appears to be due to adsorption of the fat by the coagulated protein of the milk. The adsorbed fat is not removed by simple extraction with ether. The following procedure, based on a method described by Neumann (Z. ges. Getreidew., 1912, 4, 8), is recommended for the determination of the fat:—1·5 grms. of the finely divided milk powder is heated with 50 c.c. of water and 6 c.c. of hydrochloric acid of sp.gr. 1·125 for 1½ hours on a boiling water bath. After cooling, the solution is made neutral to methyl orange by addition of concentrated sodium hydroxide solution, then acidified with dilute hydrochloric acid, and filtered. The filter with its contents is dried for 2 hours at 105° C. and then extracted with ether for 6 hours in a Soxhlet apparatus.—A. S.

Rice: Milling of —— and its mechanical and chemical effect upon the grain. F. B. Wise and A. W. Broomwell. U.S. Dept. Agric., Bull. No. 330, 1—29. Bull. Agric. Intell., 1916, **7**, 588—589.

Great breakage is caused by the "plantation huller" especially to rice of the Honduras type.

For example, after the first hulling only 32·0 % of whole grains was left, and after the second hulling 9·6 %. The effect of modern milling machinery is shown by the following results indicating the percentage of whole grains in the products obtained in the successive stages of milling :—

	Paddy machine	Hullers and pearling cone	Brush (polishing without talc). In.	Brush (polishing without talc). Out.	Trumbles (for coating in the glucose state).
	%	%	%	%	%
Honduras rice ..	74·35	52·51	49·96	52·57	51·69
Japan rice	92·38	84·22	80·37	82·52	82·57

The product from the "plantation huller" yields less ash, ether extract, and crude fibre than the rice from the old mortar and pestle mills. The effect of modern milling machinery is shown in the following results :—

Milling stage.	Moisture.	Ash.	Ether extract	Crude fibre.	Proteins.	Pentosans.
Honduras rice	%	%	%	%	%	%
Rough rice ..	11·27	5·40	1·58	8·67	7·48	5·90
Rice from paddy machine	12·32	1·18	1·79	0·99	8·57	2·42
Do. hullers ..	12·56	0·53	0·40	0·39	7·79	1·90
Do. pearling cone ..	12·50	0·47	0·28	0·30	7·88	1·53
Do. brush ..	11·89	0·30	0·25	0·30	8·06	1·80
Do. trumble	12·02	0·40	0·21	0·26	7·75	1·66
Total loss in dry substance ..	—	60·00	85·00	73·00	10·00	32·00

Very similar results were obtained with Japan rice. Milled rice is graded according to the percentage of whole grains and size of the particles. Thus Honduras rice is sold as :—(1) *Fancy head* or *head*, containing about 80 % of whole grain and yielding about 59 lb. per barrel of rough rice ; (2) *Second head*, consisting of broken grains, yielding 19 lb. per barrel ; (3) *Screenings*, yielding 15 lb., and (4) *Brewers' rice*, yielding 8 lb. per barrel. Japan rice is sold in 3 grades :—(1) *Fancy head* or *head*, containing 90 % of whole grains, and yielding 96 lb. per barrel of rough rice ; (2) *Screenings*, and (3) *Brewers' rice*, each yielding 5 lb. per barrel. The hulls approximate 30 lb., rice bran 20 lb., and the rice polishings 6 lb. per barrel of rough rice. The higher commercial grades of rice contain slightly less ash, ether extract, and crude fibre than the lower or more broken grades. Rice hulls are rich in ash, crude fibre, and pentosans, but contain little fat or protein, whilst the bran and polishings are rich in fat and protein and, when fresh, are regarded as good feeding stuffs.—C. A. M.

Benzoic acid ; Detection of —— in [edible] fats. W. Stadlin. Chem.-Zeit., 1916, **40**, 770.

From 20 to 30 grms. of the semi-melted fat is spread in an even layer over the parchment diaphragm of a Kreis dialyser, and covered with 50 % alcohol. The outer chamber of the dialyser is charged with alcohol of the same strength, and after 24 hours the dialysate is rendered slightly alkaline and evaporated on the water bath to expel the alcohol, the volume of the liquid being maintained by the addition of water. It is then made slightly acid, shaken twice with ether, and the extracts evaporated at a low temperature. The residue, which crystallises in groups of fine needles, is dissolved in 10 c.c. of water, and tested with 3 drops of dilute (1 : 10) hydrogen peroxide solution, 3 drops of dilute (1 : 10) official ferric chloride solution, and 3 drops of 3 % ferrous sulphate solution. The violet coloration due to salicylic acid appears after about ½ min. If salicylic acid is also suspected the same method is used, with the exception that the ferric chloride reaction is applied prior to the oxidation with hydrogen peroxide.—C. A. M.

Nitrogenous constituents of fodders ; Determination of ——. N. Passerini. Annali Chim. Appl., 1916, **6**, 162—164.

The following method is recommended for rapidly obtaining information as to the nature of the nitrogenous constituents of fodders. It is based on the fact that proteins are converted almost completely into soluble substances by hydrolysis with boiling 25 % sulphuric acid for 4 hours. The amides are separated from a 2-grm. sample by Kellner's method, and the crude protein (*b*) is determined in the copper precipitate. From another 5-grm. sample, the amides are separated as before, and the copper precipitate is boiled with 100 c.c. of 25 % sulphuric acid under a reflux condenser for 4 hours. The resulting solution is treated with hydrogen sulphide to precipitate copper, diluted to 500 c.c., filtered through a dry paper, and in 200 c.c. of the filtrate the ammoniacal nitrogen (*c*) is determined by distilling with a slight excess of sodium hydroxide, after expelling hydrogen sulphide. In the residue from the acid hydrolysis, the non-hydrolysed (nuclein) nitrogen (*d*) is determined. If the total nitrogen is represented by *a*, then the nitrogen present as amides (asparagine, etc.) is $a-b$, and the amino-acid nitrogen is $b-(c+d)$.—A. S.

Determination of pentose or pentosans by means of Fehling's solution. Baker and Hulton. *See* XVIII.

Nitrogen determinations by direct nesslerisation. Folin and Denis. *See* XXIII.

Patents.

Flour bleaching apparatus. F. Stacey, Birmingham. Eng. Pat. 17,841, Dec. 21, 1915.

In apparatus for treating flour with nitrogen peroxide or other gas, the admission orifice for the gas consists of a hole in a disc or plate fitted in the vertical inlet pipe ; the under side of the hole is countersunk so that the plate immediately round the hole is extremely thin. The plate is readily removed when the hole becomes choked ; a trap tube is provided in a small chamber above the plate for the purpose of removing some of the suspended particles from the gas.—W. P. S.

Yolk of egg or gluten ; Substitute for —— and process for making the same. Moskovits Mór és Fia, Nagyvárad, Hungary. Eng. Pat. 100,135, Mar. 2, 1916. (Appl. No. 3149 of 1916.) Under Int. Conv., Mar. 2, 1915.

Yolk of egg substitute. Five grms. of sunflower oil is emulsified with 11 grms. of blood serum previously evaporated to the consistence of a syrup. *Gluten substitute.* Five grms. of coconut oil or linseed oil is emulsified with 500 grms. of concentrated blood serum ; this emulsion mixed with 1 kilo. of potato flour and baked, forms a bread substitute.—W. P. S.

Eggs ; Method of preserving ——. A. N. Bennett, Assignor to Sterilized Egg Co., Chicago. U.S. Pat. 1,197,707, Sept. 12, 1916. Date of appl., Feb. 11, 1916.

Eggs are subjected to the action of hot dry air for a length of time sufficient to evaporate the moisture on and in the shell and to coagulate the

membranous and albuminous layers of the eggs immediately next the inner side of the shell; the eggs are then treated with a hot solution which forms a coating on the outside of the shell.
—W. P. S.

Rice food. T. J. Sugimoto. San Francisco. U.S. Pat. 1,198,304, Sept. 12. 1916. Date of appl., Sept. 29, 1915; renewed, Aug. 11, 1916.

Glutinous rice is steamed. mixed with about 25% of its weight of sugar. flavouring material is added, and the mixture is formed into a thin flat cake which is cut into strips and dried.—W. P. S.

Beverage extracts; Manufacture of ——. J. L. Kellogg. Assignor to Kellogg Toasted Corn Flake Co., Battle Creek. Mich. U.S. Pat. 1,198,393, Sep. 12, 1916. Date of appl., Apr. 24, 1916.

Starch-bearing material (grain) is cooked for 40 mins. to dextrinise the starch, then dried, roasted. mixed with caramelised saccharine material. and the mixture percolated.—W. P. S.

Clarifying agents from the nitro-derivatives of resins, balsams, or their constituents. Ger. Pat. 292,542. *See* XIII.

XIXb.—WATER PURIFICATION; SANITATION.

Sea water: Effect of the addition of alkali to —— on the hydrogen ion concentration. A. R. Haas. J. Biol. Chem., 1916, **26**, 515—517.

On the addition of alkali solution to sea water the hydroxyl ion concentration rises rapidly at first and then very slowly until the magnesium hydroxide has been precipitated. Another fairly rapid rise then takes place, as the addition is continued, but is checked by the precipitation of calcium hydroxide. Subsequently. the addition of alkali causes a corresponding increase in the hydroxyl ion concentration.—W. P. S.

Exchange of bases by silicates. Exchange of alkalis and ammonium by hydrous aluminium-alkali silicates (permutites). E. Ramann, S. März, K. Biesenberger, and A. Spengel. Z. anorg. Chem., 1916. **95**, 115—128. Z. angew. Chem.. 1916, **29**, Ref., 398.

The replacement of the bases of permutites by alkalis and by ammonium depends upon ionic reactions; equivalent quantities of the cations are introduced into the permutite, independent of the nature of the anion present in the solution. The composition of the permutite at the end of the reaction is independent of the total concentration of the solution. Similar relations hold in the case of the silicates, analogous to permutites, present in the soil.—A. S.

Utilisation of the residues of oil extraction from olives. Chevalier. *See* XII.

Waste waters from potato-starch factories in Hungary: their noxious action and purification. Halmi. *See* XVII.

Patents.

Water used for steam generators and for other purposes; Electrically indicating the presence of saline, alkaline, or acid impurities in feed ——. W. C. Crockatt, and Bromell Patents Co., Ltd., Glasgow. Eng. Pat. 101,387. Apr. 8, 1916. (Appl. No. 5163 of 1916.)

The water is passed through a vessel containing two carbon electrodes which are connected with a source of electrical energy of approximately constant voltage; a suitable electric lamp is also placed in the circuit. So long as the water remains pure, the resistance is high and the lamp does not glow, but if any saline impurity enters the water the resistance is lowered and the lamp filament commences to glow, its brilliancy increasing with the proportion of the impurity. A voltmeter may also be placed in the circuit to indicate changes in the resistance of the water and thus afford an additional means of ascertaining the presence of impurities in the water.—W. P. S.

Sterilisation of drinking water and other liquids; Mechanical —— without the use of chemicals. L. Linden. Fr. Pat. 478,797, May 25, 1915. Under Int. Conv., May 26, 1914.

The water to be sterilised is violently and rapidly agitated by any convenient means, preferably in a closed receptacle or series of receptacles, so that every particle of the water undergoes agitation. Sterilisation is complete in a few minutes. The water may be saturated with air before being agitated.—J. H. J.

Base-exchanging substances [for water-purification]: Preparation of ——. Water Softeners (France), Ltd. Fr. Pat. 479,152, Sept. 26, 1914. Under Int. Conv., Nov. 13. 1913.

As an example of the method of preparation. 7·5 kilos. of sodium aluminate is dissolved in 90 litres of water. and the solution is poured into 1067 litres of water. After mixing, 25·185 kilos. of sodium silicate of 40° B., containing about 25% of silica, is added. The solution is stirred for ¼ hr., and then intermittently for 3 hrs.; the gelatinous precipitate is separated in a filter-press. washed. and dried at 43° C. It is then washed with hot water. whereby it is converted into hard, vitreous grains. In this form. the substance has very active base-exchanging properties.—J. H. J.

Sewage: Purification of —— by the utilisation of activated sludge. E. Long, Manchester. Eng. Pat. 14,733. Oct. 19. 1915.

Screened sewage is passed downwards through a pipe containing a form of injector nozzle, and means are provided for admitting air to this part of the pipe (the action is similar to that of an ordinary water pump). or compressed air may be introduced. The mixture of sewage and air passes into a widened portion of the pipe which contains a rotary agitator, and thence through a rotary pump into the bottom of a tank. A pipe connects the top of the tank with the pipe above the injector nozzle, and the apparatus may be worked so as to circulate the contents of the tank until a sludge is obtained so altered in character as to justify the term "activated sludge" (see Ardern and Lockett. this J., 1914, 523, 1122; 1915. 937). The apparatus may also be employed for circulating a mixture of activated sludge and sewage or waste water.—W. P. S.

Sewage; Apparatus for the purification of ——. G. Poujoulat. Fr. Pat. 478,669, May 11, 1915. Under Int. Conv., June 22, 1914.

In a process for the biological purification of sewage. the latter is delivered on to a moving filter composed of agglomerated slag or porous brick. This is made in the form of a hollow cylinder rotating on a horizontal axis. a solid cylinder rotating on a vertical axis. or a cube having a sliding motion. In each case the filter moves under a perforated pipe conveying the sewage.—J. H. J.

Parasites and parasitic diseases of plants; Antimony compounds for the treatment of —— [and extraction of antimony from metallurgical products]. C. Vecelli. Fr. Pat. 479,097, June 24, 1915. Under Int. Conv., July 8, 1914.

The compound is prepared by grinding an antimony ore with quicklime. The lime may be slaked before use, but preferably is slaked at the conclusion of the grinding process. After standing, the mass is ground again. For agricultural use it is diluted with water. The compound may also be utilised in the extraction of antimony from metallurgical products.—J. H. J.

Disinfection of rooms with formaldehyde or by means of Salforkose [a preparation containing formaldehyde and carbon bisulphide]; Removal of noxious vapours after ——. A. Scholtz, Hamburg. Ger. Pat. 293,559, Feb. 25, 1915.

A mixture of ammonia and menthone or an essential oil containing menthone, especially dementholised Japanese peppermint oil, is vaporised within the room which has been disinfected. The room becomes fit for use more quickly than when ammonia alone is used.—A. S.

Incinerators or refuse destructors. A. Wallis, Shirehampton, Gloucester. Eng. Pat. 14,795, Oct. 19, 1915.

Phenolic condensation products capable of destroying parasites, bacteria, marine growths, etc.; Manufacture of ——. A. Heinemann. Fr. Pat. 478,635, May 7, 1915. Under Int. Conv., May 8, 1914.

See Eng. Pat. 11,394 of 1914; this J., 1915, 815.

Clarifying agents from the nitro-derivatives of resins, balsams, or their constituents. Ger. Pat. 292,542. *See* XIII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Glycerin as medicine. Board of Trade J., Nov. 2, 1916.

The following notice has been issued by the Minister of Munitions: As from 1st April, 1916, glycerin manufacturers were asked to obtain from buyers a guarantee that all medicinal glycerin delivered would be used only for making up British Pharmacopœia or B.P. Codex preparations, or where it was prescribed in individual cases, either alone or in combination with other drugs, by a duly qualified medical practitioner. These restrictions were not applied to stocks held by wholesalers or retailers before 1st April, but in view of the increased necessity for conserving the supply for the needs of the War, and the possibility that it may be necessary to reduce still further the quantity to be allowed for medicinal purposes, holders of such stocks are now asked to apply the restrictions to them. Such action will directly serve national interests in tending to secure a sufficient supply of glycerin for the general public in those cases where its value for medicinal purposes is of importance.

Vitamines; Chemical nature of the ——. II. Isomerism in natural antineuritic substances. R. R. Williams and A. Seidell. J. Biol. Chem., 1916, **26**, 431—451. (See this J., 1916, 912.)

The physiological properties of the vitamines of autolysed yeast were not altered appreciably when the solution was treated with 10% of its weight of sodium hydroxide, allowed to stand for 5 hours, and then neutralised with hydrochloric acid, but fullers' earth, "activated" by shaking it with autolysed yeast, was affected to a certain extent when subjected to similar treatment with alkali: it lost its power of maintaining the weight of pigeons fed on a deficient diet, but still had the power of preventing the development of polyneuritic symptoms in the birds. By extracting "activated" fullers' earth with 5% sodium hydroxide solution (in dilute alcohol), a crystalline antineuritic substance was obtained, the physiological properties of which were not due to adhering mother-liquor. These crystals lost their curative properties when re-crystallised, and the resulting product proved to be identical with adenine. The latter, when subjected to suitable treatment, *e.g.*, heating with sodium ethoxide, acquired antineuritic properties and gave a blue coloration with the Folin-Macallum reagent (see this J., 1913, 159). It appears that an isomer of adenine is the chemical entity responsible for the characteristic physiological properties of the "vitamine" investigated.—W. P. S.

Aromatic sulphuric acid, U.S.P.: Hydrolysis of ethylsulphuric acid and assay of ——. W. B. D. Penniman, W. W. Randall, C. O. Miller, and L. H. Enslow. J. Ind. Eng. Chem., 1916, **8**, 904—909.

To effect complete hydrolysis of ethylsulphuric acid by heating with water, the alcohol as formed must be removed; in the case of aromatic sulphuric acid no appreciable hydrolysis of the ethylsulphuric acid takes place until the whole of the free alcohol has been expelled. Methods of analysis, such as that of the U.S. Pharmacopœia, in which the sample is diluted with water and heated under a reflux condenser, always give low results, and lower the more efficient the condenser. Complete hydrolysis can be effected in most cases by diluting the sample of aromatic sulphuric acid with six times its volume of water and heating in an open beaker on a vigorously boiling water bath for 4 hours.—A. S.

Chlorination process; A modified ——. [Preparation of ethylene dichloride and chloro-derivatives of benzene.] J. A. Smythe. Brit. Assoc., Newcastle, 1916, Sect. B.

Combination between ethylene and chlorine is brought about very readily in presence of calcium chloride. When the ethylene is kept in slight excess, the main product of the reaction is ethylene dichloride, but some trichlorethane is also formed; the two compounds are easily separated by fractional distillation. The author has devised a modification of Newth's method of preparing ethylene (this J., 1901, 757), in which difficulties connected with the feed of alcohol and arising from the action of phosphoric acid on glass have been overcome.

The use of calcium chloride in chlorination-reactions has also been studied in the case of benzene. Here, too, substitution and addition take place and the products of reaction contain mono and di-chlorobenzene and also the two isomerides of benzene hexachloride. The yield of the latter is considerable.

Some points of theoretical interest were dealt with, especially the similarity in the action of calcium chloride and sunlight in these chlorination processes.—J. A. S.

Catalytic hydrogenation of organic compounds with base metals at the ordinary temperature. Influence of contact poisons on hydrogenation. C. Kelber. Ber., 1916, **49**, 1868—1879.

The behaviour of a nickel catalyst towards anticatalysts has been found to differ considerably according to its method of preparation. The catalyst prepared by reducing basic nickel carbonate with hydrogen at 450° C. was much more sensitive to contact poisons than a catalyst prepared similarly at 310° C., and the catalyst distributed on an inorganic carrier and reduced at 450° C. (this J., 1916, 382) was remarkably resistant to poisoning by anticatalysts, *e.g.*, hydrogen cyanide, hydrogen sulphide, and carbon bisulphide.—F. W. A.

Italian turpentine. Oil of turpentine from Pinus pinea, L. Palazzo. *See* XIII.

Nitrogen determinations by direct nesslerisation. Folin and Denis. *See* XXIII.

Patents.

Acetals; Manufacture of ——. A. T. King and F. A. Mason, London. Eng. Pat. 101,428, Jan. 4, (Appl. No. 134 of 1916) and July 13, 1916, (Appl. No. 9873 of 1916.)

Acetals of the type $CH_3.CH(OR)_2$, in which R is an alkyl radicle, are obtained by treating a mixture of acetaldehyde (20—50 %) and an aliphatic alcohol with hydrated or dehydrated chlorides or nitrates of aluminium, beryllium, calcium, cerium, lithium, magnesium, manganese, thorium, etc., with or without addition of hydrochloric or other acid. *Example:* 20 c.c. of saturated sodium chloride solution and 10 grms. of sodium chloride are added to 50 c.c. of a mixture containing 40 % aldehyde and 60 % alcohol, together with 1 c.c. of concentrated hydrochloric acid, and the mixture shaken for some time; the upper layer is washed with water and then sodium carbonate solution, dried over calcium chloride and then potassium carbonate, and finally fractionated to obtain the acetal. —F. W. A.

Catalyzing the synthesis of organic halogen substitution products; Apparatus for ——. F. G. Keyes, Boston, Mass., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,198,356, Sept. 12, 1916. Date of appl., July 25, 1913.

An apparatus is described for promoting the reaction between an organic compound and a halogen, consisting of an enlarged quartz vessel through which passes a mercury vapour lamp with quartz walls. The vessel is provided with a vent tube and condenser, means for supplying and withdrawing the reacting materials, and with stirring gear.—F. Sp.

Chlorine derivatives of organic substances; Preparation of ——. Soc. Chim. Usines du Rhône (anc. Gilliard, P. Monnet, et Cartier). Fr. Pat. 479,615, Dec. 24, 1914.

The substance to be chlorinated is heated with manganese dioxide and hydrochloric acid, or with manganese dioxide, sulphuric acid, and a metallic chloride. For example a mixture of 200 kilos. of benzene, 100 kilos. of manganese dioxide, and 400 kilos. of hydrochloric acid is heated at a temperature a little lower than the boiling point of benzene.—B. V. S.

Nuclein-arsenic compounds and process of preparing same. L. A. Thiele, Upper Sandusky, Ohio. U.S. Pat. 1,197,971, Sept. 12, 1916. Date of appl., June 4, 1914.

Nuclein-arsenic compounds are prepared by suitable treatment of a mixture of sodium cacodylate with a solution of nucleinic acid in an aqueous alkali phenoxide. Particular claim is made to a compound soluble in water and in alkalis, darkening at 180° C., decomposing at higher temperatures, and possessing valuable therapeutic properties.—F. Sp.

Lecithin; Hydrogenation of —— *by the catalytic action of common metals and their oxides.* Poulenc Frères. Fr. Pat. 478,193, July 22, 1914.

The hydrogenation of lecithin may be accomplished by the aid of common metals and their oxides, and at a temperature below that at which lecithin and hydrolecithin are decomposed, by having the catalyst in its most active condition, obtained by slow reduction in the case of the metals and by dehydration of the hydroxides at a low temperature in the case of the oxides; by vigorous stirring of the lecithin so as to expose continually fresh surfaces to the action of the hydrogen, and by working under increased pressure.—B. V. S.

Extraction by volatilisation of substances [alkaloids, etc.] liable to decomposition by heat; Process and apparatus for the ——. P. Landrin. Fr. Pat. 478,194, July 22, 1914.

The substance to be extracted is quickly raised to the desired temperature by mixing it with an inert substance at that temperature, local overheating being avoided. The gaseous products are withdrawn and cooled as quickly as they are formed. The apparatus described is an arrangement of concentric cylinders revolving on a horizontal axis, the outermost one heated, the innermost one perforated; the substance to be treated is introduced as a fine powder at one end of the outer cylinder where it is immediately mixed with the hot inert material in granular form; the mixture passes on to the other end of the cylinder, is there picked up by a feed tube and dropped into the cylindrical sieve. The inert material passes back to the starting point while the exhausted material passes through the perforations into an intermediate cylinder and out of the apparatus. By a suitable arrangement of tubes a gaseous current passes through the apparatus in the opposite direction and carries along and cools the gaseous products of the reaction without picking up the powder. The process is suitable for the extraction of caffeine from tea or coffee, and of theobromine from cocoa, etc.—B. V. S.

Esters; Manufacture of ——. G. Boiteau. Fr. Pat. 478,435, Aug. 3, 1914.

A mixture of an ester of ethylidene-glycol and an alcohol is heated, preferably in the presence of a small quantity of a catalyst, such as sulphuric acid. Acetaldehyde is evolved and the corresponding ester of the alcohol is contained in the residue. The reaction is general, being obtained with primary, secondary, and tertiary alcohols and with aromatic hydroxy compounds.—B. V. S.

Unsaturated hydrocarbons; Manufacture of ——. F. E. Matthews, H. J. W. Bliss, and H. M. Elder, London. U.S. Pats. 1,198,943 and 1,198,944, Sept. 19, 1916. Dates of appl., June 28 and Nov. 25, 1913.

See Eng. Pat. 17,231 of 1912; this J., 1913, 884

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Exposure in photography; Process for the reduction of ——. L. Paris and G. Picard. First Addition, dated June 30, 1914, to Fr. Pat. 477,173, May 29, 1914 (this J., 1916, 617).

In making three-colour screens for colour photographs, grains of phosphorescent zinc sulphide are used instead of starch grains. The grains are saturated with a concentrated solution of alum and then treated with ammonia to produce a thin coating of gelatinous alumina, which can be stained by treatment in a suitable dye solution.—B. V. S.

Photography in colours. Soc. Anon. Franç. Kodak. Fr. Pat. 479,796, Sept. 21, 1915. Under Int. Conv., Sept. 21, 1914.

SEE Eng. Pat. 13,429 of 1915; this J., 1916, 868.

Photographic reproductions; Preparation of——. Soc. Anon. Franç. Kodak. Fr. Pat. 479,797, Sept. 21, 1915. Under Int. Conv., Sept. 21, 1914.

SEE Eng. Pat. 13,430 of 1915; this J., 1916, 907.

XXII.—EXPLOSIVES; MATCHES.

Detonators; The sand test for determining the strength of——. C. G. Storm and W. C. Cope. U.S. Bureau of Mines, 1916. Techn. Paper 125. (68 pages.)

THE test consists in firing the detonator in approximately the centre of a mass of 100 grms. of standard sand contained within the closed cavity of a metal bomb, and measuring (by sifting) the extent to which the sand is pulverised by the detonation. In the present investigation, "Ottawa standard sand," consisting of practically pure quartz and free from particles coarser than 20-mesh or finer than 30-mesh size, was employed in conjunction with electric and ordinary detonators of various sizes charged with mixtures of mercury fulminate and potassium chlorate. For each of the detonating compositions tested, the weight of sand pulverised to a finer degree than 30-mesh was found to be a definite function of the weight of the charge. The relative efficiencies of different fulminate compositions in crushing sand and in causing complete detonation of nitro-substitution compounds of varying degrees of sensitiveness were also found to be comparable; and it is concluded that if these may be taken as a measure of the efficiency of a detonator as used with blasting explosives, the sand test fulfils every requirement of a practical test of the "strength" of commercial detonators.—W. E. F. P.

Committee on dissolved acetylene. See IIA.

Nitration of diethylbenzylamine. Noelting and Kregczy. *See* IV.

PATENTS.

Nitration process. E. F. Hitch, Alton, Ill., Assignor to Equitable Powder Manufacturing Co., East Alton, Ill. U.S. Pat. 1,198,129, Sept. 12, 1916. Date of appl., Apr. 17, 1915.

NITRO-COMPOUNDS of organic substances, particularly aromatic nitro-hydrocarbons containing two or more nitro groups, are prepared by mixing the liquid hydrocarbon with a sufficient amount of a powdered solid nitrate, and adding sulphuric acid to the mixture.—F. SP.

Cheap process for the manufacture of chlorine. Fr. Pat. 479,196. *See* VII.

XXIII.—ANALYSIS.

Sulphuric anhydride; Determination of——. E. G. Pierce. Met. and Chem. Eng., 1916, 15, 353—354.

To induce rapid diffusion and thus inhibit the formation of small crystals of barium sulphate during precipitation, a boiling solution of barium chloride is added drop by drop to the boiling assay liquid; superheating or bumping is prevented by the use of a "boiling tube"—consisting of a glass capillary attached to a bent stem of convenient length—which is retained in the liquid during the operation so as to produce a stream of fine bubbles on the bottom of the containing vessel. Boiling is continued until the precipitate settles, when the boiling tube is removed and the liquid maintained at just below the boiling point for 2 hours (instead of the 5 hours commonly specified). The liquid is then rapidly cooled and filtered, preferably through "slow" double papers. As the chief loss of barium sulphate is occasioned by the finer particles being washed through the filter, disturbance of the mat of crystals first formed on the paper should be avoided during washing and the quantity of wash-water reduced to a minimum.—W. E. F. P.

Titanium trichloride in volumetric analysis; Use of——. A. Monnier. Ann. Chim. Analyt., 1916, 21, 109—113.

IN estimating ferric chloride (compare Knecht, "New Reduction Methods in Volumetric Analysis," 1910, p. 48, footnote) and chromates (compare Atack, this J., 1915, 1005) by titration with titanium trichloride, the use of methylene blue as indicator is recommended. In the case of cupric salts, which are not reduced until any methylene blue present has been reduced by the titanium trichloride, the use of safranine or induline as indicator is suggested; copper and iron present together in solution may be determined by first titrating an aliquot portion of the solution, using methylene blue as indicator, to find the iron content, and then titrating iron *plus* copper, with safranine or induline as indicator. The necessary correction is made for the titanium trichloride required for the reduction of the indicators, and all titrations are carried out in an atmosphere of carbon dioxide.—F. W. A.

Cobalt [in presence of nickel]; Volumetric determination of——. W. D. Engle and R. G. Gustavson. J. Ind. Eng. Chem., 1916, 8, 901—902.

THE method depends on the facts that sodium perborate will completely oxidise cobaltous salts without affecting nickelous salts, and that cobaltic hydroxide liberates iodine from potassium iodide in presence of acid. The solution (100 c.c.) containing cobalt and nickel (*e.g.*, up to 0·25 grm. Co and 0·45 grm. Ni) may contain zinc and alkali and alkaline-earth salts. It is treated with dilute sulphuric acid (about 5 c.c. excess) and then with 1 or 2 grms. of dry sodium perborate. When the perborate has dissolved, the solution is made strongly alkaline with sodium hydroxide, boiled for 10 mins. to decompose the excess of perborate, cooled, treated with 1 grm. of potassium iodide, acidified with dilute sulphuric acid to dissolve the precipitated cobaltic hydroxide, and the liberated iodine titrated with thiosulphate.—A. S.

Selenium; Detection of small quantities of——and its distinction from arsenic. J. Meunier. Comptes rend., 1916, 163, 332—334.

COMPOUNDS of selenium treated in a Marsh's apparatus in the usual way are converted into hydrogen selenide; the latter is decomposed in the heated tube with the formation of a deposit of selenium which in its thickest part shows distinctly the red colour of the element, which cannot be confused with the appearance of the arsenic deposit. With minute quantities of selenium only a slight annular deposit is obtained similar to that of arsenic. On sublimation in an open tube it is

converted into white selenious acid, which is readily distinguished from arsenious oxide by means of solvents. An alternative procedure consists in treating the warmed solution with hydrogen sulphide, when a precipitate is obtained of finely divided sulphur mixed with selenium and arsenious sulphide, if present. The precipitated sulphur is coagulated by warming on the water-bath, when if it contains selenium it assumes a distinct brown colour, whilst the presence of arsenic does not alter the pure yellow colour. After drying the precipitate the sulphur and selenium may be separated by careful sublimation in a closed tube.
—G. F. M.

Nitrogen determinations by direct nesslerisation. O. Folin and W. Denis. J. Biol. Chem., 1916, **26**, 473—506.

Total nitrogen in urine. One c.c. of the urine, diluted so as to contain from 0·7 to 1·5 mgrm. of nitrogen per c.c., is heated with 1 c.c. of sulphuric acid containing phosphoric acid and copper sulphate (sulphuric acid, 100 c.c., 85% phosphoric acid solution, 300 c.c., and 10% copper sulphate solution, 15 c.c.) until all water has been expelled. The heating is then continued for about 4 minutes, the clear solution is diluted, neutralised with 10% sodium hydroxide solution, a slight excess of the latter is added, followed by 15 c.c. of Nessler reagent (containing 5% of mercuric potassium iodide and 2% of sodium hydroxide), the mixture is made up to 250 c.c., filtered, and the colour of the filtrate compared with that given by a known amount of ammonium sulphate after this has been treated with the above-mentioned quantities of reagents. *Non-protein nitrogen in blood.* To remove proteins, the blood is diluted with water and treated with 25% metaphosphoric acid solution, allowed to stand for 1 hour, or shaken for 5 mins., and then filtered. The nitrogen in the filtrate is determined as described under urine. The metaphosphoric acid solution used must not be more than 3 days old. *Ammonia in urine.* The ammonia is determined by direct nesslerisation after the urine has been treated with metaphosphoric acid and blood-charcoal; the former removes proteins and the latter more than 90% of the creatinine which may be present. The quantity of creatinine remaining after this treatment does not interfere with the determination. *Urea in urine.* The urea is converted into ammonia by treating the urine with urease (an aqueous emulsion of soya bean meal is used), the mixture then treated with metaphosphoric acid and blood-charcoal, filtered, and the filtrate nesslerised. *Urea in blood.* The "oxalated blood" is treated with urease (soya bean meal), then with metaphosphoric acid, filtered, and the filtrate is nesslerised.—W. P. S.

Filter paper with fine pores. Grossfeld. *See* V.

Cupellation losses in assaying silver. Mann and Clayton. *See* X.

Detection of arachidic acid [*arachis oil*]. Kerr. *See* XII.

Detection of marine animal oils in oils, fats, and soaps. Marcusson and Von Huber. *See* XII.

Determination of sulphides in [*tannery*] *lime liquors.* Bennett. *See* XV.

Aeration method for [*determination of*] *ammonia* [*in soil extracts*]. Davisson and others. *See* XVI.

Constants of the quartz-wedge saccharimeter, and the specific rotation of sucrose. Part I. Constants for the 26-grm. normal weight. Bates and Jackson. *See* XVII.

Saccharimetric normal weight and specific rotation of dextrose. Jackson. *See* XVII.

Determination of pentose or pentosans by means of Fehling's solution. Baker and Hulton. *See* XVIII.

Determination of citric acid in milk. Rudolf. *See* XIXA.

Determination of the fat content of dried whole milk. Mohs. *See* XIXA.

Detection of benzoic acid in [*edible*] *fats.* Stadlin. *See* XIXA.

Determination of nitrogenous constituents of fodders. Passerini. *See* XIXA.

Hydrolysis of ethylsulphuric acid and assay of aromatic sulphuric acid, U.S.P. Penniman and others. *See* XX.

The sand test for determining the strength of detonators. Storm and Cope. *See* XXII.

PATENTS.

Thermo-electric couple. C. E. Foster, Letchworth. Eng. Pat. 17,185, Dec. 7, 1915.

THE elements of a cheap thermo-electric couple, which gives approximately the same electromotive force as a platinum-platiniridium couple, are composed substantially of 94% Ni and 5% Cr, and 85% Ni and 15% Cr, respectively. When commercial nickel is used, the alloys contain small percentages of iron.—T. St.

Electrically indicating the presence of saline, alkaline, or acid impurities in feed water used for steam generators and other purposes. Eng. Pat. 101,387. *See* XIXB.

Trade Report.

Spanish industries; Government assistance for ——. Board of Trade J., Oct. 26, 1916.

A GOVERNMENT Bill, dated Sept. 24th, has been presented to the Spanish Cortes, providing for the granting of certain concessions in favour of establishing new industries, or developing those existing, in Spain. The Bill provides for the granting of concessions to Spanish enterprises engaged in coal production, iron and steel, copper, zinc, and brass industries, fertiliser manufacture, working up Spanish agricultural products, chemical industries (especially dye manufacture), wool washing, manufacture of scientific apparatus, etc.

The concessions to be granted are classified as follows:—

(1) *State concessions without direct financial help*, embracing exemption from stamp and other State taxes; postponement of the payment of all other taxes until five years after the commencement of working a new industry; free importation for a period of 15 years of raw materials required for the industry and not produced in the country; fiscal protection for a period of 15 years in respect of manufactures produced by new industries; total exemption from all export duties for 5 years; "temporary admission" regulations to be applied in respect of all raw materials for manufacture in Spain or for working up for export in conjunction with Spanish materials; special banking facilities; special transport tariff rates; exemption from municipal and port dues; preference to the products of Spanish industries in the award of Government contracts.

(2) *Loans authorised directly by the State.*—The amount of such assistance must not exceed 50%

of the capital necessary for the creation of new industries or the extension of existing ones. The interest to be paid will be 5% annually of the amount received by the industry. The loans will be granted for a maximum period of 10 years, as regards the extension of industries already established, and for 15 years in respect of new industries.

(3) *Guarantee of minimum interest on capital invested.*—With a view to encouraging the establishment in Spain of large industries in respect of which the concessions enumerated above may not be sufficient stimulus, the Government is authorised to guarantee interest not exceeding 5% annually on the capital invested in the undertaking, and for this purpose a sum of up to 10,000,000 pesetas (£100,000 at par) will be included in the annual State estimates. The period during which such interest will be granted will be 15 years.

Prohibited exports. Order in Council, Oct. 23. 1916.

The exportation of basic slag and superphosphates is prohibited to all destinations, and of agar-agar and quillaia bark to all destinations in foreign countries in Europe and on the Mediterranean and Black Seas, other than France and French Possessions, Russia, Italy and Italian Possessions, Spain, and Portugal, and to all ports in any such foreign countries, and to all Russian Baltic ports.

Books Received.

Coal Tar and Ammonia. By George Lunge, Ph.D. Fifth and enlarged Edition. In three volumes (not sold separately). Gurney and Jackson, 33, Paternoster Row, London, E.C. 1658 pages, 9 × 5½ in. Price £3 3s. net.

The large amount of new matter accumulated since the publication of the fourth edition of this work in 1909 has necessitated the addition of over 500 pages, and accordingly it now extends to three volumes, the first two being devoted to coal tar and the last to ammonia. The whole of the subject matter has been revised and brought up to date. The most important additions are to be found in the third volume, in which the modern processes for manufacturing ammonia from atmospheric nitrogen are fully dealt with. Many of the other sections have been enlarged, particularly those on naphthenes, pitch for briquetting, anthracene, examination of carbolic oil and carbolic acid, purification and testing of naphthalene, carburetting gases, and liquefied (anhydrous) ammonia. Among the new sections may be noted particulars of the estimation of tar in gases and the removal of tar fog, recovery of toluene from gas, purification of pitch by treatment with solvents, pitch cancer, use of anthracene oil for removing naphthalene from gas, synthetic production of phenol, condensation products of phenols with formaldehyde, treatment of tar oils with phosphoric acid, and ammonium chlorate, formate, oxalate, and perborate.

Bulletin of the Imperial Institute. Vol. XIV. No. 2. April to June, 1916. Price 2s. 6d. (post free, 2s. 9d.).

This issue of the Bulletin contains the results of investigations in connection with edible beans from Burma, *Voandzeia subterranea* beans from the Sudan, naked barley from Cyprus, water-melon seeds from the Sudan, colocynth pulp from the Sudan, paper-making materials from South Africa, African wild silk, and whales' bones from the Falkland Islands. Other articles deal with the occurrence and utilisation of nickel ores; sapphire-mining industry of Anakie, Queensland; and sources of supply of hazel-nuts. In addition, there are notes on the co-operation of the Chambers of Commerce with the work of the Imperial Institute, the Report of the Committee on West African oil seeds, recent investigations on sources of potash, etc.

The Bulletin also contains a section dealing with recent progress in agriculture, and the development of the natural resources of the Colonies, India, and the Tropics generally.

Reattivi e Reazioni. Di E. Tognoli. U. Hoepli, Milan. XII + 277 pages, 6⅛ × 1⅛ in. Price L.3.50.

The most important section of this little book consists of a collection of the reagents and reactions which have proved of value in analytical chemistry, especially in medico-legal and clinical practice and in the examination of foods. The list of reagents and reactions, arranged alphabetically, under the names of the authors, occupies 167 pages; and there are given also an alphabetical list of substances for which reactions are described; tests of purity for the more important reagents; a chapter on test-papers; and tables of atomic weights, and of specific gravities of solutions of alkalis, acids, ethyl alcohol, methyl alcohol, glycerol, and dextrose.

The Analysis of Permissible Explosives. By C. G. Storm. U.S. Bureau of Mines. Bulletin 96. Government Printing Office, Washington. 88 pages. Price 15 cents.*

A description of the methods used by the U.S. Bureau of Mines for the analysis and testing of "permissible" explosives.

The Sand Test for determining the Strength of Detonators. By C. G. Storm and W. C. Cope. U.S. Bureau of Mines, Technical Paper 125. Government Printing Office, Washington. 68 pages. Price 10 cents.*

This paper describes the results of a systematic investigation of the "sand test" devised by W. O. Snelling in 1913 (see page 1132).

Mines and Quarries: General Report, with Statistics, for 1915. By the Chief Inspector of Mines. Part I. Divisional Statistics. [Cd. 8361.] Price 6½d. (post free 8½d.).

This return, which forms the first part of the General Report on Mines and Quarries for 1915, contains statistics of the number of persons employed, the output of minerals, and the accidents at mines and quarries in the United Kingdom, arranged according to the inspection districts.

Some Foreign Specifications for Railway Materials: Rails, Wheels, Axles, Tyres. By G. K. Burgess and P. D. Merica. U.S. Bureau of Standards, Technologic Paper No. 61. Government Printing Office, Washington. 132 pages. Price 25 cents.*

In an introductory chapter the authors discuss and give a résumé of the specifications, together with some accident statistics. Specifications of the following countries are given:—United Kingdom, Italy, France, Belgium, Germany, Austria, Holland, Sweden.

Extraction and recovery of radium, uranium, and vanadium from carnotite. By C. L. Parsons, R. B. Moore, S. C. Lind, and O. C. Schaefer. U.S. Bureau of Mines, Bulletin 104, Mineral Technology 12. Government Printing Office, Washington. 124 pages. Price 25 cents.* (See this Journal, 1916, 44.)

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* A certain number of these publications can be obtained free on application to the respective Government Departments.

In the case of the U.S. Government publications, when this supply is exhausted, copies can be obtained at the prices mentioned from the Superintendent of Documents, Washington, D.C., U.S.A.

Journal of the Society of Chemical Industry.

No. 22, Vol. XXXV. NOVEMBER 30, 1916. No. 22. Vol. XXXV.

Official Notice.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY.

The first volume of the Reports of the Progress of Applied Chemistry is now in active preparation, and will, it is hoped, be published in December. It will cover recent progress to the end of June, 1916. The second volume will deal with the period up to the end of 1917, and subsequently it is proposed to issue the Reports annually.

The Reports will present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. It has not been found practicable to treat every section of the Journal classification. Agricultural chemistry, the chemistry of foods, and analysis are fully dealt with in the admirable series of Reports issued annually by the Chemical Society, and for the present there will be no sections on general plant and explosives.

The following is a list of the subjects which will be dealt with, together with the names of the experts who are contributing to this volume :—

Fuel—J. W. Cobb, B.Sc., F.I.C.
Gas, destructive distillation, tar products—E. V. Evans, F.I.C.
Mineral oils—A. W. Eastlake.
Dyestuffs—G. T. Morgan, D.Sc., F.I.C., F.R.S.
Fibres, paper, dyeing, printing—Julius Huebner, F.I.C.
Acids, alkalis, salts, etc.—H. A. Auden, Ph.D., F.I.C.
Glass, ceramics, cement, etc.—J. A. Audley, B.Sc.
Metals, metallurgy—W. R. E. Hodgkinson, Ph.D., F.I.C.
Electro-chemistry—J. T. Barker, Ph.D.
Fats, oils, waxes—G. H. Warburton.
Paints, pigments, varnishes, resins—R. S. Morrell, M.A., Ph.D.
Indiarubber—H. P. Stevens, M.A., Ph.D., F.I.C.
Leather, glue, etc.—J. T. Wood, F.I.C.
Sugar, starches—J. G. Macintosh.
Fermentation—A. R. Ling, F.I.C.
Sanitation, water purification—F. R. O'Shaughnessy, F.I.C.
Fine chemicals, medicinal substances, essential oils—F. L. Pyman, D.Sc., Ph.D.
Photographic materials and processes—B. V. Storr, M.Sc.

The price of issue will be, to members, 2s. 6d. (plus 6d. postage), and non-members, 5s. (plus 6d. postage). As the issue is to be a limited one, those desirous of securing copies are requested to fill in the order form attached to the cover of the Journal, and return it to the Secretary at an early date.

Editorial.

SCIENCE AND TRADE.

The Daily Telegraph recently published an article by Sir Robert Hadfield with the above title, dealing with the necessity for research in industry, and calling special attention to the importance of co-ordination in research, and to the need for constant investigation of what is being achieved abroad and for the encouragement of pure science.

Emphasising the vital necessity for co-ordination, Sir Robert says that if British industry is to hold its own after the war, research must be regarded as a national rather than an individual matter. While big firms naturally maintain their own laboratories for research along the lines of their special activities, and many of the results obtained in these laboratories are of special interest to themselves, there are a great number of questions affecting whole industries the solution of which can only be obtained by the co-operation of many workers investigating special branches of the subject. In these cases there is everything to be gained by carrying on the work of research in combination and making its results available to the whole of the organised industry.

It was announced last month that the National Research Council recently appointed by the American National Academy of Sciences to co-ordinate scientific research in the United States, had received an assurance that the funds and organisation of the Engineering Foundation would be placed at its disposal. In order to ensure practical application of all discoveries made, the great engineering societies will be strongly represented on the council.

The council also contains the names of the leading scientists in the American universities and representatives of important service and Government departments such as the directors of Ordnance and Aviation, of the National Bureau of Standards, and the Bureau of Mines. Thus, the effect of the council is to co-ordinate the work of the finest pure scientists in the United States with every important branch of national life and industry to which the results of research can be applied. It is obvious that such a combination should do much to achieve the object for which the council was established, to put the United States in the forefront of the nations in the application of science to industry or warfare.

We certainly can do much here. In the Iron and Steel Institute and similar organisations we have technical institutions as progressive as any in the world, and our scientists are in no way inferior to the best of foreign countries. It is noteworthy that Dr. G. E. Hale, the chairman of the American Research Council, and Dr. W. H. Welch, president of the National Academy of Sciences, have recently been visiting this country to see what was being accomplished in the way of scientific research, and they have returned full of praise for the work in progress and ready to hold it up as an example to their own countrymen. Dr. Hale particularly called attention to the work which pure scientists were doing on the solution of common problems, instancing the work on optical glasses carried out by Professor Jackson, of King's College, London.

All that is needed is a better co-ordination of our resources. The appointment of the Advisory Council for Scientific and Industrial Research is a first right step. It is of prime importance that the State should be ready to co-operate by bringing educational requirements up to date, by providing proper equipment for laboratories and technical colleges, and by grants in aid for the encouragement of research. But the industries must do their part. There has in the past been perhaps a little too much jealousy and unwillingness to co-operate for common ends, which must give place in the future to a great combined effort to raise the whole level of British industry. Too many of our splendid technical institutions, also, are to-day insufficiently endowed and ill-provided with centres, libraries, and appliances. If, for instance, we could bring the chief metallurgical, mining, and engineering societies under a common roof and organise their activities in co-operation with all kindred institutions throughout the country, their united power would form a most valuable factor in the promotion of research on a national scale.

Such tours of inspection as that made by Dr. Hale and Dr. Welch in this country have a great value in keeping the science and industry of a nation abreast of the latest developments all over the world and suggesting fresh lines of activity and fresh subjects for investigation.

Lastly, in our desire to obtain practical results we should not confine research to problems of immediate practical utility. Even from the commercial point of view we shall do well to provide every possible facility and encouragement for the toiler in pure science. Many of our greatest advances in trade and industry are due to incidental discoveries made in the course of purely theoretical research, which seemed at the time to serve no particular practical purpose. Thus we are to-day reaping the benefit of the careful observations made by the late Dr. Gore nearly fifty years ago of the extraordinary changes produced in iron and steel by temperatures of, say, 300° C. and upwards. Yet many years passed before these observations were turned to practical account.

The special equipment and capacities of the pure scientist can only be obtained by encouraging him to work on his own lines and for sheer love of the work. What is needed is to render the results which he obtains more readily available to the technical worker, who can then himself follow up, or request the co-operation of the scientist in following up, those discoveries which give the most prospect of commercially useful results.

Even in works laboratories it is well to encourage pure experiment in regard to all materials used in industry, without regard to immediate application. The trained observer, watching the effect of new combinations and processes, may at any time find that the notes in his experiment book give him the clue to discoveries of the first importance. It was in the course of such experiments that the clues were obtained which led to the discovery of manganese steel, which is now used on almost every steam railroad and street tramway in the world, and is largely responsible for the efficiency of modern mining machinery, and its latest use has been found in the manufacture of steel helmets for our soldiers at the front. In a similar way experiments led to the utilisation of what is known as low hysteresis material, which represents a peculiar combination of elements and heat treatment. This knowledge has been applied to transformers throughout the world, with a resulting decrease in energy losses which is saving millions of pounds each year.

SOCIETY OF GLASS TECHNOLOGY.

The Society of Glass Technology was formally constituted at a largely attended meeting held at Sheffield University on November 9th. Representatives of the industry from all the glass-manufacturing districts of Great Britain were present. It was pointed out that the glass industry, among others, had suffered in the past owing to its detachment—partial or entire—from its scientific aspects. The formation of the Department of Glass Technology in the University of Sheffield was serving to remedy this state of affairs, and the inauguration of the Society was a further step in the same direction. It was to be hoped that the Society would be an active force not only in this country but throughout Europe. Dr. W. E. S. Turner outlined the steps that had led up to the formation of the Society, and said that promises of support had been received from all over the country. The Society was not to be a local institution, but a national one in every way, and meetings would be held from time to time in various centres.

The report of the Provisional Committee was adopted and a formal resolution constituting the Society was passed. Mr. W. F. J Wood was elected President for the coming year, and Dr. W. E. S. Turner, of the University, Sheffield, Secretary, from whom further information may be obtained.

THE ACTION OF SOLVENTS ON COAL.

The earlier attempts to extract the soluble or resinoid constituents of coal by means of solvents met with little success. Alcohol, ether, chloroform, benzene, and acetone were tried, but ordinary bituminous coals yielded only about 1 % or less to the solvent, though Watson Smith (this J., 1891, 975; 1892, 591; 1893, 221) recorded the fact that the remarkable Miike coal of Japan yields nearly 10 % of its weight to benzene extraction, and Smythe (see this J., 1908, 149) by successive extractions with several solvents of low boiling point, succeeded in extracting over 7 % from German brown coal. Recently (this J., 1916, 1001) Fischer and Gluud have shown that the yield of benzene extract is greatly increased at high temperatures and pressures (*e.g.*, 275° C. and 55 atm.): under these conditions ordinary coal yielded $6\frac{1}{2}$ % extract as compared with 0·1 to 0·15 % at 80° C.; lignite 25 % as against 11 %, and cannel coal 4 % as against 1 %.

The high solvent action of pyridine on coal was first noted by Bedson (this J., 1899, 739), who found that Durham coal yielded from 16 to 18 %, and New Zealand coal from 10 to 13 % of soluble matter. Anthracites are unaffected by the solvent. Later (this J., 1901, 789), Baker examined the solvent action on coal of the fraction of pyridine bases boiling between 110° and 120° C., the powdered coal being extracted in a Soxhlet apparatus; samples of Durham coals, from the Hutton and Brockwell seams, yielded 20·4 and 11·5 % of extract respectively, and a New Zealand coal furnished 21·4 %, but of this 15·75 % consisted of water. In each case the residue had lost the coking properties of the original coal, either entirely or to a very large extent. In a later communication (this J., 1908, 147). Bedson gives the results of the extraction of some gas coals with pyridine; the extracts represented from 22·53 to 33·59 % of the coal substance, and attention is drawn to the apparent approximation between the amount yielded to pyridine and the percentage of "volatile matter." Similar treatment of four coals described as "cannels" yielded respectively 6·95, 8·31, 26·05, and 28·90 % of extract, whilst a specimen of Broxburn oil shale furnished only 1·59 %. Bedson states that the extracted substance, which is a dark, resinous, scaly solid, had been submitted to extraction with light solvents, and that the petroleum ether extract yielded a substance volatile in steam, the ether extract of the distillate furnishing a product which forms transparent red crystals, m.pt. 65° C. The ether extract also yielded a substance volatile in steam, and a basic and an acidic substance. Full details are promised, but no further communication has apparently been made on the subject.

Pyridine is not the only substance which has a high solvent action on coal constituents. Thus, Vignon (this J., 1914, 633) states that aniline dissolved 23·4 % and quinoline 47·3 % (at boiling point) of a bituminous gas coal from the Loire district, whilst Parr and Hadley (this J., 1915, 213) record the extraction of 35 to 40 % from "high volatile" coal and 20 to 30 % from "low-volatile" coal by treatment with phenol at 110° C. in an atmosphere of carbon dioxide.

The researches of Burgess, Wheeler, and Clark (this J., 1910, 1291; 1911, 606; 1913, 969) have led to the view that coal is essentially a conglomerate of degradation products of cellulose, and partly changed resins and gums of the plants from which the coal was derived. Extraction with pyridine effects only a partial separation of the two constituents, but a complete or nearly complete separation can be made by extraction with pyridine and treatment of the pyridine extract with chloroform. The properties of the residues from each of these extractions are similar, and have no effect on a photographic plate, but the portion of the pyridine extract soluble in chloroform has a marked action, similar to that produced by rosin and coal itself (cf. Russell, this J., 1908, 959). The residue from the extraction with pyridine, on distillation at 900° C., yielded chiefly hydrogen, carbon monoxide, and carbon dioxide, whilst the pyridine extract yielded paraffin hydrocarbons and hydrogen, the percentage of the latter increasing with the temperature. The chloroform extract of the pyridine fraction (about one-third of its weight) contains 80% of volatile matter and on distillation yielded 43 to 64·5% of tar, consisting mainly of paraffin hydrocarbons, together with gases consisting principally of hydrogen and paraffin hydrocarbons. It was further established by the same authors that in the distillation of coals at low temperatures (up to 450°—500° C.) higher paraffins, as well as methane, are conspicuous decomposition products, whereas hydrogen is produced in very small quantity: the evolution of paraffins ceases entirely at about 700° C., whilst between 700° and 800° C. there is a well-defined point at which the evolution of hydrogen shows a marked increase. It would thus seem probable that the constituents of the coal derived from gums and resins are the less stable ones, which yield paraffins on distillation, whilst the cellulosic degradation product is the more stable, hydrogen-yielding constituent. Further confirmation of this view was afforded by the work of Jones and Wheeler (this J., 1915, 1043), who found that the chloroform extract yielded a tar free from phenols, whilst the products obtained by distillation of the residue from pyridine extraction and from the chloroform extraction of the pyridine extract, contained phenols—a characteristic of celluloses and degraded cellulose derivatives. Harger (this J., 1914, 390) considers that the portions extracted by pyridine are somewhat modified in constitution by the process (as indicated by the fact that extraction is very slow and is accelerated by increased temperatures), just as many resins are rendered soluble only after heating.

As regards the actual identity of the constituents of coal little of a definite nature is known. Pictet and Ramseyer (this J., 1911, 1041) isolated hexahydrofluorene, $C_{13}H_{16}$, by extraction with benzene, and Pictet, Ramseyer, and Kaiser have ecently separated fourteen other saturated and unsaturated hydrocarbons from the benzene xtract (see page 1145). These compounds, however, are present in such minute proportions hat their isolation must be considered to be f purely theoretical interest. The cellulosic portion consists of compounds of the furane type (Jones and Wheeler, this J., 1916, 881), nd compounds having structures similar to that f the carbon molecule are also present, but it s improbable that coal contains free elementary arbon. The resinic constituents are considered o consist of compounds in which alkyl, naphhene, and hydro-aromatic groupings are attached o more complex groupings. The oxygenated esinic derivatives are probably chiefly cyclic xides, and esters, ketones, acids, etc., are almost ompletely absent. Free hydrocarbons are present n small quantities, but it is doubtful whether romatic groupings exist.

From the above brief summary it will be evident hat, while a considerable amount of work has been one towards elucidating the chemical nature of oal, very much remains to be accomplished before we can lay claim to a definite knowledge of the composition of the most important of our mineral resources.

THE MESSERSCHMITT PROCESS FOR MAKING HYDROGEN.

In a recent issue of *Metallurgical and Chemical Engineering* H. L. Barnitz gives some interesting details of the Messerschmitt process for the production of hydrogen, the information having been received direct from the inventor. Additional importance is added to the subject in view of the statement that the German military authorities have adopted this process in preference to all others for use in large installations. The German War Department now controls fourteen Messerschmitt plants, each having a capacity of from 100 to 600 cubic metres per hour, and erected at a cost of about £1,000,000.

The process is based on the old iron-contact method, and consists broadly in passing steam over heated iron and subsequently reducing the iron oxide by means of reducing gases—water-gas, producer gas, or coal gas. The latest type of generator consists of an upright, cylindrical shaft, lined with fire-brick, and having two concentric iron cylinders built into it, the smaller of the cylinders resting on the floor of the generator, whilst the larger cylinder is supported at a short distance from the floor, to leave a space for the admission of the steam or reducing gas to the contact mass, which is packed into the annular space between the two cylinders. The inner cylinder contains a cage-work of fire-brick which serves to store the heat required to bring the contact mass to the reaction temperature. The outer cylinder is also surrounded by a fire-brick caging, which is incorporated in the construction of the outer fire-brick mantle of the shaft. The heating of the fire-brick cage-work and the heating and reduction of the contact mass are effected by introducing reducing gases and air from beneath into the inner cylinder; the proportion of air used is not sufficient for the complete combustion of the gases.

In the first stage of the process—the heating and reduction stage—the mixture of water-gas and air is partly burnt in the inner cylinder and the combustion products, with the unconsumed portion of the gas, pass downwards through the contact mass (the inner cylinder being cut off short of the top of the generator shaft), and then again upwards around the outer cylinder, through the flue, and into the open. During the passage of the gases around the outer cylinder the unconsumed portion is burnt by means of a secondary air current, introduced through the upper part of the wall of the shaft. This heating and reduction process occupies about twenty minutes, a temperature of 700°—800° C. being necessary.

At this stage the supply of air and gas is cut off and steam is blown in from below the generator, driving the carbon dioxide produced from the contact mass into the exit flue. As soon as hydrogen is seen to escape with the steam, the steam supply from below is cut off and the ventilator leading to the flue is closed. This second, or steam-rinsing stage only occupies a few seconds.

In the third, or actual hydrogen-producing stage, steam is passed into the top of the space between the outer cylinder and the shaft casing, and traverses the generator in the opposite direction, passing upwards through the glowing contact mass, where it is decomposed, and the hydrogen is taken off at the top into a chamber provided with a water-seal. From this chamber the gas is passed through a purifier into the gasholder and is then compressed into cylinders or storage tanks. The producing period is of about 15 minutes' duration.

The entire process is then repeated by again introducing air and water-gas into the generator.

The hydrogen is purified by scrubbing with water to remove dust particles and then passing through a purifier containing iron oxide and lime to remove traces of sulphur compounds and carbon dioxide. The gas is said to be very pure (99·2 %) and to contain only traces of nitrogen.

Among the advantages claimed for the process are that over-heating is easily avoided and the necessary temperature of the contact mass can be maintained without difficulty. The fuel consumption is very low, a single water-gas generator and steam boiler being sufficient for several hydrogen generators. The actual cost of the hydrogen is governed by the cost of coke and the size of the apparatus. In one plant installed in the United States, where the process is in use for producing hydrogen for treating oils, the cost has averaged 40 to 45 cents (1s. 8d. to 1s. 10½d.) per 1000 cub. ft.: these figures include interest, depreciation, and labour. The labour item is very small, since one man is able to attend to two generators, his sole duty being to change the levers for each working period and to read the pyrometer. All lever positions are automatically locked, thus preventing wrong position of ventilators.

When the contact mass requires to be renewed, it is removed through Morton doors provided in the lower part of the shaft casing, whilst fresh material is introduced through openings arranged on the top of the generator.

The first patents for this process were taken out by Messerschmitt in Germany in 1911; his inventions have been referred to in this Journal, 1912, 1126; 1913, 944; 1914, 136, 137, 313; 1915, 1010.

HYDROGEN FOR MILITARY PURPOSES.

Though the iron-contact process is probably the cheapest method for producing hydrogen, several of the other processes possess advantages in regard to portability of apparatus, etc., when the gas is required for military purposes. The comparative figures as to the cost of the various processes, given by E. D. Ardery at a recent meeting of the American Electrochemical Society, are therefore of considerable interest.

The results of this comparison show that the price per cubic metre of hydrogen is :—Action of steam on iron, 1·5d.; distillation of crude oil and tar, 1·75d.; ferrosilicon, 10d.; water-gas, 1s. 0½d.; iron and sulphuric acid, 1s. 0½d.; hydrogenit, 1s. 4d.; hydrolith (calcium hydride), 3s. 8d. to 4s. 2d.; silicon and caustic soda, 4s. 5d.

In the Russo-Japanese war the Russians used a process based on the action of caustic soda on aluminium; the disadvantage of this method was that it required 5½ kilos. of raw materials to produce a cubic metre of gas, as against about 4½ kilos. when using the sulphuric acid and iron or zinc process. In the Morocco campaign, the Spanish Government produced the hydrogen required by the action of caustic soda solution on silicon at 80° to 90° C.; the apparatus required is made of iron, is very simple in construction, and very durable.

The ferrosilicon process has been used by the French, and also the "hydrogenit" process. "Hydrogenit" is a mixture of finely powdered ferrosilicon and soda-lime, and is especially adapted for use where water is not abundant; on ignition it yields hydrogen.

The calcium hydride process is too expensive for general use: one kilo. of the hydride yields about one cubic metre of hydrogen. A lead-sodium alloy, called "hydrone," has also been introduced for producing hydrogen by the action of water.

A process which has been used both in Russia and in Germany consists in passing the gases produced during the distillation of crude oil and tar, through a mass of hot coke; the hydrogen thus produced contains 2—3 % of carbon monoxide; the process is intermittent, but is inexpensive.

The United States Army has installed a plant for producing hydrogen by the electrolysis of water; a direct current of 1500 ampères at 85 to 120 volts is passed through thirty cells connected in series. The capacity of the plant is about 3000 cubic feet per hour.

For carrying the hydrogen from the works to the point of use, the U.S. service employs cylinders about 7 ft. long by 5¼ in. diameter and 4 ft. long by 8¼ in diameter; they are made of cold-drawn seamless steel tubing. Some of the French cylinders are about 4 metres long, 270 mm. internal diameter, and 9 mm. thick. The cylinders generally used in the French service contain 200 litres of gas at a pressure of 133 kilos., equivalent to about 25 cub. metres at atmospheric pressure. In Germany cylinders holding about 36 litres of gas at 150 atmos. pressure are used; these correspond to about 5 cub. metres of balloon space.

A pipe line for carrying hydrogen is in successful operation in Germany. It is 4½ kilometres long and can supply 1000 cubic metres of gas daily.

Communications.

COCONUT TODDY IN CEYLON.

BY K. C. BROWNING, M.A., AND C. T. SYMONS, B.A.

(Government Analyst's Laboratory, Colombo.)

An attempt has been made in this paper to give some account of the constituents of toddy (palm juice) as drawn from the coconut palm (*Cocos nucifera*) in Ceylon. Since the product is a vegetable juice, and since the climate in this Island is so variable, it is only to be expected that the analytical figures should show considerable variations.

As will be seen from the figures given in the third section, the industry which has grown up in connection with this product is a very considerable one, providing employment for comparatively large numbers of people and involving a fairly considerable capital in the Island. With the exception of a paper by H. D. Gibbs,[*] and referring to the Philippine Islands alone, the present authors have been unable to find in recent scientific literature details of any exact analyses or examination of the product in question. Details are available for toddy (Tari) drawn from other palms. Such palm juice is largely used in India for making crude sugar; but the palms used in that country appear to be limited to the Date Palm (*Phœnix sylvestris*), the Palmyrah (*Borassus flabelliformis*), and the Kitul (*Caryota urens*).

Hence it appears advisable that these figures should be placed on record. They must, however, be taken as referring only to Ceylon, but, as will be seen later, no very marked differences appear to exist between the Philippine and the Ceylon products.

An account is also given of the method of drawing toddy in Ceylon, and in addition some details as to the various organisms which have been found in fermented toddy. This biological work was largely carried out by one of us in the Jörgensen Laboratory at Copenhagen, using dried samples of toddy sent from Ceylon. It is hoped later to publish some further results on this part of the subject after the examination of fresh samples in Ceylon.

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[*] Philippine Journal of Science, 1911, 6, No. 3. See this Journa 1911, 1133.

Method of drawing toddy.

As mentioned above, this paper is limited to coconut toddy, and as the method of drawing toddy from this palm differs somewhat from that in use with other palms, a short description of the manner in which this is carried out in Ceylon is included in this section.

The part of the palm used for the purpose is the unopened flower spathe. This is prepared by the drawer (" tapper ") for a considerable time (up to one month) before the juice actually begins to flow. The tapper, who is often a Cochin immigrant from Southern India, is scantily clad and carries fastened round his waist a belt which holds a broad tapping knife, a mallet of hard wood (vernac. : Keppetiya) or a piece of buffalo horn or bone weighted with lead, a small pot made of a half coconut shell containing a mixture of crushed leaves, etc., described below, an earthenware pot (chatty) or a gourd with cord attached, and a tin containing his tapping licence. To climb the tree he may make use of bits of coconut husk which have been fastened previously to the tree trunk in the form of a primitive ladder. If these are not available he passes a small loop of fibre round both his ankles to hold his feet close together. With this simple apparatus he works his way up the tree, clasping the trunk between the soles of his feet (as a looper caterpillar clasps a small twig between its tail claspers), and holding the trunk with his arms. When he reaches the crown of the tree, he settles himself on one of the larger leaves and sets about his work.

If he is preparing a new spathe he merely bruises this with his mallet (making a noise like a woodpecker busily searching for a grub). The spathe is bound round with a few strands of fibre, etc., to prevent it from opening out prematurely. When the spathe is nearly ready to produce toddy, the tapper cuts off a small portion from the free end of the spathe, and places a chatty on the end, the pot remaining in position by its own weight. A spathe which is just coming into flower has its free end considerably higher than the other end. Hence any juice flowing from the cut end would naturally trickle down the stem and not into the pot. In order to obviate this difficulty the Sinhalese tappers when preparing a spathe, gradually bend down the free end, so that by the time it comes into use it is at such an angle that the juice will flow into the pot.

The Cochin tappers, who alone use bruised leaves, etc., to smear the cut end, are said to accomplish the same effect by the use of this greasy or mucilaginous mixture without bending the spathe. The application of the mixture appears to have also another purpose as mentioned below. For the first few days of the tapping of a new spathe very little juice flows. When the juice starts to flow freely, the tapper visits the tree once or twice (in exceptional cases three times) a day, removes the collecting chatty, pours the contents into the pot he himself carries, and lets this down by rope to the ground to be collected into a larger vessel by his assistant who remains on the ground. The tapper then takes out his knife and shaves a thin slice off the end of the spathe, taps the end with his mallet, and if he is a Cochin, smears the newly cut portion with the mixture of bruised leaves, etc., and replaces the collecting pot. This application is said to make the juice run more freely by preventing the rapid healing of the wound.

The leaves, etc., used in this mixture by the Cochins belong to several species. The mass usually includes cinnamon leaves (*Cinnamomum Zeylanicum*).

The substances used are lime (mineral), lime fruit (citrus), leaves of cinnamon (vernac.: " Kurundu "), wild cinnamon (*Litsœa Zeylanica*, vernac.: " Davul Kurundu "), shoe flower (*Hibiscus furcatus*, vernac.: Naabritta), other species of *Hibiscus*, *Aporosa* species, and *Eriodendron anfructuosum* (vernac.: Imbul).

In a *tope* (garden) the trees which are being tapped are usually " coupled " together by means of several strands of coir rope stretching from the top of one tree to the top of the next, so that the tapper may walk on this somewhat frail bridge from tree to tree, and thus save himself the trouble and time of an arduous climb and descent for each tree. In this way a tapper, using coupled trees, may be able to manage as many as a hundred trees per diem, whereas the same tapper could only work about thirty-five if they were not so coupled.

A Sinhalese tapper appears to be able to manage two or three times as many trees as a Cochin tapper. But the Cochin appears to be the more satisfactory of the two so far as yield per tree, etc., is concerned and is thus usually preferred by the tree owners.

Tappers are paid according to the amount of toddy collected. The collecting pots are usually left on the trees for twenty-four hours before the toddy is collected and taken away, even though the spathe has been prepared and cut twice in the day. The methods of tapping, etc., described above appear to have been in use from time immemorial. Robert Knox, who was a captive in the Island for 20 years from 1660, gives in his book an account which agrees almost exactly with the above.

The yield of toddy per tree varies very considerably in the various districts in Ceylon, but cannot at present be correlated with any particular variation in elevation or humidity.

With one tapping per diem, the average daily yield per tree varies from about 600 c.c. at Kurunegala on the border of the dry zone to about 1200 c.c. at Colombo, Mawanella, and Anuradhapura, the last place being actually in the dry inland zone and the others on the moister West coast. With two tappings the average daily yield varies from 600 c.c. at Matara in the South, to nearly 3000 c.c. at Mawanella, mentioned above. Three tappings per diem appear to give better results in some places, *e.g.* at Hatton (wet), where nearly 3500 c.c. are obtained per diem by this method.

The maxima and minima are also very variable. The greatest maximum recorded is 4738 c.c., or more than a gallon, at Hatton, whereas the lowest maximum is just over 1100 c.c., at Hatnapura, also in the wet zone. The lowest minimum, exclusive of records taken when a new spathe was being started, was about 190 c.c.

It is generally agreed that the best yield is obtained when the weather is neither very wet nor very dry. Along the coast it is noticed that trees near the sea yield better than those further inland.

With reference to the age of the tree, the following is an extract from a report from the Distillery district :—

" Vigorous trees of between 20 or 30 years of age are believed to yield best. . . . In my experience no rule can be laid down with regard to the age of the trees. Very old trees (more than 80 years old) in the Paiyagalbadda District of the Kalutara Totamune which have been tapped year after year and which would be blown down if not supported by the couplings, yield best. They are very scraggy looking but they are commonly known as ' toddy trunks.' "

It is quite usual to tap two spathes on a tree. The average time which is taken to use up a spathe, *i.e.*, to pare it away, varies in different places from 30 to 90 days, much depending upon the care with which the tapper prepares it each day. If the spathe is one giving a good yield, a Cochin tapper will only shave off a very thin portion each time he taps. It is in his interest to get the maximum yield from each tree since he is paid by the number of gallons he draws each day. The total yield per spathe varies from 3½ to 17½ gallons, *i.e.*, from about 15 to about 75 litres.

Trees which are being tapped do not give a good yield of nuts on the other spathes.

Uses and processes of treatment.

Coconut toddy, drawn as described in the previous section, is used for three main purposes, namely, for the production of crude sugar, as a beverage, and for the distillation of a potable spirit. It is also used to a small extent for the production of vinegar.

For use as a sugar basis, the toddy must be drawn unfermented. The inhibition of fermentation is usually attained by placing a small amount of slaked lime in the collecting pots each day, when they are put on the trees. This is the present official regulation with regard to the collection of sweet or unfermented toddy.

It was believed until quite recently that the bark and leaves of certain plants, if placed in the collecting pots, would prevent fermentation. These plants were *Valeria acuminata* (Sinhalese, "Hal"), *Cyminosma pedunculata* (Sinhalese, "Ankenda"), and *Garcinia cambogia* (Sinhalese, "Goraka"). It was found by us on investigation that none of these was in any way effectual in preventing fermentation. Hal bark is however useful for clearing toddy which is to be made into jaggery (crude sugar), this action being presumably due to the presence of tannins in the bark. If an absolutely new unused pot is used for collecting the toddy, the liquid remains practically unfermented for a considerable time, possibly in part on account of salts dissolved out from the unused pot. Tappers say that a new pot must be used without cleaning for six days before the normal results are produced, *i.e.*, before the toddy when collected is vigorously fermenting. In an old pot there is always a considerable accumulation of wild yeasts and bacteria on the inside. Hence fermentation is rapid, since the sugary liquid enters drop by drop into a strong culture of yeasts. On one occasion when we wished to collect normal toddy from a particular tope the owner was warned beforehand of our visit. In order presumably to please us he had everything cleaned up, even the toddy pots. Hence the toddy which we collected that morning was anything but normal, being practically unfermented.

If drawn in a glass pot, which is clean and practically sterile, toddy likewise remains unfermented.

Apart from the above-mentioned "liming" of the pots for sweet toddy, the process of tapping and collecting is carried out in the same way as for ordinary or fermented toddy, but in every case the yield of juice is very much smaller. This difference of yield is unmistakable. It is difficult to assign any particular reason for this.

The actual process of manufacture of the crude sugar (jaggery) from the sweet toddy is very primitive and is practically all carried out by small native proprietors.

The collected toddy, containing lime as stated above, is first strained to get rid of insects, etc., which swarm into the toddy pots; it is then boiled down in large earthenware pots over wood or coconut husk fires until it is of a syrupy consistency. When of the proper consistency, as ascertained by trial, it is poured into empty coconut shells and allowed to solidify. The resulting product varies considerably in colour, from nearly white to dark brown. It is usually very deliquescent.

Approximately 1½ lb. of jaggery can be manufactured from one gallon of toddy. Locally this crude sugar is used as a substitute for imported sugar and for the preparation of sweetmeats. Its taste is quite characteristic. This industry in jaggery appears to have been of considerable importance in the past, since, according to Bertolacci, the value of jaggery exported from Ceylon in the year 1813 was 39,425 rix-dollars (£2628). Since the introduction of cheap imported sugar and the increasing demand for copra for the manufacture of coconut oil, the industry appears to have died down, as there is no record of any export of jaggery for the last few years. At the present time the chief source of jaggery for local consumption is Kitul or Palmyrah toddy.

As a beverage, toddy from the various kinds of palms before mentioned, *i.e.*, coconut, kitul, and palmyrah, is in very considerable demand in most parts of the Island. The toddy as drawn from the trees (in unlimed pots) is brought in the morning (and in some cases also in the evening) to the taverns where it is sold by retail. As will be seen from the next section, it varies very considerably in composition, but this is only natural since its fermentation, etc., is entrusted to any chance yeasts and bacteria which may make their way into the collecting pot on the tree. For the same reason this toddy must be treated as a perishable product (like milk) and cannot be stored under present conditions. To most Europeans its smell is repulsive; but when once this is overcome, fresh fermented toddy becomes quite acceptable as a refreshing drink. Though not clear, it is strongly sparkling, as it is still fermenting when consumed. In appearance it somewhat resembles very dilute milk. Its taste may be compared with cider in harshness, with at times a suggestion of a flavour resembling champagne. It thus forms a good local substitute for beer. It should also be a very healthy drink, since it contains a large percentage of yeast; in fact it may be said to be a suspension of yeast in a liquid containing a certain amount of alcohol, sugar, and acid. However, it rapidly sours, and the morning's toddy is not pleasant to drink in the evening, except in cool weather or in the cooler parts of the Island where the acid production is not so rapid. After 24 hours the liquid is too acid to drink.

Toddy is used as a food and drink combined by some of the fishermen along the coast, who start their day's work with only the fortification of a drink of toddy to sustain them. For the production of a potable spirit, arrack, a very considerable amount of coconut toddy is used in Ceylon The process is almost entirely carried out in very primitive copper pot stills, heated by wood fires. Condensation is effected by means of a copper worm in a vat of water. This water is not circulated during distillation and no rectifiers are used. The resulting spirit is, as may be imagined, of a very inferior quality and is very seriously contaminated with copper, etc. The distilleries number rather over 250, and are practically all situated near the coast on the south-west of the Island. In this distillery area most of the toddy is reserved for distillation.

The toddy is collected at the topes (gardens) in barrels which are either carted to the distilleries or rolled along the roads thither. As most of the stills are very small, it might have been thought that sufficient toddy would be brought in each day to fill the still (100—200 gallons) and that it would be distilled as soon as possible, as fermentation is practically complete by the time the toddy reaches the distillery. This, however, is not the custom. It is usual to keep the toddy in open vats in the distillery for three or four days, by which time it has become very acid and much of the alcohol has become lost. As a result, the yield is poor and the product is bad. The condensing worm becomes coated with an acid greasy deposit which attacks the copper. The mere advice of a scientific visitor has, however, no effect in altering the custom of years, and the same wasteful process will possibly go on indefinitely.

The spent wash from the stills is usually run out on to the ground outside the distillery wall and serves as a food and as a wallowing ground for cattle and pigs, with a resulting smell which must be experienced to be properly appreciated.

The total amount of arrack distilled in the island is approximately 1¼ million gallons of 25° u.p. per annum. Practically all this is consumed locally, only a few thousand gallons being exported. As in the case of jaggery, this export of arrack has dropped very much from what it was in the past when Ceylon arrack was much in favour in India. Bertolacci records that in the year 1810 the export of arrack amounted to 980,700 gallons, whereas the total export for the financial year 1909–1910 was only 4612 gallons.

For the production of vinegar, toddy is allowed to become sour and is then stored in partially open vats with certain herbs for a considerable time, up to one year. The resulting vinegar is of fair quality, and may have an acidity of as much as 6% reckoned as acetic acid.

Analytical details.

The conductivity (K) was estimated on an Evershed and Vignoles Dionic water tester. This consists essentially of a glass tube with two electrodes. The electrodes are connected to a direct reading conductivity meter and a continuous current hand-driven dynamo. One unit of conductivity is the reciprocal of a megohm. The ordinary scale only extends to 2000 units, so the makers introduced a switch, in the meter, which can raise the scale reading to 20,000 units. Readings were taken at 30° C. It was found as the result of a large number of fermentations with different yeasts that the conductivity was unchanged as fermentation proceeded.

The refractive power (R_{30}) was taken at 30° C. by a Zeiss immersion refractometer.

The total solids were estimated by drying at 100° C., the final drying being done *in vacuo* at 90° C.

The ash was estimated as usual in a Hoskins electrically heated muffle.

The sucrose was estimated by a large Hilger polarimeter. It was found that the best way to get a clear solution was to use the minimum quantity of a crystalline basic lead acetate (usually 1 gram per 100 c.c. of toddy) followed by centrifuging, precipitating the lead by dry potassium oxalate, and re-centrifuging. It is very difficult to get a clear solution. For proteins, the factor N × 6·37 was used.

The acidity after boiling off CO_2 under a reflux condenser was estimated by standard baryta and phenolphthalein, and was calculated as acetic acid.

Alcohol was estimated by the usual distillation, followed by a density determination.

The actual observations made amounted to several thousands, and the following table gives characteristic readings taken on unfermented, slightly fermented, and fermented toddy.

	Sp.gr.	@ F.	K.	R_{30}	Total solids, grms. per 100 c.c.	Ash, grms. per 100 c.c.	Sucrose, %	Acidity (less CO_2) %	Proteins, %	Alcohol, % by weight.	
1. Unfermented	1·058	86	4300	67·9	15·19	0·33	13·5	0·145	0·32	—	Collected in a sterile glass vessel.
2. Slightly fermented....	1·077	86°	5100	—	17·22	0·398	10·0	—	0·23	—	
3. Unfermented	1·063	86°	4500	71·8	16·22	0·185	12·3	—	0·29	—	Collected in a sterile earthenware pot.
4 Unfermented	1·060	84	4100	70·0	15·82	0·31	13·75	0·21	0·26	—	Collected in a sterile glass vessel
5. Unfermented	1·060	84°	4000	70·0	16·18	0·31	12·9	—		—	Ditto.
6. Unfermented	1·061	84·5°	4000	72·5	16·28	0·31	12·6	—	—	—	Ditto
7. Unfermented	1·067	85°	4600	81·0	19·6	0·33	17·4	—	—	—	
8. Unfermented	1·065	85°	4700	—	17·0	0·39	—	0·005	—	—	
9. Unfermented	1·065	84°	5300	77·7	17·39	0·41	—	0·05	—	—	
10. Unfermented	1·067	84°	4900	78·9	19·68	0·11	17·4	Nil	—	—	
11. Fermented..	1·001	83°	5300	—	2·43	0·38	—	0·35	—	5·8	
12. Fermented..	1·005	85°	5000	—	3·36	0·23	—	0·32	—	4·9	

The changes as fermentation proceeds were followed by adding, to sterile toddy, small quantities of yeasts separated from fermenting toddy by centrifuging. The following is a typical example:—

At start	4 hours later.	21 hours later.	In 27½ hours.	In 48 hours.
Sp.gr. at 85° F. 1·071	1·055	1·013	1·007	—
Alcohol. Nil ..	1·2% by weight.	5·85	5·86	6·6%
Acidity (less CO_2)	0·16%	0·29%	0·35%	0·43%

A sample of toddy containing 17% sucrose had $R_{30} = 79·3$ and specific gravity 1·069 at 85° F. In 24 hours the figures were sp.gr. 1·020 at 85° F., refraction 46, alcohol 5·6% by weight: 5½ hours later the figures were sp.gr. 1·010 at 85° F., refraction 40, alcohol 6·6% by weight. Polarimeter readings showed invert sugar equivalent to a little over 1% sucrose. In 50 hours after fermentation had started the figures were sp.gr. 1·001 at 84° F., refraction 33, alcohol 6·45% by weight. Polarimeter readings showed no sugar left.

A sample having sucrose, 17·4%; sp. gr. 1·067 at 28° C.; conductivity 4900 units; refraction, 78·9 at 30° C.; total solids, 19·68 grms. per 100 c.c.; ash, 0·107%, and faintly alkaline to phenolphthalein was mixed with freshly separated toddy yeasts. On July 23rd at 12 a.m. the mixture had a sp.gr. 1·067 at 28° C. and refraction 78·5 at 30° C. At 11 a.m. on July 24th the sp.gr. was 1·033 at 28° C., refraction 53, acidity (less CO_2) 0·06% acetic acid, and alcohol 4·3% by weight. At 4 p.m. on July 24th, the sp.gr. was 1·020 at 28° C., refraction 46, acidity (less CO_2) 0·08% acetic acid, alcohol 5·3% by weight. At 11·30 a.m. on July 25th, sp.gr. 1·002, refraction 34, acidity (less CO_2) 0·16% acetic acid, alcohol 7·1%. At 4 p.m., July 25th, sp.gr. 1·000, refraction 32, alcohol 7·65%, acidity 0·18% acetic acid. Polarimeter readings showed that all the sugar left (just over 1%) was inverted.

The percentage of alcohol in fermented toddy just prior to distillation varies in an astonishing fashion owing to the crude fermentation methods used. In one distillery, for example, 92 samples, taken throughout the season, showed an alcohol content varying from 8·8% to 2·6% by weight, the average being about 4%.

The electrical conductivity was usually between 4000 and 5000 units. After heavy rain, the conductivity falls, owing to water getting into the pots, and has been found as low as 2750 units.

The acidity (less CO_2) calculated as acetic acid was usually under 1 %. If the toddy is kept the acidity rises rapidly and with samples a month old acidities of over 6 % acetic acid have been found.

Sugar. Up to the present only sucrose (and of course dextrose and lævulose) has been definitely found in the toddies examined. It is possible, however, that some contain a little raffinose.

As a rule one particular source of toddy gives a fairly constant yield of sugar. For example, 55 samples taken from one district in August and September showed a variation in specific gravity of 1·060 — 1·068, the sucrose varying from 15 % to 18·4 %, the mean being 1·064 with an average yield of 16·9 % sugar. In conclusion the average percentage of sucrose in unfermented toddy is high and fairly constant and an important industry could be developed by making crystalline sugar and fermenting the molasses left, by suitable ferments, for alcohol. The present methods are crude in the extreme, and not only produce a very bad quality spirit but are wasteful, losses of over 50 % of the available sugar being common.

A considerable number of samples of toddy have been examined in various parts of the Island as sold over the counter in toddy taverns and also in the topes where tapping was taking place. The following figures give the results for 50 samples of coconut toddy.

Specific gravity, average 1·012, varying from 0·998 to 1·033. Acidity averages 0·51%, varying from 0·32 % to 0·67 % reckoned as acetic acid.

Alcohol, by weight, averages 4·2%, varying from 2·7 % to 5·8%.

As is to be expected there were very considerable variations in acidity and alcohol percentage, due to various soils, or the state of fermentation of the juice.

Gibbs (*loc. cit.*) gives the following figures for Philippine coconut toddy. The average daily yield of sap is 650 c.c. and a good tree will give about 500 litres a year. The average composition of fresh sap is: Density 1·070, total solids 17·5%, acidity trace, ash 0·40%, sucrose 16·5%, invert sugar, trace. Undetermined nitrogenous compound 0·60 %.

Organisms present in fermented toddy.

A number of samples of toddy were sent to Copenhagen for examination by one of the authors in the Alfred Jörgensen Laboratory. The specimens were sent on plugs of cotton wool in sterilised test tubes. On receipt the samples were placed in suitable media, and after a short delay growths appeared which were examined in detail. In most cases pure cultures were made, *i.e.*, cultures grown each from a single cell.

Yeasts. The yeasts thus isolated consisted of the following types :—

(a) *Saccharomyces cerevisiæ*, or some very nearly allied yeasts.

This resembled a typical culture yeast. Several strains of this yeast were isolated in pure culture and showed normal phenomena of sporulation and budding, with top fermentation.

(b) A wild *Saccharomyces*, resembling a wine yeast.

This was a typical "wild" yeast, somewhat resembling *S. ellipsoideus*, with rather large but otherwise typical highly refractile spores, in shape resembling oblate spheroids. Fermentation with this yeast was fairly rapid and very complete in a solution containing 16% of sucrose.

(c) *Schizo-saccharomyces*, or fission yeasts.

These were all typical fission forms, resembling *Schizo-saccharomyces mellacei*. Fermentation with these yeasts was rather slow in starting but gave a good yield.

(d) *Zygo-saccharomyces*, or fusion yeasts.

Somewhat resembling in phenomena *Z. Barkeri*, but of no interest from the fermentation point of view.

(e) A *Saccharomycode* form, resembling *S. Ludwigii*.

No species of film-forming yeast or mycoderma or torula was found.

Moulds. The species of these forms which were present in a living state in the samples of toddy belonged almost entirely to the class of moulds which most closely resemble yeasts such as *Monilia* and *Oidium*. In the media available in the laboratory the specimens gave no signs of fructification, propagation showing itself only under the forms of budding and fission.

Bacteria. Many bacteria were found in the samples and any sample of toddy is always characterised by the presence of many long chains of these organisms.

It is not thought necessary to enter into any detail with regard to the organisms present in toddy, since firstly it is most probable that a sample of fresh toddy will be found to contain many more varieties than those which survived the journey to Europe, and secondly it is hoped that it will be possible at some future date to make a complete examination, and publish the results in a separate paper.

RUBBER VULCANISATION TESTS.

BY H. P. STEVENS, M.A., F.I.C.

The paper by Eaton and Grantham in the October 31st issue of the Journal (pp. 1046—1050) appears to be a reply to the point raised (this J., 1916, 501) as to the exclusive use by these authors of a mixing composed of 90% rubber and 10% sulphur, and the assumption that what applied to such a mixing applied in the same manner and degree to other mixings. The tenor of their reply is that it applies in the same manner but not to the same degree.

In their various papers Eaton and Grantham give rates of cure at 140° C. for plantation Para rubber varying from about one to four hours and I certainly had the impression that they supposed that similar variations take place in the rubber factory. For instance they write "It is only necessary to see the vulcanised specimens [their own] which have been prepared to realise the manufacturer's dilemma, etc," or again "the variability in respect of rate of cure which was shown to be the most important variation in different raw rubbers, both from the manufacturer's standpoint, etc." As no tests had been made except with a "theoretical mixing," that is, one not used or barely if ever used in a rubber factory, the statements made are not justified unless one assumes that the rubber mixings commonly employed in the factory show the same degree of variation in rate of cure as the theoretical mixing actually used.

So far, however, from differing from Eaton and Grantham, I am in general agreement with them as to the effect of introducing mineral matter or reducing the proportion of sulphur. The result is that, according to their own showing, the introduction of a few per cent. of litharge almost obliterates the difference in the rate of cure (as shown by their curves) between their fast and slow curing rubbers. These specimens were chosen to show as great a difference as possible in rate of cure, the difference being greater than that usually met with in commercial plantation Para rubbers (first latex). It would almost appear as if a manufacturer could substitute one such rubber by another without appreciable alteration in the rate of cure of this mixing. The importance of litharge as an ingredient of technical mixings cannot be overrated. Previous to the great increase in the output of tyres, more rubber was consumed in the manufacture of rubber shoes (galoshes) than in any other branch, and these always contain litharge. No statistics are available but quite possibly more than half the rubber goods manufactured contain litharge, and that is why some manufacturers use a mixing containing litharge for testing purposes.

Eaton and Grantham attribute the effect of litharge entirely to its action as an accelerator, but if this explanation were sufficient, magnesia should produce a similar effect. Judging from the curves (compare 138 A and E with 138 B and F) the addition of magnesia to the compound containing zinc oxide does not appreciably reduce the difference in rate of cure between the fast and slow curing rubbers. The explanation may be found in recent work of my own (this Journal, 1915, p. 524).

The title of Eaton and Grantham's paper is somewhat misleading as their mixings can hardly be regarded as generally representative of technical work. The great bulk of these contain a larger number of mineral ingredients as well as "substitute," "reclaim," etc. Nevertheless the mixings chosen are in my opinion suitable as types for research work. Finally with reference to Eaton and Grantham's "optimum cure." The authors explain that if two rubbers be taken with "optimum" cures of 3¼ and 1¼ hours respectively and the former be found overcured by say ¼ hour the correct cure of the latter may be deduced by subtracting ¼ hour from the "optimum" cure, giving a correct cure of one hour. This method appears crude and no proof or explanation is given of so simple a relationship. It is easy to show that it cannot be accepted as correct. I have shown (this Journal. 1916, 872—874) that the "optimum cure" as determined by Eaton and Grantham may exceed the correct cure by an hour or more. If we subtract this amount from the cure of the second rubber we are left with a correct cure of ¼ hour or less. It is therefore obvious that this simple arithmetical relationship cannot hold. If a simple relationship between the "optimum cure" and the correct cure be required *merely as a working hypothesis*, it would be better to adopt a geometrical relationship and to calculate the correct cure of the second sample by multiplying by the correct cure of the first and dividing by the "optimum cure" of the first. Thus if the "optimum" and correct cures of the first sample be 3¼ and 2¼ respectively we may calculate the correct cure of the faster curing rubber by the factor $\frac{2\frac{1}{4}}{3\frac{1}{4}}$, giving a provisional figure of 0·87 hour approximately.

JOINT HOUSING OF METALLURGICAL AND MINING SOCIETIES.

At a recent meeting of the Iron and Steel Institute, reference was made to the proposal to secure a joint building for the housing of our four great metallurgical and mining societies, namely, the Iron and Steel Institute, Institution of Mining Engineers, Institution of Mining and Metallurgy, and Institute of Metals. At present, three of these Societies have suites of rooms in Westminster, whilst the Institution of Mining and Metallurgy occupies its own premises in the City. A preliminary meeting of representatives of these Societies will be held shortly, and, if the main principles of the scheme can be agreed to, definite proposals will be submitted to the Councils of the respective Societies. It is not proposed that the Societies should sink their identity in an amalgamation of mining and metallurgical societies, as has been suggested recently by Prof. Armstrong for the chemical societies of the country; but it is realised that the centralisation of the 8000 members of the Societies in question, under a common roof, with suitable meeting rooms and adequate library accommodation, would be to the advantage of all.

In this connection it is interesting to note the excellent results that have followed a similar joint housing scheme in America, where, since 1907, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers have occupied the splendid premises in West 39th Street, New York, known as the Engineering Societies' building. Quite recently the American Society of Civil Engineers has decided to join the other societies in the same building, and three further storeys are being added for their accommodation. When completed, the building will house institutions having a combined membership of 26,000, with a library containing 70,000 books and 90,000 pamphlets.

Another instance of the successful housing under one roof of societies having allied interests is to be found in the Chemists' Club, New York, where the American Chemical Society, the American Electrochemical Society, and the New York Section of the Society of Chemical Industry have met for some years past with the happiest results.

With these examples of successful co-operative effort before them, it is to be hoped that in the near future the societies which represent chemistry in all its phases in this country will take active steps to come together in a joint building, where a representative chemical library, for which there is a real need, could be established.

London Chamber of Commerce.

Special Meeting of Chemical Section held on October 27th 1916.

In reference to the above meeting, a report of which was printed in the last issue of this Journal (pp. 1093—1095), Mr. R. J. Pugh, of the London Chemical Works, Southall, writes that since the outbreak of war his firm has established an industry for the manufacture of salicylates, and is able to produce sufficient for the needs of this country and her Colonies; immediately after the war, however, Germany will despatch to this market salicylates at such prices as will make it impossible for the English manufacturer to compete, owing to the smallness of the British production, and the vastness of German chemical industry, which will enable them to sell articles here at less than cost price. Mr. Pugh therefore proposes that the Chemical Section of the London Chamber of Commerce should secure a powerful Committee to ascertain which of the chemical industries can produce sufficient of their particular product to at least meet the requirements of this country and her Colonies. The data thus collected would be placed before the proper authorities, to serve as a basis for some form of protection. The suggested form which this should take is that the import of particular chemicals from abroad should be prohibited until the respective industries have attained a position which will enable them to compete with the much larger businesses in Germany. The proposed Committee would have to guarantee on behalf of the manufacturers that the price charged for the article would not be more than sufficient to provide a reasonable profit.

Dealing with the expansion of trade with British Colonies after the war, Mr. Pugh suggests that the Chamber of Commerce might create a special Department to acquaint our manufacturers with the particular requirements of the various parts of the Empire, and at the same time provide the Colonies with particulars of British manufactures.

Obituary.

DAVID HOWARD.

British chemical industry has sustained a great loss in the death of Mr. David Howard at the age of 78 years. Whilst travelling from his home at Buckhurst Hill to his Ilford factory on November 11th, he suddenly became insensible and expired a few minutes afterwards from heart failure.

The loss to this Society is an equally great one, for he had been one of its most loyal supporters since its foundation, and his record of service on its Council and committees is a remarkable one. He was elected a member of the first Council in 1882, and became a vice-president in 1883, serving in that capacity until 1885. He was elected President in 1886, and on retiring from the Presidency in 1887 he was again elected a Vice-President, serving until 1889, and again from 1890 to 1893, 1897 to 1900, and 1904 to 1907. He also sat on the Council as Ordinary member from 1894 to 1897 and from 1901 to 1904, and presided over the London Section of the Society as Chairman from 1883 to 1890. He was elected a member of the Publication Committee in January, 1883, and continued to serve in that capacity until his death; he was one of the most regular attendants at the meetings of that Committee, and his work and advice were greatly valued.

Born at Tottenham in 1839, David Howard was the son of Robert Howard and grandson of Luke Howard, F.R.S., who founded the great business at Stratford now known as Howards and Sons, which has acquired a world-wide reputation for its products, notably quinine, but also including many other "fine chemicals." His first association with the business was in 1857, and later he attended the Royal College of Chemistry as one of Hofmann's pupils. In 1860 he became a partner in the firm, and when it was formed into a company, in 1903, he was made chairman, with his two sons, David Lloyd Howard and Bernard F. Howard, and his nephews, A. G. and G. E. Howard, as his co-directors. The business of the firm expanded to a remarkable degree whilst he had the control of its destinies, and some years ago the head-quarters had to be removed from Stratford to the large premises at Ilford which it now occupies.

David Howard was one of the greatest authorities on quinine and other cinchona alkaloids, and contributed several useful papers dealing with these substances to scientific Journals, his first communication being made to the Chemical Society in 1871.

The great interest which he took in the promotion of chemistry and chemical industry is evidenced from the fact that, in addition to his long connection with this Society, already referred to, he was Treasurer of the Institute of Chemistry from 1884 to 1903 and President from 1903 to 1906, also serving on its Council as well as on three separate occasions on the Council of the Chemical Society, of which he had been a member since 1869. He was also an enthusiastic supporter of the London Chamber of Commerce, and was for some years Chairman of the Chemical Trade Section. He took a very active part in the agitation for promoting moral rectitude in business transactions, which led up to the passing of the Prevention of Corruption Act, and later acted as Chairman of the Bribery and Secret Commissions Prevention League which was formed to carry into effect the provisions of the Act. He was also a Justice of the Peace for the Borough of West Ham and a Deputy-Lieutenant for the County of Essex.

The passing of David Howard leaves a void in the chemical life of this country which it will be impossible to fill. His sterling character, his remarkable personality, his wide learning, and his genial disposition will never be forgotten by those who came in contact with him, while those who had the advantage of his closer personal acquaintance feel that they have lost a very true friend.

Journal and Patent Literature.

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English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

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I.—GENERAL; PLANT; MACHINERY.

Colloidal solutions: New method for the purification of ——. G. Wegelin. Kolloid Zeits., 1916, 18, 225—237. J. Chem. Soc., 1916, **110**, ii., 520—521.

The method depends on ultra-filtration by the use of a collodion membrane. The apparatus consists of a funnel-shaped vessel containing the colloidal solution to be purified, this vessel being closed near the top by the ultra-filter, whilst water under pressure may be introduced through the lower narrow end of the funnel, the rate of flow being regulated by means of a tap. The aqueous solution which passes through the collodion filter is run off into collecting vessels. It is essential that the flow of liquid should be upwards, for preliminary experiments in which the colloidal solution was placed above the ultra-filter showed that the colloidal particles, under the continued influence of gravity and of the current of liquid, tended to accumulate on the upper surface of the membrane to such an extent that this rapidly became impermeable to the wash water. For the production of suitable filters, the author recommends the use of solutions of nitrocellulose in acetic acid. The solution, of from 7·5 to 15% strength, is spread out in a uniform, thin layer on a glass plate, and the film subjected to the action of running water for five to ten minutes. The porosity varies very considerably with the concentration of the collodion, a membrane prepared from a 7·5% solution having been found to be about ten times as porous as that prepared from a 15% solution. The membranes may not be dried, and even when kept under water it is found that ageing takes place. The apparatus has been found to give satisfactory results in the purification of colloidal solutions of antimony, arsenic, and molybdenum sulphides, gold, palladium, silicic acid, ferric hydroxide, aluminium hydroxide, vanadium pentoxide, blood serum, and egg-albumin. The apparatus may also be employed for the preparation of colloidal solutions containing particles of determinate size, for the concentration of dilute solutions of colloids, for measurements of the size of colloidal particles, and for the purification of precipitated substances which cannot be easily washed by the usual filtration methods.

Patents.

Heating, cooling, condensing, and cleaning or purifying fluids, and the like; Tubular apparatus for ——. C. J. Goodwin, and O. Guttmann and Sons, London. Eng. Pat. 14,165, Oct. 6, 1915.

Strips of metal twisted into helical form are inserted in the inlet end of a tube through which fluid circulates, the pitch of the helix decreasing in the direction of flow.—W. F. F.

Cooling towers. F. Uhde, Breslau, Germany. Eng. Pat. 14,492, Oct. 13, 1915. Under Int. Conv., Feb. 25, 1915.

Water to be cooled enters a series of horizontal troughs at the top of the tower, and overflows over cooling hurdles to similar troughs at the bottom, from which it is discharged at the centre into a conical collecting vessel. This vessel extends upwards from the ground level nearly to the lowest trough so that a head of water is maintained on the suction side of the circulating pump to decrease the power used. Air enters the bottom of the tower around the periphery and passes upwards over the hurdles.—W. F. F.

Cooling vapours or gases issuing from condensers: Apparatus for ——. F. Fahl, Bremen. Ger. Pat. 293,896, Nov. 13, 1913.

A receptacle containing a cooling liquid is arranged above a horizontal condenser and is divided into compartments by partitions projecting alternately from the top and bottom. The gases or vapours leaving the condenser enter the receptacle at one end and pass successively through the compartments, displacing the cooling liquid therein. The first compartment contains a float, and as the liquid level falls, the float actuates a valve, and a fresh supply of cooling liquid is delivered to the receptacle.—A. S.

Compressed gases and the like; Apparatus for use with ——. L. B. Hall, Winchmore Hill, Middlesex. Eng. Pat. 14,535, Oct. 14, 1915.

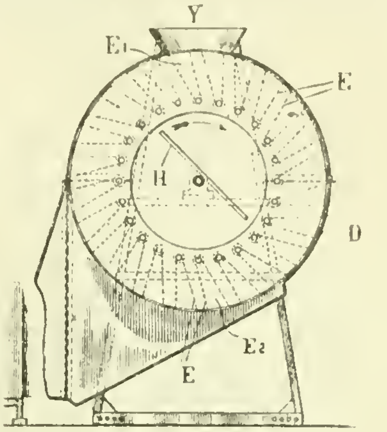
The compressed gases are released from the vessel in which they are stored, by a revolving telescopic key, fitted with a back-pressure valve. Leaks at the joints are prevented by the use of an external flexible sleeve.—W. H. C.

Dryer F. Koblank, Brackwede. Ger. Pat. 293 416, May 27, 1914.

The material to be dried is contained in a series of horizontal cylinders or drums mounted on a pair of endless chains. The drums are carried through a heated chamber by the chains and are simultaneously rotated. One end of each drum is formed by a set of wings or blades, which act as a fan and force a current of hot air through the material in the drum.—A. S.

Drying substances: Process and apparatus for ——. G. H. and J. H. Stroband, Amsterdam. Eng. Pat. 100,403, Apr. 28, 1916. Under Int. Conv., May 1, 1915. (Appl. No. 6117 of 1916.)

Air is passed in a continuous stream through a chamber containing calcium chloride and then through a heater to a rotating or oscillating drum, D. The air enters through openings in the bottom, traverses the material to be dried, and escapes at the outlet, Y. Prisms of wire gauze or webbing, E, are provided to distribute the air, and a perforated plate, H, agitates the material. Opposite prisms, E_1, E_2, may be removed for charging and discharging. The apparatus is suitable for drying grain, fruits, casein, chemicals, etc.—W. F. F.



Crystallisation; Apparatus for continuous ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fr. Pat. 479,668, Sept. 4, 1915. Under Int. Conv., Sept. 17, 1914.

The solution is fed into the upper end of a rotating cylinder which is inclined at a very slight angle to the horizontal. Water is sprayed on to the outside of the cylinder, and a fixed scraper is provided inside to lift up the crystals as the cylinder rotates. The crystals and mother liquor are discharged from the open lower end of the cylinder into a shoot, which guides them to centrifugals or other drying apparatus.—W. H. C.

Desiccation of gases intended to be liquefied. J. Cartier. Fr. Pat. 479,749, Sept. 15, 1915.

The gas is mixed with a small proportion of the previously liquefied gas and the fall of temperature, due to the expansion of the latter, causes the deposition of the moisture in the gas. The gas is subsequently passed through a scrubber filled with coke or other suitable material to retain the deposited moisture.—W. H. C.

Liquefying gases with low boiling point: Apparatus and process for ——. G. Hildebrandt, Spandau-Tiefwerder, Germany, Assignor to American Industrial Gas Co., New York. U.S. Pats. 1,199,700 and 1,199,701, Sept. 26, 1916. Dates of appl., Jan. 9, 1911, and June 11, 1914.

See Eng. Pat. 3316 of 1910; this J., 1910, 1446.

Evaporating, etc.: Method of ——. O. Söderlund and T. Boberg, Assignors to Techno-Chemical Laboratories, Ltd., London. U.S. Pat. 1,200,996, Oct. 10, 1916. Date of appl., Oct. 14, 1912.

See Eng. Pat. 22,670 of 1911; this J., 1913, 183.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Hydrocarbons contained in coal: Some ——. A. Pictet, L. Ramseyer, and O. Kaiser. Comptes rend., 1916, **163**, 358—361.

Large-scale experiments on the extraction of coal with boiling benzene (this J., 1915, 163) furnished 0·25% of a product from which a liquid with the characters of "vacuum tar" (this J., 1913, 1098; 1914, 70; 1915, 601) was separated. From this liquid the following hydrocarbons were isolated:—*Unsaturated:* C_7H_{10} (dihydrotoluene), b.pt. 108°—110° C.; C_8H_{12} (dihydro-*m*-xylene), b.pt. 135°—137°; C_9H_{14} (dihydromesitylene), b.pt. 166°—168°; $C_{10}H_{16}$ (dihydroprehnitene?), b.pt. 180°—182°; $C_{11}H_{16}$, b.pt. 200°—202°; $C_{14}H_{16}$, b.pt. 236°—238°; $C_{13}H_{13}$ (dihydrofluorene?), b.pt. 251°—254°, m.pt. 109° C. *Saturated:* C_8H_{16} (?), b.pt. 118°—122°; C_9H_{18} (?), b.pt. 135°—138°; $C_{10}H_{20}$ (?), b.pt. 172°—174°; $C_{11}H_{22}$, b.pt. 190°—192°; $C_{12}H_{24}$, b.pt. 215°—216°; $C_{13}H_{26}$, b.pt. 227°—229°; $C_{30}H_{60}$ (melene), b.pt. above 300°, m.pt. 62°—63° C.

Some of the above hydrocarbons are present also in vacuum tar and in that case, therefore, must be regarded as derived from the coal by simple volatilisation. This leads to the view that coal is a solid hydrocarbon material impregnated with a liquid which is closely allied to petroleum. The extract obtained was feebly lævorotatory ($[\alpha]_D^{20} = -0{\cdot}08^\circ$) and became dextrorotatory ($[\alpha]_D^{20} = +0{\cdot}27^\circ$) after eliminating alcohols, whereas optically active fractions have not been found in vacuum tar; it is suggested, however, that the active volatile constituents of the coal are racemised at the temperature of distillation.—F. SODN.

Benzol recovery and rectification. P. D. Walmsley and H. A. Morfey. Manchester District Inst. Gas Eng., Oct. 28, 1916. J. Gas Lighting, 1916, **136**, 229—234.

THE authors estimate that the present production of benzol is about 38 million gallons per annum and that if all the benzol was recovered from the coal carbonised at gas works, the production would be approximately 60 million gallons per annum. The oil used for absorbing benzol is generally coal tar creosote, but both anthracene oil and blast-furnace creosote are also used. The oil should be as free as possible from naphthalene and water, and the gas should be completely freed from ammonia before entering the benzol absorbing plant. Approximately 100 gallons of absorbing oil must be passed through the scrubbers for every ton of coal. The benzolised creosote oil leaving the scrubbers contains about 3% of benzol and this is recovered by distillation, either by direct fire or by steam, as "65% benzol," *i.e.*, benzol which yields 65% of distillate at 120° C., when distilled in a retort, the bulb of the thermometer being immersed in the liquid. Steam is preferable where large quantities of oil are to be dealt with, and in a recent test 66 lb. of steam at 100 lb. per sq. in. pressure was required for every 100 gallons of benzolised creosote. The 65% benzol is rectified in the usual way after washing to remove impurities.—W. H. C.

Tar from gas-producers using lignite as fuel; Utilisation of the ——. F. Fischer and W. Schneider. Stahl u. Eisen, 1916, **36**, 549—551. Braunkohle, 1916, **15**, 141—146. Z. angew. Chem., 1916, **29**, Ref., 431.

THE tar is difficult to treat by the usual distillation processes owing to its high water content. By mixing 1 part of the tar with 1½ parts of powdered lignite, a stiff pasty mass is obtained which can be formed into rods. The rods are cut in pieces and then distilled, yielding 36% of crude oil and a dark grey, crumbly residue having a heating value of about 7000 cals. The tar may also be treated by extraction with petroleum spirit, either directly or after making into briquettes with lignite powder as described above. In this way about 40% of a brown grease can be isolated which can be used as a substitute for animal oils in the leather industry. From the residue about 20% of resinous matter can be extracted with benzene. The grease extracted by petroleum spirit can be decolorised and deodorised by treatment with ozone in presence of sodium carbonate solution.—A. S.

Naphthalene wash oils; New method of testing ——. J. Wohl. Z. Ver Gas- u. Wasserfachm., 1916, **56**, 132—135. Z. angew. Chem., 1916, **29**, Ref., 426.

PROGRESSIVELY increasing quantities of naphthalene are dissolved in the oil, and a current of air is then drawn through the oil at the rate of 10 litres per hour, and after passing through a cooled washing bottle containing glass wool, is led into a solution of picric acid. After the limit of saturation of the oil under the experimental conditions is attained, some naphthalene vapour passes over with the air and is detected by the formation of a precipitate of naphthalene picrate.—A. S.

Natural gas industry in the United States in 1915. U.S. Geological Survey.

THE total quantity of natural gas produced in the United States in 1915 was 628,578,842,000 cb.ft., valued at $101,312,381. This represents an increase of nearly 37,000,000,000 cb. ft. over the production of 1914, which was the largest hitherto recorded; the increase of value compared with 1914 amounted to $7,196,857. The increased production was due chiefly to Ohio, Oklahoma, West Virginia, Pennsylvania, Kansas, and California, in the order given. Of the total quantity of gas produced, 65% (411,375,899,000 cb.ft.) was used for industrial purposes, at an average price of 9.7 cents per 1000 cb.ft., and 35% (217,202,943,000 cb.ft.) for domestic purposes, at an average price of 28.32 cents per 1000 cb.ft.

Gasoline: Production of casing-head —— *in the United States in* 1915. U.S. Geological Survey.

THE quantity of gasoline extracted from natural gas in the United States in 1915 amounted to 65,364,665 U.S. gallons, valued at $5,150,823, a gain of 22,712,033 gallons and $2,044,914 over the figures for 1914. The quantity of natural gas treated, in 1915, was over 24,000,000,000 cb.ft., the average recovery of gasoline being 2·57 gallons per 1000 cb.ft. The number of plants increased from 386 to 414, and the total daily capacity of the plants from 179,353 to 232,336 gallons of gasoline.

Cracked oil produced from petroleum; Recracking of a ——. G. Egloff and T. J. Twomey. J. Phys. Chem., 1916, **20**, 597—620.

THE oils used for the experiments were: (1) a distillate or gas oil from Pennsylvania crude petroleum, and (2) a distillate boiling between 170° and 360° C. from the recovered oil produced by cracking (1). In each case the oils were cracked at atmospheric and 150 lb. pressure at temperatures of 550°, 600°, 650°, and 700° C., under identical conditions. At all temperatures and pressures the amount of oil recovered from the cracked oil was greater than that from the petroleum oil, showing that the former was not so well adapted for the production of gasoline or aromatic hydrocarbons. The amounts of benzene, toluene, and xylenes in the oil recovered from the petroleum oil were almost uniformly twice as large as those in the oil from the cracked oil, but apparently more naphthalene and anthracene were formed from the latter. Pressure increased the formation of aromatic hydrocarbons. For example, the following results were obtained from the petroleum oil at 650° C. at atmospheric and at 150 lb. pressure respectively:—Benzene, 5·0 and 24·5%; toluene, 7·0 and 10·3%; xylenes, 3·2 and 4·6%; and naphthalene 0·0 and 9·2%. Whatever cracking to hydrocarbons of lower boiling point takes place in a cracked oil must be attributed, in the main, to the unchanged petroleum in the cracked oil. It is possible that gasoline may be obtained by a second cracking of an oil, but there is a limit to the process, since the tendency of the reaction is to produce aromatic compounds, which break up into carbon and hydrogen, rather than decompose into gasoline or benzene hydrocarbons.—C. A. M.

The Messerschmitt process for the production of hydrogen. Barnitz. *See page* 1137.

Patents.

Artificial fuel. G. B. Winter, London. Eng. Pat. 101,609, June 29, 1916. (Appl. No. 9162 of 1916.)

Bundles of folded and rolled paper are tied with wire and immersed in paraffin wax at 140° C. for about 10—15 minutes.—W. F. F.

[*Regenerators.*] *Supply of air for combustion in the heating of gas retorts.* A. Waddell, Dunfermline. Eng. Pat. 14,143, Oct. 6, 1915.

A regenerator is formed of vertical tubes of polygonal section arranged in a flue so as to provide tortuous passages between them for the hot gases or for the air to be heated. The lower ends of the tubes are secured with plastic jointing material in sockets in a tube-plate, and sand or other dry material is run through perforations in the upper tube-plate to complete the joints. The upper joints may be formed by means of asbestos rope or the like.—W. F. F.

Waste heat of gas-retort furnaces; Utilisation of the ——. F. Mieddelmann und Sohn, Strassburg. Ger. Pat. 293,910, July 4, 1915.

A section of the flue through which the hot gases from the furnace pass, is made to branch into two channels, the entrances to which are controlled by dampers. A boiler is placed in one of the channels, and the dampers are connected through an electro-magnetic circuit with a device sensitive to heat, placed at the point where the two branches unite again; the dampers are adjusted automatically so that the hot gases can pass through the channel containing the boiler only when a certain temperature is exceeded. The steam-outlet valve may be controlled simultaneously with the dampers. —A. S.

Producer gas; Production of —— *from heaps* [*of coal, etc.*]. A. Riedel, Kössern. Ger. Pat. 293,430, Aug. 29, 1915.

Parallel perforated pipes are inserted in the heap a suitable distance apart and serve to limit the portion of the heap to be treated at one time. Steam and air are introduced through one pipe, and producer gas is withdrawn through the other, but it is advantageous to reverse the flow of steam and air at intervals in order to prevent stoppages. —A. S.

Gas producer, especially for power gas. F. Kuers, Berlin-Tegel. Ger. Pat. 294,025, Mar. 28, 1915.

The combustion zone at the bottom of the producer is connected with flues in the walls, which lead to an outlet flue controlled by a damper. A portion of the gas passes through these flues and serves to heat the descending fuel in the producer. In consequence of this it becomes possible to use a larger quantity of steam and to produce a mixture of water-gas and producer-gas more suitable than producer-gas alone for use in small gas-engines. The amount of gas escaping through the outlet flue is regulated according to the suction of the engine.—A. S.

Gases (*blast-furnace*); *Simultaneous purification, desiccation, and concentration of* ——. J. Weiwers. Fr. Pat. 478,260, July 23, 1914.

The gas after a preliminary purification in ordinary dust chambers is passed in succession through two towers where it meets finely divided streams of water, and through a vessel provided with a refrigerating coil by which the temperature of the gas is quickly reduced and the vapour, deposited first as a fog or mist and then as snow or frost, carries down the remaining dust particles with it. —W. H. C.

Paraffin or crude or heavy oils; Method and means of using —— *in internal combustion engines for motor cars, motor boats, aeroplanes, and other purposes.* F. A. Wilkinson, Hatfield, Herts. Eng. Pat. 101,596, Apr. 25 and June 1, 1916. (Appl. Nos. 5921 and 7779 of 1916.)

Paraffin is sprayed and mixed with air in a carburettor of ordinary type, and hot exhaust gases are led by a small-bore pipe into the induction pipe of the engine to heat the mixture. An auxiliary air-admission valve is also provided on the induction pipe. To start the engine, the fuel may be heated by passing an electric current through a coil of wire in the float chamber of the carburettor, or in a separate chamber containing the fuel. The necessary fittings are adapted to be applied to an engine with a minimum of alteration.—W. F. F.

Hydrocarbons; Apparatus for distilling ——. G. F. Benhoff, jun., and J. O. Jensen, Baltimore, Md., U.S.A. Eng. Pat. 101,663, Apr. 7, 1916. (Appl. No. 5144 of 1916.)

Vapour from the still enters the lowest of a series of superposed cylindrical chambers forming a condensing column. Alternate chambers are spanned by vertical tubes through which the vapour passes and each set of tubes projects through the bottom of the chamber above, so as to trap condensed liquid which may be drawn off from each collecting chamber separately and, if desired, returned to the still. Air circulates round the tubes and through central passages in the collecting chambers.—W. F. F.

Coke discharged from retorts or furnaces; Apparatus for removing ——. Drakes, Ltd., and J. W. Drake, Halifax. Eng. Pat. 14,565, Oct. 15, 1915.

Coke-oven: Regenerative ——. E. Lecocq, Assignor to Soc. Gén. de Fours à Coke, Systèmes Lecocq, Brussels. U.S. Pat. 1,199,996. Oct. 3, 1916. Date of appl., Aug. 26, 1913.

See Fr. Pat. 460,399 of 1913; this J., 1914, 67.

Gases; Apparatus for washing ——. R. F. Pearce, Liverpool. U.S. Pat. 1,200,974, Oct. 10, 1916. Date of appl., June 3, 1916.

See Eng. Pat. 6199 of 1915; this J., 1916, 729.

Production of a binding agent for tar-macadam roads. Ger. Pat. 294,045. *See* IX.

Manufacture of ultramarine. Ger. Pat. 293,310. *See* XIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Furnaces; [*Reverberatory*] *heating* ——. R. F. and G. R. Hislop, Paisley, Renfrew. Eng. Pat. 5040, Oct. 1, 1915.

The side walls of the fire-box of a furnace, of the reverberatory type, are supported upon a solid cast iron plate, with a flange on the under side of suitable dimensions to clear the sides of the ash-pan in the bottom, and of suitable depth to dip into the water in the pan, thereby forming a seal.

An air-box or receiver is contained in each of the side walls of the fire-box near the bottom, and is provided on the inside with openings for the tuyère pipes, with projections on the outside for cleaning or poking purposes, and with holes at each end for air and steam supplies respectively. Under the bed of the furnace, a round flue is constructed, extending to a point near the fire-box, and connected to the chimney at one end and the furnace bed at the other. One or more pipes, carrying the air to the air boxes, are placed spirally round the flue, so that the air is heated by the waste gases passing through the flue to the chimney.—B. N.

Furnace; Gas-fired [heating] ——. C. F. Price, Birmingham. Eng. Pat. 14,668, Dec. 29, 1915.

The secondary air, after being heated by passing through a number of superposed passages arranged immediately below the combustion chamber, enters the latter by means of a series of longitudinal openings in the floor. The gas from the producer is introduced at one end of the combustion chamber.—W. H. C.

Gas furnaces. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 18,205, Dec. 31, 1915.

A gas furnace consists of an annular burner tube with tangential mixing tube for gas and air, and burner nozzles projecting radial flames inwards. The burner nozzles are fitted with narrow slits deep enough to prevent lighting back. The furnace is particularly suitable for use as a "glory hole" for heating glass articles.—J. E. C.

Furnace using oil or tar as fuel. L. C. Strub, Zürich, Switzerland. Ger. Pat. 293,116, Feb. 28, 1915. Under Int. Conv., Nov. 3, 1914.

The heating chamber is bounded at the bottom, back, and top by blocks of refractory material, in each of which are three flues, side by side. The middle flues serve for the introduction of the secondary air for combustion, and the outer flues for leading away the combustion products to the chimney. The oil or tar is supplied continuously to a dish placed on the floor of the heating chamber near the front.—A. S.

Electric incandescence lamps with metallic incandescence body; Manufacture of ——. Deutsche Gasglühlicht A.-G., Berlin. Eng. Pat. 100,387, Feb. 23, 1916. (Appl. No. 2701 of 1916.) Under Int. Conv., May 4, 1915.

In the manufacture of electric metallic filament lamps, metallic compounds such as barium azide (BaN_6) are introduced. During the heating of the lamps, the metallic compounds are transformed by chemical decomposition into drying media (*e.g.*, barium oxide) for the elimination of traces of moisture.—J. E. C.

Electrical gas-lamp. F. Skaupy, Assignor to Deutsche Gasglühlicht Akt.-Ges. (Auerges.), Berlin. U.S. Pat. 1,200,770, Oct. 10, 1916 Date of appl., May 12, 1914.

The lamp is filled with a rare gas and is provided with a cathode consisting of an alloy of thallium and an alkali metal, having a melting point not higher than 200° C., which is practically as soft as the alkali metal, but is more inert than the latter towards the material of the receptacle.—A. S.

Process of producing creosote from hardwood-tar oils. U.S. Pat. 1,199,271. *See* III.

Manufacture of silicides of tungsten, molybdenum, zirconium, and other refractory metals. Ger. Pat. 291,267. *See* VII.

III.—TAR AND TAR PRODUCTS.

Tar products; Effects of exposure on ——. C. S. Reeve and B. A. Anderton. Office of Public Roads and Rural Eng., U.S.A. J. Franklin Inst., 1916, 182, 463—475.

Seven samples of tar products, including two refined coal-tars, one refined water-gas tar, one refined mixed tar, two tar-asphalt mixtures, and one crude coke-oven tar, were subjected to the action of sun and air for three months, in a box designed to exclude dust. The authors give tables showing the percentage loss of weight each month, the figures at the end of three months varying from 3·87 to 24·24%. This loss of volatile products was accompanied by formation of "free carbon" (substances insoluble in carbon bisulphide). The tars hardened to a much greater extent than could be attributed to loss of volatile products alone, and tar products containing water-gas tar appeared to change to a greater extent than coal-tars. The comparative consistency of pitches from tars distilled to a single arbitrary temperature did not correspond with the behaviour of the tars in service.—J. E. C.

Phenol in crude phenols from tar; Determination of ——. R. Masse and H. Leroux. Comptes rend., 1916, 163, 361—363.

The crude material (3 kilos.) is fractionally distilled from a 4-litre copper vessel fitted with a 60 cm. Vigreux column (this J., 1904, 1045), the rate of distillation being regulated to 7—8 c.c. per minute, and the distillate collected in 3 fractions: (*a*) below 180° C., (*b*) 180°—203° C., and (*c*) above 203° C. (about 100 c.c.). Sufficient sodium chloride (35%) is added to fraction (*a*) to precipitate the dissolved phenol, which is added to (*b*), and the whole is transferred to a distilling vessel, utilising fraction (*c*) for rinsing purposes. With a column, as above, the liquid is rectified and fractions of 250—300 grms. collected, at a rate of 4 c.c. per minute, up to 198° C. The crystallising point of each fraction is then determined, first rapidly on a small quantity in a test-tube and afterwards by slowly cooling 30—40 grms. in a cylinder, supercooling by 1° or 2° C. and starting crystallisation by adding a little solid phenol; the maximum temperature reached during crystallisation is observed. If in the preliminary determination the crystallising temperature be below 21° C., the sample is enriched with a known proportion of phenol crystallising at 40·2° C., so as to secure crystallisation at about 25° C. The proportion of phenol (crystallising at 40·2° C.) in each fraction is read off on a straight-line freezing-point curve, on which 40·2° C. is the freezing-point of 100% phenol and 20° C. that of 66% phenol. The error in a determination is not greater than 1%.
—F. Sodn.

Resorcinol; Colours produced by —— *in solutions of certain salts and their use for the detection of resorcinol in presence of other phenols.* F. C. Krauskopf and G. Ritter. J. Amer. Chem. Soc., 1916, 38, 2182—2187.

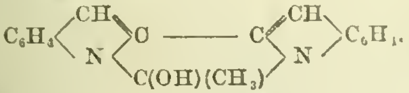
Resorcinol produces, in an ammoniacal solution of zinc salts, a blue colour which has been used for the colorimetric estimation of zinc. Colours of a somewhat similar order are, however, produced with cobalt, nickel, and cadmium, so that the reaction is of no value as a qualitative test for zinc. In studying the reaction as a test for resorcinol, it was found that the violet coloration produced with ammoniacal solutions of cobalt is the most intense. If the tubes be tightly stoppered after mixing, the violet colour develops more slowly but remains more stable than when access of air is allowed. This violet coloration is, however, either inhibited or obscured by the presence of other phenols and is not adapted for the detection of resorcinol in mixtures. On the other hand, when the test is made under the following conditions, satisfactory indications are obtained with as little as 0·001 grm. of resorcinol:—The solution is mixed in a Nessler tube with 1 c.c. of cobalt chloride solution containing 0·0004 grm. of cobalt, 0·3 c.c. of ammonia solution of sp.gr. 0·90, 3 c.c. of 95% alcohol, and water to 50 c.c. The tube is tightly closed with a rubber stopper, allowed to stand for 3—5 mins. and shaken vigorously. Resorcinol develops a dark green colour, catechol, quinol, and pyrogallol a brown, while phenol remains colourless. The brown colour developed by the other phenols does not interfere with the detection of resorcinol in the presence of substantial quantities of these.—J. F. B.

Acid chlorides; Photo-chemical decomposition of certain ——. S. C. J. Olivier. Rec. Trav. Chim. Pays-Bas, 1916, 36, 117—125.

When *p*-chlorobenzene sulphochloride in ethereal solution is exposed to direct sunlight or the rays of a "Uviol" lamp, chlorine is liberated and oxidation takes place with the formation of the free sulphonic acid. When the experiment is carried out by passing dry oxygen through the ethereal solution of the sulphochloride while exposed to the rays of the lamp, the quantity of chlorine collected shows a deficit as compared with the equivalent of sulphonic acid formed, and aldehyde and hydrochloric acid are found in the aqueous liquid on treatment with water. It is probable, therefore, that some of the chlorine reacts with the ether to form chloroethyl ether, which is subsequently hydrolysed to aldehyde. Under favourable conditions, the decomposition of the sulphochloride under the influence of light and oxygen may amount to over 40% in six hours and the reaction is practically inhibited in the absence of light or oxygen; the presence or absence of moisture has no appreciable influence. The photo-chemical decomposition of the sulphochloride is considerable in ethereal solution but only slight in chloroform solution; in benzene and carbon tetrachloride, the reaction does not take place. It is suggested that the formation of a peroxide may play a part in the reaction. Other sulphochlorides of the benzene series behave in a similar manner in a subordinate degree.—J. F. B.

Di-indolyl; New derivatives of ——. W. Madelung and F. Hager. Ber., 1916, 49, 2039—2050.

By the action of acetic anhydride on di-indolyl under varying conditions, a C-monoacetyl- and an N-mono- and diacetyldi-indolyl were obtained. N-Diacetyldi-indolyl is formed in the largest quantity by carrying out the acetylation at ordinary temperatures, and cannot be obtained by the further acetylation of the monoacetyl-derivative. It forms colourless crystals, m.pt. 208° C. The N-monoacetyldi-indolyl forms the chief product by acetylating at 40°—50° C., and reasons are given for assigning to it the constitution of an N-cycloacetyl-di-indolyl,



To the C-monoacetyl derivative, which was obtained by boiling under a reflux condenser for 4 hours, a similar ring structure is assigned. Unlike the N-compounds, this substance is yellow, and stable towards acids and alkalis. Benzoyl chloride gave with di-indolyl only the dibenzoyl-compound, m.pt. 267° C. It has acid properties, and gives a potassium salt from which enolic ethers were prepared by the action of alkyl iodides. No reduction products of di-indolyl itself could be isolated, but the reduction of this substance or of C-cyclo-acetyldi-indolyl with hydrogen iodide in acetic acid solution gave a colourless crystalline basic product, $C_{16}H_{18}N_2$, of m.pt. 214° C., to which the name cycloethylidene-tetrahydrodi-indolyl is given.—G. F. M.

Benzol recovery and rectification. Walmsley and Morfey. *See* IIa.

Utilisation of the tar from gas producers using lignite as fuel. Fischer and Schneider. *See* IIa.

Patents.

Creosote from hardwood-tar oils; Process of producing ——. L. F. Hawley, Randolph, N.Y. U.S. Pat. 1,199,271, Sept. 26, 1916. Date of appl., June 8, 1916.

Wood-tar oils are treated with sufficient of an alkaline solution to dissolve two-fifths of the phenols present; the resulting solution is distilled, being partly oxidised during the distillation, and the creosote is neutralised and recovered, dissolved in alkali, and again distilled under oxidising conditions.—F. W. A.

Sulphonic acids; Manufacture of alkali salts of aromatic —— *from the corresponding alkaline-earth salts.* M. Maxim, Berlin. Ger. Pat. 293,982, Aug. 21, 1915.

The solution of the alkaline-earth sulphonate is filtered through a layer of granulated alkali aluminosilicate, whereupon an exchange of bases takes place as in the permutite process of water-softening. The residual alkaline-earth aluminosilicate may subsequently be treated with alkali chloride solution to regenerate alkali aluminosilicate.—A. S.

Bromo-α-hydroxyanthraquinones: Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,694, Dec. 13, 1913.

Bromo-derivatives of α-hydroxyanthraquinones, difficult to prepare in other ways, can be obtained by the action of bromine in presence of substances capable of combining with hydrogen bromide. For example, α-hydroxyanthraquinone yields 1.4-bromohydroxyanthraquinone, m.pt. 197°—198° C., anthrarufin yields 4.8-dibromo-1.5-dihydroxy-anthraquinone, and chrysazin yields tetrabromo-chrysazin (2.4.5.7-tetrabromo-1.8-dihydroxy-anthraquinone).—A. S.

ω-Dibromo-p-toluyl-o-benzoic acid; Preparation of transformation products of —— [*e.g.*, *anthraquinone-2-aldehyde*]. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 293,981, July 18, 1914.

Anthraquinone-2-aldehyde is obtained by heating ω-dibromo-*p*-toluyl-*o*-benzoic acid to a high temperature; or *p*-aldehydobenzophenone-*o'*-carboxylic acid may be first formed by heating with sulphuric acid at a relatively low temperature and then the temperature raised to convert this into the anthraquinone-aldehyde. Other hydrolysing agents than sulphuric acid, *e.g.*, a dilute alkali solution, may be used to convert the ω-dibromo-*p*-toluyl-*o*-benzoic acid into *p*-aldehydobenzophenone-*o'*-carboxylic acid, and the latter converted into anthraquinone-2-aldehyde by heating with any suitable dehydrating agent.—A. S.

Mononitrocarbazoles; Preparation of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 294,016, Sept. 28, 1913.

Carbazole or an N-alkyl, N-aryl, or halogen derivative is dissolved or suspended in an inert medium, immiscible with water, and treated with nitric acid.—A. S.

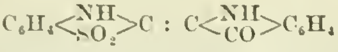
Furnace using oil or tar as fuel. Ger. Pat. 293,116. *See* IIb.

Manufacture of hard, pale-coloured coumarone resin. Ger. Pat. 294,107. *See* XIII.

IV.—COLOURING MATTERS AND DYES.

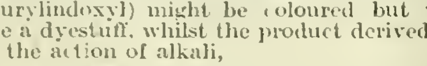
Indigo; The chromophor of ——. M. Claass. Ber., 1916, 49, 2079—2095.

The possibility or presence of quinonoid linkages is generally accepted for all dyestuffs with the exception of those of the indigoid type, where the chromophor is assumed to be the grouping CO.C : C.CO. In accordance with this theory a substance,



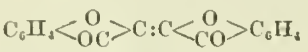
$$C_6H_4{<}\substack{NH\\SO_2}{>}C : C{<}\substack{NH\\CO}{>}C_6H_4$$

(obtained by condensing isatin chloride with sulphurylindoxyl) might be coloured but would not be a dyestuff, whilst the product derived from it by the action of alkali,



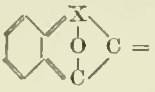
$$C_6H_4{<}\substack{NH\\SO_2}{>}CH.C(ONa){<}\substack{NH\\CO}{>}C_6H_4$$

should not even be coloured. Both substances are, however, actually blue dyestuffs. On the other hand a number of substances such as oxindigo



$$C_6H_4{<}\substack{O\\OC}{>}C{:}C{<}\substack{O\\CO}{>}C_6H_4$$

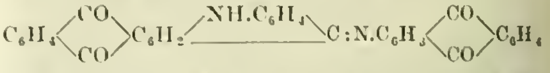
containing the group CO.C : C.CO are coloured but are not dyestuffs, whilst there are a number of substances such as Pyrrole Blue, Indophenine Blue, and Isatinpiperidine Blue, which do not contain this group and yet are exceedingly like indigo in all their properties. All indigoid compounds may, however, be regarded as containing at least one inner ring of a betaine-like structure



termed indogen, and this constitutes the real chromophor, bringing the indigoid compounds into accordance with the rule that dyestuffs are only produced when the auxochrome so modifies the ring as to produce the maximum of double linkages. Indigo would thus have the constitution represented by two indogen groupings. The inner salt formation may be greatly influenced by the entrance of other groups into the molecule; thus N.N-diacetylindigotin is a reddish compound without any tinctorial properties and hence possesses no internal betaine-like ring, whilst N.N-dimethylindigotin is a dyestuff closely resembling indigo. The fact that indigo cannot be alkylated directly is regarded as confirmative evidence that the nitrogen atoms are present in the form of an internal ammonium salt. Numerous examples from the different classes of indigoid colours are quoted in support of the theory that all truly indigoid dyestuffs, in which class are included such dyestuffs as Pyrrole Blue and Indophenine Blue, contain the indogen chromophor. It is suggested also that many dyestuffs of the anthraquinone series, *e.g.*, Indanthrene, owe their dyeing properties to the presence of a betaine-like chromophor. T. C.

1-*Aminoanthraquinone; Action of o-chlorobenzaldehyde on* ——. G. Kalischer and F. Mayer. Ber., 1916, 49, 1994—2000.

o-[Anthraquinonyl-1-amino]-benzaldehyde is the main product of the action of *o*-chlorobenzaldehyde on 1-aminoanthraquinone at 200°—210° C. in nitrobenzene solution. It forms red crystals, m.pt. 254° C. When two mols. of aminoanthraquinone are employed to one of chlorobenzaldehyde, and their solution in nitrobenzene is heated with anhydrous potassium carbonate and a small quantity of copper powder, a bluish-green dyestuff is formed in preponderating amount, to which the constitution of a [1-anthraquinonylimino]-[anthraquinone-2.1-acridone],



$$C_6H_4{<}\substack{CO\\CO}{>}C_6H_2\overset{\diagup NH.C_6H_4\diagdown}{\rule{6em}{0.4pt}}C{:}N.C_6H_3{<}\substack{CO\\CO}{>}C_6H_4$$

is assigned. If the above starting materials are heated with fused potassium acetate and copper powder in naphthalene solution at 225°—230° C. for 8 hours, as described in Ger. Pat. 280,711 (this J., 1915, 545), a blue dyestuff of apparently the same molecular formula as the above, but of undetermined constitution, is produced.—G. F. M.

Patents.

[*Sulphur*] *dyes and process of making same.* H. Heimann, Dessau, Assignor to Act.-Ges. f. Anilinfabr., Berlin. U.S. Pat. 1,199,697, Sept. 26, 1916. Date of appl., Jan. 21, 1915.

See Ger. Pat. 293,186 of 1914; this J., 1916, 1056. The dyestuff obtained by the action of sulphur on *p*-nitrobenzeneazo-N-ethyl-α-naphthylamine is specially claimed. It is easily soluble in alkali sulphide and alkaline hydrosulphite solutions, and gives on unmordanted cotton yellowish-brown tints fast to washing and to boiling dilute acids.

o-Hydroxydisazo dyestuffs; Manufacture of chrome ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,657, July 29, 1915.

Nitro-2-aminophenols or their sulphonic acids are diazotised and combined with 2-amino-5-naphthol-7-sulphonic acid in alkaline solution, and the intermediate products are again diazotised and then combined with alkylaralkylarylaminesulphonic acids. The products dye wool, the shades produced after chroming being black and of excellent fastness to light, washing, and milling. —A. S.

Trisazo dyestuffs; Manufacture of ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,659, June 5, 1915.

A 4.4′-diaminoazo compound is diazotised and combined with 1 mol. of a 1.8-dihydroxynaphthalenesulphonic acid and 1 mol. of a *m*-diamine, or a 4′-nitro- or 4′-acidylamino-1-aminoazo compound is diazotised, coupled with a 1.8-dihydroxynaphthalenesulphonic acid, and then, after reducing the nitro group or eliminating the acidyl group, the product is again diazotised and coupled with a *m*-diamine. Black to bluish-black shades are obtained from the resulting trisazo dyestuffs by after-treatment on the fibre.—A. S.

Trisazo dyestuffs; Manufacture of diazotisable ——. Act.-Ges. f. Anilinfabr. Ger. Pat. 293,858, June 30, 1915.

A diazosulphonic acid of the benzene or naphthalene series is combined with a suitable middle component, the product is diazotised and combined with α-naphthylamine or 1-aminonaphthalene-6- or -7-sulphonic acid, and the resulting disazo compound is diazotised and combined with 2-amino-8-naphthol-6-sulphonic acid in alkaline solution. The products are useful for producing level grey shades on cotton. When diazotised on the fibre and combined with compounds such as β-naphthol or *m*-toluylenediamine, grey shades fast to washing, light, and alkalis are obtained. The shades are faster to light than those produced by Diaminogen B.—A. S.

[Azo] wool dye. P. Hauptmann, Leverkusen. Germany. Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,199,890, Oct. 3, 1916. Date of appl., Jan. 20. 1915. Renewed Aug. 19. 1916.

Azo dyestuffs dyeing wool in acid baths yellow to bluish-red to brown shades, fast to fulling, are obtained by coupling azo dyestuff components with the diazo derivative of an arylenediamine of the benzene series, one of the amino groups of which is disubstituted by an acyl group and an organic radicle respectively. The dyestuffs from substituted toluylenediamines and naphtholsulphonic acids are dark powders, soluble in water, which give, generally, reddish shades on wool.—A. S.

Trisazo dyestuffs ; Manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,658, July 11, 1914. Addition to Ger. Pat. 293,184.

The process described in the chief patent (this J., 1916, 922) is modified by using 2-amino-5-naphthol-7-sulphonic acid as end component instead of 2-amino-8-naphthol-6-sulphonic acid, and by effecting the final coupling in slightly acid solution. The products are faster to light than Neutral Grey.—A. S.

Nitrosamines of primary aromatic amines and their alkali salts ; Manufacture of ——. Chem. Fabr. Griesheim-Elektron. Ger. Pat. 292,118, Aug. 29, 1915.

Nitrosamines of primary aromatic amines are obtained in the form of their alkali salts by the action of caustic alkalis on the arylsulphonates of the corresponding diazo or tetrazo compounds in separated, concentrated form.—A. S.

Dianthraquinonylene dioxides ;. Manufacture of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,660, May 6, 1914.

o-Nitrohydroxyanthraquinones are heated with alkaline condensing agents at a high temperature. The products, which are formed by the union of two mols. of the anthraquinone derivative with elimination of two mols. of nitrous acid, are either vat dyestuffs or may be used in the manufacture of dyestuffs.—A. S.

Vat dyestuffs of the anthraquinone [Indanthrene] series ; Manufacture of blue —— containing chlorine and fast to chlorine. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 293,971, June 3, 1914. Addition to Ger. Pat. 287,590 (this J., 1916, 171).

N-Dihydro-1.2.2′.1′-anthraquinoneazine (Indanthrene) is heated under pressure, at a temperature not exceeding about 170° C., with sulphuryl chloride, with or without addition of indifferent diluents.—A. S.

Vat dyestuffs of the anthraquinone series ; Manufacture of ——. R. Wedekind und Co., Uerdingen. Ger. Pat. 293,970, Dec. 28, 1913.

1-Chloro-2-hydroxyanthraquinone, a salt of anthraquinone-2-sulphonic acid, or the yellow vat dyestuff prepared from 1-chloro-2-hydroxyanthraquinone as described in Ger. Pat. 257,832 (this J., 1913, 481) is heated with dry alkali sulphide above 220° C., and the products, which are insoluble in water, alkalis, and alkali sulphides, are chlorinated.—A. S.

Sulphurylindoxyl ; Preparation of ——. M. Claass, Danzig-Langfuhr. Ger. Pat. 294,084, Jan. 27, 1916.

Sulphurylindoxyl is obtained by heating sulphazone with ammonia at a high temperature, under pressure. It combines with isatin or its derivatives to form valuable vat dyestuffs. (See also this J., 1916, 529, 1104.)—A. S.

o-[Hydr]oxy disazo dyestuffs ; Manufacture of chromable secondary ——. M. Boeniger, Assignor to Chemical Works formerly Sandoz, Basle, Switzerland. U.S. Pat. 1,199,233, Sept. 26, 1916. Date of appl., Jan. 29, 1916.

See Eng. Pat. 17,607 of 1915 ; this J., 1916, 531.

Disazo dyestuffs ; Manufacture of chromable secondary ——. M. Boeniger, Assignor to Chemical Works formerly Sandoz, Basle, Switzerland. U.S. Pat. 1,199,234, Sept. 26, 1916. Date of appl., May 13, 1916.

See Eng. Pat. 100,172 of 1916 ; this J., 1916, 733.

Gallocyanine dyestuffs ; Halogen derivatives of —— and process of making same. G. Engi, Assignor to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,199,458, Sept. 26, 1916. Date of appl., Nov. 10, 1915.

See Eng. Pat. 14,159 of 1915 ; this J., 1916, 628.

Nitrosamines of primary aromatic amines ; Process for the manufacture of alkali salts of ——. M. Hankel, Offenbach, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,200,726. Oct. 10, 1916. Date of appl., Dec. 3, 1915.

See Ger. Pat. 292,118 of 1915 ; preceding.

Vat dye [of the naphthalene series] and process of making it. M. Kardos, Charlottenburg, and P. Nawiasky, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,200,848, Oct. 10, 1916. Date of appl., Sep. 10, 1914.

See Ger. Pat. 276,956 of 1913 ; this J., 1914, 1084.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Wood ; The colour-producing constituents of ——. H. Wichelhaus and M. Lange. Ber., 1916, **49**, 2001.

The hydrolytic decomposition of wood by means of superheated steam at 180° C. gave a distillate from which, by extraction with ether, an oil was obtained which gave with phloroglucinol and hydrochloric acid a colouring matter apparently identical with that produced on wood itself with these reagents. The aqueous liquid after extraction with ether gave under similar treatment a pale red coloration which eventually became greenish-brown.—G. F. M.

Wood pulp ; The resin of coniferous woods and the de-resinification of ——. R. Sieber. Schriften des Vereins der Zellstoff- u. Papierchem., Bd. 9. Z. angew. Chem., 1916, **29**, Ref., 429—430.

The so-called resin isolated from pine wood by extraction with organic solvents, contains, on the average, 50% of fatty matter. Only traces of turpentine can be extracted from freshly-cut, relatively young wood by extraction with ether, but when the same wood is boiled with caustic soda solution under a pressure of 8 atmospheres, the vapours discharged during the "blowing-off" operation contain measurable quantities of turpentine. The "resin" extracted from sulphite-pulp by ether and alcohol contains respectively 63 and 74% of fatty matter, and it is to this fatty matter that the so-called "resin specks" (this J., 1909, 438) on paper made from sulphite pulp are due. —A. S.

Liquid Swedish resin [from wood pulp waste lyes]. Lorentz *See* XIII.

Brewers' filter pulp. Foster. *See* XVIII.

Abnormal adsorption [of hydrochloric acid] by filter paper. Murray. *See* XXIII.

PATENTS.

Ungumming silk and silk wastes; Bath for ——. P. Schmid and K. Gross, Basle, Switzerland. U.S. Pat. 1,199,433, Sept. 26, 1916. Date of appl., Oct. 7, 1915.

SEE Eng. Pat. 100,029 of 1916; this J., 1916, 733. An aqueous solution containing ½ to 6 parts of soap and 9½ to 4 parts of silkworm chrysalides is specified.

Cellulose esters insoluble in chloroform and their products of transformation; Process for the manufacture of ——. H. Dreyfus. Fr. Pat. 478,023, Nov. 11, 1914. Under Int. Conv., Oct. 12, 1914.

IN order to produce chloroform-insoluble cellulose acetate of maximum viscosity, the acetylating mixture should be cooled sufficiently during the early stages of the reaction to keep it preferably below 5° C. Later on it may be allowed to rise slowly to 30°—35° C. and should then be cooled again to 25°—30° C. These limits of temperature are more easily observed if the amount of acetic anhydride or other acetylating agent is less than three times the weight of the cellulose. The weight of sulphuric acid should be from 5% to 20% of the weight of cellulose. Similar precautions as to temperature should be observed in acetylating cellulose suspended in toluol or benzol, or when the sulphuric acid is replaced by other condensing agents in sufficient quantity to produce the same effect. *Example:* A mixture of 300—400 kilos. of glacial acetic acid, 250 kilos. of acetic anhydride, and 10—15 kilos. of concentrated sulphuric acid is cooled to below 0° C., *e.g.*, to −3° C., which causes the acetic acid to crystallise; 100 kilos. of cotton or paper of normal humidity (3—6%) is introduced and the mixture well stirred. The temperature rises after some time to 5°—15° C., and then falls to 5°—10° C. The cooling may then be stopped, and the temperature allowed to rise to 15°—20° C., or even to 25°—35° C., but if allowed to rise higher the viscosity of the product will be diminished. Cooling is then recommenced, with constant stirring, until the temperature of the mass begins to fall, and the mixture is then allowed to stand until all the fibres, and any crystalline substances formed during the cooling, have disappeared. The product may be separated by any of the known methods, or the reaction may be allowed to proceed further, with addition of water, etc., to modify the solubility of the product. (Compare Fr. Pat. 432,046 and Additions thereto; this J., 1912, 24, 329; 1913, 283, 420.)—F. SP.

Artificial silk: Process and apparatus for spinning —— in the air. Soc. La Sétaoïd. Fr. Pat. 478,315, July 25, 1914.

FOR spinning twisted artificial silk from nitrocellulose solutions of which the threads solidify almost immediately in the air (see following abstract), a central cylindrical solution reservoir of adjustable height is provided with several taps fitted with spinnerets. Each spinneret contains a number of tubes, converging towards their lower ends, and terminating in capillary orifices. Vertically below each spinneret is a small rotating table, with a central rod projecting vertically from it. The threads of nitrocellulose issuing from the converging orifices of the spinneret stick together and descend on to the rotating table, the effect of which is to twist the threads on each other, and to wind them round the rod on the table in the form of a vertical cocoon, in a convenient shape for denitration, etc. The vertical distance between the reservoir and the rotating tables is adjusted to suit the solution and the atmospheric conditions.—F. SP.

Threads having the appearance of silk; Process for obtaining ——. Soc. La Sétaoïd. Fr. Pat. 478,461, July 27, 1914.

A SUITABLE solution for use in the spinning apparatus described in the preceding abstract is obtained by adding to 10 kilos. of nitrocellulose solution, 300 grms. of anhydrous aluminium chloride, 100 grms. of purified aluminium chloride, 80 grms. of sodium formate, 200 grms. of aluminium phosphate, and 80 grms. of aluminium nitrate. Water, alcohol, or ether may be added according to the fluidity desired. The product is adapted for spinning in the air, and yields threads resembling silk in appearance and possessing considerable resistance to humidity.—F. SP.

Cork; Preparation of moulded objects of ——. Rheinhold und Co., Vereinigte Norddeutsche und Dessauer Kieselguhr-Ges., Hanover. Ger. Pat. 294,072, Oct. 30, 1913.

THE particles of cork are mixed with a suitable binding agent, moulded into shape, then coated with a suitable fireproof material, *e.g.*, water-glass, aluminium sulphate, lime, or the like, and heated above 200° C. Alternatively, the cork particles may be mixed with clay or other fire-resisting material and water or other suitable liquid, moulded, dried, and heated above 200° C.—A. S.

Decortication and scouring of urticaceous plants; Process for the ——. O. Richter and F. Pick, Vienna. U.S. Pat. 1,201,101, Oct. 10, 1916. Date of appl., Feb. 2, 1915.

SEE Ger. Pat. 284,791 of 1914; this J., 1915, 1048.

Cellulose acetates and conversion products; Manufacture of ——. H. Dreyfus, Basle, Switzerland. Eng. Pats. (A) 14,101, Oct. 5, 1915, and (B) 101,555, Oct. 5, 1915 (Appl. No. 13,447 of 1916). Under Int. Conv., Oct. 12, 1914.

SEE Fr. Pat. 478,023 of 1914; preceding. (B) Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 20,977 of 1911.

Cellulose derivatives [viscose]; Treatment of ——. F. Steimmig, Hanover, Germany. U.S. Pat. 1,200,774, Oct. 10, 1916. Date of appl., June 12, 1913.

SEE Fr. Pat. 458,979 of 1913; this J., 1913, 1153.

Celluloid; Composition of matter resembling ——. O. Schmidt, Assignor to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,200,886, Oct. 10, 1916. Date of appl., Oct. 21, 1914.

SEE Eng. Pat. 9270 of 1914; this J., 1915, 867. A mixture containing nitrocellulose and acetyldicyclohexylamine is specially claimed.

Condensation products [from phenols and formaldehyde] and method of manufacturing a substance capable of replacing ivory, mother of pearl, celluloid, etc. Fr. Pat. 478,881. *See* XIII.

Varnishes with a basis of cellulose acetate. Fr. Pat. 479,387. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Nitre cake in the textile industries. P. Bean. Manchester Chem. Club, Oct. 27, 1916. Chem. Trade J., Nov. 4, 1916.

THE supply of sulphuric acid to bleachers, dyers, and calico printers was cut off some months ago, and in September these consumers were informed by the Ministry of Munitions that on and after Oct. 18th all supplies of hydrochloric acid would be stopped, and that nitre cake must be used in its place; this time limit was afterwards extended to October 30th. In spite of statements to the contrary, in many cases it is not possible to bleach successfully without using hydrochloric acid: this applies particularly to goods in which the highest degree of whiteness and purity was demanded. Certain classes of goods, including those which have to be dyed or printed with alizarin colours, can only be bleached successfully if they are subjected to the lime boil, in which case it is essential to use hydrochloric acid for souring. In many cases a caustic soda boil could replace the lime boil, but then the increased demand for soda would render the position even more difficult. The use of nitre cake in textile operations involves a great deal of extra work and extra space, especially in connection with freeing the solution from dirt. If nitre cake has to be used it will involve either a considerable reduction in the bleaching of cotton and linen, or trouble between bleachers and dyers owing to damage.

In the discussion it was stated that the Government was prepared to supply hydrochloric acid in cases in which it was not possible to use nitre cake. Two of the speakers stated that nitre cake had been used by their firms with success.

Staining of tissue with the simplest dyestuffs, and their fixation. S. Skraup. Ber., 1916, **49**, 2142—2154.

All basic dyestuffs used as stains may be fixed by the use of mercuric chloride, due to the production of mercuramino compounds, and generally every dyestuff used for staining tissue may be fixed by selecting a fixing agent which converts it into an insoluble compound. Dyestuffs containing hydroxyl groups may, for example, be fixed with lead acetate. No specific chemical constitution can be found which gives a substance the property of staining tissue, as this property is possessed by even the simplest dyestuffs. The colloidal condition shown by previous researches to be necessary for staining is markedly affected by even slight variations in chemical constitution.—F. W. A.

Patents.

Dyeing; Process o ——. I. J. Smith, Menands, and H. B. Smith, Albany, N.Y., Assignors to Surpass Chemical Co. U.S. Pat. 1,199,745, Sept. 26, 1916. Date of appl., Mar. 21, 1916.

Uncombed cotton material is treated with an alkaline oxidising bath to soften any motes, shives, and/or leaf present, the bath also containing a direct or vegetable dyestuff unaffected by the other substances present.—F. W. A.

Dyeing apparatus. D. M. Hey, Assignor to Vacuum Dyeing Machine Co., Chattanooga, Tenn. U.S. Pat. 1,199,982, Oct. 3, 1916. Date of appl., Apr. 5, 1910.

The material to be dyed is placed in the dye vat between two perforated plates. Dye liquor is discharged into the space beneath the lower perforated plate from a distributor with radial arms, and after passing through the material overflows from the space above the upper perforated plate into a relatively shallow conduit which extends round the chamber, and communicates with the suction side of the circulating pump.—F. W. A.

Fabric-treating apparatus. T. Allsop and W. W. Sibson, Assignors to The Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,200,433, Oct. 3, 1916. Date of appl., Oct. 5, 1914.

A fabric-treating apparatus consists of a tank through which extends a perforated pipe for delivering or withdrawing liquor; a perforated drum divided into pockets by perforated radial walls is mounted on this pipe as axis and may be rotated submerged in the liquor in the tank; a second perforated pipe, provided at the end with a removable cap, extends along the bottom of the tank, outside the drum, and means are provided for circulating the liquor in either direction; the tank has an opening in one of its walls closed by a panel.—F. W. A.

Dyeing apparatus. W. A. Traver, Assignor to Franklin Process Co., Providence, R.I. U.S. Pat. 1,200,546, Oct. 10, 1916. Date of appl., Feb. 18, 1916.

A hollow tubular perforated stringer, suitable for holding a number of dye-cops strung along its length, has a non-perforated section at one end, and this section is formed with peripheral grooves spaced apart. A flange is adapted to slide on the stringer and compress the yarn in the cops, and is held in place by a plate adjustable laterally across the flange to engage the grooves in the end of the stringer.—F. W. A.

Dyeing machine. F. S. Williams, Assignor to Klauder-Weldon Dyeing Machine Co., Amsterdam, N.Y. U.S. Pats. 1,200,677 and 1,200,678, Oct. 10, 1916. Date of appl., Feb. 10, 1915.

Devices for rotating the yarn sticks are claimed.

Dyeing apparatus. L. P. Hart. Fr. Pat. 478,234, Apr. 1, 1915.

In order to ensure thorough mixing of the dye-liquor, it is introduced inside hollow non-perforated rollers, open at the ends, carrying the material to be dyed.—F. W. A.

Cotton dyed with sulphur dyestuffs; Process for preventing tendering of —— *in union goods.* Act.-Ges. f. Anilinfabr. Ger. Pat. 293,455, June 30, 1914.

The material, after dyeing with a sulphur colour, is treated with ammonium salts and chromates, whereby the wool is dyed and the cotton is prevented from tendering.—A. S.

Calcium soaps in washing baths: Process for preventing flocculation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 294,028, Oct. 15, 1914.

A colloid soluble in water is added to the bath with the soap. Suitable substances are glue, albumin or its cleavage products, vegetable glue from carragheen moss, and sulphite-cellulose waste lyes in which the lime has been replaced by alkali.—A. S.

Dyeing with dyestuffs insoluble in water or water-insoluble leuco-compounds of dyestuffs; Process for ——. M. Iljinsky, Assignor to Wedekind und Co., Uerdingen, Germany. U.S. Pat. 1,199,273, Sept. 26, 1916. Date of appl., Dec. 10, 1912.

See Fr. Pat. 451,533 of 1912; this J., 1913, 598.

Sericin soap for dyeing silk, silk-spuns, and silk tissues; Process for the manufacture of a substitute for ——. P. Schmid and K. Gross, Basle, Switzerland. U.S. Pat. 1,199,434, Sept. 26, 1916. Date of appl., Oct. 7, 1915.

See Eng. Pat. 101,169 of 1916; this J., 1916, 734.

Sulphur dyes; Process of making [*pastes for dyeing with* ——]. E. Voetter, Bockum, Germany. U.S. Pat. 1,200,055, Oct. 3, 1916. Date of appl., Feb. 26, 1907.

See Eng. Pat. 8066 of 1906; this J., 1907, 16.

Reserve style of printing or dyeing chrome-dyestuffs. Durand und Huguenin A.-G., Basle, Switzerland. Eng. Pat. 100,885, June 14, 1916 (Appl. No. 8409 of 1916). Under Int. Conv., July 12, 1915.

See Ger. Pat. 293,359 of 1915; this J., 1916, 1058.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Phosphoric acid evolved in the volatilisation method of treating phosphate rock: Use of the Cottrell precipitator in recovering ——. W. H. Ross, J. N. Carothers, and A. R. Merz. U.S. Bureau of Chem. Oil, Paint, and Drug. Rep., Oct. 2, 1916.

The authors have applied the Cottrell method of electrical precipitation (this J., 1911, 1037) to the recovery of the phosphorus pentoxide volatilised on heating a mixture of phosphate rock, coke, and sand. The charge is heated in an electric furnace, and the volatilised phosphorus pentoxide is carried by a current of air to the precipitation apparatus, which it enters at a temperature above 100° C. It is stated that phosphoric acid of 99·89% purity is thus obtained in the form of a highly concentrated solution (up to 92%).

Potash deposits in Cuba.

American newspapers recently contained reports to the effect that extensive deposits of potash salts had been discovered near Motembo, Cuba, and a company was formed, with a capital of $5,000,000, to work the deposits, which were stated to contain up to 40% K_2O. The Cuban Government Engineer has examined the property and has analysed thirteen samples from the alleged deposits, but the highest result he obtained was only 0·51% of potash.

Nitrogen works in Sweden. Engineering, Nov. 3, 1916.

A company with a large capital has been formed in Sweden to manufacture nitric acid and other products by the Birkeland-Eyde process. Works are to be erected at Trollhättan, where the power station will supply 12,000 k.w. of energy. The annual capacity of the plant will be about 7000 tons of concentrated nitric acid. The works are guaranteed to be ready this year.

Chlorides [; Volumetric determination of ——] in presence of thiocyanates. F. W. Bruckmiller. J. Amer. Chem. Soc., 1916, **38**, 1953—1955.

In solutions containing both chlorides and thiocyanates, the former may be determined volumetrically with silver nitrate, using chromate indicator, after decomposing the thiocyanate by boiling with a small quantity of nitric acid for 15 mins. The solution is cooled, and neutralised with sodium bicarbonate, using methyl orange as indicator, before titrating with silver nitrate. No loss of hydrochloric acid occurs under these conditions, and the hydrocyanic acid formed by decomposition of the thiocyanate is expelled to within 3 mgrms. per litre, an amount which is practically negligible. Moreover no sulphur compounds are formed which can interfere with the silver nitrate titration. It was incidentally determined that the chromate indicator can be used in acid solutions provided the hydrogen ion concentration is not greater than 0·0028 *N*.—G. F. M.

Hydrogen sulphide; Action of —— on mixtures of the alkaline earths with the alkalis and with oxides of the heavy metals. II. I. Guareschi. Atti R. Accad. Sci. Torino, 1915—1916, **51**, 951—962. J. Chem. Soc., 1916, **110**, ii., 529. (Compare this J., 1916, 835, 836.)

The effect of strontium and lithium oxides on the action of hydrogen sulphide on sodium hydroxide or potassium hydroxide is considerably less energetic than that of calcium oxide or barium oxide, no incandescence being observed under the conditions used. The incandescence obtained with mixtures of sodium (or potassium) hydroxide and calcium (or barium) oxide cannot be attributed to the presence or formation of peroxides. The alkali peroxides (not, however, of recent preparation) act almost like the hydroxides, whilst barium, magnesium, and lead peroxides have no action. Mixtures of calcium (or barium) oxide with mercuric or nickel oxide also react vigorously with hydrogen sulphide and, when the constituent oxides are in definite proportions, vivid incandescence or even explosion takes place. When incandescence occurs with mercuric oxide, sulphur dioxide is formed, and this reacts with the hydrogen sulphide, giving colloidal sulphur. No incandescence is observed when hydrogen sulphide acts on pumice and mercuric oxide, or on a mixture of calcium (or barium) oxide with ferric oxide, cuprous or cupric oxide, or litharge.

Mercuric iodide; Action of hydrogen sulphide on ——. G. Franceschi. Boll. Chim. Farm., 1916, **55**, 481—483. J. Chem. Soc., 1916, **110**, ii., 530.

Study of this reaction in alcoholic solution shows that it takes place in three phases, with formation of three different compounds, according to the conditions. These phases may be represented thus: (1) $H_2S+2HgI_2=2HgI+2HI+S$; (2) $6HgI+H_2S+4S=2(2HgS,HgI_2)+2HI$: and (3) $2HgS,HgI_2+H_2S=3HgS+2HI$. The action of hydrogen sulphide on mercuric and mercurous salts always yields mercuric sulphide, the mercuric salts being previously reduced to mercurous salts, and an intermediate compound formed which may be regarded as a thiobasic mercury compound of the constitution $Hg(\cdot S\cdot HgR)_2$. The compound $Hg(\cdot S\cdot HgI)_2$ forms a brown precipitate.

Copper sulphates; Basic ——. S. W. Young and A. E. Stearn. J. Amer. Chem. Soc., 1916, **38**, 1917—1953.

Basic copper sulphates were prepared by allowing finely powdered copper oxide to act on solutions of copper sulphate until equilibrium was attained. This required about 3 months at 25° C. and two weeks at 50° C. The composition of the products was independent of the temperature and the evidence indicated that they were not definite compounds, but rather formed a three-component system in which the components, CuO, SO_3, and H_2O varied continuously within certain limits, the most basic salt being probably the compound $CuSO_4,2CuO,2H_2O$. In the products of lower basicity the water content increases as the CuO decreases, but it is not certain whether this holds good throughout the whole range to $CuSO_4,5H_2O$. Basic sulphates, prepared by heating copper sulphate with varying relative amounts of water, are not definite compounds as has been maintained. The formation of a metastable series of basic sulphates, under at present undetermined conditions, was indicated. It is obvious from the above facts that the mineral brochantite will show a variable composition according to the conditions of its formation.—G. F. M.

Lead arsenates. I. C. C. McDonnell and C. M. Smith. J. Amer. Chem. Soc., 1916, **38**, 2027—2038.

Monoplumbic orthoarsenate, $PbH_4(AsO_4)_2$, was prepared by boiling diplumbic arsenate with aqueous arsenic acid of at least 86% strength. It forms long rhomboidal plates, and is completely resolved by contact with water into diplumbic arsenate and arsenic acid. It loses half its water of constitution when heated at 150° C., with the

probable formation of $PbH_2As_2O_7$. At a temperature somewhat below that of red heat it is resolved into lead meta-arsenate, $Pb(AsO_3)_2$, which was also prepared in crystalline form by fusing arsenic acid with litharge. This compound is also decomposed by contact with water. Diplumbic orthoarsenate was prepared by precipitation from lead nitrate or lead acetate solutions with potassium dihydrogen arsenate, and was obtained as long slender crystals from a saturated solution in nitric acid by gradual neutralisation with ammonia vapour from concentrated ammonia solution placed under a bell jar. A crystalline product was also obtained by pouring a boiling saturated solution in nitric acid into six times its volume of boiling water. At 280° C. it is converted into diplumbic pyroarsenate, $Pb_2As_2O_7$. Triplumbic orthoarsenate, $Pb_3(AsO_4)_2$, has a very limited range of existence. It was not obtained by any precipitation reaction, but a yellowish-brown crystalline mass was produced by fusing diplumbic arsenate with litharge in theoretical proportions.
—G. F. M.

Lead arsenates. Study of the factors controlling the reactions of lead nitrate and lead acetate with disodium arsenate. G. E. Smith. J. Amer. Chem. Soc., 1916, **38**, 2014—2027.

Lead arsenates produced by the reaction of lead nitrate or acetate with disodium arsenate are mixtures of diplumbic arsenate, $PbHAsO_4$, and lead hydroxyarsenate, $Pb_5(OH)(AsO_4)_3$. At low temperatures, when equilibrium has been attained, the product is mainly diplumbic arsenate which is produced by a secondary reaction from the hydroxyarsenate first formed:

$$Pb_5(OH)(AsO_4)_3+2Na_2HAsO_4+4HNO_3 \rightleftarrows 5PbHAsO_4+4NaNO_3+H_2O.$$

An analogous reaction occurs when lead acetate is employed instead of the nitrate. The lead hydroxyarsenate can actually be isolated by carrying out the reaction at great dilution (less than 0·001 mol.) and filtering off the precipitate immediately after its formation. As the concentrations increase, the above equilibrium is displaced towards the right and the composition of the precipitate on attainment of equilibrium more nearly approaches that of diplumbic arsenate; increase in temperature causes the reverse effect. Contrary to expectation an excess of the alkaline disodium arsenate increases the amount of lead hydroxyarsenate produced, its normal effect being apparently masked by the effect of its alkalinity.
—G. F. M.

Colloidal arsenates and phosphates of iron. H. N. Holmes and R. E. Rindfusz. J. Amer. Chem. Soc., 1916, **38**, 1970—1982.

Precipitated ferric arsenate and phosphate, washed free from adsorbed ions after mechanical disintegration with sand, are soluble in comparatively small amounts of ammonia or the hydroxides of certain other bases, with the formation of deep red sols which on long continued dialysis give excellent gels, the composition of which corresponded closely with the formula $FeAsO_4,Fe_2O_3,xH_2O$. The colloid formed by using methylamine gives a gel of a deeper red colour than the others. Ferric orthoarsenate or orthophosphate is also peptised by ferric chloride solution, and yields a red gel on dialysis after removal of most of the chloride ion, and similar gels are formed from ferric chloride and the precipitated phosphates or arsenates of any of the common metals. In both these cases of peptisation by salts the action is due to acid hydrolysis, the free acid giving equally good results, but the gel is lighter in colour. If the sulphate is used instead of the chloride a stable sol is formed which settles out, however, on dialysis. Ferric meta- and pyro-phosphates and ferric arsenite are similarly peptised by ammonia and by ferric chloride. The formation of the sol and gel in acid peptisations is due to the disturbance of the equilibrium by dialysis, since good gels may also be formed by dialysing dilute mixtures of ferric chloride solution and arsenic or phosphoric acids.—G. F. M.

Hydrogen peroxide; Catalytic decomposition of —— in certain non-aqueous solutions. J. H. Walton and De W. O. Jones. J. Amer. Chem. Soc., 1916, **38**, 1956—1961.

Compounds such as metallic acetates and iodides, cupric, ferric, and manganous chlorides, etc., which catalytically decompose aqueous solutions of hydrogen peroxide, also behave in a similar way towards solutions of the peroxide in amyl alcohol, amyl acetate, isobutyl alcohol, and quinoline. For example a solution of "perhydrol" in quinoline is decomposed quantitatively by manganous acetate. If the catalyst is present in so small a concentration that the reaction requires some hours, only about 75% of the oxygen is evolved, the remainder being utilised in oxidising the quinoline, a reaction which is also appreciably catalysed by the manganous acetate. If the quinoline is saturated with water the catalytic decomposition of hydrogen peroxide is a reaction of the first order, as in aqueous solution, but when only about 2% of water is present, the velocity constant is that of a bimolecular reaction. In solutions containing high concentrations of catalyst, the reaction velocity is approximately doubled by doubling the concentration of the catalyst.—G. F. M.

Ozonisation of liquid oxygen by radiation. E. Warburg. Ber. Deut. physik. Ges., 1915, **17**, 194—197. J. Chem. Soc., 1916, **110**, ii., 526—527.

Small quantities of ozone are formed by the action of ultra-violet radiation on oxygen at atmospheric pressure, but since rays of wave-length exceeding 0·2 μ are only slightly absorbed by oxygen under these conditions, it was considered possible that larger quantities might be obtained by the use of liquid oxygen. Experiments made with liquid oxygen and air exposed to the rays emitted by the spark discharge between zinc electrodes, show that appreciable quantities of ozone are formed after a short exposure.

The Messerschmitt process for the production of hydrogen. H. L. Barnitz. Met. and Chem. Eng., 1916, 15, 494—498. *See page* 1137.

New method for purification of colloidal solutions. Wegelin. *See* I.

Nitre cake in the textile industries. Bean. *See* VI.

Nature of the phosphates contained in mineral phosphates. Robertson. *See* XVI.

Efficiency of calcium chloride, sodium hydroxide, and potassium hydroxide as drying agents. Baxter and Starkweather. *See* XXIII.

Loss of phosphoric acid during fusion with ammonium fluoride. Davis and Prescott. *See* XXIII.

Influence of strong salt solutions on the spontaneous oxidation of pyrogallol, ferrous sulphate, and lævulose. MacArthur. *See* XXIV.

Patents.

Sulphuric acid; Continuous concentration of——. S. Dreyfus. Eng. Pat. 101,642, Jan. 7, 1916. (Appl. No. 289 of 1916.)

Sulphuric acid of about 92% strength is further concentrated by evaporation in externally heated cast-iron vessels, on which acid of this strength has no action. These vessels each consist of an outer cylindrical cast-iron pan fitted with a lid and containing a series of concentric cylinders alternately supported by the pan and the lid. The acid to be concentrated is fed into the innermost space and passes alternately downwards and upwards to the outermost space, which it leaves by an overflow pipe.—B. V. S.

Oxalic acid ; Process of producing —— from sugar and other carbohydrates. E. R. von Portheim. Prague, Austria. Eng. Pat. 101,680, Oct. 7, 1915. (Appl. No. 7863 of 1916.)

The preliminary treatment of the sugar with nitrous gases, to avoid the danger of overheating, as described in Eng. Pat. 11,231 of 1915 (this J., 1916, 889), is extended to other methods of producing oxalic acid from carbohydrates by oxidation. The temperature attained in the preliminary treatment is easily regulated by adjusting the rate of flow of the nitrogen oxides, and very little heat is evolved in the subsequent oxidation to oxalic acid.—B. V. S.

Caustic potash ; Electrolytic manufacture of ——. C. P. Rolland. Fr. Pat. 478,371, July 28, 1914.

A solution of potassium sulphate is electrolysed using a soluble anode, both electrodes being preferably of iron, thus obtaining potassium hydroxide and hydrogen at the cathode, and a mixture of potassium and iron sulphates, which may be utilised as manure, at the anode. The latter is preferably formed of waste iron clippings, and the cathode of iron sheets placed near to each other and covered by a bell.—B. N.

Cuprous oxide ; Process for the production of —— electrolytically. B. Hunt, Glasgow. Eng. Pat. 14,310, Oct. 9, 1915.

In the production of cuprous oxide by the electrolysis of a sodium chloride solution between copper electrodes, the colour and uniformity of the product is improved by the addition of sodium nitrate and by heating the solution. A solution containing 10 % of sodium chloride and 5 % of sodium nitrate, maintained at a temperature of 100° C., is found to work well. The nitrate concentration is kept up by continuous addition of fresh salt ; it is reduced to sodium nitrite, which is separated at intervals by cooling and crystallising.—B. V. S.

Aluminium nitride ; Preparation of —— in electric arc furnaces. Aluminium Industrie A.-G. First Addition, dated Feb. 3, 1915 (under Int. Conv., Feb. 5, 1914), to Fr. Pat. 465,807, Dec. 6, 1913 (this J., 1914, 613).

The material is fed over sloping surfaces of refractory material to a point just below the arcs, all the parts of the feeding surfaces being at the same distance, or nearly so, from the pairs of electrodes. Nitrogen gas is passed through the mass from the lower part of the furnace, and the material is subjected to a constant temperature suitable to the formation of nitride.—B. N.

Hydrogen peroxide ; Manufacture of chemically pure solutions of ——. L'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude). Fr. Pat. 478,167, July 22, 1914.

Impure solutions of hydrogen peroxide are distilled under reduced pressure, and more concentrated solutions are added during the distillation, with the object of increasing the strength of the liquid distillate.—B. N.

Chlorine water ; Manufacture of ——. J. Faust. Cologne. Ger. Pat. 293,721, Oct. 27, 1915.

A cylinder with blades or scoops projecting outwards from its periphery, rotates within an outer cylinder provided with freely swinging plates attached to its inner wall, so that the blades come in contact with the swinging plates. Chlorine gas and water are introduced separately into the space between the two cylinders, and saturated chlorine water is withdrawn continuously through an outlet.—A. S.

Silicides of tungsten, molybdenum, zirconium, and other refractory metals : Manufacture of ——. E. Wedekind, Strassburg, and J. Pintsch A.-G., Berlin. Ger. Pat. 294,267, Sept. 12, 1913.

A mixture of the components of the desired silicide, without addition of carbon, is heated at a temperature considerably below the melting point of either component. For example, the hitherto unknown molybdenum silicide, MoSi, may be obtained by heating a mixture of molybdenum and amorphous silicon in an evacuated tube at 1100°—1200° C. It is characterised by its great resistance to acids and other chemical reagents and may be used for the manufacture of incandescence bodies for lighting and heating.—A. S.

Nitric acid from nitrous gases ; Process for the production of ——. A. Foss, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. U.S. Pat. 1,200,334, Oct. 3, 1916. Date of appl., Feb. 23, 1915.

See Fr. Pat. 477,726 of 1915 ; this J., 1916, 601.

Catalytic reactions ; Production of light, voluminous oxide specially suitable for ——. F. Bedford, Sleaford, and E. Erdmann, Halle, Germany, Assignors to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,200,696, Oct. 10, 1916. Date of appl., Nov. 12, 1912.

See Fr. Pat. 451,155 of 1912 ; this J., 1913, 602.

Hydrogen ; Process of producing ——. C. Bosch and W. Wild, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,200,805. Oct. 10, 1916. Date of appl. Apr. 19, 1913.

See Eng. Pat. 27,117 of 1912 ; this J., 1913, 1108.

Air ; Apparatus for dividing —— into its elements by fractional distillation. Method of producing oxygen and nitrogen. M. Hazard-Flamand, St. Vrain, France. U.S. Pats. 1,201,043 and 1,201,014, Oct. 10, 1916. Dates of appl., Dec. 9, 1908, and Dec. 31, 1915.

See Fr. Pat. 394,881 of 1907 : this J., 1909, 310.

Electrolytic cells [for decomposition of water]. Eng. Pat. 101,598. *See* XI.

Preparation of tetracupric sulphate and its use as a fungicide. Addition to Fr. Pat. 476,512. *See* XIXb.

VIII.—GLASS; CERAMICS.

Glass ; Attack [by reagents] of French, Bohemian, and German ——. P. Nicolardot. Comptes rend., 1916, 163, 355—357.

Laboratory glassware as now made in France was found equal to the best German (Thuringen and Jena) ware in resisting the action of water (below, at, and above 100° C.), hydrochloric acid, ammonia, and N/10 solutions of ammonium chloride and sodium carbonate. Superior ability to withstand sudden cooling was observed only with Jena and with one make of Bohemian glass. Tables of results and analyses of the various samples examined are given.—F. Sodn.

Glass tubes; New method for the production of accurately dimensioned ——. Lambris. Z. angew. Chem., 1916, 29, 382—383.

The author has tested burettes, measuring cylinders, apparatus for gas analysis, and other measuring appliances made by Küpper's process (Ger. Pat. 292,737; see Eng. Pat. 20,192 of 1913, this J., 1914, 921) and finds that they are accurate to 0·001 mm. The process consists in placing a core, of the same diameter as that desired for the interior of the tube, inside an ordinary glass tube, which is sealed at both ends and evacuated. The tube is then heated externally until it shrinks on to the core and is thereby given the required internal dimensions. The core is then removed, leaving a tube which is so accurate in size and so uniform in diameter throughout its whole length that it may be engraved at once with a scale placed alongside and without the need for calibration, such as is necessary with ordinary tubes.
—A. B. S.

Patents.

*Glass; **Method of manufacturing*** ——. H. I. F. Strandh, Forserum, Sweden. Eng. Pat. 101,685, June 29, 1916 (Appl. No. 9196 of 1916). Under Int. Conv., May 23, 1916.

In the manufacture of glass, the batch is divided into two or more portions. One portion contains mainly silica and alkali compounds, and carbonaceous matter if alkali sulphates are used. The other contains compounds of calcium and silica, and the portions are admitted separately to facilitate the reduction of the sulphate by the carbonaceous matter and its conversion to silicate. A gas-producing substance, such as calcium carbonate or arsenious acid, may be added to effect agitation of the melting glass mass.—J. E. C.

Glass; Art of conveying molten ——. K. E. Peiler, Hartford, Conn., Assignor to Hartford-Fairmont Co., Canajoharie, N.Y. U.S. Pat. 1,199,108, Sept. 26, 1916. Date of appl., May 18, 1912. Renewed Feb. 17, 1916.

Glass-drawing apparatus. W. L. Clause and R. S. Pease, Assignors to Pittsburgh Plate Glass Co., Pittsburgh, Pa. U.S. Pat. 1,199,763. Oct. 3, 1916. Date of appl., Jan. 23, 1914.

Glass-melting receptacle. S. R. Scholes, Pittsburgh, Pa., Assignor to H. C. Fry Glass Co., Rochester, Pa. U.S. Pat. 1,200,889, Oct. 10, 1916. Date of appl., Aug. 31, 1914.

See Eng. Pat. 101,393 of 1916; this J., 1916, 1060.

Gas furnaces. Eng. Pat. 18,205. *See* IIb.

Polariscopes. Eng. Pat. 14,329. *See* XXIII.

IX.—BUILDING MATERIALS.

Effects of exposure on tar products. Reeve and Anderton. *See* III.

Colour-producing constituents of wood. Wichelhaus and Lange. *See* V.

Patents.

Wood: Preservation of ——. Grubenholzimprägnierung Ges., Berlin. Ger. Pat. 293,890, Apr. 22, 1915.

The wood is impregnated with aqueous solutions of preservatives, such as metallic salts, alkali fluorides, or compounds of phenols or naphthols, or with fireproofing agents, such as ammonium salts or magnesium compounds, together with trioxymethylene.—A. S.

Drying bricks, artificial stone, and ores by hot waste gases and hot air; Apparatus for ——. R. Witte, Osnabrück. Ger. Pat. 294,014, Oct. 18, 1912.

The dryer consists of a number of parallel chambers or tunnels through which hot waste gases from a furnace are drawn. The outlet flues are arranged transversely across the drying chambers, viz., two, side by side, and separated by dampers or slides, at each end, and one midway between the ends. The outlet flues are each connected independently with all the drying chambers.—A. S.

Refractory materials; Manufacture of ——. A. Krieger, Ickern. Ger. Pat. 294,021, June 5, 1914.

Refractory materials are obtained by burning a mixture of dolomite with quartz or magnesium silicate in such proportions that the lime combines with the silica whilst the magnesia is left in the free state.—A. S.

Tar-macadam road material; Production of a binding agent for ——. A. Studer, Neuchâtel. Switzerland. Ger. Pat. 294,015, July 29, 1914.

A mixture of 15 parts by weight of asphalt mastic, 25 parts of asphalt rock ("crab"), and 10 parts of bitumen is "boiled" for about 2 hours, and 50 parts of tar, which has been heated to 150° C. to expel benzol and light oils, is added, and the mass is well mixed and then worked up in the usual way with stones, etc.—A. S.

Kilns or ovens for annealing slag bricks or blocks. T. W. Ridley, Middlesbrough. Eng. Pat. 17,955, Dec. 23, 1915.

Cement: Process of making coloured ——. J. C. Pelton, San Francisco, Cal. U.S. Pat. 1,200,645. Oct. 10, 1916. Date of appl., June 18, 1914.

See Eng. Pat. 18,520 of 1914; this J., 1915, 963.

Timber; Method of preserving —— *from boring organisms.* J. E. Cunningham, Sydney, N.S.W. U.S. Pat. 1,201,023, Oct. 10, 1916. Date of appl., Aug. 27, 1914.

See Eng. Pat. 781 of 1915; this J., 1915, 1056.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Mineral industry in South Africa in 1915. Board of Trade J., Nov. 2, 1916.

The total value of the mineral output of the Union for 1915 was £43,531,009, as compared with £45,366,224 in 1914. The following table shows the output and value of the chief minerals produced in South Africa in 1914 and 1915:—

Exports of	1914.		1915.	
	Quantity.	Value.	Quantity.	Value.
		£		£
Gold .. fine oz.	8,396,068	35,664,230	9,096,411	38,639,095
Silver* .. „	890,782	102,471	966,177	106,245
Diamonds carats	2,801,017	5,487,194	103,386	399,810
Coal .... tons	8,477,923	2,258,896	8,281,324	2,142,479
Coke .. „	6,493	12,377	7,279	12,880
Copper „	29,326	692,355	28,970	1,042,314
Tin .... „	3,429	311,391	3,441	331,420
Asbestos „	1,191	20,087	2,138	35,899
Graphite „	34	970	41	1,204
Magnesite „	572	1,451	627	1,568
Lead .. „	136	1,396	180	1,836
Zinc .... „	—	—	352	2,214
Salt (including by-products) tons	40,290	67,618	45,104	82,089
Lime .. „	66,095	109,041	68,989	110,560
Flint .. „	425	2,508	453	2,327

* Contained in gold bullion and base metal ores.

There were no new discoveries of minerals of any importance in South Africa in 1915. Small quantities of nickel, mica, iron pyrites, kaolin, and talc were produced during the year. The output of gold in 1915 represented 39·5 % of the world's production in that year, as compared with 38 % in 1914. All diamond mines were closed down at the outbreak of the war and remained closed during 1915. A few stones, however, were " picked up " on the De Beers' floors.

Mineral output of Sweden.

THE official report of Swedish mineral production shows the following, in metric tons :

	1914.	1915.
Iron ore	6,586,630	6,883,308
Coal	366,639	412,261
Gold ore	639	221
Silver-lead ore	3,100	2,671
Molybdenite	7	37
Copper ore	8,839	10,549
Manganese ore	3,643	7,607
Zinc ore	42,279	55,937
Nickel ore	156	1,642
Pyrites	33,313	76,324
Felspar	20,818	12,105
Quartz	36,128	33,818
Graphite	56	87
Powdered pyrolusite	81	126

The production of iron ore from the Kirunavara deposits was reduced from 2,728,363 tons in 1914 to 2,076,512 tons in 1915, owing to the difficulties of shipping from Narvik on account of the war. The electrolytic production of zinc at Trollhättan was increased from 2,299,761 kilos. in 1914 to 8,588,384 kilos. in 1915. The metal production, with the exception of iron, was : Gold, 37 kilos. ; silver, 751 ; lead, 1,917,678 ; copper, 1,560,581 ; zinc, 8,588,384 kilos.

Mineral production of the United Kingdom in 1915. [Cd. 8631.]

THE figures given in the subjoined table are taken from Part 1. of the Home Office report on Mines and Quarries for 1915, and show the output of minerals from mines, quarries, and brine wells. In addition to these, a production of natural gas amounting to 87,000 cub. ft. is recorded.

Description of mineral.	Mines.		Quarries.*	Total output, 1915.	Total, 1914.
	Coal Mines Act.	Metalliferous Mines Act.			
	Tons.	Tons.	Tons.	Tons.	Tons.
Alum shale	7,911	—	—	7,911	6,078
Antimony ore	—	2¼	—	2¼	—
Arsenic	—	2,496	—	2,496	1,988
Arsenical pyrites	—	14	407	421	—
Barium compounds	7,477	53,324	1,676	62,477	48,930
Bauxite	—	11,723	—	11,723	8,286
Bog ore	—	—	1,986	1,986	2,342
Chalk	—	286	3,233,611	3,233,897	4,291,170
Chert, flint, etc.	—	3,033	99,665	102,698	76,213
Chromite	—	—	—	—	100
Clays* and shale	2,068,341	86,202	6,717,278	8,871,821	13,124,361
Coal	253,179,446	—	26,635	253,206,081	265,664,393
Copper ore and copper precipitate	—	746	76	822	2,558
Fluorspar	—	25,577	7,546	33,123	33,816
Gold ore	—	5,086	—	5,086	47
Gravel and sand	—	10,699	2,339,568	2,350,267	2,498,872
Gypsum		204,574	42,655	247,229	265,365
Igneous rocks	79	43,010	6,012,326	6,085,415	7,135,243
Iron ore	6,080,218	1,795,887	6,358,907	14,235,012	14,745,828
Iron pyrites	9,255	1,280	—	10,535	11,651
Lead ore	—	20,698	46	20,744	26,013
Lignite	—	1,783	—	1,783	300
Limestone (other than chalk)	4,464	283,216	10,828,229	11,115,909	12,180,015
Manganese ore	—	4,640	—	4,640	3,437
Ochre, umber, etc.	—	4,030	4,959	8,989	11,069
Oil shale	2,998,652	—	—	2,998,652	3,268,666
Rock salt	—	131,348	—	131,348	189,995
Salt from brine	—	—	1,874,257	1,874,257	1,879,994
Sandstone	141,420	57,626	2,321,810	2,520,856	3,464,528
Slate	—	48,893	177,144	226,037	318,912
Soapstone	—	750	100	850	180
Sulphate of strontia	—	—	640	640	13,157
Tin ore (dressed)	—	6,427	1,717	8,144	8,085
Tungsten ores	—	327	4	331	205
Uranium ore	—	82	—	82	344
Zinc ore	—	12,057	—	12,057	15,419
Total	264,497,263	2,815,816¼	40,081,242	307,394,321½	329,297,563

* Exclusive of the produce of most of the quarries less than 20 feet deep, but including the produce of all open workings for iron ore, bog ore, ochre, sulphate of strontia, and tin ore, etc.

† Including china clay, china stone, and mica clay.

Commercial sheet iron ; Atmospheric corrosion of ——, *with special reference to the influence of copper and mill scale.* E. A. and L. T. Richardson. Amer. Electrochem. Soc., Sept., 1916. Met. and Chem. Eng., 1916, **15,** 450—453. (See also this J., 1915, 83.)

THE investigation was made on commercial sheets (26 gauge) of Bessemer steel (Cu trace, Mn 0·300 %), open-hearth steel (Cu trace, Mn 0·413 %), charcoal iron (Cu 0·014, Mn 0·031 %), commercially pure iron (Cu 0·016 and 0·028, Mn 0·028 and 0·009 % respectively), copper-bearing iron (Cu 0·237, Mn 0·003 %), copper-bearing steel (Cu 0·181, Mn 0·100 %), copper-bearing Bessemer steel (Cu 0·256, Mn 0·315 %), and copper-bearing open-hearth steel (Cu 0·268, Mn 0·387 %), which were used in the " black " condition as received and after annealing and removing the mill scale by pickling in sulphuric acid and scouring with fine emery. Test-pieces of the same size were exposed to the atmosphere until failure was indicated by the sheet being in such condition that perforation was observed on removing the rust by gentle tapping with a file. The copper-bearing steels were found to be decidedly superior to pure iron, ordinary steel, or charcoal iron, and the corrodibility of pure iron to be decreased to a much smaller extent than that of steel by the addition of similar amounts of copper. Charcoal iron behaved similarly to pure iron, and both were superior to ordinary steel. Mill scale stimulated corrosion in rapidly rusting steels and retarded it in slowly rusting materials. The relative incorrodibility of copper-bearing steels is believed to be due to some mutual influence of manganese and copper, and the addition of larger amounts of these metals, with chromium, vanadium, tungsten, and molybdenum, is suggested as a possible means of increasing the resistance of iron and steel to atmospheric corrosion.—W. E. F. P.

Ferrosilicons; Poisonous gases from commercial ——. N. S. Kurnakoff and G. G. Urasoff. Gorny J., 1914, 159—201. Z. angew. Chem., 1916, **29**, Ref., 458. (See also Pellew, this J., 1914, 774.)

On cooling molten iron-silicon alloys containing from 33·4 to 100 % Si. a solid phase (" Lebeauite ") of varying composition crystallises out at 1243°—1245° C.; when aluminium and phosphorus are present, ternary or quaternary solid solutions are formed. The ternary systems (Fe-Si-P and Fe-Si-Al) are not affected by water, but the quaternary solid solutions containing both phosphorus and aluminium are decomposed by water with evolution of hydrogen phosphide, and disintegrate when exposed to the air. The evolution of poisonous gases from commercial ferrosilicon containing 33·4—100 % Si is attributed to the presence of this unstable quaternary solid solution. In alloys of lower silicon content, phosphorus (up to 1·7 %) and aluminium (up to 3 %) occur as constituents of the γ-solid solution of silicon in iron, and only insignificant quantities of hydrogen phosphide are produced from such alloys. Calcium phosphide is not soluble in either liquid or solid ferrosilicon, and the quantity of hydrogen phosphide evolved from commercial ferrosilicon is always considerably greater than corresponds to the calcium content of the alloy.—A. S.

Copper deposits discovered in Newfoundland; New ——. U.S. Commerce Reports, Oct. 20, 1916.

The discovery of important copper deposits at Little Bay, about 200 miles north of St. John's, Newfoundland, has been reported. The lode is known at present to be 300 ft. wide, and there are veins, 1—2 ft. wide, containing nearly pure cupropyrites with up to 29·5 % Cu. The working of the deposit has already begun, and hydraulic plant is being installed for operating a 200-ton concentrator.

Blast v. reverberatory furnace [*for copper-gold ores*]. B. Magnus. Eng. and Min. J., 1916, 102, 668—669.

Estimates of the cost of treatment of the copper-gold ore of Mount Morgan, Australia, in blast-furnaces and in reverberatory furnaces, showed only slight differences in profits, but operating considerations and known results turned the balance in favour of blast-furnace treatment, which has been adopted.

Zinc; Comments and speculations on the metallurgy of ——. W. R. Ingalls. Eng. and Min. J., 1916, 102, 621—624.

In a critical discussion of the details of zinc metallurgy, the conditions affecting hydro-electrolytic methods of production are considered in conjunction with the recovery of residual zinc from the leached ore by direct smelting in the electric furnace or " burning " on Wetherill or mechanical grates and collecting the resulting fume of zinc oxide in a bag-house or by the Cottrell system of electrical precipitation. The relative merits of the various types of furnace in use or proposed for roasting and distillation are also discussed, together with the probable advantages of vertical retorts and pre-reduction of the charge before distillation. In view of the increasing production of zinc concentrates by flotation, the problem of briquetting excessively fine ore for smelting is likely to become urgent in the near future.—W. E. F. P.

Zinc dust; Electrolytic ——. H. J. Morgan and O. C. Ralston. U.S. Bureau of Mines. Amer. Electrochem. Soc., Sept. 28, 1916. Met. and Chem. Eng., 1916, **15**, 465—468.

By electrolysing aqueous solutions of zinc salts under various conditions, deposits of spongy zinc were obtained which crumbled into " zinc dust " on drying. The spongy metal deposited from solutions of zinc sulphate and chloride was more or less satisfactory; but the best product was obtained by electrolysing, at 5 volts, a solution of sodium zincate, prepared by saturating a 30 % solution of sodium hydroxide with zinc oxide, and maintaining the zinc content of the bath by the addition of zinc oxide or by the use of zinc anodes. The average current efficiency in the deposition of spongy zinc by this method was about 60 %, the power required was somewhat less than 3 kilowatt-hours per lb. of zinc dust. The efficiency of the latter as a precipitant for gold and silver in cyanide solutions (determined by Sharwood's silver cyanide method; this J., 1912, 437) was 74 % as compared with 45 % for the average grade of European zinc dust.—W. E. F. P.

Lead-smelting practice in the United States. A. S. Dwight. Eng. and Min. J., 1916, 102, 671—677.

Recent progress in lead smelting has been practically confined to the preparation and handling of the different components of the furnace charge with a view to effecting economy in labour and improvement in furnace operation. The essential features of the lead blast furnace have undergone no appreciable change during the last decade. A typical, modern, rectangular blast furnace will smelt about 250 short tons of charge per 24 hours (or about 4·5 tons per sq. ft. of area at the tuyères), the blast pressure being 30—40 oz., and the charge containing the fuel equivalent of 10—11 % of fixed carbon, plus 3 % of sulphur. A satisfactory roasting process for lead smelting should effect a maximum elimination of sulphur and leave the product in coarse form. The sulphur content of raw ore is readily and economically reduced to 10 % in the old style of mechanically-rabbled roasting hearth; but the finishing roast is best effected in Huntington and Heberlein in pots or on Dwight and Lloyd sintering machines, by means of which a coarse product (containing 2·5—5 % S) in excellent condition for smelting is obtained. By the development of these modern roasting methods, hand roasting has been rendered practically obsolete, and modern American practice is based on the use of one or other of these systems for the desulphurisation and agglomeration of all ore fines. A charge for sintering should contain not more than 16—18 % S, and, to ensure regular action by avoiding fusion, should be so compounded that the sulphide particles are in contact with others of a more refractory nature. In some plants the Dwight and Lloyd and/or the Huntington and Heberlein systems are used for initial and finishing roasting, but two operations are always necessary to effect a sufficient reduction of the sulphur content; sintered products containing as little as 2·5 % S have been recently obtained from raw ore by the employment of automatic apparatus in conjunction with this method of " double roasting." The old Scotch hearth, formerly used to a considerable extent in lead smelting but practically superseded by modern roasting methods, has been recently revived in modified form by W. E. Newnam and successfully employed in the treatment of rich lead concentrates.—W. E. F. P.

Lead from brine leaches: Electrolytic recovery of ——. C. E. Sims and O. C. Ralston. Amer. Electrochem. Soc., Sept., 1916. Met. and Chem. Eng., 1916, **15**, 110—115.

Experiments have been made on the electrolysis of lead compounds, such as the sulphate and chloride, in brine solutions, and, considering the cheapness of the leaching agent, the high electrochemical equivalent of lead, and the high efficiencies possible, it appears that a metal of low value, such as lead, may be profitably electrolysed. Applied to mill tailings or a mine dump, a fair profit might be made, but a 10 % material could not be profitably worked with a mining charge of several dollars per ton added to the cost, although a lead carbonate deposit near the surface could stand a fairly considerable mining charge if a 15 to 20 % ore were available. It is stated that the method will be found applicable to ores, such as many of the carbonate ores, obtained at points distant from lead smelters, too low in grade to ship and refusing to yield to gravity concentration. —B. N.

Mercury ores; The smelting of ——. W. H. Landers. Eng. and Min. J., 1916, **102**, 630—633.

Little progress has been made in the metallurgy of mercury since the introduction, in 1876, of the Scott tile furnace which is still the standard type for the reduction of cinnabar ores; but in view of the diminishing mercury content of the ores now mined in the U.S.A. (less than 1 % on the average during the last 5 years), wet concentration is becoming more general. Continuous furnaces of several types, generally operated on the lime-kiln principle, are still employed with satisfactory results in the treatment of coarse ore, suggesting the practicability of briquetting the finer ores or concentrates as a preliminary to similar treatment. Briquetting has been unsuccessful hitherto, owing to the lack of a suitable binding material. The binder should be free from substances which evolve hydrocarbon vapours on heating, since these cause trouble in the collection of mercury from the condensing system; the use of oil fuel in mercury furnaces is attended by a similar difficulty, and the best results in all types of furnaces have been obtained hitherto by the use of wood fuel. The method of reduction in retorts is still practised and will be probably further developed in the treatment of rich products from wet concentrating mills. The use of multiple-hearth roasting furnaces for the treatment of cinnabar concentrates has scarcely yet passed the experimental stage, but these furnaces have proved more economical than the Scott type in fuel consumption, and by reason of their lower first cost and greater facilities for control are likely to be still further developed. Owing to the high losses of mercury occurring in the tile furnace method of treatment (20 % on comparatively high-grade, coarse ore, and up to 40 % on low-grade, fine ore), a wet process of extraction is desirable; and in the author's opinion future developments will either take this course or result in the improvement of wet concentration until extractions exceeding 90 % are possible on the commercial scale.—W. E. F. P.

Mercury; Freezing point of ——. R. M. Wilhelm. U.S. Bureau of Standards. Scient. Paper No. 294. J. Franklin Inst., 1916, **182**, 525.

Using platinum resistance thermometers, calibrated at 0° C., 100° C., and 444·6° C. (b.pt. of sulphur), the value —38·87°C. was found for the freezing point of mercury. This is in very good agreement with the value, —38·89° C., obtained by Henning in 1913 at the Reichsanstalt, Germany.—B. V. S.

Bismuth; Pure ——. F. Mylius and E. Groschuff. Z. anorg. Chem., 1916, **96**, 237—264. Z. angew. Chem., 1916, **29**, Ref., 458.

Commercial samples of reputedly pure bismuth all contained silver, lead, and copper; tin, nickel, zinc, and platinum were also present in certain cases. Samples of electrolytic bismuth contained platinum and silver and traces of lead, copper, and zinc. The best method of purification was found to be crystallisation of normal bismuth nitrate from acid aqueous solution and of the metal from the fused impure metal. The melting point of the purest bismuth obtained was 271° C., and the electrical resistance of pure bismuth wire was 1·20 ohms.—A. S.

Secondary metals in the United States in 1915.

According to a report by J. P. Dunlop, of the United States Geological Survey, on the production of secondary copper, zinc, lead, tin, antimony, and aluminium from scrap metal, sweepings, skimmings and drosses, the total value of the recovery amounted to more than $111,000,000, exclusive of the value of old iron, steel, platinum, nickel, gold, silver, and other metals.

Assuming that remelted brass had an average content of 70 % copper, the total recovery of secondary copper was 196,187 tons, of which 29,787 tons was recovered by plants refining primary metals and the balance by plants treating only secondary materials. Secondary lead recovered in 1915 amounted to 78,900 tons. The total increase over 1914 was about 17,800 tons, and that of lead in alloys more than 10,700 tons. Secondary zinc, including that in brass, amounted to 92,575 tons in 1915, being equal to 19 % of the production of primary spelter in the United States. Secondary antimony production increased from 2646 short tons in 1914 to 3102 tons in 1915, all but two tons being recovered in alloys. Secondary tin recovered in 1915 was equal to about 24 % of imports as metal or oxide, being 13,650 tons as compared with 12,447 tons in 1914. The metal recovered as tin was 5250 tons and that in alloys and chemical compounds, 8400 tons. The latter includes the tin content of products made from clean tinplate scrap, consisting mainly of tin chloride with some oxide, etc. Secondary aluminium recovery in 1915 amounted to 8500 tons, as compared with 4522 tons in 1914. Of this 2800 tons was recovered in alloys, mainly of 92 % aluminium and 8 % copper. The increase in quantity of secondary aluminium in 1915 is said to be due to the use of old castings in automobile manufacture.

Flotation [*of ores*]; *Laboratory experiments on the* ——. C. Y. Clayton. Bull. School of Mines and Met., Univ. of Missouri. Vol. 3, No. 1., Aug., 1916. 40 pages.

Experiments were undertaken to compare the value of different oils for flotation purposes under the same conditions. Those oils which are more or less miscible with water (*e.g.*, essential and pine oils, cresol, wood creosote) seem to be the best in regard to frothing properties; those that give an ephemeral, small-bubble froth yield a cleaner concentrate than oils which form a thick stiff froth (*e.g.*, fixed oils, coal tar, wood tar) though in the latter case the recovery may be greater. To get a clean concentrate it may therefore be necessary to sacrifice recovery, and *vice versa*. With a low-grade dolomitic lead ore, coal-tar creosote gave the purest concentrate (Pb 74 %), oil of cloves giving the highest extraction. With a zinc slime (Zn 1·75%) pine oil gave a 50% concentrate, a mixture of creosote and refined tar a 46% product. Oils giving good flotation results were found to have a high dielectric constant. As the quantity of added oil increased above a certain quantity, the purity and quantity of concentrate decreased. The flotation concentrates submitted to screen analysis showed the largest proportion of gangue in the finest material.—W. R. S.

New method for measuring resistivity of molten materials. Results for certain alloys. Northrup and Sherwood. *See* XI.

High temperature heat developed during electrolysis. Hering. *See* XI.

Patents.

Roasting furnaces; Mechanical ——. A. Zavelberg, Hohenlohehütte, Germany. Eng. Pat. 12,708, Sept. 4, 1915.

The air which is circulated through the hollow rake-arms and rakes to cool them, is discharged through outlet ports, inclined downwards, in the rear faces of the rakes, thus coming directly in contact with material which has been broken up by the rakes.—A. S.

Cupolas and other shaft furnaces. J. A. Parsons, Johannesburg, Transvaal. Eng. Pat. 14,205, Oct. 7, 1915.

A tubular air-blast heater forms a continuation of the furnace stack above the charging floor, and comprises upper and lower headers connected by vertical heating pipes, with baffles between the wall of the stack and the pipes. The air enters through the upper header, and the lower header communicates with down-take pipes connected with corresponding tuyères.—W. R. S.

Tin from tinned iron-scrap; Process of separating and removing all the ——. P. Marino, London. Eng. Pat. 14,231, Oct. 7, 1915.

The scrap is treated with a solution of an alkali bichromate in hydrochloric acid.—W. R. S.

Soldering of aluminium or aluminium alloys. W. Overend, H. G. Grinlinton, and Overend Aluminium Soldering Processes, Ltd., Auckland, N.Z. Eng. Pat. 17,118, Dec. 6, 1915.

The surface of the aluminium is prepared, prior to soldering, by heating it and applying a flux of stearic acid and then an alloy of tin and zinc. The temperature is raised to melt the alloy, and the heating maintained whilst the surface of the aluminium is gently rubbed by a special tool comprising a strip of zinc. The molten alloy is distributed, and the coating of oxide on the surface of the aluminium is acted upon by the tool, thus causing the oxide to separate from the metal and mix with the molten alloy. The action is carried on at, or above, the temperature at which the zinc is melted, and the surface of the aluminium becomes covered or alloyed with a coating consisting practically wholly of tin, the surplus alloy being wiped off. The heating of the coated aluminium is continued, and an alloy of tin and cadmium applied, using stearic acid as a flux. The prepared surfaces, covered with the alloy of tin and cadmium, are then soldered or sweated together, with the use of stearic acid as a flux.—B. N.

Oil flotation; Process of and apparatus for the separation of metalliferous particles by ——. Metallurgical Co. of America, New York, Assignees of D. F. Haley, Wallace, Idaho, U.S.A. Eng. Pat. 100,637, May 9, 1916 (Appl. No. 6658 of 1916). Under Int. Conv., June 4, 1915.

The ore pulp is mixed with oil, or oil and air, and discharged downwards in the form of a jet of high velocity on to the surface of a confined body of liquid of relatively small volume, so as to aerate the pulp and form a froth as a result of the splashing action. The froth and liquid overflow into a flotation box where the froth is skimmed off by a slowly rotating scraper. The colloidal and slimy gangue matter just below the froth is removed separately through an adjustable outlet; the tailings are discharged through a valved outlet at the bottom of the box.—W. R. S.

Ingots and castings; Production of ——. Sir W. G. Armstrong, Whitworth and Co., Ltd., Newcastle-upon-Tyne, E. F. Law, Manchester, and C. P. Sandberg, London. Eng. Pat. 101,650, Feb. 7, 1916. (Appl. No. 1810 of 1916.)

In order to keep the ingot molten and prevent piping, blowholes, and segregation, the mould is provided at the bottom with a loose electrical contact device, and an arc is produced between the top of the casting and an electrode above it. —W. R. S.

Silver and gold; Extraction of silver, or —— from ores. J. Y. Johnson, London. From M. H. Caron, Weltevreden, Java. Eng. Pat. 101,665, Apr. 10, 1916. (Appl. No. 5219 of 1916.)

Silver or gold ores containing manganese dioxide are subjected to a reducing roast preparatory to amalgamation or cyaniding.—W. R. S.

Heat treatment [of metals]. W. J. Wrighton, Philadelphia, U.S.A. Eng. Pat. 100,679, May 3, 1916. (Appl. No. 6356 of 1916.) Under Int. Conv., June 15, 1915.

A thermo-couple or other heat-responsive device is placed within the furnace chamber in which the metal is heated, not necessarily in contact with the metal, and a temperature-time curve is plotted. The critical range of the metal is indicated by abrupt changes in the direction of the curve. It is thus possible to control processes of heat treatment involving the heating of the metal to or above the critical range, and the "soaking" operation may be omitted. The process is based on the fact that although the thermo-couple, even if in direct contact with the outer surface of the metal, does not register the true temperature of the metal unless the latter be kept at a given temperature for a considerable time, yet the critical point or range occurs at the same time on the temperature-time curve of the external thermocouple as on the corresponding curve of a thermocouple placed at any point within the mass of metal. The thermo-couple need not be calibrated. —A. S.

Zinc; Process for separating —— from alloys containing it. G. Heinecker, Breslau. Ger. Pat. 294,287, Feb. 5, 1916.

The alloy is melted in a pot placed in the upper part of a furnace. In the bottom of the pot is an opening which is alternately opened and closed, in rapid succession, by a valve. The molten alloy flows through the opening and through a short connecting tube and is discharged into a retort in the lower part of the furnace. The zinc is volatilised in this retort and the vapour passes to a condenser.—A. S.

Classifier and dewaterer. W. J. Boudwin, Assignor to The General Engineering Co., Salt Lake City, Utah. U.S. Pat. 1,201,014, Oct. 10, 1916. Date of appl., July 22, 1916.

Ore-concentrating apparatus. T. A. Janney, Garfield, Utah. U.S. Pat. 1,201,053, Oct. 10, 1916. Date of appl., Apr. 23, 1914.

Simultaneous purification, desiccation, and concentration of [blast-furnace] gases. Fr. Pat. 478,260. *See* IIa.

Apparatus for drying bricks, artificial stone, and ores by hot waste gases and hot air. Ger. Pat. 294,014. *See* IX.

XI.—ELECTRO-CHEMISTRY.

Molten materials: New method for measuring resistivity of ——. Results for certain alloys. E. F. Northrup and R. G. Sherwood. J. Franklin Inst., 1916, 182, 477—509.

A description is given of two types of a "resistometer" which is inserted directly into a considerable mass of the molten material whose resistivity it is desired to measure. Tungsten or molybdenum wires are used both for current and potential terminals. The latter, which serve for measuring potential drop when current is passed through the "resistometer," are arranged so that the distance between the points is constant. The cross-section and length of the fluid-column of which the resistance is measured are thus made invariant. The constant of the "resistometer" is obtained by measuring the resistance when pure mercury is taken. The temperature of the column is measured by a thermo-couple. Alternating current must be used for the measuring current to avoid difficulties arising from parasitic electromotive forces and currents. These become so large and erratic above 500° C. that accurate measurements become exceedingly difficult when direct current is used as the measuring current. A specially designed alternating-current galvanometer is used, and resistivity readings are made directly in microhms per cm. cube with a Kelvin double-bridge. Resistivity-temperature curves for several metals and alloys are given, a common characteristic being their linear character for the molten materials. The curves obtained with different bismuth-tin alloys in the molten state have approximately the same slope, and a linear relation exists between the resistivity of these alloys and the percentage of grm.-atoms of each constituent.—T. St.

Electrical conductivity; Chemical composition versus ——. C. G. Fink. Amer. Chem. Soc., Sept. 28, 1916. Met. and Chem. Eng., 1916, 15, 464—465.

From observations made on a black metal powder (tungsten), a white insulator powder (thoria), and mixtures of these, which were pressed into rods and heated to 1600° C. in a "tungsten hydrogen furnace," it is concluded that the electrical conductivity of a substance is dependent upon the shape and distribution of the component grains or particles and upon the presence or absence of thin films of secondary material enveloping such grains. On this basis the comparatively high conductivity of gels containing only a trace of conducting material is explicable; and also the marked difference in resistance between, for example, two samples of commercial copper of identical composition but having the impurity uniformly dissolved in one case, and forming a film ("cement") around the grains of the pure metal in the other. The high resistance of such films of copper sulphide, oxide, or arsenide would account for the high resistivity of copper containing only traces of these impurities.—W. E. F. P.

High temperature heat developed during electrolysis. C. Hering. Amer. Electrochem. Soc., Sept., 1916. Met. and Chem. Eng., 1916, 15, 454—455.

When the current density on a cathode immersed in certain aqueous electrolytes is increased sufficiently, the cathode becomes red hot and may even melt. In the present experiments a lead anode was employed with a small cathode of thin sheet iron in an electrolyte of dilute sulphuric acid (sp.gr. 1·2), the cathode being gradually raised until the high temperature effect was produced and then slowly lowered again in the electrolyte. The high temperature condition was found to persist for a depth considerably greater than that at which it was first produced during the raising of the electrode. The red-hot period was succeeded by a stage in which the cathode was enveloped by a blue, hissing film which, as the lowering proceeded, broke suddenly, thus causing the surface of the cathode to be again wetted and the normal conditions of electrolysis to be restored. During the heating period, globules of black, brittle material were formed on the cathode—presumably black iron oxide formed by transference of oxygen across the gas film through which the passage of the current appeared to take place by arcing. The surface energy developed on the cathode during the first and second stages of heating and at the final breaking of the film amounted to about 370, 250, and 120 kw. per sq. ft. respectively; 370 kw. represents a rate of surface heating about 440 times that obtained in ordinary boiler practice, and is much higher than that obtainable by a blast flame. The surface hardening of steel objects by this method, although impracticable at the voltages used (up to 120) owing to oxidation, might be possible with more rapid heating at higher voltages; and the method might be employed, for example, in alloying a metal surface with another metal plated upon it.
—W. E. F. P.

Chemical reactions under the influence of the electric discharge in an atmosphere of an inert gas. F. Skaupy. Ber., 1916, 49, 2005—2006.

It has previously been shown that a separation of the components of gaseous mixtures can be effected by means of a direct current in a discharge tube (this J., 1916, 1068), and it is now found that by similar means the components of dissociable gaseous compounds, such as aluminium chloride, can be completely separated and either deposited or led off from the neighbourhood of the electrodes. By carrying out the discharge in an atmosphere of an inert gas, such as helium or argon, lower potentials can be employed, and the electrodes can be protected from the action of the reacting materials by restricting the latter to the middle portion of the discharge tube, and separating the reaction products, *e.g.*, by condensation, before they reach the electrodes. By a further application of the method certain reactions can be brought about under the influence of the discharge, either direct or alternating. Thus if hydrocarbon vapours are led into the tube, polymerisation, without any trace of carbonisation, occurs with considerable reaction velocity, and carbon-containing gases or vapours mixed with nitrogen are converted into organic nitrogen compounds.—G. F. M.

Patents.

Electrolytic cells [for decomposition of water]. C. Churchill and Co., Ltd., London, and E. Geeraerd, Oldham, Lancs. Eng. Pat. 101,598, May 11, 1916. (Appl. No. 6735 of 1916.)

The sides of the cell are used as electrodes, and, in place of a diaphragm, two series of superimposed vanes of non-conducting material are placed close to, but not necessarily touching, the faces of the respective electrodes, and are inclined thereto at a suitable angle in order to deflect the gas towards the electrode at which it was liberated. The gas passes either through the narrow passages between the extremities of the vanes and the electrode, or through vertical grooves in the electrode to the respective receivers for the hydrogen and oxygen.—B. N.

Ozone; [Electrical] apparatus for producing ——. J. Steynis. Fr. Pat. 478,133, July 17, 1914.

Condensation of moisture on a high-tension apparatus for the production of ozone is prevented by enclosing the generator, the refrigerating apparatus for drying the air to be ozonised, and the transformer in an air-tight, heat-insulated chamber filled with dry air. The movable electrodes and dielectrics may be removed from the generator, without removing them from the chamber.—B. N.

Furnaces; Method and apparatus for treating materials in electric ——. Soc. Anon. Métallurgique "Procédés de Laval." Fr. Pat. 478,940, June 7, 1915.

See U.S. Pat. 1,196,202 of 1916; this J., 1916, 1068.

Electric furnaces; Treatment of materials in ——. Soc. Anon. Métallurgique "Procédés de Laval." Fr. Pat. 478,941, June 7, 1915.

See U.S. Pat. 1,160,241 of 1915; this J., 1916, 259.

Production of cuprous oxide electrolytically. Eng. Pat. 14,310. *See* VII.

Preparation of aluminium nitride in electric arc furnaces. Addition to Fr. Pat. 465,807. *See* VII.

Electrolytic manufacture of caustic potash. Fr. Pat. 478,371. *See* VII.

XII.—FATS; OILS; WAXES.

Ray liver oils. M. Tsujimoto. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1916, 19, 833—841.

Oils extracted from the livers of five species of Japanese rays gave the following values :—

	Guitar fish, *Rhinobatus schlegelii.*	Common ray, *Raja kenojei.*	"Uchiwa zamé," *Discobatus sinensis.*	Sting-ray, *Dasyatis akajei.*	Eagle ray, *Myliobatis tobiei.*
Sp.gr. at 15°/4° C.	0·9267	0·9329	0·9324	0·9316	0·9203
Acid value	2·66	2·02	2·36	1·17	0·83
Saponif. value	182·81	182·69	179·36	183·10	175·18
Iodine value (Wijs)	183·67	200·06	192·54	184·50	136·08
Ref. index at 20° C.	1·4825	1·4843	1·4826	1·4827	1·4773
Butyrorefractometer, 20° C.	87·3	90·4	87·5	87·6	78·2
Unsaponif. matter, per cent.	3·15	3·11	2·60	2·94	4·47
Melting pt. of fatty acids, ° C.	34—35	28—29	—	34—35	above 37
Polybromides of fatty acids, per cent.	60·20	65·23	62·96	63·08	33·51
Br content of polybromides, per cent.	70·03	69·97	70·36	70·79	68·87

The polybromides (insoluble in ether) turned black and decomposed above 200° C. The unsaponifiable matters were crystalline and semi-solid. They contained cholesterol, but were free from the liquid hydrocarbon found in shark oils (this J., 1916, 609, 1121). The characters of the liver oils from the common ray, "uchiwa-zamé," and sting-ray resemble those of shark liver oils of high sp.gr., such as the liver oils of the dog shark, hammer-headed shark, and angel-fish.—C. A. M.

Oils and fats; Relation between the most important physical and chemical constants of ——. H. J. Backer. Chem. Weekblad, 1916, 13, 954—967. J. Chem. Soc., 1916, 110, ii., 543.

For oils and fats composed solely of mixtures of glyceryl esters of saturated and unsaturated mono-carboxylic acids, the relation between the refractive index (n), the density (d), the saponification value (V), and the iodine value (I) is given by the expression:

$$(n_t^2-1)/(n_t^2+2) \times 100/d_4^t = 33{\cdot}07 + 0{\cdot}00075I - 0{\cdot}01375V + 0{\cdot}002(t-15).$$

Extracted soya meal poisoning. See XIXa.

Patents.

Glycerides; Process of saponifying ——. *Process of producing fatty acids and manufacture of soap and candles therefrom.* S. G. S. Dicker, London. From The Reuter Process Co., Chicago, U.S.A. Eng. Pats. (a) 9393 and (b) 9394, June 26, 1915.

(a) The glycerides are fractionally saponified by boiling with sulphonic acids, such as Twitchell's reagent (Eng. Pat. 4741 of 1898; this J., 1898, 588), the discoloured fatty acids being removed after each stage, and only the watery portion returned to the saponifying vessel for the next boiling. In this way a much whiter product is obtained. (b) The process claimed in (a) is adapted to the production of fatty acids in accordance with Eng. Pat. 10,199 of 1913 (this J., 1914, 603). Saponification is effected by means of an organic catalyst in the absence of air, while impurities are removed between the successive boilings. Soap, candles, etc., made from the resulting fatty acids are not discoloured by exposure to air and sunlight for 10 days.—C. A. M.

Catalysts [for hydrogenating oils]; Preparation of ——. E. B. Higgins, Liverpool. Eng. Pat. 21,011, Sept. 17, 1913.

Fatty acid salts of nickel, cobalt, iron, or copper are heated in an inert medium, such as a fatty oil, until the mass blackens. The process is preferably carried out in a vessel from which air is excluded, *e.g.*, by passing a stream of a gas such as nitrogen or carbon dioxide through the mixture. —C. A. M.

Fish oils; Process for deodorising ——. G. Weiss, Hilchenbach. Ger. Pat. 294,136, June 5, 1913.

The oil is heated at about 200° C. at atmospheric pressure and subsequently treated with steam in the presence of basic substances, especially oxides or hydroxides of alkali, alkaline-earth, or other metals. The deodorised oils are not darker in colour than the original oils.—A. S.

Process for preventing flocculation of calcium soaps in washing baths. Ger. Pat. 294,028. *See* VI.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Resin [from wood pulp waste lyes]; Liquid Swedish ——. K. Lorentz. Seifensieder-Zeit., 1916, 43, 501—502. Z. angew. Chem., 1916, 29, Ref., 445.

The liquid resin obtained from wood pulp waste lyes by treatment with acid was formerly a waste product, but cannot now be obtained at a lower price than M.90 per 100 kilos. (about 4½d. per lb.). The resin obtained from sulphate-cellulose waste lyes is light brown, but gradually darkens on exposure to air until ultimately it becomes black. It has an unpleasant odour and has no drying properties. It contains fatty acids, a yellow colouring matter, and resins, and may be used in soap manufacture. The resin from sulphite-pulp waste lyes has a high sulphur content. It has an unpleasant odour, but, unlike that from sulphate lyes, is soluble in water and has drying properties. It is not suitable for soap manufacture, but may find application in the varnish industry and in the manufacture of adhesives. The crude resin may be refined by distillation, by boiling with sulphuric acid or with a strong solution of sodium chloride and milk of lime, or by saponification. Bleaching is best effected with bleaching powder. The crude resin may be used in the preparation of wagon-grease, lubricants for driving belts, and bird-lime.—A. S.

The resin of coniferous woods, and deresinification of wood pulp. Sieber. *See* V.

PATENTS.

Coloured lime and process of producing same. G. I. Keck, Springfield, Ohio, U.S.A. Eng. Pat. 101,514, Apr. 13, 1916. (Appl. No. 5425 of 1916.)

QUICKLIME is slaked with a quantity of coloured water sufficient to hydrate the lime and leave it as a dry, uniformly coloured powder suitable for wall paints, etc., or the quicklime may be mixed with colouring matter before the addition of the water.—C. A. M.

Zinc white; Process of manufacturing ——. T. Seirensho, Ltd. Fr. Pat. 479,611, Aug. 28, 1915.

ZINC hydroxide is precipitated from an aqueous solution of zinc sulphate by means of milk of lime, in presence of sodium sulphate or a mixture of sodium sulphate with chlorides, and the precipitate is filtered off while the calcium sulphate still remains in the form of a supersaturated solution, and is subsequently converted into zinc white.
—C. A. M.

Ultramarine; Manufacture of ——. Gebr. Vossen, Aachen, and L. Bock, Bad Homberg-Kirdorf. Ger. Pat. 293,310, Mar. 25, 1915.

SULPHUR contaminated with tar, as obtained from spent oxide from gas purification by extraction, distillation, or the like, is used in the manufacture of ultramarine.—A. S.

Condensation products [from phenols and formaldehyde] and method of manufacturing a substance capable of replacing ivory, mother of pearl, celluloid, etc., and its applications in dentistry and industry. L. Eilertsen. Fr. Pat. 478,884, May 13, 1914.

PHENOLS or their homologues are fused with a substance capable of yielding formaldehyde (trioxymethylene), 1 to 10% of a base (soda solution) is added, and then an acid to effect the final condensation, which takes place without elimination of water or separation of the constituents. The use of phosphoric acid, alone or in admixture with other acids, gives a white translucent product, while alcohols and esters (notably amyl alcohol and amyl acetate) insoluble in water but capable of dissolving the product, may be introduced to increase the transparency. Colouring matters may also be incorporated. The product may be moulded, with or without pressure, and in dentistry may be used for artificial teeth and plates, and for stopping teeth.—C. A. M.

Phenols and aldehydes; Condensation product from ——. W. Reeser. Fr. Pat. 479,319, July 20, 1915. Under Int. Conv., July 29, 1914.

CONDENSATION products are prepared from a mixture of oils or fats with aldehydes and phenols, which is treated with alkali in about twice the proportion required to saponify the fats: or a mixture of about equal quantities of oils and resins (preferably colophony) or of resins alone (preferably in half the molecular proportion of the phenols) may be used instead of the oil or fat.
—C. A. M.

Cellulose esters; Varnishes with a basis of ——. L. Clément and C. Rivière. Fr. Pat. 479,387, July 26, 1915.

ETHYL acetoacetate and methyl acetoacetate are employed as the least volatile constituents of solvents for cellulose esters, particularly cellulose acetate, to prevent deposition of moisture and precipitation of the ester during the drying of the varnish. For example, a varnish composed of cellulose acetate, 10 grms., acetone 40 grms., alcohol 25 grms., benzene 25 grms., and ethyl acetoacetate 10 grms., dries in air to a bright transparent film.—F. Sp.

Coumarone resin; Manufacture of hard, pale-coloured ——. F. H. Meyer, Hannover-Hainholz. Ger. Pat. 294,107, Feb. 1, 1916.

SOLVENT naphtha is polymerised in the usual manner by treatment with acid (compare Ellis and Rabinovitz, this J., 1916, 1025) and then vigorously agitated with a slight excess of powdered alkali or alkaline-earth carbonates, preferably with addition of a small quantity of sodium or barium peroxide, until the acid is completely neutralised. The liquid is separated by decantation, filtration, or centrifuging, and volatile constituents removed by distillation.—A. S.

Sizing of wooden articles; Waterproof ——. H. Grünewald, Hanover. Ger. Pat. 293,365, Nov. 8, 1914.

AFTER applying the size, the articles are immersed in a bath of formaldehyde for at least 12 hours and then dried.—A. S.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

Rubber latex; Treatment of —— *with sodium formaldehyde hydrosulphite.* A. Dubosc. Caout. et Gutta-percha, 1916, 13, 9031—9032.

IT is doubtful whether the small quantity of sodium bisulphite used in order to produce pale rubber from *Hevea* latex is sufficient to destroy the colour-producing enzymes, as suggested by Beadle and Stevens (this J., 1915, 1101), but there can be no doubt that the small quantity of colouring matter already formed is bleached by the sulphur dioxide liberated in presence of acetic acid. Strongly coloured crêpes can be decolorised by the action of hot or cold solutions of sodium formaldehydesulphoxylate, especially in presence of a small quantity of bisulphite, and the use of the former substance and its congeners (known commercially as *Rongalites* or *Hyraldites*) in preference to bisulphite is suggested. The action of these substances is at once reducing, as hydrosulphites, and antiseptic, as aldehyde derivatives.
—E. W. L.

Hevea latex; Distribution of nitrogen in coagulum and serum of —— *on coagulation with acetic acid.* B. J. Eaton and F. W. F. Day. Agric. Bull. Fed. Malay States, 1916, 4, 350—353.

LATEX was diluted with water until it contained 1·5 lb. dry rubber per gallon. One gallon of diluted latex was coagulated with 3 oz. of a 5% solution of acetic acid, and the coagulum was left in the serum overnight. 100 parts by weight of latex (containing 0·11% N) yielded 67 parts of wet coagulum, containing 0·15% N and 33 parts of serum containing 0·06% N. In 60 days the nitrogen content of the serum fell to 0·03%, whilst in 6 weeks that of the coagulum fell from 0·78 to 0·23%, calculated on dried coagulum. The greater part of this must have disappeared in gaseous form. Sheet and crêpe prepared on the day following coagulation contained respectively 0·38 and 0·40% nitrogen. In the partially dried coagulum the nitrogen is distributed uniformly through the mass, except in the skin, where, owing to drying of the coagulum and exuded serum, the proportion was found to be about three times as great (0·32%) as in other parts of the slab (0·10—0·12%). The rough scales of dried serum were removed from the surface before analysis. E.W.L.

"Coagulatex"; a new coagulant. B. J. Eaton. Agric. Bull. Fed. Malay States, 1916, 4, 355—356.

"Coagulatex," advertised as a substitute for acetic acid, is a heavy yellow liquid of sp.gr. 1·4075 at 15° C. It consists essentially of sulphuric acid, of which it contains 50%. 2—3% of ordinary concentrated hydrochloric acid was also present in the sample examined, together with 2·3% of a white crystalline residue, probably consisting of acid sulphates. The value of this product as a coagulant depends entirely on the sulphuric acid present, and it is therefore not a desirable coagulant. Its price also compares unfavourably with that of sulphuric acid.—E.W.L.

Patents.

Rubber and rubber-like materials; Process of treating ——. W. J. Mellersh-Jackson, London. From Rubber Regenerating Co., New York. Eng. Pat. 12,943, Sept. 9, 1915.

See U.S. Pat. 1,158,843 of 1915; this J., 1915, 1261.

Plastic and like materials [e.g., rubber]: Roller apparatus for masticating —— and for other purposes. J. H. Nuttall, Manchester. U.S. Pat. 1,200,226, Oct. 3, 1916. Date of appl., Feb. 19, 1915.

See Eng. Pat. 22,105 of 1914; this J., 1916, 371.

Elastic material for use in tyres and other objects; Process for the manufacture of ——. M. Barricelli, Bygdö, Norway. U.S. Pat. 1,200,296, Oct. 3, 1916. Date of appl., July 18, 1914.

See Eng. Pat. 17,242 of 1914; this J., 1916, 266.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning and wattle bark extract industries in South Africa. Board of Trade J., Nov. 2, 1916.

There are at present about twenty tanneries in the Union of South Africa, mostly in Cape Province. The output of leather from these tanneries is now valued at over £500,000 annually; in 1914 the value was £260,000. A certain amount of leather is exported, and during this year about £3500 worth has been sold in the United Kingdom. The manufacture of wattle bark extract from bark grown in Natal has now commenced; one firm is treating 50 tons of green bark daily and a second company expects to commence work within a few months. The first consignment of extract has already been sent to the United Kingdom. Exports of wattle bark in 1915 amounted to 40,027 tons, a decrease of about 18,000 tons compared with 1914; the decrease is attributed to difficulties as to cargo space.

Utilisation of the tar from gas producers using lignite as fuel. Fischer and Schneider. *See* IIa.

Patents.

Hides and skins; Conversion of —— into leather. A. T. Hough, London. Eng. Pat. 17,137, Dec. 6, 1915.

After the usual preliminary treatment, the hides are tanned by steeping them in a solution of an alkali silicate or a solution containing colloidal aluminium silicate, soluble or colloidal silicic acid, or other silicon derivative, with or without the addition of sodium chloride. The process may be used in conjunction with other methods of tanning. (Reference is directed, in pursuance of Sect. 8, Sub-sect. 2, of the Patents and Designs Act, 1907, to Eng. Pat. 100,163; this J., 1916, 854.)—C. A. M.

Salicylic acid or its homologues and formaldehyde; Manufacture of condensation products [tanning agents] from ——. Deutsch-Koloniale Gerb- und Farbstoff-Ges., Karlsruhe. Ger. Pat. 293,866, May 16, 1913.

One part by weight of salicylic or cresotic acid is condensed with formaldehyde in presence of not more than 2—4 parts of concentrated sulphuric acid, the mixture being cooled to prevent sulphonation. The products are free from sulphur and are valuable tanning agents.—A. S.

Leather substitutes; Production of ——. E. Meszaros, Budapest. Ger. Pat. 293,751, June 16, 1914. Under Int. Conv., Jan. 21, 1914.

Animal textile fibres are treated first in dilute sulphuric acid or the like, heated nearly to boiling, and then in a mixture of glue, rosin, Venetian turpentine, and galena, the specific gravity of which is the same as that of the fibres and which is also heated nearly to boiling. The product remains plastic for a time but subsequently sets and becomes waterproof.—A. S.

Leather and products resembling leather; Manufacture of ——. W. Spalteholz, Leipzig, and K. Haring, Assignor to Anhydat-Leder-Werke A.-G., Hersfeld, Germany. U.S. Pat. 1,200,146, Oct. 3, 1916. Date of appl., Dec. 13, 1912.

See Ger. Pat. 273,652 of 1911; this J., 1914, 759.

Glue and the like; Process of making ——. W. M. Grosvenor, Ridgewood, N.J., Assignor to Perkins Glue Co. U.S. Pat. 1,200,488, Oct. 10, 1916. Date of appl., Nov. 25, 1912.

See Addition of Jan. 11, 1913, to Fr. Pat. 436,297 of 1911; this J., 1913, 761.

Condensation products [from phenols and formaldehyde] and method of manufacturing a substance capable of replacing ivory, mother of pearl, celluloid, etc. Fr. Pat. 478,884. *See* XIII.

XVI.—SOILS; FERTILISERS.

Chalking: a useful improvement for clays overlying the chalk. E. J. Russell. J. Board Agric., 1916, 23, 625—632.

The old practice of sinking chalk pits and spreading the chalk over the surface of clay land has not been common of recent years owing to the fact that stable manure, artificial fertilisers, and ground lime have been more readily obtainable, but experience has shown that better results are obtained with chalk. The essential feature of the method is that the chalk is dug out from the field to which it is to be applied. From 50 to 60 loads (a load is about 20 bushels) of chalk is spread over each acre and the dressing usually lasts for 25—40 years; the annual loss is about 1·5 load per acre. The chalk dressing renders clayey soil more porous and draining is facilitated, the soil is easier to plough and work down to a fine tilth, and yields better crops of clover and barley. Swedes and turnips are less liable to "finger-and-toe" disease when grown on chalked land, but winter oats and potatoes do not give any extra return.—W. P. S.

Silica; Quantitative determination of the —— in soils. B. von Horváth. Z. anal. Chem., 1916, 55, 513—536.

THE estimation of the amorphous silica set free when a soil is extracted with hydrochloric acid is usually performed by digesting the insoluble residue from that extraction with alkali hydroxide or carbonate solution, treating the filtered solution with hydrochloric acid, evaporating to dryness, and weighing the separated silica. Theoretical considerations having cast doubts upon the validity of this general method, six well-known modifications of it were submitted to a thorough investigation. The selected soil was digested with hydrochloric acid (sp.gr. 1·115) at a raised temperature for 5 days, filtered off, washed, and dried at 100° C.; 5-grm. portions were then taken and treated in silver dishes on the water-bath with 100 c.c. of the selected solvents, which consisted of aqueous solutions of sodium and potassium hydroxides and carbonates, and also of diethylamine. The results obtained were very discordant, the extreme variation being 60%. It was found that the amount of silica dissolved depended upon the nature of the dissolved alkali compound, upon its concentration, and on the time of action: upon the temperature during extraction, and on the temperature to which the original soil, or its HCl-extract, had been subjected: upon the size of the soil particles, upon the amount of agitation, and upon the ratio of the amount of soil to the amount of solvent. All the methods investigated had the defect that the alkaline solution dissolved not only the silica liberated by hydrochloric acid, but also that derived from other sources. The greater part of the excess silica found resulted from the action of the solvent solution upon silicates, a small quantity came from quartz particles, and a very small quantity from the original amorphous silica of the soil. The amount of liberated silica found by these methods varied with the conditions under which the soil was treated with acid, *i.e.*, with its concentration and with the time of action. It is possible that the use of weaker bases, *e.g.*, certain organic bases, would give more reliable results.—E. H. T.

Phosphorus compounds of the soil; Reaction between dilute acids and the ——. E. J. Russell and J. A. Prescott. J. Agric. Sci., 1916, 8, 65—110.

DETERMINATIONS of the amounts of phosphoric acid removed from soils by the action of dilute acids afforded new evidence that the soil cannot be regarded merely as a collection of inert matter containing small quantities of soluble constituents. 50 or 100 grm. portions of five different kinds of soil were digested with 1 litre of dilute acid at 23° C. for a definite time, and the dissolved phosphorus compounds were then determined. In every case the amount so extracted was found to increase continuously with the concentration of the acid, the increases being nearly proportional to the concentration. All the dilute acids used, when of equal concentration, gave extraction curves of the same type, but the amount of action was less with the strong acids than with citric or oxalic acids, and it was not proportional to the time. Using acids of $N/20$—$N/10$ concentration, it was found that the amount of phosphorus compounds extracted diminished with the time, so that less was dissolved out in 24 hours than in 10 minutes. Hence a reverse action, slower than the direct action, must take place. As experiments proved that the reverse action was not due to precipitation, it was inferred that the cause was to be found in the soil itself. When disodium phosphate was added to the mixed soil and acid, some of it was absorbed by the soil, and this absorption occurred even when the concentration of acid was $N/5$, though to a less extent than when $N/10$ acid was present. The absorption of the P_2O_5 ion is of the same kind as adsorption by colloids. It varies considerably with the nature of the acid, being greatest for hydrochloric and nitric acids, and least for citric acid of equivalent strengths. The greater power of citric acid to extract phosphorus compounds from the soil is due, not to its greater solvent action, but to the fact that in its presence the reverse action of adsorption is least. When, by means of a diffusion process, the reverse actions were prevented, it was found that the quantity extracted was the same for hydrochloric, nitric, and citric acids, and somewhat greater for sulphuric acid. Determinations of "available P_2O_5" do not give the true quantities of phosphorus compounds dissolved, and the results vary with the nature of the acid used and with the experimental conditions. Comparative determinations upon soils of the same type would, however, be useful, but only when the soil has been surveyed and definite types have been established. The order in which the acids themselves are adsorbed by soil is: oxalic and citric (most), phosphoric, sulphuric, hydrochloric, and nitric. Little phosphoric acid is adsorbed by the soil in presence of citric or oxalic acid, probably because its adsorptive capacity is satisfied by the latter acids. The amount of adsorption of phosphoric acid by the soil depends also upon the time; with nitric acid the amount increases, but with citric acid it is less after 24 hours than after 1 hour. The adsorption is probably instantaneous, and is influenced by chemical changes effected by the acid in which silica is liberated; but the adsorptive capacity does not appear to be affected by the presence of the acid as such.—E. H. T.

Absorption; The phenomenon of —— in its relation to soils. J. A. Prescott. J. Agric. Sci., 1916, 8, 111—130.

THE removal of salts and colouring matters from solution by the action of sand or soil has been known since very early times (Aristotle); but the first definite agricultural observation was made by Gazzeri in 1819, when he recorded that soil, especially clay soil, takes up soluble substances which might afterwards become available for plant nutrition. Lambruschini (1830) suggested that a loose kind of combination took place between the soil and the nutrient matter absorbed by it, and H. S. Thompson (1845) investigated quantitatively the effect of adding ammonium sulphate to soil and then extracting with water. He found that much of the ammonia remained in the soil and that it was replaced in solution by calcium and magnesium, a phenomenon that is now called "base-exchange." These observations were extended by J. T. Way (in 1850), who gave them a chemical explanation in opposition to Matteucci, who thought the action was purely physical. According to Way, the action is due to the precipitation of insoluble substances, *e.g.*, double silicates of calcium and magnesium react with the added ammonium or potassium salt yielding insoluble alkali aluminium silicates and setting free calcium and magnesium salts. A. Voelcker and Warington supported the chemical hypothesis and Liebig accepted the physical explanation, regarding the nutritive capacity of a soil as depending solely on the quantity of nutrient substances physically retained by it. Since 1880 very few new facts have been discovered, the main development having been on the theoretical side. Two practical methods have been in vogue: the soil is either brought into equilibrium with a definite volume of solution, or the latter is filtered through a column of soil; the former method is the more accurate. Valuable work was done by Knop and Biedermann (1871), by Kellner (1886), and recently by Ramann, in establishing the law that the amounts of bases removed by soils are equal to the quantities taken up by the vegetation growing in them. Although small temperature changes are without appreciable effect on soil absorption, W. Schuhmacher (1867) found that it was usually less at high temperatures than at low. The part played by humus has received little attention. The author has shown that the amount of phosphoric acid absorbed by humus is independent of the concentration of the phosphate solution employed. The connection between soil problems and colloidal phenomena was first indicated by Van Bemmelen (1883). Convinced by the fact of "base-exchange," he at first favoured Way's interpretation, holding the silica "gel" in the soil to be the main factor in soil absorption; but later work on simple gels, *e.g.*, silica, iron oxide, and alumina, and neutral solutions, where the possibility of chemical action was extremely remote, led him to the conclusion that soil absorptions are of the same kind as ordinary physical absorptions. Recent work has comfirmed this view; soil absorption is of the same nature as physical adsorption—"the concentration of any substance on the surface of another"—increasing with the concentration of the solution according to a simple mathematical relationship. The absorption of dyestuffs by the soil proceeds in accordance with the laws of adsorption. The phenomena of "base-exchange" have been shown to be governed by the same laws by Patten, Cameron, Parker, and Wiegner. The last-named has shown that the removal of ammonia by "permutite" from ammonium chloride solution follows the adsorption laws very closely; the equilibrium is instantaneous, the chlorine ion is not absorbed, and the absorption diminishes with rise of temperature. The reaction between the soil and phosphates in presence of a dilute acid obeys the adsorption equilibrium law (see previous abstract), and percolation experiments with soil containing monocalcium phosphate gave results in agreement with the assumption that the concentration of the percolate at any moment is proportional to the amount of absorbed substance.

—E. H. T.

Ammoniacal nitrogen of peats and humus soils. J. C. B. Ellis and C. G. T. Morison. J. Agric. Sci., 1916, 8, 1—6.

The determination of the ammonia liberated from soils by distillation with magnesia, was conducted in a litre flask fitted with a trap and a tube conveying a current of ammonia-free air. To the trap was connected a 100 c.c. pipette, which passed through the cork of a filter flask. The latter contained 100 c.c. of $N/100$ acid, and its side tube communicated with a filter pump. In this way the distillation was effected under greatly reduced pressure at about 40° C. The excess acid was titrated in presence of methyl orange. Experimenting with 30 grm. portions of three kinds of air-dried peat and using 3 grms. of magnesia, it was found that the greater part of the ammonia passed over during the first two hours, and it was inferred that 3 hours would suffice to expel the whole of the nitrogen derived from the more unstable nitrogen compounds. Distillations with eight different peat soils and three arable soils showed that the former evolved much more ammonia than the latter, and acid peats gave more than neutral peats. When the aqueous extracts of air-dried peats were distilled with magnesia, it was found that 50—80% of the ammonia, as obtained above, was recovered. The amounts of ammonia that were set free by distillation and that were removed in the aqueous extracts, showed marked variations with the depths from which the soil samples were taken.

—E. H. T.

Ammonification by certain soil fungi; Effect of soil reaction on ——. N. Kopeloff. Soil Sci., 1916, 1, 541—573. J. Chem. Soc., 1916, 110, i., 702—703.

Rhizopus nigricans, Zygorrhyncus Vuilleminii, and *Penicillium* are equally affected by changes in the reaction of the soil; such changes have a greater effect when dried blood is employed as source of nitrogen than with cottonseed meal, and in clay soils as compared with sandy soils. The maximum accumulation of ammonia by these fungi occurs between the neutral point and an acidity equivalent to 2000 lb. of calcium oxide per acre. Acidity greater than this, and an increase in alkalinity beyond the neutral point, generally cause a depression in ammonia production. It is suggested that ammonification by fungi may be of practical importance under conditions unfavourable to soil bacteria.

Protein decomposition in soils. E. C. Lathrop. Soil Sci., 1916, 1, 509—532. J. Chem Soc., 1916, 110, i., 703.

A sandy loam soil was thoroughly mixed with dried blood (40 : 4) and kept for two hundred and forty days in a jar covered with perforated paper. The percentage of water in the soil was kept at 10%, water being added at intervals of five to eight days, when the soil was turned out and mixed to promote aeration. Samples were taken for estimating the different forms of nitrogen after eighteen, forty-four, eighty-six, one hundred and forty-eight, and two hundred and forty days. Ammonification was very rapid during the first eighty-six days, after which there was a marked fall until the end of the experiment, when the production of ammonia was only at about 10% of the rate observed after the first eighteen days. In two hundred and forty days 79% of the blood protein was converted into ammonia. Of the nitrogen of the monoamino-acids about 89% was converted into ammonia, whilst arginine and histidine each gave about 83%. Indications were obtained that new protein substances were formed, and that these are more resistant to the action of micro-organisms than the proteins of dried blood. The lysine of the dried blood disappeared almost completely in eighty-six days, whilst during the last one hundred and fifty-four days there was a continual increase in this form of nitrogen. At the end of two hundred and forty days the soil contained protein-like substances soluble in 1% sodium hydroxide. It is uncertain whether these substances form undecomposed residues of the dried blood, or whether they are newly formed proteins.

Manganese salts: Effect of some —— on ammonification and nitrification. P. E. Brown and G. A. Minges. Soil Sci., 1916, **2**, 67—85. J. Chem. Soc., 1916, **110**, i., 703—704.

THE soil employed was a clay loam, containing 0·1732% of manganese. In the ammonification experiments the soil received 5% of dried blood, whilst for nitrification 0·1 grm. of ammonium sulphate was added. Manganese chloride, applied at the rate of more than 2000 lb. per acre, retarded both ammonification and nitrification. Applications of 100 and 200 lb. increased ammonification slightly and nitrification distinctly. Manganese sulphate increased both ammonification and nitrification when applied at the rate of 100 lb. per acre, whilst large amounts (2000 lb.) had a depressing effect. Manganese oxide applied at the rate of 2000 lb., or more, per acre retarded both ammonification and nitrification.

Lead; Action of —— as a stimulant for plants. A. Stutzer. J. Landw., 1916, **64**, 1—8. J. Chem. Soc., 1916, **110**, i., 704.

THE results of water culture experiments with rye, wheat, oats, barley, maize, and peas showed better growth when a portion of the nitrogen was in the form of lead nitrate than with sodium nitrate only. The best plants, especially barley, were obtained in solutions containing 0·5 grm. of lead nitrate per litre. In field experiments the yields of sugar beet and of sugar were considerably increased by application of 4 kilos. of lead nitrate per hectare. With oats the yield of grain was increased, whilst the yield of straw was diminished. The same amount of lead nitrate (4 kilos. per hectare) gave unsatisfactory results with potatoes, which seem to be very sensitive to lead nitrate. Another field experiment, with wheat, showed that whilst lead nitrate gave good results in conjunction with 50 kilos. of nitrogen as sodium nitrate, the results were much less satisfactory when smaller amounts of sodium nitrate were employed.

Soils; Comparison of the nitrifying powers of some humid and some arid ——. C. B. Lipman, P. S. Burgess, and M. A. Klein. J. Agric. Res., 1916, **7**, 47—82.

THE nitrifying powers of about 45 humid, and of about 150 arid soils were determined under laboratory conditions. The humid soils included a typical soil from every State or Territory in the United States, and the arid soils represented the different types of four soil-survey areas in California. The nitrifying power of each soil was determined on the soil nitrogen itself, and on the same with the addition of 0·2% ammonium sulphate, 1% dried blood, or 1% cottonseed meal, the nitrate being estimated by the phenoldisulphonic acid method. The 100-grm. soil portions, containing the optimum amount of moisture, were incubated for one month at 28°—30° C. As a class, the humid soils contained more total nitrogen than the arid soils, but no relationship between this content and the power of nitrification could be traced. In the humid soils, nitrification was greatest in presence of dried blood and least in presence of ammonium sulphate; in fact, the amount of nitrate produced from soil nitrogen was less when the ammonium salt was present than when it was absent. The nitrifying powers of arid soils were generally less than those of the humid soils; the power was increased by ammonium sulphate and by cottonseed meal but decreased by dried blood. This retarding action of 1% of dried blood in an arid soil may be due to the circumstances that ammonia is rapidly produced from this fertiliser in the ammonification stage, that ammonia is fatal to the nitrifying organisms, and that it is less readily adsorbed and eliminated in such soils than in moist soils rich in humus and organic colloids. Less nitrate was produced from the soil with added ammonium sulphate than from the soil alone in 88% of the humid soils, but only in 19% of the arid soils; with dried blood the percentages were 20 and 48 respectively, and with cottonseed meal 46 and 24, but the extent of nitrification in arid soils containing the last-named fertiliser varied very considerably. Thus different forms of fertiliser nitrogen produced widely different results on different soil types.—E. H. T.

Phosphates contained in mineral phosphates; The nature of the ——. G. S. Robertson. J. Agric. Sci., 1916, **8**, 16—25.

PHOSPHATIC rocks from seven different sources were analysed, and the P_2O_5 and lime contents of the citric-soluble portions also determined. In the case of the harder rocks, the ground material was separated by means of sieves into five different grades of fineness and each grade was analysed separately. The citric solubility was found by subjecting 5-grm. portions to consecutive extractions with 2% citric acid solution, and test experiments with apatite showed that the lime and phosphoric acid were dissolved out in the same ratio as they were present in the mineral. The analyses of the citric-soluble fractions indicated the presence of the following compounds: Makatea Island phosphate, $2Ca_3P_2O_8,CaO$; Florida pebble and Tunisian, $4Ca_8P_2O_8,CaO$; Algerian, Gafsa, and Belgian, $Ca_8P_2O_8,CaO$; apatite, $3Ca_3P_2O_8,CaO$. The results with apatite indicate that the ratio P_2O_5 : CaO is not different it the oxygen of one of the CaO groups is replaced by fluorine or chlorine, a fact which would account for the lower solubility of rock phosphate in citric acid as compared with bone meal; and the higher lime content would explain the higher solubility in citric acid as compared with apatite (see Robertson, this J., 1916, 216—217). In general, the solubility increased with the amount of lime combined with phosphoric acid, thus confirming the observations made by Collins on basic slag (this J., 1915, 527). The effect of calcining the rock phosphates in a muffle furnace was to diminish greatly the citric solubility. Calcination causes the production of a "silica phosphate" which is soluble in the first citric solution, and also of one or more phosphates with a lower (combined) lime content than the mineral. The longer the calcination the greater the change in this direction. (Compare Aita, this J., 1916, 1074.)—E. H. T.

Oxygen derived from the reduction of nitrates by green plants; Liberation of ——. M. Molliard. Comptes rend., 1916, **163**, 371—373.

COMPARATIVE experiments in which radishes were grown in a confined volume of air and in similar culture media (except that nitrogen was supplied in some cases as potassium nitrate and in others as ammonium chloride) showed that the fixation of nitrogen from a nitrate was accompanied by a characteristic liberation of oxygen. The pressure developed accorded with an evolution of 2 atoms of oxygen for each atom of nitrogen fixed. —F. SODN.

Loss of phosphoric acid during fusion with ammonium fluoride. Davis and Prescott. *See* XXIII.

PATENTS.

Peat; Treatment of ——, and production of a preparation suitable for use in horticulture and agriculture. J. J. A. and H. C. S. de Whalley, Lee, Kent. Eng. Pat. 14,487, Oct. 13, and 17,848, Dec. 21, 1915.

BLACK or dark peat is treated with just sufficient ammonia to render it slightly alkaline, and then 5—20% of its weight of calcium carbonate, or similar substance, is added to prevent subsequent development of acidity. The ammonia may be generated within the peat mass by the action of an alkali, alkali carbonate, or alkaline earth upon an ammonium salt, both ingredients being added directly to the peat and well stirred in. Thus, for example, one ton of partly dried peat, containing about 35% of moisture, may be mixed with 2 cwt. of ammonium sulphate, either solid or dissolved, and 2 cwt. of powdered potassium carbonate, and subsequently with 1—4 cwt. of calcium carbonate. The fertilising value may be enhanced by the addition of potassium compounds, phosphates, etc.—E. H. T.

Sterilisation of soil: Process and apparatus for the ——. F. Minervini. Fr. Pat. 479,056, June 17, 1915.

Steam is introduced into the soil at a temperature, under a pressure, and in quantity sufficient to raise the mass of earth to about 120° C., the temperature being maintained for a sufficient length of time to sterilise the soil. The plough is provided with one or more steam boilers, connected by a distributor tube to a number of injectors, consisting of a series of tubes pierced with holes, the openings being covered by bells. During the treatment, the soil and the injectors sunk in the soil are covered by impermeable cloth bands, preferably mounted on wood frames. When applied to arable land, the plough is provided with an arrangement for sinking the injectors at the side, between the plough-share and the draught-animals, in the preceding furrow, the injectors being immediately covered automatically by the earth thrown up by the plough in forming the furrow.—B. N.

Electrolytic manufacture of caustic potash. Fr. Pat. 478,371. *See* VII.

Preparation of tetracupric sulphate and its use as a fungicide. Addition to Fr. Pat. 476,512. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Reducing sugars; Supposed precipitation of —— *by basic lead acetate. Estimation of carbohydrates. V.* W. A. Davis. J. Agric. Sci., 1916, 8, 7—15.

In opposition to the general belief that lævulose is precipitated from solution by basic lead acetate, it is shown that no such action occurs in dilute solution, even in the presence of such salts as chlorides, sulphates, or carbonates. There is however a loss of this sugar if the lead salt be kept in the liquid for a considerable time. Thus, 100% of lævulose is recoverable if the lead is precipitated immediately after addition of the acetate, but if it is left in solution for 15 mins., 1 hour, or 24 hours, and then eliminated, increasing amounts of sugar disappear, and at the same time the liquid becomes more and more yellow. The loss of lævulose ranged from 20% to 30%, but the values found by reduction were always 13—14% higher than those calculated from the rotatory power. The discrepancy is due to the conversion of lævulose into glutose, $C_6H_{12}O_6$, a substance which has a lower reducing power than lævulose, and is optically nearly inactive. The conversion is accelerated when the temperature is raised. The use of normal lead acetate to clarify liquors containing reducing sugars is not recommended. Experience has shown that the sugars in leaf material can be determined accurately if the basic acetate be added, little by little, until precipitation is complete, excess being carefully avoided. Usually 5 c.c. of acetate solution to 300—500 c.c. of liquid is sufficient. The precipitate should be filtered off immediately, and then washed thoroughly; the excess of lead salt is removed with sodium chloride or sulphate. By observing similar precautions, tannin admixed with sucrose and reducing sugars can be precipitated without loss of sugars. Dextrose and maltose are not affected by hot digestion with basic lead acetate.
—E. H. T.

Molasses; Colouring matter of ——. H. Stoltzenberg. Ber., 1916, **49**, 2021—2023.

Beet sugar molasses and the residue from the desaccharification process, after extraction with alcohol, still contain a brown non-fluorescent colouring matter, which can be extracted by precipitating with lead acetate, decomposing the precipitate with hydrogen sulphide, evaporating the filtrate in a vacuum, and diluting the resulting syrup with water. On standing it slowly precipitates as a black amorphous substance, very slightly soluble in water, and still less so in organic hydroxy compounds, insoluble in chloroform, ethyl acetate, etc. It decomposes at 100° C., forming a black resin. Its composition corresponds to the formula $C_{20}H_{24}N_2O_9$. Its solubility in alkali points to the presence of hydroxyl groups, whilst basic nitrogen is indicated by its solubility in acids. It is unsaturated and on reduction in alkaline medium gives a grey substance insoluble in alkali, and a yellowish solution in acid medium. The yield of colouring matter amounted to 1·2 grms. from 1 kilo. of molasses.—G. F. M.

Wheat-starch industry; New methods in the ——. C. Goldbeck. Chem.-Zeit., 1916, 40, 829—830.

Modern methods of starch manufacture enable a larger yield to be obtained from the flour than was possible with the older methods, this being attained by a more perfect separation of the starch from the gluten. The following method gives a yield of 58—60% of starch as compared with 34—52% by the old methods. The flour is kneaded into a dough with water and washed in an extractor; the starch-milk obtained is passed through the usual sieves and the fine starch then separated by centrifugal action. The portion of the starch still remaining mixed with the gluten on the sieves is separated by subjecting the gluten to fermentation or treatment with dilute ammonia and acetic acid, and centrifuging the mixture. The gluten and a small quantity of bran separated in the process may be used as feeding stuffs.—W. P. S.

Formation of methylglyoxal and formaldehyde in glycolysis. Sjollema and Kam. *See* XVIII.

Influence of strong salt solutions on the spontaneous oxidation of pyrogallol, ferrous sulphate, and lævulose. MacArthur. *See* XXIV.

Patents.

Sugar refining. R. A. Chesebrough. Fr. Pat. 479,506, Aug. 13, 1915.

A filtering and decolorising agent is employed, made by impregnating dried, ground, and sifted fullers' earth with petroleum, of sp.gr. preferably below 34° B. (sp. gr. 0·854), and heating in an oven or retort at red heat. A layer of carbon is thus deposited on the particles, rendering them insoluble in water, so that the pores of the filter do not become clogged. The prepared material is heated to about 135° F. (57·2° C.) before being placed in the filter, and filtration is conducted at about 130° F. (54·4° C.).—J. H. L.

Glucose, maltose, starch-syrups, and dextrins; Manufacture of ——. Soc. d'Exploit. des Proc. H. Boulard. Fr. Pat. 477,927, July 8, 1914.

Saccharification of starch is effected by means of *Mucor Boulard No.* 5 (see Fr. Pat. 461,601; this J., 1914, 497) or similar robust organism. To prepare products containing a high proportion of dextrose, and very little maltose and dextrins, the amylaceous material may be heated for 35 mins. under 3½ kilos. pressure with some water and 0·5—0·8% of acid, then transferred to a closed vat provided with means for aerating, and seeded at 40° C. with a small quantity of the mould. When saccharification is complete, the filtered liquid, which does not require neutralisation, can be concentrated; it yields quite colourless syrups without treatment with charcoal. Products containing a high proportion of dextrins may be prepared by employing certain acids for the preliminary digestion, and aerating more strongly during saccharification.—J. H. L.

Sugar and like rolling mills. J. Miller, and G. Fletcher and Co., Ltd., Derby. Eng. Pat. 101,693, Aug. 5, 1916. (Appl. No. 11,075 of 1916.)

Process of producing oxalic acid from sugar and other carbohydrates. Eng. Pat. 101,680. *See* VII.

XVIII.—FERMENTATION INDUSTRIES.

[*Brewing.*] *Pre-mashing, proteolytic digestion, and protein turbidity.* W. Windisch. Woch. Brau., 1916, 33, 105—108, 121—125.

Pre-mashing, *i.e.*, the digestion of malt in cold water before the mashing process, has a favourable influence on transformations in the mash, by rendering the material more easily attacked by the malt enzymes and by increasing the amount of these enzymes which pass into solution in the wort. The yield of extract is increased, and the chance of starch escaping saccharification and afterwards producing starch-haze is reduced. The possibility of undesirable flavouring and colouring matters of the husk passing into the wort as a result of pre-mashing, may be avoided by first screening the grist and adding the husk fraction only after pre-mashing is completed; this is specially recommended when waters rich in carbonates are used. Pre-mashing should invariably be conducted at a low temperature, to prevent the development of excessive acidity; at 5°—10° C. the process may be continued safely for 6, 9, or even 12 hours, provided that the mashing process proper is commenced as soon as the temperature is allowed to rise. The author discusses the practice of proteolytic digestion, *i.e.*, the holding of mashes for a time at 50° C. to promote proteolysis (see this J., 1912, 654), and gives examples of its application to the decoction method of mashing. Its chief benefit is that it tends to free the wort from proteins likely to separate later in the form of a haze or turbidity in the beer, and it is therefore of most service with malts of deficient modification, such as the short-grown malts widely used in Germany at present. Pre-mashing and proteolytic digestion have been wrongly held responsible for sluggish fermentations, but they are rather a remedy than a cause. Such fermentations are most common when highly nitrogenous and poorly modified malts are used, the worts from which are liable to contain abnormally large amounts of imperfectly dissolved colloidal protein matters. The deposition of these colloids on the yeast cells is the cause of slow and arrested fermentation. Their elimination by decomposition into simpler and more soluble substances, before fermentation, can in many cases, if not in all, be brought about by pre-mashing and proteolytic digestion. A high wort acidity, produced for example by the use of *Bac. Delbrücki* (see this J., 1913, 955), also assists in the elimination of undesirable proteins from the wort, by promoting their separation in a flocculent form on the wort cooler.—J. H. L.

Fermentation; Acceleration of —— *by certain materials.* H. Wüstenfeld. Woch. Brau., 1916, 33, 89—90.

The author criticises the explanation suggested by Moufang for the observed accelerating effect of dead yeast on fermentation (see this J., 1913, 303; 1915, 1159). The cell walls of dead yeast lose their property of selective permeability, and in Moufang's experiments enzymes from the surrounding liquid may have entered the cells and produced substances having a stimulating action on the living yeast. A more probable explanation is, however, that the dead cells and other materials prevented, in a purely mechanical manner, supersaturation of the liquid with carbon dioxide, which has a somewhat toxic influence on yeast, and that in consequence of the freer evolution of gas from the liquid the latter was kept in more rapid circulation. The presence of grains in distillers' worts accelerates fermentation in a similar manner.—J. H. L.

Beer: Sensitiveness of —— *towards cold, and the Wallerstein process.* P. Petit. Brasserie et Malterie, 1916, 6, 161—166.

Details are given of trials made by a number of French brewers with Wallerstein's peptonising agent for rendering beers chill-proof (see U.S. Pats. 995,824 and 997,873, this J., 1911, 916, 1027). The substance, a white powder, was added after the primary fermentation, at the rate of ⅓—½ oz. per barrel of beer. Provided it was allowed to act for a sufficient time it gave very satisfactory results, rendering the elimination of glutin by chilling and filtration unnecessary, and having no undesirable effects on other characters of the beers, such as retention of head. The time required was found to depend on the temperature, viz., 3 days at 15° C., 12—15 days at 10° C., or 30—40 days at 2°—3° C. The addition of finings arrests the action of the substance, and in cases of top-fermentation, where owing to this cause the duration of treatment was insufficient, the beers formed a "glutin-haze" at low temperatures but on warming the haze vanished more readily and completely than in the case of untreated beers.—J. H. L.

Brewers' filter pulp. W. A. J. Foster. J. Inst. Brew., 1916, 22, 413—424.

Pulp equal in quality to the German products, which were exclusively used before the war, is now made in this country. The raw materials which have been used for the manufacture of brewers' pulp are cotton, linen, jute, wood, and wool fibres, and sometimes small quantities of asbestos, but cotton usually forms the main constituent and the best pulp is made from this alone. A pulp possessing a good white colour and guaranteed unbleached, can only have been made from clean cotton fibre. The moisture-content of such a pulp should not exceed 10%, or mouldiness may develop. The ash-content should be less than 1% unless asbestos has been added. The author does not recommend the addition of asbestos, but brewers desiring it should add it themselves. The pulp should contain no substances soluble in hot or cold water or alcohol, and should impart no flavour to these liquids. A cake of pulp should disintegrate readily in boiling water, and give rise to a flaky and homogeneous mass free from knots or balls. The author describes the microscopic appearance of cotton, linen, jute, wood, and wool fibres and some tests to distinguish them. The commonest defect in pulp is the formation of knots or balls. This may be due to the use of unsuitable fibres or their improper treatment during manufacture, but it is often produced by wrong methods of handling, especially during washing. Apparatus for washing pulp should not be fitted with paddles or wheels for churning the material. The pulp should be washed with cold water until free from yeast, and then for an hour with water at 168°—190° F. (75—87° C.), and afterwards again with cold water. Boiling water or live steam should not be used.—J. H. L.

Brewery: Use of hydrogen peroxide in the ——. H. B. Wooldridge. J. Inst. Brew., 1916, **22**, 436—446.

Hydrogen peroxide has been successfully applied to the disinfection of casks, filter pulp, and other objects in the brewery. Casks which have become mouldy are steamed for about 15 mins., and then 1 quart, or in bad cases more, of 12-vol. hydrogen peroxide, diluted to 1 gall., is introduced into each; the casks are closed and rolled thoroughly at intervals during several hours. The peroxide penetrates deeply into the wood, destroying moulds and other organisms; it has no injurious action on the wood and leaves no undesirable decomposition products. In the treatment of filter-pulp, this is first washed with cold water and then with water at 160° F. (71° C.); after cooling to about 120 F. (49° C.), 2 quarts of 12-vol. peroxide is added for about 25 lb. of pulp. After standing for half an hour the pulp can be used; it is white and quite sterile. Wooden stoppers are put through an ordinary washing machine and then left for several hours in 12-vol. hydrogen peroxide diluted eight-fold.—J. H. L.

Wine; Approximate determination of the sugar content of ——. J. Pritzker. Schweiz. Verein Anal. Chem., May, 1916. Chem.-Zeit., 1916, **40**, 832.

The wine is evaporated to remove alcohol, then treated with lead acetate, filtered, and 2·5 c.c. of the filtrate is placed in a tube similar to that described previously for the determination of sulphates in wine (this J., 1916, 859); boiling Fehling's solution is then introduced into the tube until the latter is filled up to the 10 c.c. mark, the tube is placed in boiling water for 4 mins., then cooled, and centrifuged for 3 mins. Any cuprous oxide adhering to the sides of the tube is now detached with a rubber-tipped glass rod, and, after centrifuging for a further 3 mins., the volume of the cuprous oxide in the capillary portion of the tube is read off; its volume is a measure of the sugar content of the wine. The difference in the amount of sugar found by this method and that obtained by the ordinary gravimetric method varies from ±0·2 to 0·3 grm. per litre.—W. P. S.

Wine: Detection of artificial colouring matters in ——. H. Kreis. Schweiz. Verein Anal. Chem., May, 1916. Chem.-Zeit., 1916, **40**, 832.

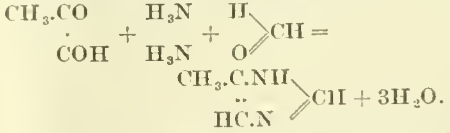
Dark red wines, even when diluted with five parts of water, sometimes dye wool so intensely that the colour cannot be removed by washing with boiling water; this may lead to the conclusion that an aniline dye is present in the wine. If, however, the wine is diluted previously with 10 parts of water, the colour is usually removed from the wool when this is washed with boiling water. In doubtful cases the coloured wool should be heated on a water-bath with 1% ammonia; this destroys the natural colouring matter derived from the wine, whilst aniline dyes, for the most part, go into solution. The ammoniacal solution is then acidified with sulphuric acid and heated with a fresh thread of wool. If aniline dyes are present the wool is coloured, but in their absence it remains white.—W. P. S.

Vinegar and wine: Use of the iodic acid-starch reaction in the control of ——. J. Jeanprêtre. Schweiz. Verein Anal. Chem., May, 1916. Chem. Zeit., 1916, **40**, 833.

Landolt has pointed out (Ber., 1886, **19**, 1317) that a mixture of sulphurous acid, iodic acid, and starch develops a blue coloration after a varying lapse of time. The author shows that if a sulphite and an acid be used instead of free sulphurous acid, the time which the coloration takes to appear depends on the kind and concentration of the acid, the temperature, age of the reagent, etc. For instance, the time elapsing before the blue coloration appears is as follows, when 10 c.c. of the $N/10$ acid is mixed with 10 c.c. of the reagent (10 c.c. of 0·2% sodium iodate solution, 10 c.c. of 0·2% sodium sulphite solution, and 5 c.c. of 0·5% starch solution, diluted to 100 c.c.):—acetic acid, 438; succinic acid, 320; malic acid, 52; citric acid, 45; tartaric acid, 26 secs.; oxalic acid and mineral acids, at once. Since the presence of a trace of mineral acid greatly reduces the time required for the devlopment of the coloration, the reaction may be used for the detection of mineral acids in vinegar and wine. If 10 c.c. of wine gives a blue coloration in less time than does 10 c.c. of citric acid solution of equal strength, an abnormal quantity of free mineral acid is present. Generally, a non-sulphured, non-plastered wine reacts as slowly as does a succinic acid solution.—W. P. S.

Glycolysis; Formation of methylglyoxyl and formaldehyde in ——. B. J. Sjollema and A. J. H. Kam. Rec. Trav. Chim. Pays-Bas, 1916, **36**, 180—193.

In the breakdown of sugars under biological agencies, *e.g.*, in alcoholic fermentation, and the building up of proteins, the formation of pyruvic acid or its aldehyde, methylglyoxal, in the intermediate stages has been considered very probable. This hypothesis has received support by Windaus and Koop (this J., 1906, 1231) and by Neuberg. The formation of methyliminazole (a histidine derivative) by the action of ammoniacal zinc hydroxide on dextrose was explained by the former authors through the intermediate production of methylglyoxal and formaldehyde, thus:



$$\begin{matrix}CH_3.CO\\ \cdot\\ COH\end{matrix} + \begin{matrix}H_3N\\ \\ H_3N\end{matrix} + \begin{matrix}H\\ \\ O\end{matrix}\!\!>CH = \begin{matrix}CH_3.C.NH\\ \cdot\cdot\\ HC.N\end{matrix}\!\!>CH + 3H_2O.$$

Although neither methylglyoxal nor formaldehyde can be detected among the products of glycolysis, the hypothesis would be considerably strengthened if it were shown that the synthesis of the nitrogenous complex took place by the condensation of the simpler components by the same reaction more readily than from the more remote dextrose. This has now been done by the authors: 208·5 grms. of an aqueous solution containing 14·9 grms. of methylglyoxal, determined by the semicarbazide method, was mixed with 17·6 grms. of 35 % formaldehyde solution and the mixture treated with ammoniacal zinc oxide partly in solution and partly in suspension. A precipitate of the zinc salt of methyliminazole was immediately produced and fully identified with the product obtained by Windaus and Koop from dextrose, which is only formed slowly in the course of some weeks. Neuberg has asserted that dihydroxyacetone in alkaline solution is very readily converted into methylglyoxal and should be capable of the same condensations, but the authors do not confirm this view. Dihydroxyacetone, with or without formaldehyde, only yields the zinc derivative of methyliminazole very slowly, as in the case of dextrose. Further, on treatment with hydrazine it yields a hydrazone which is very different from the product of the action of hydrazine on methylglyoxal, and whereas methylglyoxal condenses very readily with thiourea, dihydroxyacetone does not. The hypothesis founded on the probable formation of dihydroxyacetone as an intermediate product is therefore not supported by the present investigation.—J. F. B.

Velocity of scission of lactose by action of the Bulgarian ferment. Quagliariello and Ventura. *See* XIXa.

An examination of certain methods for the study of proteolytic action. Sherman and Neun. *See* XIXa.

Comparison of barbituric acid, thiobarbituric acid, and malonylguanidine as quantitative precipitants for furfural [from pentoses]. Dox and Plaisance. *See* XXIII.

Reactions of peroxydase purified by ultrafiltration. Bach. *See* XXIII.

Patents.

Hops ; Process for the preparation of an extract of ——. E. W. Kuhn, London. Eng. Pat. 14,330, Oct. 9, 1915.

Hops and cooled wort are introduced into a cylinder such as that described in Eng. Pat. 8823 of 1907 (this J., 1908, 761) until the cylinder is full. Further wort is then forced in by hydraulic pressure, the contents of the cylinder are heated to 60° C. for a suitable length of time, next cooled to 0° C., the pressure being maintained, the liquid is drawn off and is ready, after the hop petals have been separated, for introduction into cooled wort or beer.—W. P. S.

Brewers' worts ; Rousing and mixing apparatus for ——. M. F. Chambers, Cork, and C. F. E. Skilton, Blackrock, Ireland. Eng. Pat. 101,363, Jan. 28, 1916. (Appl. No. 1377 of 1916.)

The apparatus comprises an open pan, perforated at its circumference, and connected at the bottom with a central pipe extending downwards. A rotating shaft passes down through the pipe and is provided at its lower end with a ribbed disc, above which is a covering disc attached to the lower end of the pipe. The central pipe is telescopic and, when the apparatus has been arranged at a suitable height in a vat, with its open top above the liquid level, the rotation of the shaft and ribbed disc draws the beer and yeast through the perforations and down the pipe, and distributes it horizontally round the bottom of the vat.—W. P. S.

Musts ; Preservation of ——. J. A. Dejeanne. Fr. Pat. 177,953, July 8, 1914.

The organisms of grapes being confined in general to the outer surface of the fruit, musts not liable to spontaneous fermentation are obtained by sterilising the grapes, preferably by means of sulphurous acid, before pressing.—J. H. L.

Starch ; Liquefaction of ——, *and use of fluorides in fermentations with moulds.* H. Jomela. Fr. Pat. 178,972, May 18, 1915.

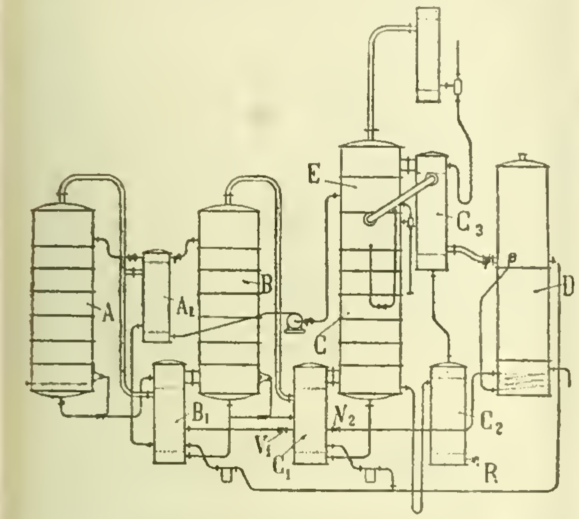
After a preliminary cooking the amylaceous material, without addition of alkali, is liquefied by *Bact. Burdigalense* (see Fr. Pat. 471,918, this J., 1915, 1107); a few litres of culture suffice for 1000 kilos. of material. Before saccharification, which is effected by *Mucor Elocis* (*loc. cit.*) or a similar mould, in open vats, the mash is preferably heated for a short time to destroy adventitious infection, and a further culture of *Bact. Burdigalense* may be added together with the *Mucor*. Claim is also made to the use of sodium fluoride, which may be added after the first cooking, at the rate of 10 grms. per hectolitre of wort. The liquefying bacterium is not affected by this, and the *Mucor* as well as the yeast employed may be acclimatised to it. The characters of *Bact. Burdigalense* and *Mucor Elocis* are described.
—J. H. L.

Distillation and rectification of wines and fermented musts, methyl alcohol, etc. ; Apparatus for the continuous ——. E. Barbet et Fils et Cie. First Addition, dated Apr. 25, 1914, to Fr. Pat. 470,242, June 10, 1913 (this J., 1915, 194).

Modifications have been made in the apparatus previously claimed, in order to obtain rectified products free from esters. The vapours driven out of the wine in column, A (*loc. cit.*), undergo a preliminary purification by condensation, in an upper extension of the column, the lighter head-impurities passing out of the top of the column as vapour. The condensed liquid, still containing some esters, passes, together with a regulated quantity of caustic alkali, into the column, B, C, in which are intercalated some plates of relatively great depth to ensure that the liquid remains in this column for a sufficient time for the esters to be hydrolysed. Any ammonia or volatile bases produced during hydrolysis, are eliminated with other head-impurities from the top of column, B. The alkaline spirit leaving C, is neutralised on its way to the rectifier, K, L, by a regulated flow of sulphuric acid into the pipe, and small test-portions of the liquid can be taken from the plate of entry in K, to ascertain that the supply of acid is correct. A small quantity of caustic alkali is supplied continuously to the bottom plate in the upper extension of the column, A, and to the top plate of the de-alcoholising column, J, the object in both cases being to neutralise volatile acids from the wine, which would otherwise form esters on contact with vapours rich in alcohol. The rates of flow of alkali and acid to the parts of the apparatus mentioned, are easily observed and controlled by means of a special form of sight-glass.—J. H. L.

Distillation of alcoholic and similar liquids ; Process of multiple-effect ——. E. Barbet et Fils et Cie. Fr. Pat. 478,885, June 9, 1914, and First Addition thereto, dated Oct. 19, 1914.

Distillation takes place simultaneously in a series of distilling columns, each working under a lower pressure than the preceding one. In the apparatus described there are three, each comprising a tubular heater and a plate column; the first is heated by steam, the second by the alcoholic vapours from the first, and the third (at atmospheric pressure), by those from the second column. Each column has in communication with its lower end a tubular recuperator for the transfer of heat from the outflowing vinasses to fresh wash. The whole of the fresh wash for re-charging the series passes first through the recuperator of the last column and also serves to condense the vapours from this column; it then passes through the recuperator of the second, or of the first column, or through a steam heater, according as it is destined to re-charge the third, second, or first column respectively. The phlegms from the first and second units, condensed in the second and third, are led into the top of the third column which contains some additional plates; the whole of the alcohol from the series is thus obtained finally from the third column, and in fairly concentrated condition. In a modified form of apparatus (see fig.) described in the Addition to the principal patent, there are no recuperators attached to the first two columns, A and B. The vinasses from each column pass through all the succeeding ones (or their tubular heaters. B_1, C_1) and then through the single recuperator, C_2, in which they raise the temperature of fresh wash (entering at R) to 80°—85° C. The fresh wash is further heated almost to boiling, in C_3, by condensing the vapours from the last column, and passes thence to a receptacle, E, at the top of the last column, C, where it is maintained in gentle ebullition to expel gas. From here the wash is transferred to the various columns, that destined for the first two being pumped through a tubular heater, A_2, heated by a portion of the alcoholic vapours from A. The phlegms from the first two units, condensed in B_1 and C_1, pass into the column of "épuration," D, and this column is heated by uncondensed portions of the same phlegms, which are regulated by the valves, V_1, V_2. The distillates from the last column, condensed in C_3, also pass into the column, D, for "épuration."—J. H. L.



Alcohol; Process and apparatus for the continuous rectification of —— at the expense of vapours from the distilling column. E. Barbet et Fils et Cie. Fr. Pat. 478,946, Oct. 19, 1914.

In a process of continuous distillation and rectification, the latter is effected at the expense of the heat of the vapours from the distilling column, by operating this column at a higher pressure than the rectifier. Apparatus for applying the process to washes containing about 4% of alcohol is described. It comprises three columns, for distillation, "épuration" (removal of head products from phlegms), and rectification respectively. The rectifier works under ordinary pressure, and the distilling column under an excess pressure of at least 0·5 atm. The purifying and rectifying columns are heated by the alcoholic vapours from the distilling column, which are thereby condensed; these condensed phlegms then enter the purifying column, whence after removal of their head-impurities they pass into the rectifier. Fresh wash, after serving to condense vapours from the top of the rectifier, descends to a recuperator in which it is heated by vinasses from the distilling column, to such a temperature that on re-ascending to a receptacle at its former level it enters into gentle ebullition and is thus freed from gases This receptacle is at such a height that the boiling wash flows from it into the top of the distilling column at the required pressure. In the distillation of washes containing only about 2% of alcohol the vapours contain more heat than is required for their rectification, and the excess can be made to operate a complementary distillation process under atmospheric pressure. A modification of the apparatus to suit these conditions is described.—J. H. L.

Sparging; Process of ——. J. Schaefer, Assignor to Simon, Bühler, und Baumann, Frankfort, Germany. U.S. Pat. 1,200,763, Oct. 10, 1916. Date of appl., Aug. 10, 1912.

See Eng. Pat. 17,028 of 1913; this J., 1914, 978.

Column-stills; Process of heating ——. E. Guillaume, Paris. U.S. Pat. 1,199,371, Sept. 26, 1916. Date of appl., May 24, 1910.

See Fr. Pat. 403,385 of 1909; this J., 1910, 104.

Manufacture of malt extract. Eng. Pat. 16,887. *See* XIXa.

XIXa.—FOODS.

Lactose; Velocity of scission of —— by the action of the "Bulgarian ferment." II. G. Quagliariello and C. Ventura. Atti R. Accad. Lincei, 1916, [v], 25, i., 793—798. J. Chem. Soc., 1916, **110**, i., 699.

The conversion of lactose into lactic acid by *Bacillus bulgaricus* is not a unimolecular reaction, the value of the velocity constant showing a continuous diminution as the action proceeds. With two samples of milk containing different proportions of lactose, the action ceased in each case when the concentration of the lactic acid formed became about 0·270 grm.-mol. per litre, or about 2·5%, the bacteria apparently being incapable of vitality beyond this point. With an aqueous solution of lactose or with whey this maximal acidity has different values, but in all probability the hydrogen-ion concentration is the same in the three cases.

Yeast, polished rice, and white bread; Nutritive value of —— as determined by experiments on man. C. Funk, W. G. Lyle, and D. McCaskey. J. Biol. Chem., 1916, 27, 173—191.

The experiments indicate that the value of yeast as a source of protein is not very great; a large part of the yeast nitrogen has apparently no food value, it is assimilated badly, and causes a rise in the uric acid content of the blood. The amount of nitrogen which would be fully adequate in the form of potatoes proves to be insufficient in the case of yeast; this also applies to white bread and polished rice. A positive nitrogen balance cannot be obtained by the addition of vitamine prepared from autolysed yeast by Seidell's method (U.S. Pat. 1,173,317; this J., 1916, 653).—W. P. S.

Carotin; Toxicity of ——. H. G. Wells and O. F. Hedenburg. J. Biol. Chem., 1916, 27, 213—216.

Carotin, the colouring matter of wheat flour and carrots, has no appreciable toxic action, and chlorination does not increase its toxicity. Quantities of 0·2 grm. of the substance injected into guinea pigs (weighing 215 to 265 grms.) had no effect on the health of the animals.—W. P. S.

Growth-producing substance from sheep pancreas; Isolation of a ——. W. H. Eddy. J. Biol. Chem., 1916, 27, 113—126.

Sheep pancreas was extracted with alcohol containing 4% of HCl, the extracts were evaporated at a low temperature, the residue was dissolved in water, the solution filtered, the filtrate evaporated, then diluted with water, treated with sulphuric acid and phosphotungstic acid, the precipitate collected, decomposed by mixing with water and barium hydroxide, and the mixture filtered. After removing excess of sulphuric acid from the filtrate, the latter was evaporated, the residue treated with alcohol, and the alcoholic solution treated with alcoholic mercuric chloride solution. The precipitate obtained was decomposed with hydrogen sulphide, the mercury sulphide separated, and the purines in the solution then precipitated with silver nitrate and separated by filtration. The filtrate was treated with silver nitrate and barium hydroxide, the precipitate formed was decomposed with hydrogen sulphide, and the solution freed from barium, sulphuric acid, and chlorides. The resulting solution contained a substance which was capable of producing a marked increase in growth when administered to rats. The substance was precipitated by phosphotungstic acid and by colloidal hydrated aluminium silicate (Lloyd's reagent); it was not a protein, fatty substance, or a mixture of amino-acids.
—W. P. S.

Proteolytic action; An examination of certain methods for the study of ——. H. C. Sherman and D. E. Neun. J. Amer. Chem. Soc., 1916, 38, 2199—2216.

Eight different methods have been comparatively investigated with commercial preparations of pepsin and trypsin. For the study of proteolytic activities solutions of casein form the most convenient substratum; in the case of pepsin 1 grm. of casein is dissolved in *M*/20-hydrochloric acid, the solution warmed, the enzyme added, and the volume made up to 100 c.c. After digestion, the undigested casein may be precipitated by pouring into 25 c.c. of 20% sodium sulphate solution. For experiments with trypsin, solutions of sodium caseinate of slight alkalinity are employed. One of the best quantitative methods of comparison is based on the determination of the total nitrogen by Kjeldahl's method in the filtrate after digestion and precipitation. The proportionality of the results to quantity of enzyme extends over a considerable range and the comparisons may be made either on the basis of the amount of digestion products produced in a given time (which should not be too long) or of the time required to render a given amount of nitrogen soluble, the latter method offering a longer range of accurate observations. Equally satisfactory comparisons are obtainable by Van Slyke's amino-nitrogen determination method (this J., 1911, 771, 1135; 1915, 1110, 1275), with the added advantage that the proteolytic action may be followed in its more advanced stages, long after the total dissolved nitrogen has reached its maximum limit. Here also, it is important to confine the observations to reasonably short digestion periods of ½ to 1 hour, as over prolonged periods, differences in activity tend to become equalised. Another method of measuring the results of proteolysis which appears capable of giving useful indications, is the titration of the carboxylic acidity of the digestion products in presence of thymolphthalein as indicator; this method is somewhat less delicate than the determination of total nitrogen and about as delicate but not so regular as the amino-nitrogen method; the general trend of the indications is comparable with the total nitrogen method. Indirect methods, such as electrical conductivity and polarimetric methods, may be useful in certain cases, but are less desirable than methods based on direct chemical functions. Colorimetric methods, such as the biuret and the ninhydrin reactions, are of subordinate value for quantitative comparisons.
—J. F. B.

Humin formation; Reaction between amino-acids and carbohydrates as a probable cause of ——. M. L. Roxas. J. Biol. Chem., 1916, 27, 71—93.

To obtain information on the structure and formation of humic substances, experiments were made to determine which amino-acids react with carbohydrates under certain conditions, whether different sugars behave alike towards the same amino-acid, and what group of the reactive amino-acids takes part in the reaction. It was found that under the conditions of the experiments alanine, leucine, phenylalanine, glutamic acid, and proline were not important factors in humin formation. The following amino-acids were responsible for humin formation, and when digested with 20% HCl *plus* sugar, the proportion of their nitrogen converted into humin-nitrogen was: tyrosine, 15·0; cystine, 3·1; arginine, 2·33; lysine, 2·62; histidine, 1·84; tryptophane, 71·0%. Xylose and lævulose were, as a rule, more reactive than was dextrose. Arginine, histidine, and lysine reacted with sugars more readily in weak acid or aqueous solutions than in strong acid solution. Arginine, histidine, and tryptophane reacted with loss in reactivity of their amino nitrogen towards nitrous acid, but the amino group apparently remained intact in the humin from tyrosine and cystine. (See also Gortner, this J., 1916, 1030.)—W. P. S.

Beans; Detection and determination of hydrocyanic acid in ——. L. Guignard. Ann. Falsif., 1916, 9, 301—305.

Burmah beans (*Phaseolus lunatus* species) imported into France for edible purposes were found to contain 0·025% of hydrocyanic acid, a quantity slightly in excess of the maximum quantity allowed. The isopurpurate reaction was used to detect the presence of hydrocyanic acid in these beans; 2 grms. of the powdered bean was mixed in a flask with 10 c.c. of water, and a strip of filter-paper dipped previously in a solution containing 1 grm. of picric acid and 10 grms. of sodium carbonate per 100 c.c. of water was suspended in the flask. An orange-red coloration developed on the paper within 12 hours when hydrocyanic acid was present. To determine the quantity of hydrocyanic acid, 20 grms. of the powdered beans was macerated with water for 12 hours, then steam distilled, and the distillate titrated with silver nitrate solution, potassium iodide being used as indicator.—W. P. S.

Soya meal poisoning; Extracted ——. J. Board Agric., 1916, **23**, 691—692.

Soya beans, after the oil has been extracted with a solvent, are made into a meal or cake and used for cattle feeding: naphtha is usually employed for extracting the oil, but trichloroethylene has been used recently. The soya bean itself is not poisonous, nor is the meal prepared from beans which have been extracted with naphtha, but about four years ago a number of cases of cattle poisoning were caused by meal prepared from soya beans which had been extracted with trichloroethylene. Experimental proof was obtained that cattle were badly and in many cases fatally affected by this meal, but pigs and sheep were not affected. The symptoms appeared some days after the meal had been given. It would appear that trichloroethylene formed a poisonous substance by combination with some constituent of the meal, or that the trichloroethylene used was impure. Extracted soya bean meal is an excellent fodder, but it is inadvisable to use trichloroethylene for extracting the oil.—W. P. S.

Cocoa; Determination of fat in ——. H. Kreis. Schweiz. Verein Anal. Chem., May, 1916. Chem.-Zeit., 1916, **40**, 832.

One grm. of the cocoa is boiled for 15 mins. in a graduated tube with 20 c.c. of 1·5% hydrochloric acid, the mixture then cooled to 30° C., shaken for 5 mins. with ether, and centrifuged for 15 mins. (at least 1000 revolutions per min.). An aliquot portion (say 25 c.c.) of the ethereal solution is transferred to a nickel basin, the ether evaporated, the residue of fat heated for 10 mins. in a Soxhlet drying oven, and weighed.—W. P. S.

Chicory; Detection of beetroot in ——. E. Collin. Ann. Falsif., 1916, **9**, 271—272.

A portion of the suspected chicory is washed with Labarraque's solution (prepared by triturating 75 grms. of bleaching powder with 600 c.c. of water, added in two or three portions, filtering, adding a solution of 150 grms. of sodium carbonate in 400 c.c. of water, and again filtering) until all soluble colouring matter has been removed, and the particles are then examined under the microscope. If any particles of beetroot are present they will be seen to contain numerous black cells filled with crystals of calcium oxalate. The cells are oval or elongated and are more numerous near the ligneous vessels of the woody portion of the root. (See also this J., 1915, 568).—W. P. S.

Calcium; Determination of —— in the ash of forage plants and animal carcases. S. B. Kuzirian. J. Amer. Chem. Soc., 1916, **38**, 1996—2000.

The following method is recommended as being more accurate and rapid than the so-called basic acetate method in general use:—From an acid solution of the ash the phosphorus is removed by precipitation as ammonium phosphomolybdate, and the calcium is precipitated as oxalate in the filtrate, either before or after the removal of the excess of molybdenum as sulphide. If the former alternative, which is probably preferable, be adopted, the oxalate precipitate is collected in a Gooch crucible, ignited to oxide in an electric furnace, dissolved in dilute hydrochloric acid, filtered, ammonium chloride and ammonia added to the filtrate, to precipitate iron and aluminium, and the calcium again separated as oxalate, the precipitate now being entirely free from molybdenum. If the second alternative be adopted the molybdenum in the filtrate from the phosphomolybdate precipitate is precipitated by digestion with colourless ammonium sulphide, and subsequent addition of 12% hydrochloric acid. The boiled filtrate is then ready for iron, aluminium, manganese, and calcium determinations. The results obtained by either procedure showed close agreement with the theoretical in the case of known solutions, and could be closely reproduced in analyses of plant and animal ashes.
—G. F. M.

New methods in the wheat starch industry. Goldbeck. *See* XVII.

Formation of methylglyoxal and formaldehyde in glycolysis. Sjollema and Kam. *See* XVIII.

Modification of the Pratt method for the determination of citric acid. Willaman. *See* XX.

Comparison of barbituric acid, thiobarbituric acid, and malonylguanidine as quantitative precipitants for furfural [from pentoses]. Dox and Plaisance. *See* XXIII.

Patents.

Beverage extracts; Manufacture of ——. J. L. Kellogg, Battle Creek, Mich., U.S.A. Eng. Pat. 14,134, Oct. 6, 1915.

A mixture of ground algaroba (carob) bean, malt sprouts, and amylaceous materials is made into a dough which is moulded into loaves and these are kept at 140° to 160° F. (60° to 71° C.) for about 2 hours; the loaves are then dried and ground to a coarse powder. This powder is roasted, extracted with water, and the extract evaporated to form a dry powder. (See also Eng. Pats. 2472 of 1915 and 17,255 of 1915; this J., 1915, 1162; 1916, 940.)—W. P. S.

Beverage extract; Soluble ——. J. L. Kellogg. Assignor to Kellogg Toasted Corn Flake Co., Battle Creek, Mich. U.S. Pat. 1,199,387, Sept. 26, 1916. Date of appl., Oct. 23, 1915.

A soluble extract of a cooked and roasted mixture of about 3 parts of cereal flour, 2 of bran, and 3 of malt.—A. S.

Milk or other liquids; Apparatus for the pasteurisation of ——. A. McCulloch and W. R. Walkey, London. Eng. Pat. 14,200, Oct. 7, 1915.

The apparatus comprises a corrugated tray placed in the upper part of a heating bath. The liquid is delivered from an upper tank on to the corrugated tray, flows through the channels formed by the corrugations, and is discharged through an outlet pipe. The heating bath has a corrugated bottom and is provided with an expansion chamber.
—W. P. S.

Cheese or a cheese-like food product; Manufacture of ——. H. W. Crowe, Yelverton, Devon. Eng. Pat. 101,641, Jan. 3, 1916. (Appl. No. 27 of 1916.)

The cheese curd is obtained by treating milk, skimmed milk, or heated milk with a culture of bacteria which produce but a small quantity of lactic acid. These bacteria exist in the atmosphere in the district of Christiania, Norway, and cultures may be prepared from milk curd imported from that district. If desired, the curd obtained may be mixed with a proportion of ordinary rennet curd.—W. P. S.

Muscular flesh of animals of the bovine genus; Process for the preparation of the —— which may be preserved afterwards by means of heat in appropriate receptacles. J. Balzari, Buenos Aires. Eng. Pat. 15,559, Nov. 4, 1915.

The flesh is freed from fat, minced, sterilised in the presence of water at 120° C., again minced. the liquid portion is separated and evaporated to a density of 7° B. (sp.gr. 1·05). the minced meat and the concentrated liquid are mixed. and the mixture is sterilised in hermetically closed receptacles.—W. P. S.

Malt extract; Method of manufacture of ——. S. H. Green, Lelaut, and J. D. Opie, Hayle, Cornwall. Eng. Pat. 16,887, Dec. 1, 1915.

Perforated receptacles containing crushed malted cereal are placed in tanks arranged in steps and each provided with a heating coil. The containers are transferred successively from one tank to another after a suitable period of extraction. whilst the extracting liquid is transferred from tank to tank in the opposite direction. The arrangement is such that the nearly exhausted material is extracted in the upper tank with a weak liquor, and the material in the lowest receptacle and tank is extracted with an already strong liquor which has passed in succession through the series of tanks. The temperature of the liquids in the tanks is so graduated in regular steps that the liquid in the top tank is nearly boiling whilst that in the last tank is at about 120° F. (49° C.). The extract is discharged from the last tank and concentrated under reduced pressure.—W. P. S.

Gelatinous substances; Method for the production of solid ——. Solid gelatinous [food] product. P. Askenasy, Karlsruhe, Assignor to A.-G. für Chem. Prod. vorm. H. Scheidemandel, Berlin, Germany. U.S. Pats. 1,201,132 and 1,201,133, Oct. 10, 1916. Date of appl., Oct. 19, 1915.

See Eng. Pat. 100,392 of 1916; this J., 1916, 855. The process may be applied to the manufacture of food products consisting of small globules containing a food substance mixed with an animal gelatinous substance.

XIXb.—WATER PURIFICATION; SANITATION.

Hydrogen sulphide; Determination of —— in water. L. W. Winkler. Z. angew. Chem., 1916, **29**, 383—384.

Very small quantities of hydrogen sulphide in water may be determined colorimetrically (this J., 1913, 957). The following method is recommended for larger quantities:—The water is collected in a glass-stoppered bottle of 500 c.c. capacity, containing 10—20 grms. of coarse marble which has previously been washed with dilute hydrochloric acid. For the determination, the stopper is removed and replaced by another carrying a bulb tube, a side tube from which leads first to a U-tube containing cotton wool and then to an absorption bulb containing 50 c.c. of freshly-made bromine water which must be free from acid. A stopper in the upper end of the bulb tube carries the stem of a separating funnel in which is placed 50 c.c. of 18% hydrochloric acid. The acid is discharged in three portions: half to start the reaction, one quarter after the lapse of an hour, and the remainder after another hour. The hydrogen sulphide is oxidised to sulphuric acid by the bromine, and after evaporating until the excess of bromine and the hydrobromic acid are expelled, the sulphuric acid may be titrated with *N*/100 borax, using methyl orange as indicator, or, preferably, the bromine alone may be expelled by boiling, and the mixed hydrobromic and sulphuric acids titrated with borax. A method for determining the strength of hydrogen sulphide water consists in placing 100 c.c. of *N*/10 potassium permanganate solution and 1 grm. of pure sodium hydroxide in a glass-stoppered flask of 250 c.c. capacity, weighing the flask with its contents, adding a few c.c. of the water to be tested, and re-weighing. After an hour the solution is acidified with sulphuric acid, treated with potassium iodide, and titrated with *N*/10 sodium thiosulphate solution. 1 c.c. of *N*/10 potassium permanganate solution = 0·4263 mgrm. H_2S. It is necessary to have an excess of permanganate, and if the acidified solution is green the test must be repeated with a smaller quantity of the sample.—A. B. S.

Sewage disposal; Experiences with the Emscher tank and similar methods of ——. K. Thumm and A. Reichle. Mitt. Kgl. Landesanst. f. Wasserhyg., 1914, **18**, 48. Chem.-Zeit., 1916, **40**, Rep., 347—348.

The chief difficulties encountered in the Emscher tank (see Fowler, this J., 1911, 1316) and similar methods of sewage disposal arise from the formation of acid sludge in the sludge-decomposing chambers, the separation of sludge as a floating layer, and frothing. Sludge from a properly working Emscher tank has a deep black colour due to ferrous sulphide, an alkaline reaction, and a characteristic, not unpleasant odour, and drains easily; the effluent has no putrid odour and contains ammonia and free carbon dioxide. When, however, the sewage contains an excessive quantity of carbohydrates, and relatively small quantities of nitrogen compounds and ammonia or other bases, fermentation frequently occurs instead of putrefaction, and yellow to black, acid sludge is obtained, which has an unpleasant smell and drains badly. To obtain sludge of satisfactory quality, effective agitation, by means of stirrers and by blowing, is required; the ratio of sludge to sewage in the sludge-decomposing chamber should be about 1 : 2. Limited quantities of moderately hard water or of lime may be added to the sewage to increase the acid-fixing power. The separation of sludge as a floating layer occurs most frequently when the sludge-decomposing chambers first come into operation, and one of the chief causes is insufficient mixing of the sludge and sewage. The floating layer should be broken at intervals by pumping sewage on to it, by mechanical stirring, or by lowering the liquid level in the settling or decomposing chambers.—A. S.

Preparation of diphenylamine-sulphuric acid reagent. Tonius. *See* XXIII.

Patents.

Waters containing iron in organic combination: Purification of natural ——. Stadtgemeinde Breslau, and W. Wagenkneckt, Breslau. Ger. Pat. 294,098, Nov. 5, 1913.

The water to be purified is mixed with water containing iron in inorganic combination, and the mixture is treated with a quantity of lime water equivalent to the inorganic iron, and then passed over a trickling filter. The colloidal ferrous hydroxide first formed is oxidised to ferric hydroxide, and precipitated, and carries down with it the iron present in organic combination.—A. S.

Tetracupric sulphate; Preparation of ——, and its use as a fungicide. Soc. des Prod. Agricoles Mouillants à l'Adhésol. First Addition, dated June 22, 1914, to Fr. Pat. 476,512, Apr. 24, 1914 (this J., 1916, 67).

Penta-cupric sulphate, $CuSO_4,4CuO,6H_2O$, is obtained by operating under the conditions described in the main patent, if the strength of the copper solution is kept low in comparison with the high concentration of the sodium carbonate, but the copper sulphate must always be kept in excess. By replacing the free alkali or carbonate by an alkaline-earth carbonate, *e.g.*, calcium carbonate, the copper sulphate being kept in excess during the preparation, a tetracupric sulphate, $CuSO_4.3CuO.4H_2O$, may be obtained, or, with a less proportion of calcium carbonate, a basic cupric sulphate of the formula, $2CuSO_4.3CuO,5H_2O$, may be obtained.—B. N.

Purifying water containing mineral salts. P. Münzer, Braunsfeld, Germany, Assignor to Reisert Automatic Water Purifying Co. U.S. Pats. 1,199,098 and 1,199,099, Sept. 26, 1916. Dates of appl., Jan. 28, 1910, and Mar. 24, 1916.

See Fr. Pat. 411,532 of 1910; this J., 1910, 974.

Sterilisation of fluids; Apparatus for the ——. W. R. Walkey, London. U.S. Pat. 1,199,612, Sept. 26, 1916. Date of appl., Apr. 8, 1915.

See Eng. Pat. 14,689 of 1914; this J., 1914, 1221.

Water and other liquids; Apparatus for treatment of —— by ultra-violet rays. V. Henri, Paris, and A. Helbronner and M. von Recklinghausen, Suresnes, France, Assignors to The R.U.V. Co., Inc. U.S. Pat. 1,200,940, Oct. 10, 1916. Date of appl., Nov. 10, 1913.

See Eng. Pat. 20,436 of 1910; this J., 1911, 1229.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Ipecacuanha; Alkaloids of ——. P. Karrer. Ber., 1916, 49, 2057—2079. (See also this J., 1914, 761.)

The empirical formulæ, $C_{29}H_{40}O_4N_2$ and $C_{28}H_{38}O_4N_2$, attributed by Carr and Pyman to emetine and cephaeline respectively, are confirmed when the analysis is made on the substances dried at 110° C. Emetine contains four and cephaeline three methoxyl groups, and when demethylated with hydriodic acid yield compounds containing iodine which can be removed by shaking the alcoholic solutions with silver oxide, the same substance emetoline, m.pt. 205° C., being obtained in each case. Cephaeline on methylation with sodium methoxide and dimethyl sulphate or with diazomethane is converted into emetine and can be converted similarly into higher homologues such as ethyl-emetine (emetethyline), m.pt. 68°—71° C., propyl-emetine (emetpropyline), m.pt. 58°—60° C., and allyl-emetine (emetallyline) which possess similar physiological properties to emetine but in a gradually diminishing degree. Emetine on complete methylation yields a well-crystallised salt, $C_{29}H_{39}N_2O_4(CH_3)(CH_3I)_2$ which gives the corresponding base with silver oxide. This base on distillation in a vacuum gives a new base, anhydrotrimethylemetine, $C_{29}H_{37}O_4(NCH_3)_2(NCH_3)$, without loss of nitrogen. This base on complete methylation with methyl iodide and treatment with silver oxide yields after distillation in a vacuum a base $C_{29}H_{35}O_4N(CH_3)_2$ together with trimethylamine. From this the conclusion is drawn that one of the nitrogen atoms in emetine is in a simple ring whilst the other forms part of two ring systems. Emetine on oxidation with an alcoholic solution of iodine yields dehydro-emetine iodide, which forms golden-yellow needles, m.pt. 177°—179° C., similar to the products obtained by the oxidation of hydrogenated isoquinoline derivatives such as canadine and corydaline.—T. C.

Cryptopine and protopine. W. H. Perkin, jun. Chem. Soc. Trans., 1916, **109**, 815—1028.

Cryptopine, $C_{21}H_{23}O_5N$, occurs in opium in very minute proportions (5 oz. of the hydrochloride obtained from 10,000 lb. of opium) and is isolated after the separation of the morphine and thebaine. Hitherto the only direct constitutional clue was the formation of *m*-hemipinic acid on oxidation with permanganate, indicating a dimethoxybenzene nucleus. The presence of a methylenedioxybenzene or piperonyl nucleus was regarded as probable and is now confirmed. Cryptopine combines readily with methyl sulphate yielding the methosulphate: when this is reduced with sodium amalgam in boiling acid solution, it is converted into tetrahydromethylcryptopine, $C_{22}H_{29}O_5N$. By the action of acetyl chloride on this, water is eliminated yielding anhydrotetrahydromethylcryptopine, and this latter, on oxidation with dry permanganate in acetone solution, yields a syrupy base (A), an aldehyde (B), m.pt. 74°—75° C., an acid (C), m.pt. 153° C., an acid (D), m.pt. 217° C., and *m*-hemipinic acid. The syrupy base is the N-methyl derivative of 4 . 5-dimethoxy-2-β-methylaminoethylbenzaldehyde and therefore represents the dimethoxybenzene nucleus with a methylated side chain of $\cdot CH_2\cdot CH_2\cdot N(CH_3)_2$. The acid (C) is the N-formyl derivative of a similar benzoic acid and belongs to the same portion of the cryptopine molecule. The aldehyde (B) and acid (D) represent the methylenedioxybenzene nucleus; the aldehyde is a methylpiperonal, yielding on oxidation a methylpiperonylic acid identical with (D), and it has been characterised as 5 . 6-methylenedioxy-*o*-tolualdehyde. Combining products (A) and (B), on the assumption that their aldehyde groups are produced by the oxidation of an ethylene bond, the formula of anhydrotetrahydromethylcryptopine may be reconstructed, and the addition of H.OH at the ethylene bond gives that of tetrahydromethylcryptopine, with $CH(OH).CH_2$ joining the two nuclei. This link is also present in dihydrocryptopine and is formed by the hydrogenation of $CO.CH_2$ or its enolic equivalent $C(OH):CH$ in cryptopine itself, the CO being attached to the dimethoxybenzene and the CH_2 to the methylenedioxybenzene portion. To complete the structure of cryptopine, the nitrogenous side-chain (*supra*) of the dimethoxybenzene nucleus is joined up to the methyl group of the methylpiperonyl nucleus, with subtraction of H and CH_3. Thus the two nuclei are united in cryptopine by a closed chain of nine carbon atoms and one nitrogen ($N\cdot CH_3$), which becomes ruptured in the hydrogenation of the methosulphate, whereby the N becomes terminal in taking up a second CH_3. Cryptopine cannot be resolved into optically active components and contains no asymmetric carbon atom; it does not yield an acetyl derivative and, in spite of the $CO.CH_2$ group, it does not combine with hydroxylamine or semicarbazide, which is explained by steric hindrance. From the enolic form of cryptopine are derived by the action of strong acids well defined quaternary salts of *iso*cryptopine in which the hydroxyl of the enol migrates to the $N.CH_3$ and the dihydro*iso*quinoline ring is closed; the sparingly soluble disulphate is most characteristic. By the action of dilute nitric acid under certain conditions, cryptopine yields a mixture of nitrocryptopine and dibasic cryptopidic acid in which the piperonyl nucleus is oxidised away; strong nitric acid yields two dinitrocryptopines. Dihydrocryptopine is formed by reduction with sodium amalgam and boiling dilute sulphuric acid and yields quaternary chlorides of *iso*dihydrocryptopine on digestion with acetyl or phosphoryl chloride. With methyl alcoholic potassium hydroxide, these chlorides lose HCl, giving two anhydrodihydrocryptopines, from which are derived by exhaustive methylation, first methyl*iso*anhydrodihydrocryptopine and then α- and β-*iso*cryptopidols, $C_{20}H_{20}O_5$, with elimination of the nitrogen as trimethylamine. This series of reactions is closely duplicated in the berberine series. By the methylation of cryptopine, two methylcryptopines may be obtained according to whether the rupture of the ring takes place on one side of the nitrogen atom or the other; both yield cryptopidiol and anhydrocryptopidiol on exhaustive methylation. Anhydrocryptopine is formed by the action of methyl alcoholic potassium hydroxide on *iso*cryptopine chloride; this compound has the closed dihydro*iso*quinoline ring characteristic of *iso*cryptopine through the union of the nitrogen with the enolic group, but the remainder of the original ten-member ring of cryptopine forms an open side chain $\cdot CH:CH_2$. Anhydrocryptopine, from a constitutional point of view, is one of the most interesting members of the cryptopine series, owing to its extraordinary reactivity, and forms the starting point of a large number of important derivatives. One of the most striking series of transformations is its conversion by strong hydrochloric acid into the *epi*cryptopines, in which the $CO.CH_2$ group is inverted as compared with cryptopine. By the subsequent action of phosphoryl chloride a range of intensely coloured *epi*cryptopirubin salts is obtained. *Protopine*, $C_{20}H_{19}O_5N$, is an alkaloid also present in opium but most conveniently extracted from the root of *Dicentra spectabilis*. Protopine shows a complete analogy with cryptopine in the most characteristic transformations now elucidated and there can no longer be any doubt that these alkaloids are intimately related in constitution, in such a manner that the two methoxy groups in cryptopine are replaced by a methylenedioxy group in protopine.—J. F. B.

Camphor oil of high boiling point; Constituents of ——. K. Kafuku. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1916, **19**, 815—822.

Camphor oil distilled by the Monopoly Bureau, Formosa, had the following characters:—Sp.gr. at 15° C., 0·9805; $n_D^{17\cdot5}=1\cdot5035$; ester value, 0·66; ester value after acetylation, 126; and acid value, 3·14. The oil contained lauric acid, and a substance, $C_{14}H_{26}O_2$, probably a lactone of an aliphatic hydroxy acid. The fraction of highest boiling point contained piperonylic acid, which had possibly been formed by oxidation of the safrol during the distillation. A tricyclic sesquiterpene alcohol was also isolated.—C. A. M.

Optically active diaminoglycerol; Synthesis of ——. E. Abderhalden and E. Eichwald. Ber., 1916, **49**, 2095—2103.

Allyl bromide, prepared by passing hydrogen bromide into allyl alcohol, is added gradually to sodium methoxide, the resulting allylmethylether distilled off below 62° C., dissolved in chloroform, and the theoretical quantity of bromine added, with ice-cooling, to convert it into dibromoallylmethylether, $CH_2Br.CHBr.CH_2OCH_3$. The latter is then converted into αβ-diamino-γ-methoxyglycerol by heating for 2 days at 90°—100° C. under pressure with a saturated alcoholic solution of ammonia, the diaminomethoxyglycerol being separated by adding solid potassium hydroxide, removing the alcohol by heating in a salt bath, and distilling off the crude diamine in a vacuum. The yield of diaminomethoxyglycerol is only 5 to 6%, the chief products being high-boiling, unsaturated, amino compounds. αβ-Diamino-γ-methoxyglycerol gives a well-crystallised salt with bromocamphorsulphonic acid which after recrystallising ten times and then distilling with potassium hydroxide yields *d*-αβ-diamino-γ-methoxyglycerol, $[\alpha]_D^{18} = +8°\cdot19$ in aqueous solution. The *l*-αβ-diaminomethoxyglycerol can be recovered as hydrobromide from the mother liquors by passing in hydrogen bromide. *i*-Diaminomethoxyglycerol on heating with concentrated hydrobromic acid is converted into *i*-diaminoglycerol dihydrobromide, m.pt. 198° C., whilst the *d*- and *l*-modifications are similarly converted into *d*- and *l*-diaminoglycerol dihydrobromides, $[\alpha]_D^{18} = +5°\cdot20$ and $-2°\cdot51$ respectively. On heating *i*- and *d*-αβ-diaminoglycerol dihydrobromide for 4 to 6 hours in a sealed tube with a saturated solution of hydrobromic acid at 140°—150° C., they are converted respectively into *i*-αβ-diamino-γ-bromoglycerol dihydrobromide and *d*-αβ-diamino-γ-bromoglycerol dihydrobromide, $[\alpha]_D^{18} = +7°\cdot27$.—T. C.

Citric acid [in fruit juices, etc.]; Modification of the Pratt method for the determination of ——. J. J. Willaman. J. Amer. Chem. Soc., 1916, **38**, 2193—2199.

With Pratt's method, based on the oxidation of citric acid to acetone and precipitation of the latter as mercuric compound, considerable difficulty is experienced in obtaining concordant results. The author has modified the original method in many important respects and recommends the following procedure as satisfactory:—The pectins are separated by adding to the juice twice its vol. of 50% alcohol; the precipitate is filtered off with the aid of the pump, sucked as dry as possible, and washed twice with 65% alcohol. The filtrate is diluted to contain approximately 30% of alcohol by vol., and 5 c.c. of a 10% solution of barium acetate in 30% alcohol slowly added. The barium citrate is collected on asbestos in a Gooch crucible, washed once with 30% alcohol, and dried in the oven. It is then dissolved with hot 6% phosphoric acid, using three portions of 20 c.c. each, followed by hot water; filtrate and washings should amount to about 100 c.c. The solution is transferred to a 200 c.c. distillation flask connected with a spiral condenser and with a reservoir of potassium permanganate (0·5 grms. per litre) controlled by a screw pinch-clip. The adapter of the condenser dips into 40 c.c. of Denigès' solution (this J., 1899, 179); the citrate solution is briskly boiled over a naked flame, and the permanganate introduced at the rate of 20—25 drops in 10 secs. When a deep pink colour has persisted for 2 mins. the reaction is finished; it it is necessary to add more water, the addition of permanganate must be stopped a little while before the distillation is interrupted. The distillate is made up to 300 c.c. and boiled gently under a reflux condenser for 45 mins.; if the distillate is over 300 c.c., it is important that more of the Denigès' solution be added at the rate of 15 c.c. for each 100 c.c. excess of distillate. The solution is filtered hot through paper, the precipitate washed twice by decantation with hot water, and the filter thoroughly washed. The precipitate in the flask and on the filter is dissolved in hot 5% hydrochloric acid, the solution and washings are collected in a 100 c.c. flask, nearly neutralised with 10% sodium hydroxide, and made up to 100 c.c. This solution is titrated against 10—15 c.c. of standard potassium iodide at 28·0218 grms. per litre, 1 c.c. of which is equivalent to 2·0 mgrms. of citric acid.—J. F. B.

Nitriles; Studies in the preparation of ——. *II. Preparation of aliphatic nitriles.* G. D. van Epps and E. E. Reid. J. Amer. Chem. Soc., 1916, **38**, 2120—2128.

Aliphatic as well as aromatic nitriles are readily prepared with good yields by distilling mixtures of well dried heavy metal salts of the acids with a slight excess of lead or other thiocyanate. As a rule, the zinc salt of the acid mixed with lead thiocyanate gives the best results. The use of a large excess of the thiocyanate or of reduced pressure in distillation shows no material advantage. For the preparation of acetonitrile, a mixture of 1 part of dried zinc acetate and 2 parts of lead thiocyanate is heated in a glass retort until no more distillate comes over; the residue consists of a mixture of zinc and lead sulphides. The crude distillate is mixed with half its volume of water, saturated with solid potassium carbonate or ammonia gas, and the nitrile separated and fractionated. In dealing with larger quantities an iron retort may be used, but the product is generally slightly coloured. For small quantities better yields may be obtained by distilling from a glass tube, 300 mm. long and 22 mm. in diameter, fitted into a hole bored in a brass block 50 mm. square and 300 mm. long; the block is heated by two Bunsen burners and the heat is thereby applied slowly and uniformly to the reaction mixture. Generally, higher yields are obtained of nitriles of higher molecular weight. In the case of isovaleronitrile, 80% of the theoretical quantity was recorded; hydrocinnamonitrile was also obtained with specially high yields. Manganese salts of the acids, particularly manganese acetate, may also be employed with advantage but are not so generally available as the zinc salts; in certain cases cuprous thiocyanate may be employed instead of lead thiocyanate.—J. F. B.

Nitriles; Studies in the preparation of ——. III. The catalytic preparation of nitriles. G. D. van Epps and E. E. Reid. J. Amer. Chem. Soc., 1916. **38**, 2128—2135.

When acetic acid vapour mixed with a moderate excess of ammonia is passed over alumina or thoria heated at 500° C., acetonitrile is formed, with yields which may amount to 85% of the theoretical quantity. This reaction forms the basis of a continuous process for the preparation of acetonitrile in large quantities, requiring very little attention. The best yields are obtained with glacial acid of approximately 100% strength, introduced into the reaction tube with ammonia gas drawn directly from a cylinder. The catalyst is prepared by soaking pumice stone, in pieces 3—5 mm. in diam., in a strong solution of aluminium sulphate, treating with ammonia solution, and washing. The prepared pumice is dried in the reaction tube in a current of ammonia gas. Thoria gives slightly inferior results to alumina and is not employed on the practical scale. The apparatus consists of a very thick-walled copper tube, 762 mm. long and 32 mm. bore, heated by long burners. The acid is run in through a brass tube containing a trap to prevent the exit of vapours; this tube is carried to about 80 cm. inside the copper tube, so that the acid is vaporised on entering; it is surrounded by a wider but shorter tube through which the ammonia is introduced, so that the acid enters directly into an atmosphere of ammonia at the temperature of reaction. The products issuing from the copper tube pass through a condenser into a receiver, beyond which is a flask containing acid for the absorption of the excess of ammonia. The temperature of the copper tube is indicated by an apparatus which measures its expansion; the most favourable range is 500°—530° C. The acetic acid enters the trap-tube at the rate of about 1 drop per sec., and the ammonia is regulated so that white vapours fill about one-half of the condenser tube. The liquid in the receiver generally forms two layers, the acetonitrile being concentrated in the upper and ammonium acetate in the lower layer. After a certain time, the catalyst becomes inefficient and covered with a black deposit; the yield depends on the activity of the catalyst and is affected by trifling differences in the method of preparation.—J. F. B.

New method for purification of colloidal solutions. Wegelin. *See* I.

Colours produced by resorcinol in solutions of certain salts and their use for the detection of resorcinol in presence of other phenols. Krauskopf and Ritter. *See* III.

Formation of methylglyoxal and formaldehyde in glycolysis. Sjollema and Kam. *See* XVIII.

Reactions of peroxydase purified by ultrafiltration. Bach. *See* XXIII.

Patents.

Anhydrides of aliphatic acids; Process for the manufacture of ——. H. Dreyfus. Fr. Pat. 478,951, June 30, 1914.

Anhydrides of aliphatic acids may be prepared by distilling a dry intimate mixture of a pyrosulphate with a salt of the appropriate acid, *e.g.*, distillation of a mixture of sodium pyrosulphate and sodium acetate yields acetic anhydride. Diluents such as acetic anhydride or acetic acid may be employed.—F. Sp.

Acetic acid and acetaldehyde; Manufacture of —— from acetylene. H. Dreyfus. Fr. Pat. 479,656, Dec. 23, 1914. Under Int. Conv., Nov. 30, 1914.

In the manufacture of acetaldehyde by the combination of water with acetylene in the presence of a mercury salt, a liquid medium is employed in which the mercury salt is soluble, *e.g.*, acetic acid, or which has a greater solvent power for acetylene than water, *e.g.*, acetone. In order to oxidise the acetaldehyde to acetic acid, oxidising substances are added, *e.g.*, hydrogen peroxide, perborates, percarbonates, permanganates, bichromates, ozone, etc., or the oxidation may be effected by oxygen or air, with or without catalysts such as cerium oxide, vanadium pentoxide, cerium salts, copper acetate, manganates, manganese or copper nitrate, platinum or palladium sponge, etc. *Example:* Into a mixture of 400 parts of glacial acetic acid, 100 parts of water, 50 parts of mercuric nitrate, and 10 parts of cerium oxide at 50°—100° C., is passed 130 parts of acetylene and 80—100 parts of oxygen. Acetic acid is produced continuously, and may be drawn off at intervals and distilled, the residue being returned to the reaction vessel.
—F. Sp.

Ethers [e.g., ethyl ether, or esters]; Apparatus for the continuous production of rectified ——. E. Barbet et Fils et Cie. Fr. Pat. 479,435, Dec. 1, 1914

The apparatus is described more particularly for producing ethyl ether by the action of sulphuric acid or alcohol. Sulphuric acid is fed into the top compartment of a plate tower containing, for example, twelve sections, each of which is heated by a coil to a suitable temperature. Alcohol is introduced into the fourth section from the bottom, where it meets the descending stream of hot sulphuric acid and is partially converted into ether. A mixture of ether and alcohol vapours rises through the tower, and by contact with the acid in each section the conversion of the alcohol to ether becomes more and more complete. The three lowest sections remove alcohol and ether from the dilute sulphuric acid which reaches the bottom of the tower, where it is run off continuously by means of a siphon tube. The ether vapour

from the top of the tower passes into a rectifying column, where alcohol is condensed and returned to the fourth section of the tower. The ether passes to a condenser and is condensed and collected. The apparatus may also be used for the preparation of esters, *e.g.*, ethyl acetate.
—F. Sp.

a-Methylcoumarones : Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 293,956, Feb. 5, 1915. Addition to Ger. Pat. 279,864 (this J., 1915, 151).

By the action of alkalis on a-halogen-*o*-allylphenols, a-methylcoumarones are formed, suitable for pharmaceutical purposes and for use in perfumery.—A. S.

2-Phenylquinoline-4-carboxylic acid and its substitution products : Manufacture of amino-derivatives of ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 294,159, July 23, 1914. Addition to Ger. Pat. 287,804 (this J., 1916, 198).

Amino-derivatives of 2-phenylquinoline-4-carboxylic acid or its substitution products are prepared by condensing mono-acyl derivatives of phenylenediamines, their homologues or substitution products with benzaldehyde, its homologues or substitution products, and pyruvic acid, and saponifying the resulting N-acyl compounds. (See also Ger. Pat. 288,865 ; this J., 1916, 384.)
—A. S.

Manufacture of malt extract. Eng. Pat. 16,887. *See* XIXa.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Proportional [photographic] reducers. K. Huse and A. H. Nietz. J. Franklin Inst., 1916, **182**, 532—33. From Eastman Kodak Research Laboratory, Comm. No. 39. (See also Brit. J. Phot., 1916, 580—582.)

By density measurements before and after reduction it was found that most photographic reducers have the greatest proportional effect on low densities, this being most marked with Farmer's ferricyanide and "hypo" reducer. Only ammonium persulphate has a proportionally greater effect on the higher densities. A mixture of persulphate and permanganate, suggested by Deck, has an effect more nearly proportional to the density, and after trying various proportions, the authors recommend the following as the best: 1 part of a solution containing 0·025% potassium permanganate and 1·5% of 10% sulphuric acid to 3 parts of a solution containing 2·5% ammonium persulphate. The exact effect, however, is dependent both on the plate used and on the developer.
—B. V. S.

Photochemical decomposition of certain acid chlorides. Olivier. *See* III.

Influence of strong salt solutions on the spontaneous oxidation of pyrogallol, ferrous sulphate, and lævulose. MacArthur. *See* XXIV.

Patents.

Photographic colour records, and method of and means for producing them. Panchromotion, Inc., Assignees of C. Raleigh and W. van D. Kelley, Jersey City, U.S.A. Eng. Pat. 14,225, Oct. 7, 1915. Under Int. Conv., Oct. 7, 1914.

In taking cinematograph negatives by successive exposures through different coloured screens, each screen is provided with a section passing white, or approximately white, light, so that each negative is due partly to a colour exposure and partly to a white light exposure. The proportion of white light may vary with each screen, and it may be modified by an extra screen to cut out ultra-violet or to correct an artificial light. It is preferred to arrange that the white light exposure shall come in the middle of the coloured light exposure. The time of exposure is reduced and the times for the different screens are made equal. It is claimed that a reproduction is obtained with more detail and more delicate colouring than is usual.—B. V. S.

Flashlight powders ; Production of smokeless and odourless ——. E. Wedekind, Strassburg, and Geka-Werke Offenbach Dr. G. Krebs Ges., Offenbach. Ger. Pat. 293,998, Mar. 21, 1914.

Flashlight powders which burn without smoke or odour, and permit of photographing rapidly moving objects, are obtained by mixing finely-divided rare earth metals, such as zirconium, thorium, or titanium, with their nitrates or perchlorates.—A. S.

XXII.—EXPLOSIVES; MATCHES.

German explosives industry. Engineering, Nov. 2, 1916.

An all-round increase of capital is noted in the German explosives industry. Thus the Verein, Köln-Rottweiler Pulverfabriken is to increase its capital from 16,500,000 marks to 33,000 000 marks. The Rheinisch-Westfälische Sprengstoff A.-G. is also doubling its existing capital of 6,700,000 marks, and the Siegen Dynamite Company, of Cologne, is increasing its capital of 800 000 marks in the same proportion. The Köln-Rottweiler company paid a dividend of 35% in 1915, whilst the Dynamit A.-G. vorm. A. Nobel und Co., of Hamburg, with a capital of 36,000,000 marks, paid 20%.

Trinitrotoluene and tetranitromethylaniline ; Sensitiveness to detonation of ——. G. B. Taylor and W. C. Cope. U.S. Bureau of Mines, Tech. Paper 145. Chem. News, 1916, **114**, 203—204, 211—212.

Tests were made to determine the minimum charges of fulminate-chlorate (90 : 10) primer required to cause complete detonation of mixtures in varying proportions of trinitrotoluene and tetranitromethylaniline. The mixtures were made by fusing the two substances together. The cooling curves for different rates of cooling gave no indication of the formation of an unstable compound as concluded by Giua (this J., 1915, 984). The "sand-test" of Storm and Cope (this J., 1916, 1132) was used :—Exactly 0·4 grm. of the explosives or the mixtures was placed in a copper shell 5 mm in diameter, and slightly pressed with a flat-headed glass rod. The primer (90% mercury fulminate and 10% potassium chlorate) was placed above the explosive, and a thin copper reinforcing cap (9 mm. long with 2·3 mm. perforation) was inserted and pressed down into the shell for 1 min. under a pressure of 200 atmos. A short length of fuse was introduced and the detonator was fired in the cylindrical steel sand bomb. In cases of incomplete detonation part of the charge unexploded was found in the sand. The minimum charge was taken as being that which produced five complete detonations and no failures. The following results were thus obtained :—

Trinitrotoluene (T.N.T.)	Tetranitromethylaniline (tetryl)	Smallest weight of primer causing complete detonation.
%	%	grm.
100	0	0·25
90	10	0·22
80	20	0·21
50	50	0·20
0	100	0·19

Mechanical mixtures of the two finely powdered explosives gave the same results as mixtures prepared by fusion, so that it is unnecessary to assume the existence of a compound to account for the increased sensitiveness of the mixtures. Analogous detonators with 0·4 grm. of base charge and 0·32 of primer were stored over water and tested at intervals. Pure T.N.T. failed when the detonator had absorbed 0·003 grm. of moisture; a mixture containing 10% tetryl detonated when the moisture was 0·0037 grm., but failed when it reached 0·0018 grm.; a mixture containing 50% tetryl detonated when the moisture was 0·0048 grm., but failed at 0·0055 grm., and the pure tetryl still detonated with a moisture absorption of 0·0062 grm. Lead azide (PbN_6) detonates tetryl more readily than T.N.T., as little as 0·001 grm. often being effective and 0·1 grm. invariably so. In the case of T.N.T. the minimum charge under a loading pressure of 200 atmos. is 0·23 grm., and with a pressure of 400 atmos. about 0·15 grm. By using a suitable mixture of the two explosives as a base charge with a fulminate-chlorate primer, about half as much fulminate is required for a cap of given strength. The insensitiveness of T.N.T. to slightly moist fulminate makes it an unsuitable base charge.
—C. A. M.

Patents.

Explosives. J. A. Marin. Fr. Pat. 478,351, April 12, 1915. Under Int. Conv., Mar. 3, 1914.

An explosive in crystalline form is obtained by the interaction of glycerin with basic lead chlorate, or of lead oxide or hydroxide with a solution of lead chlorate in glycerin. Compounds of mannitol, sugar, dextrose, dextrin, or tannin with basic lead chlorate may be made in a similar manner; or these substances may be made to react with glycerin and basic lead chlorate. One or more combustible substances may also be mixed with the crystalline product.—C. A. M.

Explosive powder; Powerful —— and method of manufacturing it. Smokeless powder and method of making it. J. M. Brown. Fr. Pats. (A) 478,383 and (B) 478,384, Apr. 13, 1915. Under Int. Conv., Mar. 3, 1915.

(A) A solution of, say, 8 to 10% of a resin and an oil (boiled linseed oil) is mixed with an alkali chlorate (70 to 76% of sodium chlorate), a cereal flour (about 22%) is added to the mixture, with or without the addition of about 4% of charcoal, and the mass is pressed and granulated. (B) A solution of, say, 8 to 16% of resin and linseed oil (preferably boiled oil) is mixed with an alkali perchlorate (60 to 70% of ammonium perchlorate), sulphur (5 to 10%) added, and the mixture incorporated with a cereal flour (about 23%). The mass is left to harden and is then granulated.
—C. A. M.

Explosives; Manufacture of ——. F. Steppes, Munich. Ger. Pat. 290,156, Aug. 11, 1915.

By treating the diazo derivatives of more or less highly nitrated, substituted derivatives of diphenylamine or its homologues with nitric acid, stable products are obtained which are not more sensitive to percussion than picric acid.—A. S.

Smokeless powder; Manufacture of stable ——. G. Spica, Venice. Ger. Pat. 291,578, Dec. 2, 1914.

A mixture of collodion-cotton, nitroglycerin, and phenanthrene is treated in a roller apparatus at a temperature of at least 100° C., then immersed in a bath of warm water saturated with nitroglycerin, and afterwards again rolled under the same conditions as before.—A. S.

Explosive charges; Method of firing ——. C. A. Baldus and A. Kowastch, Charlottenburg. Ger. Pat. 292,551, June 23, 1914. Addition to Ger. Pat. 282,780 (see Fr. Pat. 474,508; this J., 1915, 1118).

According to the chief patent, liquid air was added to a cartridge containing a mixture of 60% of kieselguhr and 40% of petroleum. By adding aluminium, magnesium, or the like to this mixture, the velocity of detonation and the explosive force are considerably increased.—A. S.

Fireworks; Preparation of mixtures for ——. J. J. Braun, Schmalkalden. Ger. Pat. 293,582, Oct. 9, 1915.

Liquid air is used in conjunction with combustible or incombustible substances which by themselves are not inflammable or explosive. Suitable mixtures are chalk 70, and soot 30%; coke dust 80, and soot 20%; and powdered glass 60, and soot 40%.—A. S.

Explosives; Moulding press for ——. F. Quartieri, Milan, Italy. U.S. Pat. 1,200,982, Oct. 10, 1916. Date of appl., Sept. 1, 1914.

See Eng. Pat. 19,645 of 1914; this J., 1915, 1118.

XXIII.—ANALYSIS.

Filter paper; Abnormal adsorption [of hydrochloric acid] by ——. R. R. Murray. J. Phys. Chem., 1916, **20**, 621—624.

Five grms. of shredded filter paper was shaken with 100 c.c. of standard hydrochloric acid solution, and allowed to stand for 1 hour to 10 days, and the filtered liquid then titrated. It was found that the adsorption of the acid increased with the concentration of the solution. For example, 9·6 mgrms. of HCl per grm. of paper was adsorbed from a solution containing 0·986 grm.-equiv. of acid per litre, whilst 2·9 mgrms. was adsorbed from a solution containing 0·489 grm.-equiv. per litre. When the filter paper was left in contact with the acid solutions for 7 to 10 days it underwent some change, which reduced the adsorption capacity to less than half its original value. The abnormal results obtained by Evans (J. Phys. Chem., 1906, **10**, 290) must be attributed to errors due to his choice of indicator. When phenolphthalein was used as indicator the apparent adsorptions were much lower than when methyl orange was the indicator in titrating the residual acid solution.—C. A. M.

Calcium chloride, sodium hydroxide, and potassium hydroxide; Efficiency of —— as drying agents. G. P. Baxter and H. W. Starkweather. J. Amer. Chem. Soc., 1916, **38**, 2038—2041.

The aqueous vapour pressures of the lowest hydrates of the following substances have, respectively, at 0°, 25°, and 50° C., values in millimetres as under: $CaCl_2$, 0·07, 0·34, and 1·34; NaOH, 0·04, 0·15, 1·15; KOH, not measurable in first two cases, 0·007 at 50° C. The considerable temperature coefficients with calcium chloride and sodium hydroxide, and the great efficiency of potassium hydroxide, which at 25° C. is as efficient as sulphuric acid, are noteworthy. The weights of residual water in a litre of a gas dried at 25° C. by the various drying agents are given as follows for comparison: $CaCl_2$, 0·36 mgrm.; $ZnCl_2$ 0·8 mgrm.; NaOH, 0·16 mgrm.; KOH, 0·002 mgrm.; H_2SO_4, 0·003 mgrm.—G. F. M.

Anions of group 1; Systematic separation of the ——. Anions whose silver salts are insoluble in nitric acid. H. C. P. Weber and H. A. Winkelmann. J. Amer. Chem. Soc., 1916, **38**, 2000–2013.

A PROCEDURE is described for the systematic separation of the anions of group 1 in the order $Fe(CN)_6''''$, $Fe(CN)_6'''$, CN′, CNS′, Cl′, Br′, I′, S″. From the solution slightly acid with nitric acid, zinc nitrate precipitates ferro- and ferricyanide; these are further separated by dissolving in sodium hydroxide and adding 5% ammonium nitrate solution, which precipitates zinc ferrocyanide, leaving ammonium ferricyanide in solution. From the original filtrate silver nitrate precipitates the remaining ions, and the silver salts are digested with mercuric acetate and acetic acid, when the cyanide passes into solution as a complex mercury cyanide; its identity is confirmed by conversion into thiocyanate. The remaining silver salts are boiled with alkaline sodium formate containing 8% sodium hydroxide, when the chloride and thiocyanate are alone reduced, the ions passing into solution as the sodium salts, from which they are re-precipitated as cuprous thiocyanate and silver chloride respectively. The residual precipitate of silver, and silver bromide, iodide, and sulphide is treated with concentrated ammonia solution and copper powder, when cuprous bromide and iodide dissolve instantly, and silver sulphide remains. On neutralising the filtrate with sulphurous acid and adding an excess of dilute sulphuric acid, cuprous iodide is precipitated, and the bromine is separated as silver bromide after adding nitric acid and boiling to expel sulphur dioxide. Finally the silver sulphide is converted into sulphate by boiling with nitric acid, and the sulphate precipitated as barium sulphate. Full data are given as to the quantitative aspect of the separation.—G. F. M.

Phosphoric acid; Loss of —— during fusion with ammonium fluoride. W. A. Davis and J. A. Prescott. J. Agric. Sci., 1916, **8**, 136—138.

THE results obtained for the phosphoric acid content of salts, soils, and minerals when these are ignited with ammonium fluoride to eliminate silica as tetrafluoride, are low, probably owing to the loss of phosphorus as fluoride. No loss was observed during the subsequent ignition with sulphuric acid. The loss was greatest (over 50%) in the case of alkaline-earth phosphates, and it was less with disodium hydrogen phosphate than with potassium dihydrogen phosphate.—E. H. T.

Diphenylamine-sulphuric acid reagent; Preparation of ——. W. Tönius. Z. Unters. Nahr. Genussm., 1916, **31**, 322. J. Chem. Soc., 1916, **110**, ii., 534.

THIS reagent may be prepared with ordinary sulphuric acid provided that the mixture is heated at 110° C. until any blue coloration due to the presence of nitric acid has disappeared. The heating expels the nitric acid and does not injure the reagent.

Lactic acid; New method of extracting —— for its determination. E. Ohlsson. Skand. Arch. Physiol., 1916, **33**, 231—234. J. Chem. Soc., 1916, **110**, ii., 512—513.

IN the estimation of lactic acid according to von Fürth-Charnass (this J., 1910, 903) as modified by Embden, the extraction with ether is a troublesome and lengthy process. For the isolation in a pure state the author finds ethyl acetate a better solvent, and when the acid is merely to be estimated, amyl alcohol is much better. The liquid containing lactic acid is saturated with ammonium sulphate, filtered after twelve hours, and mixed with 1/10-volume of 50% sulphuric acid. It is then shaken with 2 volumes of amyl alcohol, which is then freed from the acid by shaking with sodium carbonate, and used similarly for four more successive extractions of the fluid. Traces of amyl alcohol are removed from the sodium carbonate extracts by three extractions with benzene, and the estimation is then carried out in the usual way.

Furfural [from pentoses]; A comparison of barbituric acid, thiobarbituric acid, and malonylguanidine as quantitative precipitants for ——. A. W. Dox and G. P. Plaisance. J. Amer. Chem. Soc., 1916, **38**, 2156—2164.

BARBITURIC acid possesses certain advantages over phloroglucinol as a precipitating agent in the determination of furfural; the precipitate is a definite condensation product of 1 mol. of the aldehyde with 1 mol. of barbituric acid, through its methylene group, with elimination of H_2O; the reaction is more specific than with phloroglucinol, and, whereas the latter gives high results owing to hydroxymethylfurfural when sucrose is present with the pentose, barbituric acid still gives normal values. The precipitate, however, is sufficiently soluble to require a correction for solubility (1·22 mgrms. per 100 c.c.) and it is necessary to employ a large excess of the reagent (16 times the theoretical amount) if low results are to be avoided. The authors have found that thiobarbituric acid possesses the advantages without the drawbacks of barbituric acid. The precipitation in the ordinary acid distillate is quantitative at the ordinary temperature without using a large excess of the reagent; the furfuralmalonylthiourea forms a flocculent, voluminous yellow precipitate which filters slowly but without practical difficulty and can be dried to constant weight at 100° C. It is practically insoluble in cold dilute acids and no correction is necessary; good results are obtained with as little as 12 mgrms. of furfural. Methylfurfural yields with thiobarbituric acid a condensation product having substantially identical properties, and it is to be inferred that methylpentoses would be quantitatively determined with the pentoses. As the products possess a perfectly definite composition, mixtures of furfural and methylfurfural could be determined from the percentages of nitrogen and sulphur in the precipitates. It is important for accurate work that the thiobarbituric acid be carefully purified; if impure, the results may show only 90—95% of the furfural and the filtrate have a red or green colour. This is attributed to the presence of ethyl cyanacetate in the ethyl malonate employed. The ethyl malonate should be subjected to repeated simultaneous saponification and esterification before being condensed with sodium ethoxide and thiourea, and the thiobarbituric acid purified by one or two recrystallisations of its sodium salt. Malonylguanidine gives a green flocculent precipitate with furfural, but its solubility is such that its use for quantitative purposes is quite out of the question.—J. F. B.

Peroxydase purified by ultrafiltration; Reactions of ——. A. Bach. Arch. Sci. phys. nat., 1916, [iv.], **42**, 56—61. J. Chem. Soc., 1916, **110**, i., 682—683.

WHILST phenol, guaiacol, quinol, and pyrogallol were found to give the same colour reactions with an extract of horse-radish and the same extract subjected to ultrafiltration, in presence of hydrogen peroxide, very different results were obtained with orcinol, aniline, dimethyl- and diethylaniline, benzidine, and *p*-phenylenediamine. When *o*-cresol and saligenin are treated with a mixture of purified peroxydase and hydrogen peroxide, a yellow colour is produced in both cases, which changes to brown and then to reddish-brown. Salicylaldehyde only reacts when the solution is made slightly alkaline with hydrogen dipotassium phosphate. Salicylic acid gives no reaction. In the oxidation of *o*-cresol and saligenin, formic acid is produced, but no appreciable amount of carbon dioxide could be detected. Ethyl alcohol is not attacked. It is considered more probable that ethyl alcohol is oxidised by a mixture than by a specific "alcoholoxydase."

New method for purification of colloidal solutions. Wegelin. *See* I.

New method of testing naphthalene wash oils. Wobl. *See* II.

Determination of phenol in crude phenols from tar. Masse and Leroux. *See* III.

Colours produced by resorcinol in solutions of certain salts and their use for the detection of resorcinol in presence of other phenols. Krauskopf and Ritter. *See* III.

Staining of tissues with the simplest dyestuffs, and their fixation. Skraup. *See* VI.

Volumetric determination of chlorides in presence of thiocyanates. Bruckmiller. *See* VII.

Attack [by reagents] of French, Bohemian, and German glass. Nicolardot. *See* VIII.

New method for the production of accurately dimensioned glass tubes. Lambris. *See* VIII.

Freezing point of mercury. Wilhelm. *See* X.

Quantitative determination of silica in soils. Von Horvàth. *See* XVI.

Ammoniacal nitrogen of peats and humus soils. Ellis and Morison. *See* XVI.

Supposed precipitation of reducing sugars by basic lead acetate. Davis. *See* XVII.

Approximate determination of the sugar content of wine. Pritzker. *See* XVIII.

Detection of artificial colouring matters in wine. Kreis. *See* XVIII.

Use of the iodic acid-starch reaction in the control of vinegar and wine. Jeanprêtre. *See* XVIII.

An examination of certain methods for the study of proteolytic action. Sherman and Neun. *See* XIXa.

Detection and determination of hydrocyanic acid in beans. Guignard. *See* XIXa.

Determination of fat in cocoa. Kreis. *See* XIXa.

Detection of beetroot in chicory. Collin. *See* XIXa.

Determination of calcium in ash of forage plants and animal carcases. Kuzirian. *See* XIXa.

Determination of hydrogen sulphide in water. Winkler. *See* XIXb.

Modification of the Pratt method for the determination of citric acid. Willaman. *See* XX.

Patent.

Polariscopes. L. Laurance and H. O. Wood, London. Eng. Pat. 14,329, Oct. 9, 1915.

A polariscope of the reflection type, for the examination of spectacle lenses, crystals, gems, etc., is formed of a dark box with a source of light at one end, and a tubular support at the other containing a converging lens or lens-system, and an "eye-rest" at the extreme end of the support. Two black reflectors are arranged at suitable angles at each end of the box, and between these are perforated screens between which the substance to be examined is placed. The parts are arranged so that of the two principal foci of the lens, one lies approximately midway between the reflectors or screens, and the other approximately at the principal plane of the observer's eye when the latter is upon the "eye-rest."—B. N.

XXIV.—MISCELLANEOUS ABSTRACTS.

Pyrogallol, ferrous sulphate, and fructose [lævulose]: Influence of strong salt solutions on the spontaneous oxidation of ——. C. G. MacArthur. J. Phys. Chem., 1916, **20**, 545—553.

A definite quantity of the substance to be oxidised was mechanically shaken with 50 c.c. of $N/10$ sodium hydroxide solution containing in solution quantities of salt in concentrations of $\frac{1}{2}$ to 4 M. The flask was provided with a thermometer and was connected with a manometer, and the amount of oxygen absorbed was determined by the negative pressure measured by the manometer. The results showed that higher manometer readings are obtained, with an increase in time, for all concentrations of salt. The effect of sodium chloride, potassium chloride, and potassium nitrate upon the rate of oxidation of pyrogallol, ferrous sulphate, and lævulose is about the same. Sodium bromide, however, reduces the solubility of oxygen more than the above salts, and therefore causes a greater decrease in the rate of oxidation, whilst sodium sulphate and magnesium chloride affect both the oxygen solubility and the rate of oxidation more than sodium bromide. In all cases an increase in the amount of salt causes a decrease in the rate of oxidation. Except in the case of lævulose in dilute salt solutions the rate of oxidation is parallel to the solubility of oxygen.—C. A. M.

Trade Report.

France: Prohibited exports.

A French Presidential Decree, dated October 26th, prohibits the exportation from France of the following:—Formic acid, oxalic acid, albumin, benzyl benzoate, ethyl benzoate, borate of lime, carbon chloride, carbon tetrachloride, chlorine compounds, colchicum and its preparations, coffee substitutes, dextrin, dyeing extracts, kaolin, manures of all kinds, "chemical matches," products containing essence of turpentine, radium and its salts, silica bricks, spirits and liqueurs, volatile or essential oils.

Of the above, however, all with the exception of oxalic acid, albumin, borate of lime, carbon chloride, and chlorine compounds may be exported without special authorisation to the United Kingdom, the British Dominions, Colonies, and Protectorates, and certain other countries.

Prohibited Exports.

By virtue of an Order in Council, dated November 17th, the exportation of Cocaine and its salts and preparations to all destinations is prohibited. The heading, "Emery, corundum, etc.," in the Proclamation of May 10th last (see this Journal, 1916, 621), is altered to "^{2}Emery and corundum and manufactures thereof, carborundum, alundum, crystolon, and all other artificial abrasions and manufactures thereof." The heading "Casin and preparations thereof" is transferred from Class 3 to Class 2, the heading "^{3}Varnishes, spirit, containing gum" is replaced by the heading "^{3}Varnishes not otherwise prohibited," and a new heading is added, viz., "^{3}Oils, essential (except turpentine oil)."

Books Received.

A System of Physical Chemistry. By W. C. McC. Lewis, M.A., D.Sc. 2 volumes. Longmans, Green and Co. London. Price 9s. net each volume.

The study of physical chemistry in this country has hitherto scarcely received the attention which its importance deserves both from the purely scientific and the technical standpoints. There is scarcely an industry connected with chemistry for which the principles of this branch of the subject are not of importance, and the future progress of certain of our industries will depend in no small measure on the skill and intelligence shown in applying the methods of physical chemistry to the problems involved. Any book which facilitates the acquirement of this knowledge deserves a hearty welcome.

The book under review belongs to the series of text books on physical chemistry edited by Sir William Ramsay, but differs from the other members of the series (which are devoted to special topics) in affording a general and fairly comprehensive view of the subject. It is not an easy matter to give within a moderate compass an adequate and connected presentation of what has now become a very extensive branch of chemistry, and it is satisfactory to be able to state that Prof. Lewis has been conspicuously successful in his task. The author has a thorough and up-to-date knowledge of his subject, commands a lucid style, and shows excellent judgment in the selection and arrangement of material. The clearness and care with which the thermodynamical principles of the subject are explained and illustrated deserve special praise.

The method of presentation adopted is as follows. Physico-chemical phenomena are divided into those exhibited by material systems when in a state of equilibrium and those exhibited by systems which have not reached a state of equilibrium. The phenomena exhibited by systems in equilibrium and not in equilibrium are treated first from the classic kinetic standpoint only (Volume I.), then independently from the thermodynamic standpoint, and finally from the standpoint of thermodynamics and statistical mechanics (Volume II.). This system has undoubtedly much to recommend it, more particularly as regards the postponement of the difficult thermodynamical treatment until the student has obtained a good grasp of the subject from the simpler kinetic standpoint. Most of us are acquainted with works on physical chemistry which, although in most respects excellent, repel at the outset all except the mathematically-minded student by plunging into difficult thermodynamical reasoning in the first few pages.

Volume I. (kinetic theory) deals with molecular magnitudes and allied phenomena, equations of state, chemical equilibrium in homogeneous and heterogeneous systems from the kinetic standpoint, and reaction velocity. The treatment is very similar to that in other books and calls for no special remark except that attention should be directed to one commendable feature, namely the reproduction of parts of the classic papers on the subject in the investigators' own words. Volume II., Part II., in which physico-chemical phenomena are considered from the standpoint of thermodynamics, contains full accounts of some important recent advances, such as Smits' theory of allotropy, Donnan's theory of membrane equilibria and Nernst's heat theorem. Volume II., Part III. contains a good account of photo-chemistry and a full and excellent account of the theory of energy-quanta. There is little in the book that calls for adverse criticism, even in details. The style on the whole is good, but split infinitives are met with rather frequently. "Hantsch" instead of "Hantzsch" occurs three times on p. 317 and also in the index, and so is presumably not a printer's error. The book is provided with excellent subject and author indexes, and therefore should be very useful for reference.

George Senter.

The Mineral Resources of Texas. By W. B. Phillips. Bulletin of the University of Texas No. 365. Published by the University, Austin, Texas. 362 pages and 40 illustrations.

Trattato di Chimica Analitica Applicata. Metodi e norme per l'esame chimico dei principali prodotti industriali ed alimentari. Vol. I. Di V. Villavecchia, Direttore dei Laboratori Chimici della Gabelle, con la collaborazione dei G. Fabris, A. Bianchi, G. Armani, G. Rossi, G. Silvestri, G. Bosco, R. Belasio, F. Barboni, ed A. Cappelli. U. Hoepli, Milan. XX+622 pages, 9½×6¾ in., with 58 illustrations. Price L.12.50.

This is the first volume of a work on technical chemical analysis to be completed in two volumes. The present volume contains chapters on the examination of: waters (20 pages); chemical products, such as acids, alkalis, salts, etc. (133 pages); fertilisers (30 pages); cements, plasters, etc. 31 pages); metals and alloys (184 pages); fuels (24 pages); coal tar and tar products (23 pages); mineral oils and their derivatives (47 pages); fats and oils (94 pages); and commercial products from fats and oils (36 pages). The methods recommended have, in most cases, been thoroughly tested in the Italian Customs Laboratory, and found trustworthy: and with few exceptions only one, or two, methods are given for a particular determination.

Journal of the Society of Chemical Industry.

No. 23, Vol. XXXV. DECEMBER 15, 1916. No. 23, Vol. XXXV.

Official Notices.

PORTRAIT OF MR. C. F. CROSS.

There has been considerable delay in receiving an adequate supply of the portrait of Mr. C. F. Cross, recipient of the Society's Medal, which was inserted in some copies of the November 30th issue of the Journal, and it has therefore been necessary to postpone the distribution of the remainder of these.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY.

The first volume of the Reports of the Progress of Applied Chemistry is now in active preparation, and will, it is hoped, be published shortly. It will cover recent progress to the end of June, 1916. The second volume will deal with the period up to the end of 1917, and subsequently it is proposed to issue the Reports annually.

The Reports will present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. It has not been found practicable to treat every section of the Journal classification. Agricultural chemistry, the chemistry of foods, and analysis are fully dealt with in the admirable series of Reports issued annually by the Chemical Society, and for the present there will be no sections on general plant and explosives.

The following is a list of the subjects which will be dealt with, together with the names of the experts who are contributing to this volume :—

Fuel—J. W. Cobb.

Gas, destructive distillation, tar products—E. V. Evans.

Mineral oils—A. W. Eastlake.

Colouring matters and dyes—G. T. Morgan.

Fibres, paper, dyeing, printing—Julius Huebner.

Acids, alkalis, salts, etc.—H. A. Auden.

Glass, ceramics, cement, etc.—J. A. Audley.

Metals, metallurgy—W. R. E. Hodgkinson.

Electro-chemistry—J. T. Barker.

Fats, oils, waxes—G. H. Warburton.

Paints, pigments, varnishes, resins—R. S. Morrell.

Indiarubber—H. P. Stevens.

Leather, glue, etc.—J. T. Wood.

Sugar, starches—J. G. Macintosh.

Fermentation—A. R. Ling.

Sanitation, water purification—F. R. O'Shaughnessy

Fine chemicals, medicinal substances, essential oils—F. L. Pyman.

Photographic materials and processes—B. V. Storr.

The price of issue will be, to members, 2s. 6d. (plus 6d. postage), and non-members, 5s. (plus 6d. postage). As the issue is to be a limited one, those desirous of securing copies are requested to fill in the order form attached to the cover of the Journal, and return it to the Secretary at an early date.

London Section.

Meeting held at Burlington House on Monday, November 20th, 1916.

MR. ARTHUR R. LING IN THE CHAIR.

The Chairman, in opening the meeting, referred in feeling terms to the loss of two past Presidents of the Society, Sir William Ramsay and Mr. David Howard.

Mr. Tyrer also paid a tribute to the memory of Mr. Howard.

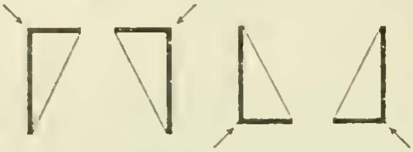
CHEMISTRY AND ENGINEERING.

BY DR. CHARLES CARPENTER.

I propose to initiate a talk about Chemists and Engineers and their relationship to the great problem of bringing up to date our national Chemical Industries. The Charter of the Institution of Civil Engineers defines the profession of the engineer as being the art of directing the great sources of power in Nature for the use and convenience of man. We might in similar language define the aim of the chemist as being to wrest from Nature some of her most hidden secrets for the same purpose. (I attach no importance to the definition of a chemist which describes him as an organic body more liable than any other of similar nature to spontaneous explosions.)

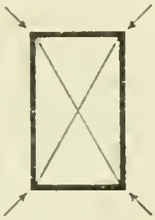
As I am talking to chemists and not engineers it will be best to begin at the beginning even at the risk of being considered elementary. The popular conception of the engineer is that he is an empiric who has been trained on cotton waste and engine oil. This is, of course, a fallacy. He has just as scientific a foundation for his work as has the organic chemist, and, like him, has a ring structure for the starting point from which spring his great creations. His ring, however, is centuries older and it is basic in simplicity. The diagram (Fig. 1, p. 1186) shows several such rings. Their form is a triangle with rigid sides and a flexible base. If force is applied to the apex the ring is stable and resists distortion under the stress ; in other words, it does the work for which it is designed. If force is applied to either of the other two angles it is seen to be unstable and collapses. Two such rings may be joined together with a common base, and the two rings so coupled become a structure which has similar attributes to its components. If force be applied to either or both apexes, this double ring is stable ; if to the opposite angles, it is unstable. But if the complete rings are combined to form a compound ring as in fig. 2, the structure becomes a stable one in all directions. The ring formation thus described is the basis of all construction and building in metals, from the framework of the Forth Bridge to that of a Zeppelin.

Let us now consider how the engineer sets out to achieve the task with which he has been entrusted. One of the necessary qualifications of an engineer is the possession of the imaginative faculty ; he must see in his mind's eye the general outline of his finished production before it is designed in detail or its creation is begun. What will be his procedure if his work be the construction of, say, the former structure of the two examples just given ? Drawings or maps would be useless to him without knowledge of the surrounding landscape itself. He goes then to seek inspiration on the spot just as a painter would to visualise and make studies for his picture. He watches the long slope of land stretching down to the river's edge from Fife on the one shore and from Linlithgow on the other, and realises that what he builds must join those widely separated crests. He sees before him between mid-stream and the right bank the islet of Inchgarvie lifting its rocky head above the waters of the Forth. Then begin his musings and gradually the mists clear and the mental creation of his work begins. He dreams of setting up on the edge of the river a compound ring structure, placing another on Inchgarvie, and then as the expanse of stream beyond makes the width of span impossible, the idea comes to him of building for himself another islet in steel and artificial stone corresponding to Inchgarvie and reaching up from the river bed. At these three points he erects his massive compound rings, and from both sides of them he then proceeds to build out other rings each balancing the other and growing smaller and smaller as they stretch to meet each other across the waters below. He joins the gaps with smaller bridges until he makes the whole structure a continuous one from shore to shore. Observe the language of the engineer, Titan that he is. He has faith in himself, in his ability to master Nature, and he *throws* a bridge across what she made as a widely-parted chasm. The diagrams show the progress of the work. Figure 3 represents a profile of the spot looking down stream in which Inchgarvie is prominent. The next diagram (Fig. 4) shows the artificial island he plants solidly upon the river's rocky bed on which his compound "rings" stand on feet or bases, and soaring upwards for a height of 350 feet. These "rings" are drawn more in detail in Figure 5, which clearly shows the building up of the structure from simple triangles. The sixth diagram shows the completion of the arms or cantilevers jutting widely out from the big ring, like the arms of some great monster seeking his mate. The seventh diagram gives a more general view of them before joining up, and the eighth figure shows the completed structure itself, more than a mile long and with a clear headway from high water mark of 150 feet, under which our great Dreadnoughts can pass at will.



Simple Ring Structures

FIG. 1.



Compound Ring Structure.

FIG. 2.

I want now to invite your consideration of the engineer from another point of view, and which bears a certain resemblance to the immediate necessities of our own industries. The picture on the screen* is from a drawing made between a half and three-quarters of a century ago. The vessel in the background is a first-class battleship, oak-built and wind propelled. The steamship is the Admiral's tender, and bears a name still honoured in the Service. It is a picture of the beginnings of the mighty Navy which now protects our shores, and which includes battle cruisers

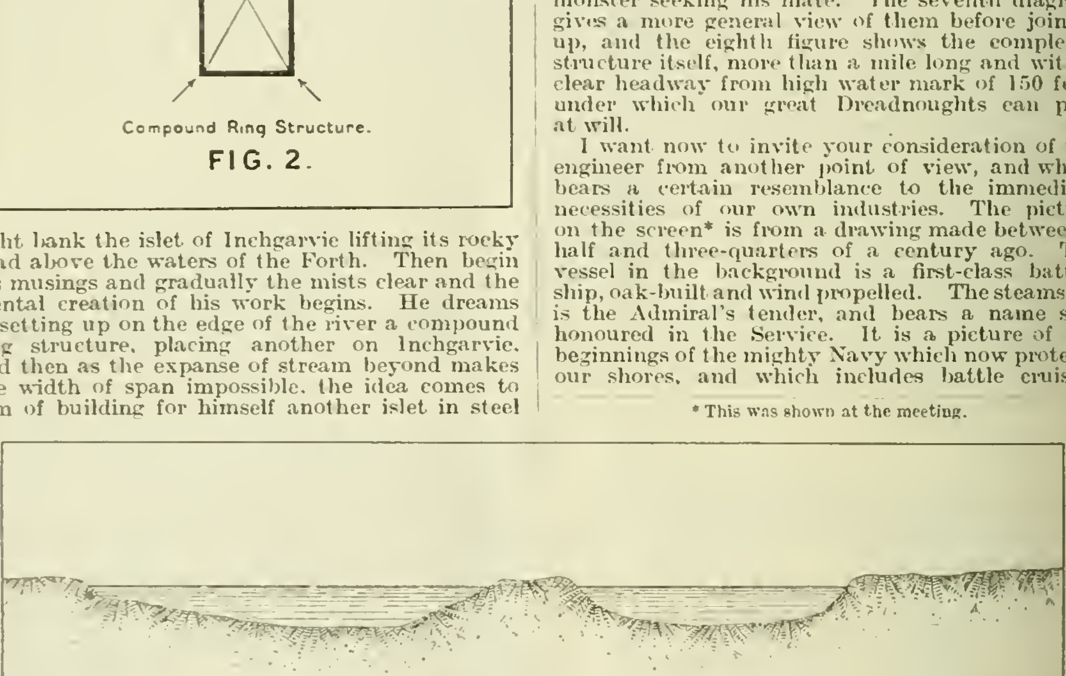


FIG. 3.

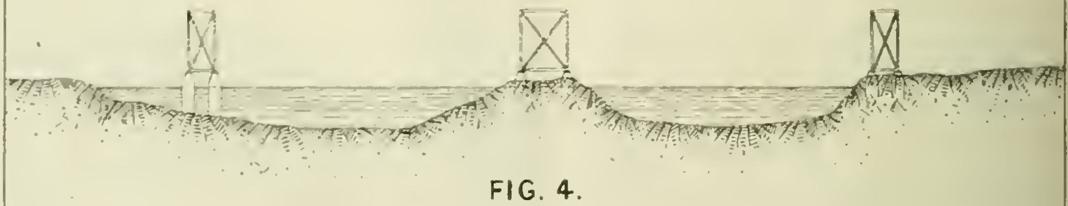


FIG. 4.

* This was shown at the meeting.

of such an enormous size that some of them consume fuel at the rate of an equivalent of over one thousand tons of coal per day. Imagine the mechanism of the appliances capable of first producing energy on such a scale down in the bottom of the ship's hold and then of utilising it within her walls! No one could have any doubts as to the important part which must be played by the engineer in such an organisation. Now from the earliest days of the application of steam to the Royal Navy until quite modern times its engineers were looked upon in the same more or less contemptuous fashion as they are not infrequently by chemists to-day. For many a day they messed apart from the ship's officers whose butt for ridicule they often were. In recent years, however, one man great above his fellows set himself to remedy this state of things which threatened seriously to menace the efficiency of the Navy and the safety of our Empire. That man is the present Lord Fisher, and I now want to tell you something of the work which he set himself to accomplish. With, I think, the thoroughness born of the Service to which from boyhood he was attached, he realised the importance of beginning life early, and instead of taking youths, who are more or less spoilt by the kind of training given them at the public schools, the entering age for a Naval cadet was made 13 years or a little more. At that age he is expected to satisfy his examiners in English, History, Geography, Arithmetic, Geometry, French or German, with some knowledge of Latin. From that time his training begins in Physics, Chemistry, Applied Mechanics, Applied Electricity, and, above all, in Engineering with workshop practice. Until he is 17 years of age and goes to sea, that is the training of every officer in His Majesty's Navy. Whether he may be destined for a battleship commander, an engineer commander, or head of a dockyard, the value of engineering in the making of a man as well as training him to a profession is recognised from the commencement. There is, however, a preliminary sorting out which is of great interest and importance. I cannot do better in this respect than quote the words of the Director of Naval Education, in which it is laid down that some indications of the qualities likely to conduce to the boy's becoming a good officer may be discernible by the time the boy is 13. "There is scope and need in the Navy for many types of men and varieties of talent, for the

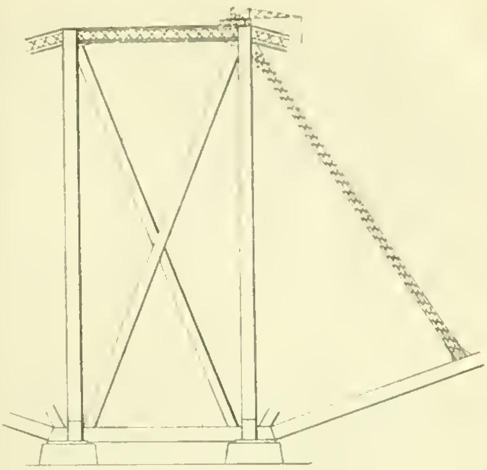


FIG. 5.

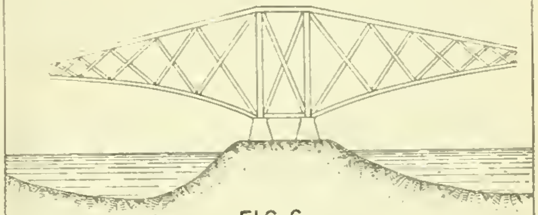


FIG. 6.

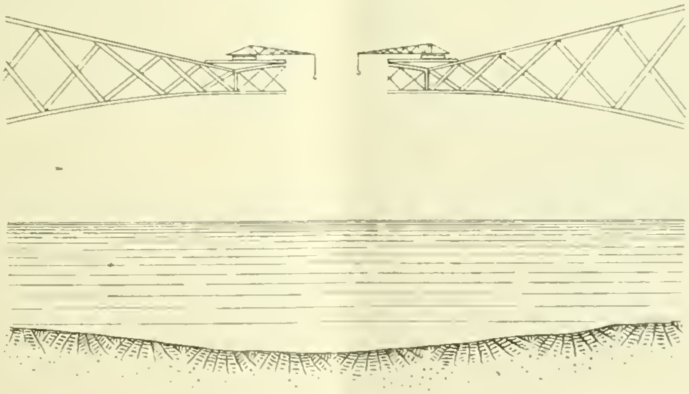


FIG 7.

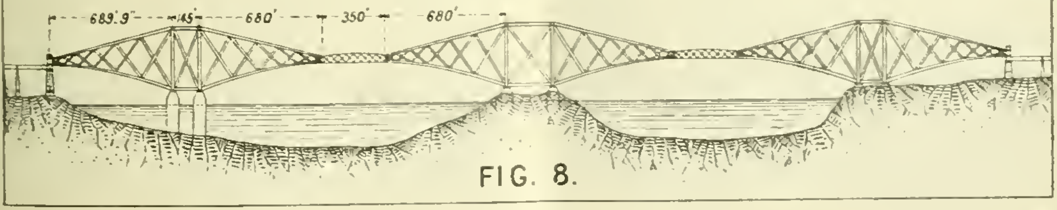


FIG. 8.

cultivated faculty of scientific thought and for the personal force that assures leadership. The boy of sensitive, poetic spirit, the ruminating young philosopher, the scholar whose whole heart is in his books, are types that have a real use in the world, but their proper place is not in the Navy. The boy of the right sort will, within the limits natural to his age, show initiative and readiness for responsibility." Such, generally, are the methods by which were trained many of those brave men who are now fighting our sea battles and defending our shores.

Now it seems to me that the condition of affairs in Chemical Industry is very much akin to what has happened in the Navy, viz., that specialised engineering is becoming more and more necessary to it.

I had hoped to have been able to give you on the screen one or two pictures of a modern German-built chemical works, erected on British soil under the regulations of our Patent Laws, but forfeited to the Nation as a result of the war in which we are now engaged. It was considered, however, that this would disclose secrets of design and construction to which the Nation as a whole were not entitled. For my own part I consider that every single detail of the whole of these works should be drawn out and described for the benefit of the entire British Chemical Industry. I look upon this as an absolute right to which the Nation should be entitled. However, I have one or two other slides, very kindly lent to me by Dr. Harker, which will help to point the moral.*

The first is the power house at Saaheim. Next the Badische furnace at Rjukan. Next the interior of the furnace house in the new factory there. And the last the granite absorption towers. These are, of course, parts of the nitrogen fixation plants. I give them as reminders that engineering design and construction is figuring more and more in modern chemical processes.

Now I believe it is increasingly necessary for the engineer to take a larger part not only in the design but in the running of this special kind of plant. I do not mean that the control should not be chemical, for I think in the majority of cases, if not all, it must be. But I am convinced that when the conditions are found and laid down, the engineer will be quite capable of carrying them out, while his natural ability for handling men and materials cannot but be most useful assets. For instance, it is quite an easy matter to lay down the conditions of working in, say, an autoclave or a centrifugal, and chemical control should be kept over such operations, but the practical working of the machines, their design and upkeep, and the regulation of the attendant labour, the design of the plant and its best lay-out, having regard to the general conditions of economy and the handling of materials, should in a large degree be left to the engineer, since by training he is the more practical person.

If we start with the theory that everybody can be trained to be an engineer or a chemist we shall go hopelessly wrong. The function of our teachers should be to ascertain in what direction the mental capacity of each pupil lies, and to direct him to follow the right main road. It would be very easy to put forward a theory in respect of this if one were needed. In the branch of industry with which I am closely associated, I am aware that in the past there has been much lack of progress through the engineer not deciding to take the chemist into his counsel, but I am also sure of this, that had the chemist been substituted without on his part taking the engineer into his counsel we should have been no further forward. The case is essentially one for their working in harmony towards the common goal of perfection. I cannot but think, too, that British chemical industries have been to some extent partly sterilised by the narrow spirit in which some chemical manufacturers have regarded their operations. In my opinion, progress as a whole will be best achieved by them, not by hiding from everybody broad principles of design and working, but by placing reliance upon scientific knowledge and experience to keep themselves in the forefront of their competitors. The general principles of ship construction, of bridge making, and of engine building, to take one or two examples, are open practically to every apprentice engineer, who thus grows up in a general atmosphere of such employment which is of untold value to him if he has ability or opportunity to rise above his fellows and to specialise in any particular direction. And yet there are secrets in ship-building, in bridge-making, and in engine-designing, just as there are in the various chemical industries. The need of such men so trained is now becoming a national one and the full story of their serious shortage cannot yet be told. If we are to maintain our position among the Nations, we must in this respect make a radical change of our pre-war methods. A well-known engineer of wide reputation spoke to me not so very long ago of "those stupid chemists!" and an able Professor of Chemistry said in my hearing, more recently, that "Engineers were such stupid people!" Neither profession deserves such reproaches. The engineer should be taught sufficient chemistry to be able to appreciate the chemist's point of view, and the chemist should know enough of engineering to realise that with the engineer thus trained he can leave the practical application of the processes he devises in the laboratory and supervises in the chemical works.

I have had costly experience of the engineer working in a water-tight compartment of his own, and of the chemist doing likewise. Both courses result in inefficiency. The plan I have found to meet all such difficulties is to organise two distinct staffs under the headship of a chemist on the one hand, and of an engineer on the other, who consult with each other and work together in overcoming the difficulties which daily confront them. I should be sorry to go back to any other system. Chemists and engineers may, I think, be looked upon as the physicians and surgeons of industry, with their respective parts to play in building up and maintaining in increasing strength the well-being of chemical science, and extending its usefulness in the service of man.

DISCUSSION.

Mr. J. W. MACDONALD said that he was connected with the business of sugar refining, the success of which had been assured by following out the very principles which the President had advocated. When first he was connected with sugar refining, the managers generally were neither engineers nor chemists, and had a distrust for both the branches of science. But gradually they had learned the benefits of applying both engineering and chemistry, the result of which had been that British refiners, in spite of the bounties, and in spite of the skill of foreign refiners, had held their own, and had in fact even done better than many of their rivals abroad. He heartily endorsed all that the President had said.

Mr. THOMAS TYRER said that the whole question was one of co-operation. That class of manufacturer usually known as a fine chemical manufacturer, was often thought to be one who did things on such a small scale that engineering and similar problems had not to be considered. The sooner that notion was dissipated the better, for just as great care and consideration for surround ings and conditions were required on the comparatively small scale as on the gigantic scale. Only by the co-operation and collaboration which had been emphasised by the President, could success be attained. From what he knew of his own competitors in the fine chemical department of applied chemistry, they had all those problems on a smaller scale, but of no less intensity, and there was no less need for the co-operation of the mechanically minded man with the chemical philosopher, student, and technologist. They must put things in their true perspective, and call engineering and other branches of science to their aid, whether the things they dealt with were the big things which had been referred to by the President, or the smaller things.

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* These slides were exhibited at the meeting.

Professor G. T. **Morgan** said that the subject of the need for co-operation of the chemist and the engineer was not a new one in that Section of their Society, because it had been many times advocated in that room, notably some years ago by Dr. W. H. Nichols, who said when he wanted chemical work, he selected young chemists, and when he wanted any engineering problems interpreted, he selected young engineers, and got them to work together. A great deal had been said about their comparative neglect of the chemical industry as contrasted with Germany. His own feeling was that it was simply due to a general lack of appreciation for science. He recalled the fact that such substances as Perkin's Mauve, Meldola's Blue, and Erhlich's Salvarsan had been started by the chemist *qua* chemist, working from the point of view of the atomic and molecular theories, and then those products had subsequently come within the province of the engineer. He believed the future success of British chemical industry would depend very largely on the personal loyalty subsisting between those who worked at it, whether they were chemists or engineers. It was essential to foster that particular branch of chemistry which was so widely practised in Germany, namely, synthetic chemistry. They had recently been told that that kind of chemist was a molecule juggler. He could not help thinking that the reason France 50 or 60 years ago had not advanced in dye production as much as Germany was because her chemists had failed to recognise Kekulé's important generalisation. Their great chemists were prejudiced, as frequently French chemists are, against the chemistry of other countries, and the consequence was that their young chemists who had to work those dyes out in the factory, were striving in the dark. Unfortunately, the same mistake was being made to-day as then. Chemists were ignoring the teaching of Werner. They had been very troubled in the United Kingdom by a school of what he called Malthusian chemistry, a school which supposed that chemistry could be advanced by restricting the output of new chemical compounds. He believed it was largely the synthetic chemist who would help them to solve the problems they now had to face and who would provide the necessary work for the engineer. The engineer was now being called upon to solve problems arising from the fact that the English chemist was imitating the Germans, but when the war was over it would be found that the Germans had advanced further, and that our synthetic chemists would be called upon to make greater efforts.

Dr. H. G. **Colman** said that in addition to the question of engineering on the one hand and of chemistry on the other, there was another question to be considered, namely, that of the costs of production. In using the term "chemistry," they were perhaps a little unfair to their "physical" brethren, because chemical industry was equally concerned with physics, and that applied specially on the engineering side. He felt what had done a great deal of harm was, that those who were more specially interested in one of the two sides of chemical engineering thought that their part was the bigger, whereas all sides, including the human side, were absolutely and equally essential if progress were to be made.

Mr. J. W. **Hinchley** said that he wished to put in a plea for the chemical engineer. It was absurd to talk about the chemist appealing to the engineer unless they defined what sort of engineer was meant. The ordinary mechanical engineer was quite untrained in the particular points which the chemical manufacturer had to handle. The synthetic chemist was necessary, and he agreed with Prof. Morgan that the training of large numbers of synthetical chemists who were mentally and temperamentally equipped for handling synthetic problems was necessary, but the training of chemical engineers was also necessary. In his opinion the chemical engineer had to be a better engineer than a mechanical engineer, as the chemical engineer had to go into the extremes of mechanical engineering and work with materials at the highest stresses possible, subject to corrosion, and under such conditions that the knowledge of the average mechanical engineer was almost useless. They did not want to produce the kind of engineer who simply copied somebody else's machine. The chemical engineer must, in a sense, be a synthetic man, adopting new ideas, working them out, and consequently resisting the average practice of the day.

Mr. **Bertram Blount** said that for some 30 years he had urged the true co-ordination between the engineer and the chemist, and that had been his fortunate experience as a chemist, as he had had the common sense not to pretend to be an engineer, and had collaborated with engineers who did not pretend to be chemists. He had found that collocation entirely satisfactory, as they each knew their limitations. Both sets of people were trained on the sound basis of science to do what they could in the best way, and they could come together and deal with any problem which presented itself to them, on equal terms. Although the blessed word collaboration had been used often enough, he still maintained that that was the best way, and he did not believe in a man being a jack of all trades. He disagreed with what had been said as to the provision *ad hoc* of the chemical engineer.

Colonel **Smithells** said that as he had listened to the President, he could not help thinking what a regrettable thing it was that he was one of such a very small number of men in this country who spoke with equal knowledge and sympathy on both sides of that most important question. His conclusion that they must have the engineer trained with chemical sympathies, and the chemist trained with engineering sympathies, was the most important thing in his address, and they must not talk too much about that doubtful and indescribable person, the chemical engineer, being trained for that particular vocation in life. In his experience, extending over 30 years, one of the cries they had had to listen to, and which had been almost louder than any other in the industrial community, had been the cry for chemical engineers. He had been constantly told that was the kind of person they wanted, and ought to produce. He believed that there were different shades of talent and capacity, and, generally speaking, the talent and capacity that made an engineer were not the same as those which made a chemist. Although it sometimes happened that a man was found who was equally susceptible to both kinds of training, those men were the exception and not the rule. Also he did not believe that they would get people who would undergo the long training which would be necessary to make them worth calling chemical engineers, but in all probability they would fall between two stools. Everybody engaged in teaching, and with an intelligent knowledge of chemistry, knew that four years was not too much to make a chemist; and he was told by engineers that the same thing applied to engineering. Those questions had always to be decided by what was practicable, and not by what was theoretically conceivable. He himself had always thought the length of the curriculum which was required to be imposed in order to produce a chemical engineer was one which the British public was not prepared to undertake. Another point which had always come forward when he had had to face the question was, that the chemical engineer had a great deal more in him than a knowledge of chemistry and a knowledge of engineering. Chemical engineers were more numerous in other countries than in England; but the greatest element in their value was the element of experience. That experience could only be acquired in the world of work. So that on the whole he was on the side of the President, and believed the only satisfactory conclusion was that the chemist should be trained with a much greater knowledge of engineering than he now possessed, and a much wider sympathy with it; and the engineer should also be trained with a greater knowledge of chemistry, and the two must work hand in hand, separate in many respects, but constantly combining in the sphere of chemical industry. If they were to produce a chemical engineer, were they going to superpose chemistry on the engineer, or superpose engineering on the chemist? Those who were primarily chemists would oppose the possibility of superposing any adequate training to making a man worthy of being called an engineer within the time that was practicable; and the converse equally applied.

Mr. J. J. **Eastick** said that he called himself a chemical engineer, and could not agree with the last speaker. There was difficulty with regard to the question of co-operation, namely, divided responsibility. If he in his experience had told his chemist or engineer that there was to be mutual co-operation, he was afraid sometimes they would have been landed in a dilemma as to which man was to blame. Chemical industry wanted all kinds of chemists as well as engineers, but they also wanted chemical engineers. There was room for the chemical engineer, who should be called in to solve problems such as those of crystallisation, drying, filtration, etc.

Mr. J. **Abady** said that the time to specialise in a particular direction was when a man was embarked on his career, and the only way to avoid putting square pegs in round holes was to follow that system. There had been a great deal of talk of their backwardness in comparison with Germany, and how much of it was due to their deficient educational system. He did not think those who held those views had made out their case. The general manufacturer should awake to the fact that in nine cases out of ten he could improve his production and lessen his costs and increase his profits by employing the trained talents of both engineer and chemist.

Mr. G. N. **Huntly** said that the President had stated that it was desirable that chemists should learn some engineering, and that engineers should learn some chemistry; but he had not laid down with what object they should set out. He thought the chemist might learn engineering with a view of finding out his limitations. In the same way the chief value to the engineer of some knowledge of chemistry was that it taught him when to call in the chemist, and he thought that should rather be the object of the addition of chemistry to the engineer's curriculum, and *vice versa*, rather than that the two should be combined, because in his opinion the two subjects were too big for one man, save in a few exceptional cases.

Dr. L. T. **Thorne** said that he thought the President had taken the right view. He had been engaged for a great many years in work where chemistry and engineering touched one another very closely. His experience was that if they were to have their chemical work go on in the way they hoped, and which was necessary if it were to be successful after the war, it was essential they should have the thorough co-operation of the highly trained chemist with a sufficient knowledge of engineering with the highly trained engineer who had a knowledge of the fundaments of chemistry. The honourable co-operation of both would result in good work. He felt that the attempt to create the chemical engineer who was a master in chemistry and a master in engineering, was too big an undertaking for ordinary college work and would only result in the production of second-rate men. But just as an engineer who was originally trained as a mechanical engineer would often develop into a civil engineer, so, in his opinion, the chemical engineer would always exist, since the skilled mechanical engineer would occasionally find himself drawn, by circumstances, into the chemical industry.

Professor **Donnan** said that a great deal of the criticism had been based on most profound misunderstanding; the words "chemical engineer" gave rise to all the trouble. They certainly wanted constructional engineers, and engineers of every sort, and they absolutely wanted chemical engineers. The Americans were developing the training and production of chemical engineers on an enormous scale, and it was America and not Germany they would have to fear in the next 25 years. They must interest their professors of chemistry and of engineering, and the colleges should direct some of their young engineers off the old lines of making bridges and electrical motors, and put them on to some of those engineering problems presented by the chemical industries. A chemical engineer who had devoted himself to special problems of chemical work would not be objected to by anyone. He agreed with Professor Morgan as to the necessity of a large number of men trained in chemical research, but there was a very large class of young man who was required to go into the mill and turn the wheels and carry out experiments in order to get the data required for the engineering design of a chemical plant which might very well be included under the name of applied physical chemistry, or applied chemistry. A man who was accustomed to the laying out and designing of very large chemical works, when asked how many men he thought he required for research chemical laboratories, and how many for the other type of applied physics or chemical engineering, had replied that there were ten of those men wanted for one research chemist, and they could not be got at this moment. He said that the future progress of this country depended on producing those men in enormously greater numbers than at present—men who were trained in determining the conditions of reaction velocity, equilibrium, etc., which were not perhaps the most highly scientific forms of research.

Professor H. E. **Armstrong** said that it seemed to him that, throughout the discussion, there had been a curious assumption made that the engineer and chemist could and were going to work together. Dr. Carpenter was the first engineer who had occupied the chair of their Society, and the reason he took that position was not because he was a chemist, but because he had shown such extraordinary sympathy with the chemist, by really co-operating with the chemists on his staff. He thought Dr. Carpenter was the first man in the country who actually had proved it was possible for the engineer pure and simple to have sympathy with the chemist and work with the chemist. It was particularly fortunate that he had brought forward the example of the Navy schools. In the speaker's opinion it was the only rational school in this country, and represented the biggest educational experiment which had been made in the world. He had known it intimately from early days, and knew exactly on what lines it was working, and the kind of results they obtained. What they must do in the next few years was to make similar experiments in education in order to find out what was desirable. The question would arise whether special schools should not be developed for the purpose of producing chemists and engineers, and not only naval engineers. The main feature of the school was that it gave only half the time ordinarily given to literary work, the other half of the time being devoted to practical workshop work. The effect was not merely to make the boys efficient as manual workers, but also to make them alert and practical, which was the one thing they needed to do in most of their schools. If to-morrow every school were forced to devote half its time to manual work, they would be taking the most important step forward in education that could possibly be taken. With regard to training chemists and engineers to be one and both, that subject had been talked about as though nothing were known about it. It was forgotten that the Finsbury Technical College, and the City and Guilds College at South Kensington had carried on such work since the early '80's. The Finsbury College had been started by Professors Ayrton and Perry and himself in 1880. They had advisedly insisted that the course of training should be obligatory and should include a certain amount of mathematics, the elements of engineering, especially engineering drawing and some workshop instruction, together with physics and chemistry. That was also carried through at South Kensington. He had spoken on many occasions of the relations between chemistry and engineering. It was not a question of what they wanted to do, but of what they could do. As their President had indicated, the two types of men were not alike. In speaking of them as related as surgeon and physician, he had used a very happy phrase. There was a great deal more behind those words than might appear at first sight. They did not merely indicate two different branches of a profession, but they indicated two different types of mind, the one the man who did the outside carving, and the other man the physician, who sought to look inside and understand some little of what he saw. The chemist was in the same position as the physician more often than not, whereas the engineer was usually in a simpler position. For ever 30 years he had tried very hard to give the would-be engineer some instruction in chemistry, but with very few exceptions he had absolutely failed. The man who took engineering because it was in him was a constructive animal, whereas the chemist was much more an analytical animal than a constructive animal. He maintained that what they wanted in the chemist now and for a long time to come was a man who was a chemist and not a mere hanger-on. That was where the Germans had gone ahead so much of late years, and even they had deplored that there had been much less true chemistry taught in their schools recently. In the course of his career he had only known one successful man who had really been congenitally a chemical engineer, namely, Dr. Messel. He had known his works from very early days, and he was one of those astounding men who could be chemist, engineer, financier, and everything else. It was not merely as Professor Smithells had said, that a man could not afford the time to be both. There was no doubt if they could get the men they would be of infinite value, but in framing their scheme of education they had to bear many things in mind, and be more careful in selecting their men and developing them. The man who would become really valuable as a chemical engineer would be a man who got his experience in works. But they must not forget there were very few works which could afford such luxuries.

Mr. D. A. SUTHERLAND said that the chemical engineer had been recognised in Germany for a long time, and was coming forward rapidly in America. It was essential in his opinion to have a man who had specialised in a particular branch. So many chemists when they went into a works either did not care about, or took no interest in the engineering side of the work. On the other hand he had found that engineers were anxious to grasp the chemical side, but unfortunately they had no knowledge and could not help the chemist.

The CHAIRMAN, in moving a vote of thanks to the President for his address and for allowing them the unusual privilege of discussing it, pointed out that the discussion had not been of a critical nature, for all the speakers had been in agreement with the President, even those who advocated the creation of a chemical engineer, for what they meant was, as Mr. Blount had pointed out, sympathy between the two branches of science which could only be gained by professional experience. A man after he left college might become a chemical engineer or an engineer chemist according to his training and environment.

The PRESIDENT, in reply, said that a great deal had found its own answer in the discussion. He hoped his simile of the discipline of the battleship was an effective answer with regard to the point of dual control. They had on the battleship the engineer who was responsible for the engineering organisation of the ship, but that did not at all affect the fact that it was the captain of the ship who was responsible for the course steered, and for the tactics. No difficulty arose with dual control, nor could he conceive it to be a practical difficulty if it were only clearly understood that both the chemist and the engineer had their limitations. He was very pleased to find how many of those present were convinced that the qualities necessary to make a chemist and to make an engineer were quite different. It was fundamental to the human organisation, and what their teachers would have to do was find a means of discovering it, so that they could, as the speakers had said, lead the chemist along his path, and the engineer along his. There would be some respects in which they would overlap, but he believed the main principle would be, as Professor Armstrong had pointed out, that there were two different qualities of organisation in the brain of the chemist and of the engineer. Nothing would ever alter that; but they must work in the one direction, and their united forces would mean progress.

Manchester Section.

Meeting held at Grand Hotel on Friday, April 7th, 1916.

MR. J. H. HOSEASON IN THE CHAIR.

THE MINERAL CONSTITUENTS OF COTTON LINT.

BY J. H. BARNES, B.SC., F.I.C.

In 1913 a communication was received from a large exporting firm interested in Indian cotton to the effect that complaints had been made by one of their customers in England that the yarn of certain Indian cottons showed irregularity in its behaviour towards aniline colours. This was attributed by the dyers to the presence of hygroscopic salts in the raw cotton. An examination of this cotton, made on behalf of the exporters, revealed the presence of from 0·073 % to 0·014 % of magnesium chloride, which might have been added by the producer to prevent the evaporation of the water in the fibre, or might have been a natural constituent of the cotton.

The Punjab Agricultural Department was asked to ascertain the truth of the rumour that mineral salts are artificially added by the Punjabi cotton grower to increase the water holding capacity of the raw cotton.

Arno. Schmidt* mentions that damping of the cotton to increase the weight of the bales is or was carried on in Berar and the Central Provinces and that saltpetre and seed cotton is used with the same object in the north of the Madras Presidency.

The loose use of chemical terms by such a responsible person is to be much deprecated. Saltpetre referred to as an adulterant of cotton is nearly 1½ times as valuable to the cultivator as the cotton he is selling.

By "saltpetre," Mr. Arno. Schmidt probably means the naturally occurring earth-salts, the composition of which varies but which generally contain sulphates and chlorides of the alkali metals, calcium, and magnesium.

The Punjab Department of Agriculture instructed Mr. Milne, the botanist, to visit the ginning mills of the place specified, viz., Chak Jhumra. He found that the buildings were of mud with mud floors and that these floors showed evidence of earth-salts which are nearly always to be found in such buildings in the cold weather.

The manager of one of these ginning mills gave the information that the farmers do sometimes add earth-salts (local names "shori" or "kallar") with the object of adulterating the raw cotton and increasing the hygroscopic properties, and that factory owners and buyers usually put the samples to the test of *taste* in order to detect this sophistication.

It would thus appear *prima facie* that the complaint lodged by the cotton buyers and users against the producers is a genuine one and that steps ought to be taken to suppress this fraud as one likely to do considerable harm to the whole Indian trade in cotton. Before doing so, however, a further scientific examination of these cottons was deemed advisable and this paper embodies the result of these inquiries. This examination has shown that the inorganic constituents of the cotton fibre are far more variable than has hitherto been supposed, and we are inclined to believe that sufficient importance has not been attached by the grower, the spinner, and the dyer to this point. This paper is to be regarded merely as the prelude to further work on this subject.

The first point to be considered was the average composition of cotton fibre, particularly with regard to its mineral constituents, and to see how far these are likely to influence the process of dyeing.

An examination of the bibliography of this subject shows that it has received the attention of the U.S. Department of Agriculture. In their bulletin No. 33 the following average composition of the American cotton plant and its parts is given:—Roots, 8·8 %; stems, 23·15 %; leaves, 20·25 %; bolls, 14·21 %; seed, 23·03 %; lint, 10·56 %. The mineral constituents in a crop of cotton yielding 100 lb. of lint per acre expressed in lb. per acre—the weight of the entire crop being 947 lb.—are given as follows:—

Part of plant.		Nitrogen.	Phosphoric acid.	Potash.	Lime.	Magnesia.
	lb.					
Roots	83	0·76	0·43	1·06	0·53	0·34
Stem	219	3·20	1·29	3·09	2·12	0·92
Leaves	192	6·16	2·28	3·46	8·52	1·67
Bolls	135	3·43	1·30	2·44	0·69	0·54
Seed	218	6·82	2·77	2·55	0·55	1·20
Lint	100	0·34	0·10	0·46	0·19	0·08
Total	947	20·71	8·17	13·06	12·60	4·75

No similar figures for East Indian cotton are as yet available; they will be forthcoming in a later contribution. The only information obtainable was with reference to the total amount of inorganic matter present on burning the lint.

The following table gives the amount of ash contained in different varieties of cotton lint according to previous workers:—

	Matthews.	Monie.*
Dharwar	4·16	—
Dhollerah	6·02	4·10
Sea Island	1·25	1·10
Peruvian soft	1·68	1·80
Peruvian rough	1·15	1·25
Bengal	3·98	5·20
Broach	3·14	2·58
Oomrawuttee	2·52	2·93
Egypt brown	1·73	1·60
Egypt white	1·19	1·75
Pernambuco	1·60	1·98
American	1·52	Texas 2·1 Orleans 1·6

* For commercial cottons as they arrive at Liverpool.

In this table Matthews infers that Monie does not include the amount of mineral matter in the fibre of the cotton but only the sand or foreign mineral matter held mechanically in the baled material. I do not think this interpretation is correct, however. It seems based on this author's opinion that the amount of ash in true cotton fibre never exceeds 1 % (J. M. Matthews, "The Textile Fibre," J. Wiley and Sons, 1907, page 211).

I shall show later that this is not true for Indian cottons.

The ash of true cotton fibre consists of the carbonates, phosphates, chlorides, and sulphates of potassium, calcium, and magnesium. Some difference of opinion seems to exist as to the amount of these constituents, as may be seen from the following table quoted from Matthews' "Textile Fibres," page 212.

Mineral constituents of true cotton fibre.

	Ure.	Davis, Dreyfuss, and Holland.*
	%	%
Potassium carbonate	44·8	33·22
Potassium chloride	9·9	10·21
Potassium sulphate	9·3	13·02
Sodium carbonate	—	3·35
Calcium phosphate	9·0	—
Calcium carbonate	10·6	20·26
Magnesium phosphate	8·4	8·73
Magnesium carbonate	—	7·81
Ferric oxide	3·0	3·40
Aluminium oxide and loss	5·0	—

* Mean % 12 different varieties.

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* International Federation of Master Cotton Spinners and Manufacturers' Association, Secretary's reports, Dec., 1911,—Jan., 1912, page 82.

These figures may be compared with analyses made in the Lyallpur laboratory of a number of cottons from different sources.

Analysis of East Indian cotton lints. Lyallpur 1915 (*Barnes*).

Register No.	Description of sample.	Moisture, %	Ash, % on dried lint.	Ash analysis, %.		
				Soluble in HCl.	Silica and silicates insol. in boiling HCl.	Chlorine.
37	Lint fully good med. Texas	5·41	1·27	86·98	13·02	2·81
38	Lint fully good med. Memphes 13/16 in. staple	5·36	1·92	89·29	10·71	4·88
39	Lint fully good med. Arkansas 15/16 in. staple	5·09	1·67	93·08	6·92	2·23
40	Lint fully good med. 13/16-1 staple Arkansas	2·34	1·33	83·87	16·13	4·35
42	Lint American Sea Island	2·32	1·18	84·29	15·71	4·29
43	Lint Brown Egyptian	2·46	1·50	85·56	14·54	4·34
44	Lint White Egyptian............	2·23	1·37	88·95	11·05	4·11
45	Lint Alov.	2·39	2·37	85·60	14·40	5·11
41	Lint Amble (Guzerat)	2·23	3·99	84·44	15·56	6·55
46	Khandwa	5·45	1·86	84·77	15·23	2·92
47	Lint Kirkilly	5·01	2·76	81·15	18·85	2·98
48	Lint Nanded (Barsa)	4·74	3·08	72·00	28·00	2·62
49	Lint Parbhum (Barsa)............	4·89	3·71	68·28	31·72	2·09
50	Lint Sawqui.	4·48	3·06	83·1	16·9	3·75
51	Lint Fine Broach.	4·28	2·24	91·33	8·67	4·39
52	Lint Sample No. 1	4·68	1·63	94·47	5·53	4·42
53	Lint Sample No. 2	3·78	1·85	85·6	14·4	3·81
54	Lint Sample No. 3	3·79	1·96	95·56	4·44	2·48
55	Lint Sample No. 4	3·30	1·34	93·85	6·15	4·69

Samples Nos. 37 to 41 exclusive of No. 41 were supplied by the British Cotton Association; they are ordinary market cottons, not East Indian. Nos. 45 to 51 and No. 41 are genuine specimens of cotton grown in the Bombay Presidency and were supplied by the Imperial Cotton Specialist. Nos. 52 to 55 are Punjab cottons picked near Chiniot Road under the supervision of the Economic Botanist. A copy of Mr. Milne's note regarding these samples is given in the footnote.*

These latter samples may be taken as representative Punjab cotton such as was grown in the Lyallpur district in 1913-14. One of these samples (No. 3) was picked from plants growing on saline soil. Saline patches exist throughout the Punjab cotton tracts and the land around Chiniot Road is no exception but is rather worse in this respect than much of the surrounding country.

The principal points brought out in this table are these :—

In the first place Matthews' contention that the ash of genuine cotton lint does not exceed 1% is not borne out by the figures obtained at Lyallpur; either for American or for Egyptian cotton samples supplied by the British Cotton Association or for pure East Indian lints, and the wide variation in the amount of mineral matter found in different varieties of genuine cotton lint precludes us from laying down any specific figure for this as a determinant factor of purity. This received support in the amount of silica and chlorine found to be present. Secondly there is no apparent connection between the moisture contents of the lint and the amount of mineral substances present in the ash of the cotton. This latter seems to indicate that these mineral substances have been taken up by the plant itself in the course of its growth and are contained in the substance of the fibre. They are evidently not on the outside of the fibre, otherwise they would render the mixture attractive to water. Thirdly, there is the widely divergent figure for silica and silicates (mineral matter of the ash insoluble in boiling hydrochloric acid); with the sole exception of samples 52 and 53, the local Punjab cottons contain less than any of the Bombay cottons and do not differ very much from the American, Egyptian, or Island cottons supplied by the British Cotton Growing Association. Sample No. 53 is higher than No. 52, though why I cannot say. It is supposed to be the same as No. 52 with the exception that it was stored under better conditions, namely, on a brick floor instead of on one of beaten earth. There was no evidence of salt on the bricks and the moisture contents of No. 53 preclude any supposition that it had been watered and had drawn its salt from the soil, for the total amount of ash is very little higher, while the silica and silicates are much higher. No. 53 is much cleaner than No. 52 so we cannot explain the difference as due to dust or dirt.

I am inclined to lay stress on the composition of the ash and particularly on the insoluble portion of this as likely to be of importance to the dyer and spinner in affecting the behaviour of the cotton towards the chemicals used in dyeing. The presence of minerals in such a varying proportion cannot be without effect on the physical properties of the fibre, that is on the strength and life of the yarn. Within the limited scope of the inquiry there seems to be some connection between the quality of the fibre and the amount of silicates present in its ash.

Unfortunately I have not had the opportunity of pursuing the inquiry to the point of examining in detail the chemical composition of the ash of all these samples or of going further afield in the analysis of other cottons of known origin and value, though I am sure such an inquiry will yield results of great practical importance to both the grower and the user of the cotton.

The following table gives the complete analyses of two of the above samples.

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* Description of samples collected by Mr. Milne :—

Register No. 52. (Unginned desi cotton.) Taken from the cotton store-room at the extreme south-west side of the Haji Amanullah Fazal Din Factory. Walls of room of mud, floor of unbaked brick, no sign of "*kallar.*" The cotton was taken from very near the floor and it had been there for 12 days or so.

Register No. 53. (Ginned desi cotton.) Taken from same factory as sample No. 1 and from the store-room next to that from which that sample was taken. Walls of room of unbaked and floor of burnt bricks laid in mud. Sample taken from near the floor and had been there for 5 days approx. The room seemed free from "*kallar.*"

Register No. 54. (Unginned.) It is a mixture of local Indian and American cotton. The sample was taken in my presence from fields of these mixed cottons badly infested with "*kallar.*" The fields belonged to Lal Singh Bhagwan Singh of chak 185 R.B. The crop was very poor, owing, it was said, to "*kallar.*"

Register No. 55. (Unginned Indian cotton.) Picked by myself and others from a field close to Chak Jhumra railway station and to the north-west of it. The field belongs to chak 186 R.B. village Dogranwala. The crop was healthy and there was no sign of "*kallar*" in the soil.

Composition of the ash of pure cotton fibre.
Lyallpur 1915. (*Barnes.*)

Ingredients	Sample No. 41. (Amble Guzerat, Bombay.)	Sample No. 53. (Chiniot Road, Punjab.)
Silica (insol. in hot HCl)..	15·56	14·40
Alumina	10·80	12·87
Iron oxide	5·89	1·92
Lime	9·75	10·65
Magnesia	1·87	4·36
Sulphates (as SO_3)	1·96	2·52
Phosphorus pentoxide	3·26	4·46
Potash	27·32	26·03
Chlorine	6·55	3·81
Carbon dioxide	12·19	8·03
Soda	4·51	8·40
Undetermined and loss ...	0·34	2·52

This table shows a great difference in the composition of the two samples. Perhaps one of the most interesting features of this difference is the greater percentage of ash of No. 41 together with its higher carbon dioxide content as compared with the sample No. 53; the presence of a large proportion of carbonates in the ash seems to indicate that the metals in this sample were (previous to its ignition) present as organic salts to a greater extent than were the metals in sample No. 53. This would account for the production of more carbonates on ashing.

How far this results from the chemical nature of the soil, the type of plant, and the conditions of growth, the water supplied, and the temperature and humidity of the atmosphere, we do not know, but it offers a fruitful line of inquiry. So also does the relation between the composition of the fibre and its value to the manufacturer. Sample No. 53 was grown on soil and under climatic conditions which, we believe, should result in a maximum absorption of saline matter. The soil is saline to the point of barrenness in places—the climate is such as to induce the maximum amount of transpiration of water from the leaf, for the Lyallpur district lies in one of the hottest and dryest portions of N.W. India, the whole of the cultivation there being carried on by means of irrigation canals. On the other hand the cottons from Bombay are with one exception far more heavily impregnated with saline matter, in spite of the damper and more equable climate there during the growing season, which must certainly result in lower losses of water by transpiration.

In the Punjab, cotton sowing takes place in the end of March and the harvesting commences at the end of October and goes on until the middle of January—an average of from 8 to 8½ months for the crop. In the Bombay Presidency (Kirkee) sowing takes place in June (about the 10th), and harvesting is complete by January 15th. The crop in this case occupies the ground for about 2 months less than it does in N.W. India. It seems strange, therefore, that the cottons of this tract should contain more mineral constituents than do the cottons of N.W. India, which have a longer growing period and which, as we have shown above, are moreover grown under conditions which induce a presumably higher rate of transpiration. It is clear that the subject requires further investigation.

Church and Müller (Matthews' "Textile Fibres," page 213) gives the composition of raw cotton as follows:—

	I.	II.
Cellulose	91·15	91·35
Hygroscopic water	7·56	7·00
Wax and fat	0·51	0·40
Protoplasmic nitrogen	0 67	0·50
Cuticular tissue	—	0·75
Ash	0·11	0·12

Bull. 33, U.S. Department of Agriculture gives the proximate constituents of cotton to be:—Water, 6·74%; ash, 1·65%; protein, 1·5%; fibre (cellulose), 83·71%; nitrogen-free extract, 5·79%; fat, 0·61%. I am inclined to consider these latter figures to be the more representative; they are supported by the results of my own investigations so far as these are comparable.

It is of course known that all cellulose fibres, no matter from what source they may be derived, contain inorganic salts. It is known also that all these salts have been derived from the soil. It does not seem a satisfactory explanation to consider the salts found in cellulose fibres as the residue left after the drying up of the plant sap, for we know that such fibres resist the extraction of the mineral constituents to a remarkable degree. The amount of ash for example in bleached cotton varies from 0·1 to 0·6%, while special filter paper prepared for laboratory use by successive treatments with hydrochloric and hydrofluoric acids still often contains as much as from 0·03 to 0·05% of ash. What is more important is that so far as is at present known, it is impossible to remove the last traces of such mineral matter by chemical treatment.

Ladenburg (Ber., 5, 568) and Louge (Ber., 11, 822) as a result of an investigation of the ash of certain *Equisetum* species, consider that there is no evidence of an organic silicon compound in the plant. Likewise the rigidity of the bamboo and of the cuticular tissues of the cereal straws does not appear to be due to siliceous compounds. On the other hand the ash of a fibrous structure takes the form of the organic original, thus showing the mineral constituents to have existed throughout the fibre.

The presence of large and varying amounts of carbonates in the ash of cotton fibre leads us to suppose that some portion of the mineral matter is present in combination with an organic acid. Pectin salts play an important part in forming the binding substances between plant fibres. They have been shown by Mangin to consist of two classes of substances, viz., (a) neutral bodies including pectose, which is an insoluble compound closely resembling cellulose in its properties, and bodies of a gelatinous nature soluble, in water, known as pectins, (b) faintly acid substances, the principal member of the group being pectic acid which occurs in nature as calcium pectate. Such acids will account for the absorption of some of the mineral matter, and indeed neutralisation of excessive acidity may be one of the functions of alkaline salts in the sap of plants. Variation in the amount of the acid will lead to variation in the quantity of carbonates produced on ashing the fibre. The acid portion of the pectin group, the pectic acid, will therefore probably play an important part in the absorption of mineral matter by the fibre.

But besides this we know that cellulose has a high absorbent action on mineral salts in solution. This is admirably illustrated in the well-known experiment with barium hydroxide and phenolphthalein solutions on filter paper.

When solutions of these substances are allowed to wet a piece of filter-paper by placing a few drops of each some distance apart, so that the expanding wet portions gradually overlap, a pink colour is not developed immediately on contact of the phenolphthalein ring with the barium hydroxide ring—this follows later. As the solution of the alkali proceeds to spread through the paper the concentration of hydroxyl ions diminishes at the outer edge due to adsorption by the fibre of the paper. This affinity of the fibre for the salt is due to the presence of colloidal bodies possessing this special property. The same phenomenon is observed in some soils containing clay in a colloidal form. Pectins on the one hand, as well as pectoses and cellulose on the other, probably possess this property in a variable degree. The affinity of cotton for certain dyes is closely connected with this property. See Biltz (Nachr. Wiss. Göttingen, 1904, 1) and Suida (Sitzungsber. Wien, July, 1904), Knecht, Rawson, and Loewenthal ("Manual of Dyeing," C. Griffin, 1910, Vol. 1, pages 19, 25, 32, 38, 73, 78, 79, 87 and 89).

Matthews ("Textile Fibres," page 211) states that pectin compounds form the greater part of the impurities present in cotton. Suringor and Tollens (Z. angew. Chem., 1897, 1), examining the statement made by Link and Voswinkel (Pharm. Centralhalle, 1893, 253) that raw cotton yields wood gum as a product of hydrolysis, were unable to obtain any pentoses as products of acid hydrolysis of raw cotton and traces only of carbohydrates yielding furfural: they infer, therefore, that raw cotton contains no appreciable quantity of pentosans.

The widely different opinions of these several workers indicates the need of further investigation on the composition of different varieties of cotton grown in India.

According to Schunck (Matthews, page 210) American cotton contains about 0·84% of fatty matter while East Indian cotton contains only 0·337%. This oily matter appears to be identical with cotton seed oil.

The following table gives the results obtained at Lyallpur for the amount of ether extract obtained from the samples mentioned above.

Sample No.	Ether extracts from East Indian and other cottons.
	%
37	0·496
38	0·560
39	0·618
40	0·500
42	0·316
43	0·384
44	0·216
41	0·308
45	0·232
46	0·412
47	0·280
48	0·236
49	0·576
50	0·452
51	0·188
52	0·272
53	0·260
54	0·288
55	0·214

We do not obtain such high figures for fatty matter from either the American or East Indian cottons here examined as do other authors. Though low in its fatty contents the cotton of the Lyallpur district still contains sufficient of these substances to render it resistant to wetting by water.

The subject of the wetting of cotton by water and water vapour has been examined by Masson (Proc. Roy. Soc., 1904, 74, 230). His results, however, have not led to elucidation of the actual mechanism of interaction of the fibre and water. Further information on the subject seems required.

Summarising :—

There appears to be no evidence of the reported practices of salting the cotton to increase its water-holding capacity. Arno. Schmidt reports that he has seen watering of raw cotton actually taking place, but this is a crude form of sophistication and will certainly lead to deterioration of the fibre and cannot but come to the notice of the buying agents of exporting firms in India. It will thus rebound immediately on the persons practising this fraud and can be dismissed from the scope of this inquiry.

The complaint that the Chiniot cotton contains an unusually high percentage of magnesium chloride seems to be true, but we do not think that this substance has been artificially added, for the analysis of sample No. 53 shows that it compares with other genuine samples in the amount of water and mineral matter which it contains. The assumption that cottons grown on saline soils will produce a fibre more heavily impregnated with mineral matter does not seem to be justified by the results, for alkaline soils are much more prevalent in the Punjab than in Bombay.

The total amount of ash material in cotton fibre seems to have been under-estimated by previous workers, who seem to have assumed that this was largely due to foreign mineral matter in the form of dirt in the baled cotton.

The presence of highly varying quantities of silica especially seems to have escaped attention. I am inclined to lay considerable stress on the established fact that genuine cotton fibre may contain upwards of 1% of ash and that the composition of this ash is variable, and variable to a far greater extent than has hitherto been supposed.

There is little doubt but that this will seriously affect the reaction of the fibre to dyes; how far it will affect the tensile strength and keeping qualities of the fibre remains to be shown. It is evidently a factor which both grower and breeder must take into consideration, namely, the nature and quantity of the mineral salts taken up by different varieties of cotton grown in the same soil and under the same conditions and how far climatic variation will affect this as well as the effect of these mineral constituents on the commercial value of the fibre.

Nottingham Section.

Meeting held at University College, Nottingham, on Wednesday, October 25th, 1916.

DR. R. M. CAVEN IN THE CHAIR.

THE CHEMICAL EDUCATION QUESTION.

(Abstract.)

BY R. M. CAVEN, D.SC., F.I.C.

Since the occasion of my address to this Section on "The Education of the Industrial Chemist of the Future" (this Journal, 1915, 533), so much stress has been laid upon our national needs by those in high authority that it may well be supposed the public has been really awakened to these needs, and will consequently be asking advice as to how to meet and supply them.

It is true that our existence as a nation does not depend immediately on our general scientific equipment as it has depended on our equipment in munitions; but there are many who think that our existence in the future does so depend. Therefore if we are really aware as a nation of the scientific needs of the future, we ought to consider earnestly how they are to be met.

No doubt he would be a bold man who would advocate immediate expenditure in building new schools of science, or enlarging old ones, but it is the plain duty of those who can read the signs of the times to point to the inevitable need for such new or enlarged schools in the future, and for the adequate provision of qualified teachers to work within them.

It appears to me that the fundamental problem that confronts us as a nation and empire at the present time is this: How to cause the scientific spirit to permeate all our national and imperial enterprises. The problem is vast indeed, and the first necessary step towards its solution is the recognition amongst all classes of society of the Universality of Science. If we narrow the issue to chemical science alone, the question becomes this: how is our science to be made to permeate all those industries in which chemistry plays a part? And in truth this question is but a little narrower than the general scientific question; for it would be hard to find an industry in which chemistry plays no part.

In the teaching of evening students engaged during the daytime in industrial operations and anxious to acquire some knowledge of the chemistry of their industry, a matter of some difficulty arises. What is to be done for a student in a specific trade, who without any previous chemical knowledge wishes to learn quite quickly the chemistry of his trade? Here for example is a student who wants to learn the chemistry of leather-dressing. First, we enunciate the principle that some general knowledge of chemistry is necessary, before the science can be applied to any trade. The student acquiesces, and the elementary work begins. One of two things will then happen: either the student finds that he has no bent for chemistry, and promptly disappears; or else he persists, and in time grows restless and wants to come to leather-dressing.

In this case some conversation on the subject gives one points on which to hang a system of practical work; and perhaps a little book may be found which gives some really serviceable advice. The student finishes his course; he has done the chemistry of leather-dressing—or what not—and returns to the factory to apply his knowledge. What does not transpire—what we never know—is just precisely how far the industry of leather-dressing is advanced by this student's special course. Does any good come of it? In view of the high ideal of chemical training we are striving after, and of the extraordinary complexity from a chemical standpoint of many trade processes, can any good come of such partial training, such tinkering at the subject? Really I do not know. This is an illustration of a problem of chemical education that we need to solve.

Regarding the question of the education of the chemist in the highest sense, I would point out that this education and training do not begin within the walls of the university or college. There is the previous school course to be thought of. The complaint has been made that not enough science has been taught in our schools. That is no doubt true of some of our great public schools, but it is not universally true. Instead of complaining of the lack of science, I would rather complain of the lack of the scientific spirit, laying emphasis on the words of the Poet Laureate: "Not only should natural science be introduced, but all teaching of all subjects should be scientific in method." That is what matters most. If I have any criticism to offer of the school training of some of our chemical students, it is that they have been taught too much chemistry of a sort, not too little.

In my opinion qualitative analysis in the ordinary sense should not be taught at school. It should be reserved until the student is gaining a thorough insight into the chemistry of the principal elements, and of the nature of solutions; until his mental outlook is sufficiently advanced to enable him to appreciate the significance and beauty of the chemical separations which he carries out. Volumetric analysis should precede qualitative work, but here, again, the accuracy aimed at is more important than the number of methods studied. Nothing can be more harmful than for a student to rush through a number of volumetric methods in order to comply with an examination syllabus, and very likely to pass the examination, because no very high standard of accuracy is required in the examination room; for the habit of slipshod work is most difficult to eradicate, and should never be contracted to meet the exigencies of any examination.

I would suggest that if a boy matriculates at sixteen, and has another year at school, it is better that he should not immediately prepare for the intermediate science examination, but should occupy his later schooldays, before entering college, with the quiet maturing of his knowledge and his faculties. And if I am asked how he should occupy his time during this year, I suggest that the year should be a wander-year, a year of intellectual and spiritual preparation for the life of the university.

What an advantage it would be to a boy if before entering college he could learn a little about the historic sources of his science, and sit for a time at the feet of the great masters of the past. Then careful quantitative experiments should be devised and carried out with the greatest possible accuracy. At the same time numerous exercises in practical physics and physical manipulation might be worked, the main purpose throughout being that rigorous training in accuracy and delicacy of thought and action without which no true science is possible. Some slight acquaintance with biology, economic geography, and geology might also be gained during the year.

The college course of the chemical student is clearly indicated, and consists of the simultaneous preparation for an honours degree in chemistry and for the examinations of the Institute of Chemistry. I see no reason to complain of such a course, and I do not know how it could be improved upon. I sometimes think, however, that it is an anomaly that the same degree syllabus should be made to serve, whether the student is to become a teacher, an analyst, or a works chemist, but as regards the syllabus of the Institute of Chemistry, it seems to me altogether admirable, and indeed stiff enough to deter all but the most brainy and enthusiastic people from daring to embark upon the career of a scientific chemist.

While it is undeniable that facts may be learnt from books, there is no such thing as action at a distance in a true chemical education, any more than in a true chemical reaction. Continuous intercourse must be maintained between teacher and student, and one cannot exaggerate the importance of the personality and scientific ideals of the teacher.

In my former paper I discussed the question of the technical training of the chemical student, and whether he should receive instruction in actual technical processes during his college course. The question appeared to be one of difficulty, but Mr. F. H. Carr has recently (this J., 1916, 919) offered a valuable solution of this particular problem.

DISCUSSION.

Mr. H. **Droop Richmond** said that there should be more co-ordination of chemistry and the allied sciences in teaching. In the universities a little more might be done in the way of teaching chemistry from the point of view of mass and energy and value. There should also be more co-ordination between the mathematical side and the chemical side, and the student should not only be taught the language of chemistry and the language of mathematics but be taught to translate the one into the other.

Mr. S. G. **Sastry** said that a small works could not always afford to employ a qualified chemist and in consequence was driven to the public analyst. The interests of the proprietor of such works should be safeguarded, and his secrets not divulged. If each society could have a central laboratory which would undertake all important investigations for the advancement of chemical industry, perhaps manufacturers might be induced to confide in those engaged in such a laboratory and thereby improve their own industries.

Mr. C. H. **Parsons** said that a little knowledge would enable those who had simple processes to conduct to follow more clearly the instructions of their superiors. Therefore he would suggest that those who had not the scientific spirit but yet had the desire and the ambition, should be allowed to know something about the processes they worked. It was a good thing that they should have even a small smattering of knowledge. Many years ago he (the speaker), as junior chemist in a works, with only a smattering of chemical knowledge, had been able to arrest a process that was an absolute failure and transform it into one that was profitable. Small works could co-operate by either employing or supporting a trained man in their special trade. Managers of works should be educated to the necessity of the trained man. A man could not do good work on £2 a week or anything like that.

Professor F. S. **Kipping** said that on the question of how chemists should be trained, after the B.Sc. had been passed, there were two utterly divergent opinions. One opinion had been expressed by Mr. Carr, who thought that the chemist who was going into a works should go to a college where he should learn a great deal of engineering, a great deal of chemistry, and a great deal of what might be called the commercial aspect of the case. The other point of view, and one which he himself held, was that the career of the student was so short that it was impossible to give him training of that kind, if he were going to be a scientific chemist. Now the chemists engaged in works have to carry on totally different duties; therefore it seemed to him that their training should be absolutely distinct. The question arose where and how was that training to take place? In a college like University College, Nottingham, any attempt to teach the commercial aspects of chemistry necessary for a departmental manager would be a failure: in the college suggested by Mr. Carr no doubt it might be a very great success; but for the great majority of students it seemed to him that it would be sufficient to train them in research. Would it not be possible for the training of the chemist as regards his research work to take place in the recognised colleges, and for his further training to take place in the works? It would seem that such an arrangement should fulfil all the necessities of the case. Works managers, he understood, were now willing to take chemists who had no training as works chemists. Many works managers in fact, did not wish to have any technical bias given to the training of their chemists while at college; they wanted them to be trained merely in pure science; then when the chemists went into the works laboratory they could be sorted according to their ability and employed either as practical men or as research chemists. It seemed to him that the training of departmental managers should be done in the works. In colleges or universities any attempt to give a distinctly commercial bias to teaching would be worse than useless. What they had to do was to train in methods of research—to train not only chemists but men who would be reliable and useful in many other directions as a result of such training.

Mr. F. H. **Carr** agreed with practically all Dr. Caven had said. So far as his experience went of candidates for positions, and he had met a great many such, it had always been that the man who had thought himself to be most excellent was he who had done best at examinations, but in most cases that was the very man who was least likely to fill the vacant post well. And it was not at all uncommon to come across a candidate who imagined that one should make no enquiries beyond asking whether he had passed this or that examination. Now that attitude of mind was unmistakable evidence that the man would be a failure in the works.

As regards the man who attended evening classes and got just a smattering of knowledge, he agreed that if a student were properly taught and if he really did learn ever so little, he became a better employee for it; it was not that he had become a chemist or anything of the sort, but he had got something to which his works experience could add more. He was extremely interested in the suggestion of a "wander-year." The idea was quite new to him, but it coincided in some ways with the proposal to teach in the sixth form of our schools something of the achievements of science and of the work of great men of science, and that was perhaps even more suitable for those students who had not taken science than for those who had. It had never occurred to him, however, to go to the extent of making it a whole year's course preparatory to science.

In answer to the point raised by Prof. Kipping respecting the utilisation of the study of research as an introduction to the technology of chemistry, in the paper referred to he had carefully pointed out the difficulties of that. It was a fundamental mistake that had been made in this country. Research men were wanted in works, but still greater than that need was that of chemists with certain qualities of mind and of interest which were different from, though not incompatible with, those of the research chemist. That was the gist of the argument on which he based his distinction between the training of a research chemist and a commercial chemist. His suggestions related to a post-graduate course and not to the training inside a university. As to whether there was possibly time for such a scheme of education in the student's career, a chemist did not complete his training in three years whether he became a research chemist or an analytical chemist, nor could the works chemist complete his training in that time—it took at least five or six years and then he had not finished.

Mr. T. H. **Gray** said that the great thing to consider was whether a man was to be a research chemist, a works chemist, or a departmental manager—whether a man should be trained on highly scientific lines or in a haphazard way was not to the point.

Mr. M. **Barrowcliff** said that in the college the inculcation of the "spirit of research" should not be left for a post-graduate course, which so few were able to take. The thorough working out of the preparation of quite simple and well-known organic substances to the extent of finding the best method and obtaining the highest yield called for the same qualities as did a complicated new synthesis. They would get better men, in his opinion, if each student in his third year, instead of carrying out indifferently a large number of preparations, were given one only at a time and required to work it out completely over a number of weeks or months, with the collaboration of the demonstrator. The training and experience gained in a laboratory where a number of these simple researches were being simultaneously carried out would be of much greater value than under present conditions.

Dr. E. B. R. **Prideaux** said that of the obstacles which stood in the way of Great Britain being in the future the most important centre for the industrial utilisation of the raw materials of the Empire, not the least was the lack of men trained to use their heads as well as their hands. In many industries the day of the factory "hand" was rapidly passing away, and the less progressive nation which allowed an unduly large proportion of industrial work to be carried out by unskilled labour, would inevitably be beaten both in peace and war by others which had the skill and foresight to make the greatest and most economical use of natural sources of energy. Therefore a preliminary training of at least one year in mathematics, physics, and chemistry must in the future be placed within the reach of a large majority of the population. The instruction should be given in continuation schools, either day or evening, which should continue the elementary education system without a break. It will be quite impossible for existing technical schools to deal with the numbers; and the multiplication of technical schools for this purpose seems unnecessary. A technical school of a good type was equipped for other work than the giving of the irreducible minimum of instruction to the rank and file of the industrial army.

Beyond that, educational facilities ought to be such that every man should be able to progress just as far as his abilities and energies permitted. That was the field of the technical college and the university which might, broadly speaking, train the works manager on the one hand, and the researcher or inventor on the other. The continued education of the vigorous thinker who was to take a leading position in industry was a matter which has been discussed recently in this Society, and a most valuable definite scheme had been put forward by Mr. Carr. In discussing such schemes there were two points which must always be borne in mind. In the first place it was most desirable that the university should develop freely the individual bias of the student if any such were displayed in the post-graduate years. In the second place, there were often most stringent limitations to what the university or college could attempt, on account of lack of room, lack of funds for supplies, and a staff far too limited both in numbers and in opportunities. Those conditions would probably get worse unless the large industrial concerns came to the rescue. Even with all those disabilities, a closer association between the university teacher and the technical specialist, who was or ought to be still a student, offered some advantages to each. In the first place the professional teacher could often teach, that is to say he was accustomed to explain all kinds of chemical operations and theories for hours at a time. The specialist often arrived at his ideas by a very rapid train of reasoning, and had some difficulty in explaining them to immature or uninstructed minds. A teacher might even put the original ideas of a specialist so clearly into words, that other ideas might be suggested. Then again, a teacher possessed a fairly wide knowledge of principles, and hence had a certain power of outlining new situations and getting new points of view, which was sometimes lacking when the mind had been concentrated too closely on a particular department, and mainly with an eye to costs and yields. That was the justification for university courses on general or special departments of chemistry which had been studied by the teacher mainly from the theoretical point of view.

If the technical specialist would more often in return invite the teacher to see some interesting process, and let him see how and where the economic factors come in, the benefit would be mutual.

The CHAIRMAN, in reply, said he believed it was a common practice in Germany for a young man of means to have a year of travel before he settled down to his life work, and if it were desirable for a young man to have such an experience at the end of his university course, it might also be well for a youth to have an analogous intellectual experience at the end of his school life, and before he went to the university.

Communication.

THE STEM CORRECTION OF THERMOMETERS.

BY EDWARD G. WHEELER, A.I.C.

During continuous distillation in the laboratory, the conditions for the accurate demonstration of the temperature of vapours leaving the distillation flask or rectifying head, preclude the total immersion of the mercurial column of the thermometer in the vapour of a boiling liquid.

A correction, therefore, becomes necessary for the heated portion of the thread. It may happen that circumstances require this to be ascertained speedily, for a succession of readings, during, for example, the separation of a series of fractions by a continuous distillation, when there is hardly time to make the necessary calculation.

The correction has been expressed by the formula $C = K(t-t_1)n = K(t-t_1)(t-t_{11})$, where t = the observed temperature on the thermometer; t_1 = the temperature of the external column, as determined by an attached thermometer; t_{11} = the first unexposed graduation on the thermometer; $n = (t-t_{11})$ = the length of the external column expressed in degrees, and K = a coefficient representing a function of the length of the external column, $= (\alpha + \beta n)$, but which according to Thorpe (J.C.S., **37**, 159) can be taken as having a mean value of 0·000143, and which gives sufficiently accurate results for all values which are likely to occur in practice.

Although the component parts of the correction C, are independent of one another, it has been found possible by means of the accompanying graph, to read off the stem correction directly, from the observations made, viz., from t, t_1 and t_{11}. The method of utilising it is as follows:—

Find the junction of the ordinate of t_1 and the abscissa of t_{11}, then move parallel to the curved lines to the junction with the ordinate of t, when the corresponding stem correction can be read off.

The following are two examples:—

If $t = 200°$, $t_1 = 25°$, and $t_{11} = 59°$, find the junction of the co-ordinates corresponding to the latter two values; move parallel to the thick curved lines to the junction with the ordinate of $t = 200°$. This point will be seen to give a reading of $C = 3·5°$ on the thick slanting lines.

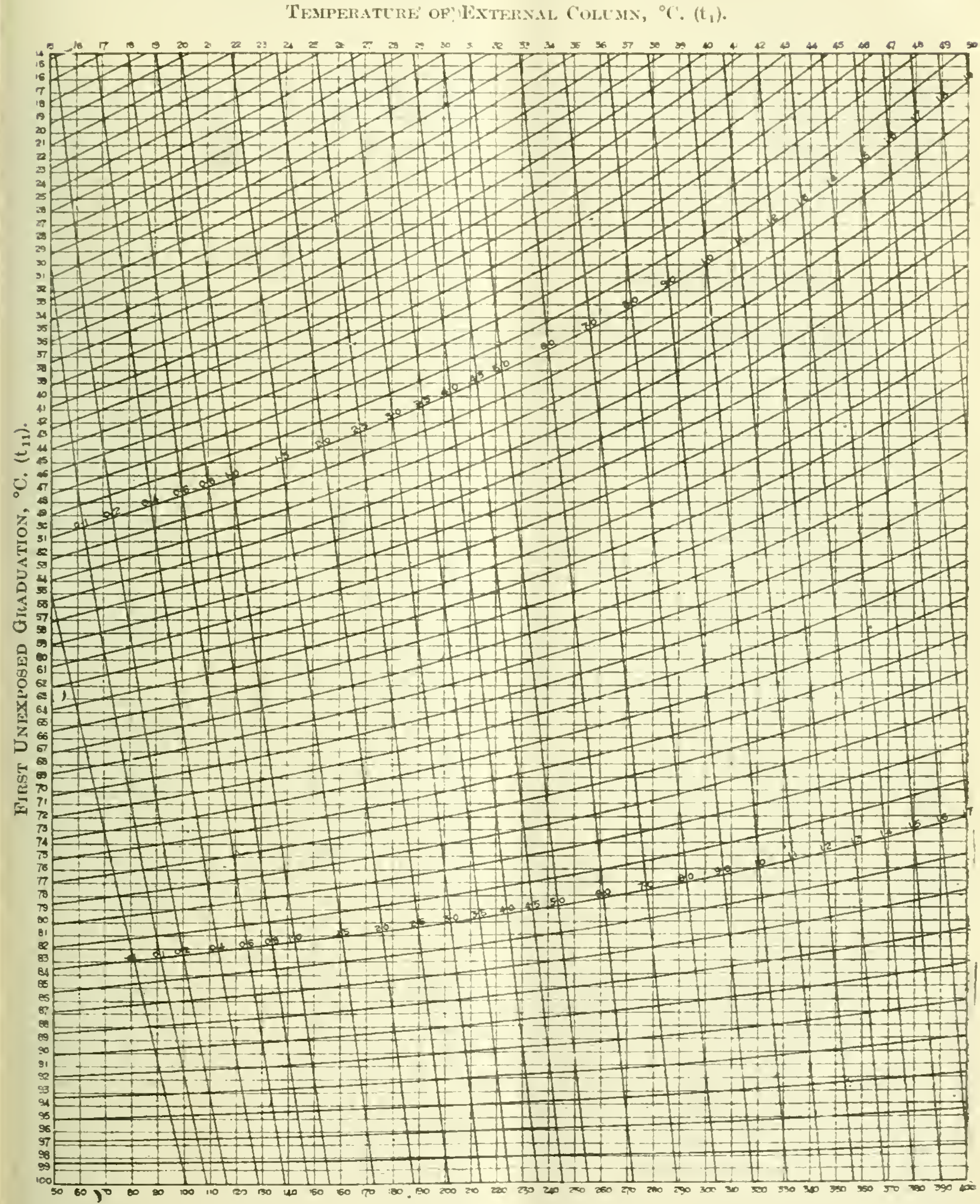
Again, if $t = 300°$, $t_1 = 30°$, and $t_{11} = 70°$, find the point whose co-ordinates are $t_1 = 30°$ and $t_{11} = 70°$; move parallel to the thick curved lines to the junction with the ordinate of $t = 300°$. This point gives a reading of $C = 8·9°$ on the thick slanting lines.

The graph was plotted in the following manner:

Let C_{100} = the stem correction at 100° in $C = K(t-t_1)(t-t_{11}) \therefore C_{100} = K(100-t_1)(100-t_{11})$.

By taking various even values for C_{100} in this equation corresponding values of t_1 and t_{11} were calculated and plotted; this gave the curved lines which represent constant stem corrections at 100°.

The values of t and t_1 were so plotted that the corresponding values on the same ordinates were connected by the equation, $t_1 = \frac{t+100}{10}$



THERMOMETER STEM CORRECTIONS. °C.

By substituting t_1 and t_{11} in the first equation, the following equation is obtained :

$$t^3 - \frac{9100}{9}t^2 - \left(\frac{10C_{100}}{K} + \frac{10C}{9K} - \frac{910,000}{K}\right)t + \frac{1000C_{100}}{9K} + \frac{1000C}{K} - 10^6 = 0$$

This is a cubic equation in t, which can be solved on giving particular values to C and C_{100}.

Taking the C_{100} lines as one axis, and the base line (t) as the other axis, lines of equal stem correction can be plotted.

I have pleasure in recording my indebtedness to Dr. Percy E. Spielmann for his suggestions and continued interest.

Industrial Notes.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

An announcement of the greatest importance to British industries was made in the Press on December 1st, to the effect that the Government have decided to establish a Department of Scientific and Industrial Research for Great Britain and Ireland, under the Lord President of the Council, with the President of the Board of Education as Vice-President. They have also decided, subject to the consent of Parliament, to place a large sum of money at the disposal of the new Department, to be used as a fund for the conduct of research for the benefit of the national industries on a co-operative basis.

The Board of Inland Revenue have decided, with the approval of the Chancellor of the Exchequer, that no objection shall be offered by their surveyors of taxes to the allowance, as a working expense for income-tax purposes, of contributions by traders to industrial associations which may be formed for the sole purpose of scientific research for the benefit of the various trades, and the allowance would be equally applicable as regards traders' contributions specifically ear-marked to the sole purpose of the Research Section of an adapted existing association. In both cases the allowance would be subject to certain conditions, *e.g.*, the association or the research section to be under Government supervision and the trader's contribution to be an out-and-out payment, made from his trade profits, and giving him no proprietary interest in the property of the association, etc.

In order to enable the Department to hold the new fund and any other money or property for research purposes, a Royal Charter has been granted to the official members of the Committee of the Privy Council for Scientific and Industrial Research, under the title of the "Imperial Trust for the Encouragement of Scientific and Industrial Research." The Trust is empowered "to accept, hold, and dispose of money or other personal property in furtherance of the objects for which it has been established, including sums voted by Parliament to that end." The Trust can take and hold land, and can "accept any trusts, whether subject to special conditions or not, in furtherance of the said objects."

A substantial gift has already been made to the Trust by two members of the Institution of Mechanical Engineers for the conduct of a research in mechanical engineering to be approved by the Department, in the hope that this example will be followed by other members of the institution.

Mr. H. Frank Heath, C.B., has been appointed permanent secretary of the new Department, to whom all correspondence should be addressed until December 31st next, at the offices of the Board of Education, Whitehall. On and after January 1st, 1917, all correspondence should be addressed to The Secretary, Department of Scientific and Industrial Research, Great George Street, Westminster, S.W.

On November 30th the Marquis of Crewe received a deputation from the Conjoint Board of Scientific Societies. The deputation, which numbered about 150 representatives of the various branches of science, was introduced by Sir J. J. Thomson, President of the Royal Society, and included, as representatives of this Society, Dr. Charles Carpenter, Sir Boverton Redwood, and Mr. Walter F. Reid.

Sir JOSEPH THOMSON said that the deputation desired to urge the importance of increased grants for scientific and industrial research. Research in pure science was of vital importance, and had led to a number of discoveries which had proved subsequently to be of the greatest practical value. The discovery of Röntgen rays, for example, arose from a research of a purely scientific character, undertaken with a view to elucidating the nature of electricity.

Research in applied science might lead to reforms, but research in pure science led to revolutions. The State could insure that professors and others engaged on purely scientific research could devote sufficient time to it, and that their income from the professorships was not so small that they had to spend their free time in undertaking work to enable them to live. To neglect pure science would be on a par with omitting to sow the seed on land on which a large amount had been spent in manuring and ploughing.

Sir Maurice Fitzmaurice, President of the Institution of Civil Engineers, and Prof. Brereton Baker, of the Imperial College of Science and Technology, also spoke.

The MARQUIS OF CREWE said that we had to provide for the new conditions which would arise in this country, and in the rest of the civilised world, when the war was concluded. The Government had been impressed by the need of coming further to the help of those who were engaged on research work in relation to industry. They had had to consider what could be done to assist the great staple industries of the country in developing systematic research on a large scale. There were cases in which an individual research worker needed a grant to enable him to go on at all, and a sum would be set aside for that purpose. There were some professional societies which stood in need of assistance from time to time to enable them to carry on research work, and this charge would also be met. There was, further, an area of research which paid nobody in the pecuniary sense for the time being, and in some of these cases it would be necessary to find the money from public funds. Then there were some researches which were so obviously of purely national importance that no one would be found to finance them if the Government did not do so. Here, again, the Government felt that public money ought to be applied in specific and selected cases.

The matter of scientific research applied to industry was, it was considered, one of the cases in which an exception might be made to the usual plan of procedure by annual estimates. Therefore the Chancellor of the Exchequer was prepared to advise the Government to devote a very large sum, generally estimated to meet the needs for this purpose for the next five years, on a scale which ought to enable them to spend certainly four and possibly five times as much on the co-operation between the Department and the different industries as had been spent for the whole purposes of research by vote hitherto.

They desired to see the creation or adaptation of trade associations on a large scale, which might be able to assess the contribution which the industry was able to make towards systematic research. In some cases it might be found advisable to form a series of distinct associations for research purposes. On the other hand, it was quite possible that an individual great firm having various activities might belong to several associations and make its contribution in respect of the particular class of research which might be proceeded with at a given time. These associations should as far as possible be placed under small committees of direction, including leaders of the particular business, men of science, and representatives of the skilled workers in different trades.

It was proposed to give some further help for technical instruction. The Government had arrived at the conclusion that the present regulations under which technical schools received public money were not quite up to date, and they were going to discuss with the local authorities concerned, and the governors of the schools, certain new draft regulations, which, it was hoped, would both simplify administration and stiffen up the instruction. A substantial addition would be made in the Estimates so as to permit of a levelling up of the grants to a reasonable figure, and also to make improved arrangements for the training of technical teachers, as well as to permit of scholarships being established to carry on selected industrial students to the Universities.

Referring to the work of the Coal Conservation Committee, Lord Crewe said he understood that that Committee and the Advisory Council had agreed upon a series of researches which were designed to establish, on a scientific basis, a systematic economy in the use of fuel. The research was to begin with a systematic survey of all the various coal measures in the United Kingdom. It was to examine and experiment on coal under various furnace tests, and the suitability of different kinds of coal to different processes of coking, and so forth.

Although, in the higher forms of discovery, we in this country were not prepared to yield the palm to any country in Europe or out of it, we felt that for many the path of scientific learning had not been made as easy as it ought to be. What was desired was to make the road easy for those sons and daughters of Britain who saw the beacons of science shining ahead of them on a high hill, which it was their life's work to climb.

BENZOL FROM COAL GAS.

The national demand for benzol and toluol in increasingly large quantities has met with a prompt response by a large number of gas undertakings in this country, who are removing these hydrocarbons from their gas by washing with oil. An interesting discussion on the subject took place at a recent meeting of the Southern District Association of Gas Engineers and Managers. Although certain difficulties have presented themselves, particularly in regard to naphthalene troubles, it was clearly shown that these difficulties are by no means insuperable. It is to be hoped that the practice of oil-washing will very shortly become almost universal, and that it will not be necessary for compulsory measures to be introduced as was advocated by some of the speakers. Even very small gas works are using this process of washing—works making from 10 to 20 million cubic feet per annum.

Oil washing takes place after the gas has been freed from ammonia. Creosote, anthracene oil, or gas-oil may be used. Dr. Colman's specification for creosote, as approved by the Department of Explosives Supply, is as follows:—sp.gr., 1·020 to 1·030 at 60° F.; tar acids, immaterial; should deposit no naphthalene on cooling to 55° F.; should not boil below 200° F.; and on distillation not less than 70 % nor more than 90 % should distil up to 300° C. This oil takes up from 3 to 4 % of its bulk of benzol and toluol, which is subsequently removed by distillation.

As mentioned above, one of the chief troubles which has been met with in connection with the oil-washing process, is that due to naphthalene. With a wash oil containing an excessive amount (10—20 %) of naphthalene, and gas at a high temperature, the naphthalene content of the gas may even be raised, but in general, with a wash oil containing about 5 % of naphthalene, the amount of naphthalene in the gas is considerably reduced. The trouble in this case is caused by the fact that at the same time the naphthalene solvents in the gas are removed in even greater proportion than the naphthalene itself, and hence deposition in the mains will occur. This difficulty is got over by adding to the gas after oil-washing a sufficient amount of solvent to prevent the deposition of naphthalene before it reaches the point of use. Many solvents can be used for the purpose, but ordinary kerosene is the most easily obtainable. It can be introduced into the gas either as vapour, or in the form of a very fine mist, produced by spraying, but the mist must be fine enough to carry to the extremes of the district supplied. It is important that this addition of solvent should be made at the time oil-washing is adopted, and not deferred until naphthalene troubles appear.

Gas which has been freed from its benzol and toluol contents is naturally deficient in illuminating power, and cannot comply with the standards in this respect. To meet this difficulty the Government has given permission to gas companies to apply for powers to work to a calorific standard (see this J., 1916, 882).

Further particulars as to the process may be found in this Journal, 1915, pages 170, 481, 539, 1001, 1079; 1916, pp. 460, 682, 1146.

THE BRITISH COAL-TAR COLOUR INDUSTRY AND ITS DIFFICULTIES IN WAR TIME.

BY C. M. WHITTAKER.

In a lecture delivered before the Royal Society of Arts on December 6th, and reprinted in the Journal of that Society for December 8th (Vol. 65, pp. 61 *seq.*) reference was made to the initial success of the British dye industry following the discovery of mauve by Sir William Perkin in 1856. This success, however, was not maintained, chiefly due to lack of effort and was subsequently followed by a period of decline. Succeeding this period the dye industry was reanimated as a result of more enlightened management, and during the 14 years prior to the outbreak of war was able to offer competition to the German firms. Thus at the outbreak of war the British firms were a considerable national asset.

Certain statements which had been made concerning the lack of British enterprise in the distribution of circulars and pattern cards, and the failure to match colours, were shown to be without foundation, and reference was made to the fact that the hydrosulphite vat process for dyeing indigo, which was a French invention, was first introduced to the British dyers by Read Holliday and Sons, Ltd.

At the outbreak of war the consumer quickly realised his dependency upon German firms for supplies, and statistics were quoted to show that a very large percentage of the coal-tar colours imported by Great Britain were derived from Germany. Attention was drawn to the false impression prevalent concerning the capital involved in the German dye industry and to disperse the existing delusion of the dependence of Germany upon outside sources for raw materials (see this Journal, 1916, 783).

Concerning the difficulties which beset the British coal-tar industry, mention was made of the scarcity of chemists experienced in large scale operations, and the diversion of many forms of labour to the manufacture of explosives. Again the bulk of raw material required for the manufacture of explosives is inseparably associated with the production of coal-tar colours, and in this statement lies the answer to the consumer who urges the early production of the commoner types of dyes, the manufacture of which has long been known and established.

Next in importance to the demand for explosives has been the urgent requirements of dyes for military purposes—requirements embodying those of the Allies apart from those of Great Britain. The quality of these dyes has been, contrary to various assertions, fully equal to that of the German colours. Under the extenuated circumstances of shortage of skilled controllers, of labour, and of material, it was gratifying to know that this huge demand had been successfully met, and the British colour industry had every reason to be proud of its achievement.

Reference was then made to some of the more important derivatives of benzene, toluene, and naphthalene used in the manufacture of dyes; this part of the subject has already been dealt with by the lecturer in the paper read before this Society (see this J., 1916, 784—786). In connection with the vat dyestuffs, a specimen was exhibited which had been dyed with Chloranthrene Blue (Indanthrene Blue), produced by British Dyes, Ltd.

Regarding the future of the British coal-tar colour industry, the hope is expressed that this industry will survive the peculiar difficulties which beset the initial stages of most British trades.

E. H. B.

DYESTUFF CENSUS OF THE UNITED STATES.

The United States consumes annually about 29,000 tons of dyestuffs, of which about 90% was imported before the war. The cessation of German imports in the early months of the war threatened the American textile industry with very serious dislocation unless a large output of dyes could be secured within a comparatively short time. The Bureau of Foreign and Domestic Commerce speedily realised that it would be of the greatest assistance to manufacturers if they were in possession of detailed particulars of the various kinds of dyestuffs normally consumed in the country, and therefore took active steps to complete a census of these products. It was early realised that it would be impracticable to obtain the necessary particulars from the numerous consumers—similar efforts in Great Britain resulted in a return of details of about 12% of the total consumption. The method adopted was to use the data furnished by the records of imports of artificial dyestuffs into the United States during the year ended June 30, 1914, adding to these figures the returns of the Bureau of the Census for the American coal tar industry for 1914. The import invoices contained entries under 5674 heads, each representing a distinct commercial designation. Many of these, however, were synonymous, and the list has been reduced as far as possible to correspond with the classification of Schultz and Julius' "Farbstofftabellen" (1914). A summary has been prepared, showing the amounts of the more important dyes consumed, namely, those of which more than 10,000 lb. was imported in the year ended June 30, 1914. The summary is given here as, although it relates to the United States, it should be of great value to the other countries that are endeavouring to render themselves independent of foreign imports of dyestuffs.

Summary of the most important colours imported by U.S. during fiscal year 1913—14.

The abbreviation V.M. denotes "various marks." The serial numbers employed correspond to those found in Schultz's "Farbstofftabellen" (edition of 1914). Numbers preceded by letters refer to colours regarding the manufacture and chemical composition of which little or nothing is known. Azo dyes in this category are indicated by A, sulphur colours by S, and other dyestuffs of unknown composition by U.

CLASS I. (10,000 TO 100,000 lb.)

Serial No.	Commercial name.	lb.	Invoice value.
	Nitroso and Nitro Colours.		$
4	Naphthol Green	19,146	2,902
	Stilbene Colours.		
9	Direct Yellow	71,399	11,295
9a	Naphthamine Yellow (V.M.)	42,180	6,748
9b	Direct Yellow (V.M.)	79,055	16,784
9g	Direct Yellow B	29,123	2,766
10	Stilbene Yellow	50,477	7,464
10a	Stilbene Yellow RX	34,688	6,305
11	Chloramine Orange	24,688	5,914
13a	Diphenyl Orange GG	13,646	3,938
14	Diphenyl Chrysoine	9,898	3,071
18	Diphenyl Fast Yellow	9,656	2,988
	Total	364,710	67,273
	Pyrazolone Colours.		
19	Fast Light Yellow	33,514	10,272
20	Flavazine S	19,000	4,927
20a	Flavazine (V.M.)	62,375	10,700
22	Xylene Yellow	23,074	9,750
	Total	137,963	35,649
	Azo Colours.		
33	Chrysoidine	63,303	8,585
37	Croceine Orange	11,366	1,535
38	Orange G	48,456	7,159
45	Brilliant Lake Red R.	31,674	2,337
56	Autol Red	49,847	5,379
58	Mordant Yellow	26,670	4,112
58a	Alizarin Yellow (V.M.)	59,000	7,676
58	Orange 13, 14	10,974	2,031
61	Victoria Violet	47,126	10,998
63	Azo Acid Blue	44,258	8,541
64	Lanafuchsine	68,055	9,375
66a	Amido Naphthol Red	36,000	25,970
70	Brilliant Orange O	21,480	8,835
73	Helio Fast Red	13,413	2,141
73a	Lithol Fast Scarlet	36,295	9,287
80a	Wool Scarlet (V.M.)	39,888	6,293
82a	Ponceau (V.M.)	20,972	1,981
88a	Acid Anthracene Brown (V.M.)	30,555	7,932
96a	Chrome Fast Yellow	16,165	3,056
102	Diamond Flavine G	23,080	4,226
112	Bordeaux B	10,383	1,474
112a	Claret Red	14,338	1,291
118	Geranine	18,917	6,090
126a	Union Blue (V.M.)	15,353	2,116
132	Lake Red P	40,346	2,019
137	Acid Yellow	35,982	6,313
139	Orange IV.	11,238	1,966
140	Curcumeine	39,260	6,257
141	Azo Yellow	59,894	13,755
141a	Azo Flavine (V.M.)	20,114	3,151
141b	Indian Yellow (V.M.)	10,537	2,392
146	Azo Fuchsine G	17,810	2,685
147	Azo Fuchsine 6 B	13,206	1,867
151a	Orange R O	90,174	7,395
152	Permanent Red 4 B	44,850	14,513
152a	Permanent Red (V.M.)	56,545	7,403
154	Palatine Chrome Brown	18,264	1,674
159a	Vigoureux Fast Black T	16,000	3,522
160	Fast Brown N	67,531	6,290
161	Fast Red A	46,369	5,465
163a	Carmoisine (V.M.)	17,107	2,427
163b	Chrome Blue (V.M.)	53,404	19,871
164a	Diamond Blue R	20,117	3,800
168	Amaranth	73,973	9,420
168b	Wool Red (V.M.)	11,497	2,285
169	Cochineal Red	29,984	3,669
173a	Lithol Red (V.M.)	67,615	5,029
177	Mordant Yellow	85,003	11,280
177a	Anthracene Yellow	16,050	3,011
177b	Salicine Yellow	23,068	3,536
180	Eriochrome Blue Black B	43,880	8,487

Serial No.	Commercial name.	lb.	Invoice value.
			$
181	Salicine Black U	65,658	10,606
184	Eriochrome Black A	96,570	13,530
185	Anthracene Chrome Black	51,577	7,869
188	Sulfone Acid Blue R	45,038	11,372
189	Sulfone Acid Blue B	35,112	8,813
198	Thiazine Yellow	29,879	8,410
211	Resorcin Brown	13,189	2,549
212a	Acid Brown (V.M.)	14,705	3,238
217	Agalma Black 10 B	40,763	7,518
217a	Agalma Black (V.M.)	13,465	2,359
217c	Naphthol Blue Black (V.M.)	62,864	8,861
217e	Acid Black (V.M.)	47,489	7,547
217g	Wool Black (V.M.)	23,371	4,866
217h	Acid Wool Black	13,518	4,202
220a	Amido Acid Black	32,624	3,614
236	Wool Red	13,245	1,942
247	Scarlet	36,598	4,228
257b	Tolyl Blue	16,750	2,967
265	Sulfon Cyanine Black	69,590	7,663
269	Acid Black	35,662	5,765
272	Brilliant Black	39,454	5,588
272b	Wool Black (V.M.)	15,756	3,596
275a	Chrome Black (V.M.)	72,521	13,616
275c	Chrome Fast Black (V.M.)	35,999	10,532
277	Anthracene Acid Black	17,793	2,647
279	Benzo Fast Scarlet	36,674	9,010
283	Bismarck Brown	27,576	5,352
288	Palatine Chrome Black	18,985	1,607
296	Cotton Yellow	21,437	6,161
303	Renol Brilliant Yellow	12,786	3,290
307	Congo	12,040	1,687
308	Diazo Black	62,854	8,257
312	Congo Corinth	39,748	6,030
313	Congo Rubine	46,113	6,329
319	Diamine Scarlet	28,887	9,027
326	Oxy Diamine Violet	11,514	1,938
326a	Benzo Violet R	12,467	1,552
327	Diamine Violet N	13,107	2,840
333d	Develop Black	17,495	4,333
334	Diphenyl Blue Black	26,240	4,415
335	Naphthamine Black	47,969	7,132
337	Benzo Blue	19,035	789
338	Naphthamine Blue	11,707	2,455
343	Diamine Fast Red	47,724	17,131
344	Diamine Brown	63,716	12,457
346	Oxamine Red	11,636	2,568
348	Diphenyl Brown BN	13,471	4,015
358	Diphenyl Red	12,808	5,001
360	Pyramine Orange R	21.329	7,818
362	Oxydiamine Orange	19,905	4,223
365	Benzopurpurine (V.M.)	21,090	1,442
366	Deltapurpurine 5 B	20,284	3,646
370	Brilliant Congo	19,133	3,133
384a	Diamine Blue (V.M.)	21,725	3,687
392	Toluylene Orange	55,562	13,236
400	Acid Anthracene Red	17,560	5,174
405	Benzopurpurine 10 B	47,708	11,181
410	Benzazurine (V.M.)	78,699	21,018
416	Brilliant Azurine 5 G	18,395	3 206
418	Diamine Brilliant Blue G	11,592	2,496
419	Chicago Blue R W	15,176	3,364
421	Oxamine Blue B	14,091	2,436
421a	Oxamine Blue (V.M.)	21,800	3,749
426	Benzamine Pure Blue	12,881	5,663
428a	Direct Blue (V.M.)	21,322	5,366
449	Trisulfon Brown	16,781	5,255
450	Benzo Fast Blue	73,936	20,607
456a	Benzo Fast Blue (V.M.)	26,559	8,439
462	Direct Deep Black E.W.	32,830	5,032
462c	Cotton Black (V.M.)	91,485	22,206
462d	Union Black (V.M.)	61,218	9,044
469	Chloramine Black	20,095	5,278
469a	Chloramine Black (V.M.)	19.505	3,951
474	Oxamine Green B	23.832	5,134
474a	Diamine Green (V.M.)	53,268	8,318
476a	Benzamine Brown 3 G	16,988	2,470
477a	Naphthamine Brown (V.M.)	48,734	9,452
478	Columbia Green	24,749	4,723
478a	Direct Green (V.M.)	19.313	4,291
485a	Benzo Brown (V.M.)	41,905	7,125
490a	Cotton Brown (V.M.)	23,975	5,207
	Total	4.371.797	825.916
	Unclassified Azo Colours.		
A 6	Chrome Fast Black (V.M.)	76,451	10,172
A 12	Columbia Brown (V.M.)	29,793	3.073
A 16	Columbia Fast Blue (V.M.)	84,661	18,879
A 28	Naphthogene Blue (V.M.)	33,847	6,824
A 32	Nerol (V.M.)	65,441	9.751
A 44	Colamine Blue B	21,704	8.376
A 69	Corvan Black (V.M.)	10,033	1,870
A 71	Cotton Black (V.M.)	24,505	4.843
A 81	Lithol Fast Orange R	36,641	4.381
A 88	Oxamine Black (V.M.)	50,032	10,472
A 95	Oxamine Brown (V.M.)	93,454	22,569
A102	Oxamine Copper Blue RR	10,222	1.941
A104	Oxamine Dark Blue (V.M.)	23,810	4.246

Serial No.	Commercial name.	lb.	Invoice value.
			$
A108	Oxamine Dark Brown G. R.	10,599	1,312
A122	Palatine Chrome Blue BB	42,244	4,679
A124	Palatine Chrome Green G	19,665	6,452
A131	Scarlet (V.M.)	80,778	7,281
A142	Wool Scarlet (V.M.)	12,780	1,417
A144	Acid Black E. M.	18,660	2,031
A147	Acid Chrome Black (V.M.)	39,508	8,052
A150	Acid Silk Black R	12,928	2,234
A157	Benzo Chrome Black Blue B	51,315	9,804
A166	Benzo Dark Green B, GG	13,038	2,123
A176	Benzo Fast Heliotrope (V.M.)	18,018	5,541
A184	Benzo Green (V.M.)	16,506	2,850
A191	Benzo Red 10 B, 12 B	19,420	4,715
A203	Benzo Rhoduline Red B, 3 B	11,873	1,813
A210	Brilliant Fast Blue (V.M.)	11,653	3,309
A215	Cashmere Black 3 BN, V	12,269	1,881
A227	Diazo Brilliant Scarlet (V.M.)	38,909	14,210
A242	Diazo Fast Black (V.M.)	29,330	7,476
A259	Direct Black (V.M.)	12,048	2,019
A266	Helio Bordeaux BL	14,703	793
A277	Orange RO	24,288	2,246
A285	Phenylamine Black 4 B	14,066	1,619
A286	Pluto Black (V.M.)	30,010	6,034
A292	Pluto Brown (V.M.)	14,580	2,542
A303	Alphanol Black (V.M.)	30,189	3,124
A336	Azo Wool Violet (V.M.)	12,944	3,298
A346	Diamine Catechine (V.M.)	66,876	11,942
A351	Diamine Fast Blue (V.M.)	28,880	7,227
A355	Diamine Fast Orange (V.M.)	17,387	4,819
A361	Diamine Jet Black (V.M.)	14,091	4,315
A362	Diamine Neron BB	36,982	6,204
A367	Diamine Orange (V.M.)	17,068	2,851
A368	Diamine Sky Blue FF	41,115	7,574
A384	Oxy Diamine Brown (V.M.)	23,498	3,810
A385	Oxy Diamine Carbon (V.M.)	34,388	7,864
A388	Para Diamine Black (V.M.)	18,634	2,690
A403	Salicine Blue B	16,224	8,449
A414	Amido Naphthol Black 4B, RK	10,750	1,219
A418	Azo Acid Black (V.M.)	19,500	3,042
A430	Fast Mordant Blue B, R	17,000	4,612
A437	Naphthalene Blue B, DL	28,000	5,102
A439	Victoria Scarlet R, 3 R	22,400	2,379
A444	Direct Green (V.M.)	31,194	5,091
A451	Heligoland Black FFN	25,132	4,151
A469	Oxychrome Brown (V.M.)	10,490	2,235
A472	Oxychrome Yellow (V.M.)	10,085	1,985
A478	Triazol Blue (V.M.)	10,148	1,580
A485	Triazol Brown (V.M.)	17,067	2,854
A489	Triazol Dark Blue (V.M.)	19,489	2,647
A515	Brilliant Scarlet 2R, 4R	12,565	1,425
A521	Anthracyl Chrome Blue 2B, D	24,979	6,385
A527	Croceine Scarlet MO, MOO	12,210	2,235
A531	Acid Blue Black	15,501	3,023
A532	Acid Chrome Blue	12,952	4,365
A533	Acid Fast Green 8 B	14,050	7,068
A541	Diazogene Black (V.M.)	30,042	6,813
A550	Direct Black ABC, C	15,245	2,804
A552	Direct Chrome Brown	12,178	2,665
A556	Drazaline Blue (V.M.)	10,831	4,425
A566	Drazaline Brown (V.M.)	21,756	1,979
A593	Drazaline Sky Blue FF	10,910	5,204
A600	Excelsior Black	59,956	16,690
A603	Hydrazol Black	10,981	1,620
A605	Hydrazol Chrome Black CB, DB	51,694	7,499
A612	Chicago Red III	13,195	2,420
A617	Diphenyl Blue (V.M.)	12,677	3,842
A622	Diphenyl Deep Black (V.M.)	21,098	4,216
A629	Diphenyl Green (V.M.)	18,021	4,667
A664	Chlorantine Brown (V.M.)	18,267	4,034
A674	Chrome Fast Brown (V.M.)	12,204	3,550
A682	Chrome Fast Green (V.M.)	12,943	6,670
A687	Cupranil Brown (V.M.)	24,851	4,859
A692	Direct Black E	22,223	4,205
A696	Direct Fast Black B	11,290	2,790
A711	Azo Rhodine 2 B	10,108	2,624
A719	Direct Sky Blue FF	58,838	12,827
A729	Azomine Milling Black N	22,500	5,124
	Total	2.269,308	462.922
	Triphenylmethane Colours.		
497a	Victoria Green	44,595	10,305
499	Brilliant Green (V.M.)	73,904	16,345
502	Guinea Green	14,666	3,302
502a	Acid Green (V.M.)	35,305	9,379
503	Neptune Green (V.M.)	40,868	13,825
505	Light Green (Yellowish) (V.M.)	24,946	5,960
505a	Acid Green (V.M.)	16,461	20,176
506	Erioglaucine (V.M.)	66,526	28,971
512	Magenta	87,102	25,659
516	Crystal Violet	33,653	13,664
516a	Violet (V.M.)	18,219	5,289
517	Benzyl Violet	22,387	6,018
518	Ethyl Purple	51,933	23,101
521	Aniline Blue	50,563	18,586
524	Acid Magenta	19,098	4,030
527	Acid Violet	13,078	4,362
527a	Acid Violet (V.M.)	16,106	5,360

Serial No.	Commercial name.	lb.	Invoice value.
			$
528	Fast Acid Violet 10 B	12,919	3,229
530	Acid Violet	50,055	12,806
530a	Acid Violet (V.M.)	65,395	20,954
530b	Formyl Violet (V.M.)	19,810	4,185
530c	Guinea Violet 4 B, 6 B:	18,854	5,114
531	Eriocyanine	25,091	11,987
534a	Acid Violet (V.M.)	19,960	6,310
537a	Navy Blue (V.M.)	31,499	6,275
538a	Cotton Blue (V.M.)	45,019	9,809
539	Soluble Blue	86,523	31,093
543c	Acid Blue	14,467	4,916
545	Patent Blue A	40,848	10,229
545a	Neptune Blue (V.M.)	10,765	2,305
545c	Brilliant Acid Blue (V.M.)	10,120	3,525
546	Cyanol	40,015	15,757
551	Eriochrome Azurol BC	21,070	14,480
	Total	1,171,829	377,366
	Diphenyl-naphthyl-methane Colours.		
564	Naphthalene Green	22,144	5,901
566	Wool Green S	33,863	13,526
566b	Cyanol Green (V.M.)	10,988	2,193
	Total	66,995	21,623
	Xanthone Colours.		
571	Rhodamine 6 G	37,460	18,495
573	Rhodamine B	58,339	23,777
576	Rhodamine 3 G	16,940	6,858
580a	Fast Acid Violet (V.M.)	19,811	13,975
587	Eosine	35,511	13,183
587a	Eosine (V.M.)	21,017	7,891
587b	Bromo-Fluoresceic Acid	38,000	18,397
590a	Acid Eosine	17,499	7,388
599	Galleine	15,404	8,817
	Total	259,981	118,781
	Acridine Colours.		
606c	Patent Phosphine	28,627	17,881
606g	Leather Flavine	24,153	8,235
607	Rheonine	19,704	5,261
608	Euchrysine	15,403	5,343
609b	Diamond Phosphine	30,336	5,897
609c	Corioflavine	40,343	13,438
	Total	158,566	56,055
	Quinoline and Thiobenzenyl Colours.		
612	Quinoline Yellow (spirit-soluble)	79,553	28,170
613	Quinoline Yellow (water-soluble)	15,324	7,072
616	Primuline	56,212	8,478
617	Columbia Yellow (V.M.)	86,090	10,165
617a	Diamine Fast Yellow (V.M.) ..	88,688	12,972
618	Thioflavine T	31,714	17,683
	Total	357,581	84,540
	Oxazine and Thiazine Colours.		
627	Gallocyanine	78,253	27,227
649	Cotton Blue (V.M.)	32,509	0,675
660	Methylene Green (V.M.)	30,812	13,196
661	Thionine Blue (V.M.)	18,618	7,873
663	New Methylene Blue (V.M.) ...	30,392	12,127
667	Indochromine (V.M.)	19,060	12,430
	Total	209,614	82,528
	Azine Colours.		
672	Azo Carmine	17,500	5,453
679	Safranine (V.M.)	59,921	21,273
681	New Fast Gray (V.M.)	29,507	10,436
697	Induline, Soluble in Spirit (V.M.)	25,342	5,016
699	Induline, Soluble in Water (V.M.)	21,775	5,514
705a	Indocyanine B, 2 RF	23,138	5,205
	Total	177,183	52,897
	Sulphur Colours.		
708	Sulfaniline Brown O, R	11,327	1,158
710	Immedial Yellow D (V.M.)	13,395	2,266
725	Immedial Brown (V.M.)	23,887	2,558
726	Pyrogene Blue (V.M.)	10,934	2,582
734	Pyrogene Yellow M, O	18,515	5,102
735	Pyrogene Indigo (V.M.)	22,661	6,652
739	Immedial Maroon B	15 496	2,885
746	Katigene Green (V.M.)	63,929	9,950
750	Kryogene Brown A, G	10,313	072
	Total	190,457	34,125
	Unclassified Sulphur Colours.		
S 3	Sulfur Blue (V.M.)	73,434	15,489
S 12	Sulfur Brown (V.M.)	79,091	9,505
S 18	Sulfur Catechu G, R	48,973	5,071
S 26	Sulfur Indigo (V.M.)	10,488	2,085
S 37	Katigene Black Brown (V.M.) .	11,006	1,336
S 45	Katigene Brown 2 R, V	22,811	2,452

Serial No.	Commercial name.	lb.	Invoice value.
			$
S 49	Katigene Direct Blue, B, RF .	11,299	2,305
S 51	Kaligene Indigo (V.M.)	42,157	5,924
S 55	Katigene Khaki G	14,242	1,691
S 58	Katigene Red Brown R, 3 R .	68,864	9,380
S 62	Katigene Yellow G, GG, GR ..	55,227	9,318
S 65	Kaligene Yellow Brown (V.M.)	36,826	5,617
S 75	Immedial Direct Blue (V.M.) ..	73,892	11,145
S 76	Immedial Indogene (V.M.)	90,077	13,141
S 78	Immedial New Blue G	37,492	10,016
S 84	Sulfur Brown	12,735	1,926
S 86	Thion Brown (V.M.)	18,579	2,824
S 97	Thiogene Blue (V.M.)	14,344	2,261
S100	Thiogene Brown (V.M.)	97,551	10,601
S109	Thiogene Deep Blue	13,106	3,049
S155	Pyrogene Brown (V.M.)	63,450	6,689
S168	Sulfur Bronze	15,152	1,392
S177	Cross Dye Drab N	15,758	1,324
	Total	927,154	134,547
	Anthraquinone and Allied Colours.		
760	Indanthrene Gold Orange G ...	20,092	10,088
761	Indanthrene Gold Orange	50,496	2,052
763	Indanthrene Dark Blue BO	11,096	2,516
765	Indanthrene Green B	72,227	16,377
767	Indanthrene Violet RR	68,419	21,516
768a	Indanthrene Black B, BB	50,034	12,876
774b	Alizarin Black (V.M.)	61,187	19,239
779	Alizarin Orange (V.M.)	14.239	3,184
780	Alizarin Red	53,154	24,784
780a	Alizarin Red (V.M.)	28,775	3,708
785a	Alizarin (V.M.)	49,021	5,379
790a	Anthracene Blue (V.M.)	22,444	7,174
800	Anthracene Blue WB, WG	54,712	9,228
803	Alizarin Blue WX, A	16,575	6,453
804	Alizarin Blue S	79,679	69,871
804a	Alizarin Blue SB, 942	12,409	6,158
804c	Alizarin Sky Blue B	19,471	24,555
805	Alizarin Green S	15,885	2,497
807a	Patent Alizarin Black (V.M.) ..	61,500	10,049
808	Alizarin Green S	11,096	2,337
810a	Helindone Yellow CG	20,744	6,054
820	Algol Brilliant Violet R	12 784	3,623
827	Indanthrene Claret B	28,728	9,923
832	Indanthrene Violet RN	11,667	5,181
833	Algol Olive R	13,334	2,850
841	Indanthrene Blue GGS	10,163	4,284
849	Indanthrene Yellow G, GP ...	12,683	4,353
849a	Indanthrene Violet Yellow GP	62,509	20 738
850a	Indanthrene Blue WR	31,658	4,272
851a	Alizarin Direct Blue (V.M.) ...	10,201	11,878
856a	Alizarin Rubinol R	10,937	11,826
859	Cyananthrol R	18,792	27,555
862	Alizarin Blue Black B, 3B ...	54,706	61,370
	Total	1,071,397	434,848
	Indigo and its Derivatives.		
877	Indigo Extract	19,329	6,577
879	Indigo MLB	53,610	11,604
881	Ciba Blue 2 B	16,880	7,423
886	Brilliant Indigo GD	12,057	1,747
888	Indigo MLB, T	12,730	1,598
901	Ciba Violet B	19,830	6,975
904	Helindone Brown G	12,936	6,710
907	Ciba Scarlet G	22,265	11,479
910	Belindone Pink (V.M.)	39,393	47,317
913	Helindone Orange R	14,489	5,841
918	Helindone Red 3 B	27,874	10,942
920	Helindone Violet B, 2 B, R ..	28,607	15,945
	Total	280,000	133,958
	Aniline Black group.		
923	Ursol	53,720	15,779

Unclassified Coal-Tar Colours.

Include imported artificial colours, the composition or manufacture of which are not known and which have not been mentioned among the unclassified azo colours and sulfur colours.

			$
U 20	Guinea Bordeaux (V.M.)	23,252	3,233
U 24	Indo Violet B	23,060	4,647
U 27	Metachrome Blue B, G	14,301	3,996
U 31	Metachrome Brown BL, BRL .	57,313	7,271
U 61	Scarlet 53446	13,314	1,246
U 78	Chrome Fast Blue 4 B	23,585	5,198
U 86	Columbia Fast Black (V.M.) ..	82,040	15,756
U100	Basic Kraft Brown Y 2	11,235	2,039
U109	Brilliant Scarlet (V.M.)	23,382	2,588
U121	Corvoline BT	10,789	3,241
U138	Fast Acid Marine Blue HBB ..	25,567	6,212
U145	Japan Black (V.M.)	13,974	2,766
U151	Jet Black APX, RR	19,442	4,779
U155	Kraft Brown L, Y 2	43,807	10,218
U158	Leather Black BO, CR	16,433	4,843
U163	Oil Black 6 B, 6 G, HG	28,603	4,258
U180	Pigment Black................	22,448	926

Serial No.	Commercial name.	lb.	Invoice value.
			$
U183	Quercitron Substitute WBL, V	16,812	2,422
U192	Thiazine Brown R	12,105	2,809
U206	Acid Chrome Blue 3 G, 2 R, 5 R	25,633	6,553
U217	Blue 27071	14,775	994
U238	Claret Lake BL	15,290	949
U246	Half Wool Blue 3 R	20,610	3,790
U271	Wool Fast Blue BL, GL	19,238	6,331
U279	Brilliant Lanafuchsine (V.M.)	11,289	1,757
U283	Brilliant Scarlet (V.M.)	41,082	4,317
U290	Leather Black (V.M.)	11,784	3,063
U293	Nerazine G, GA	44,676	8,484
U304	Acid Red (V.M.)	30,099	6,238
U321	Carpet Red B, BT, R	15,445	1,649
U329	Cotton Brown (V.M.)	15,079	4,959
U332	Cotton Marine Blue 4676	79,035	10,902
U333	Cotton Orange (V.M.)	21,665	5,116
U335	Direct Black (V.M.)	42,277	8,438
U336	Direct Blue (V.M.)	57,224	14,318
U337	Direct Brown (V.M.)	21,828	4,709
U361	Naphthamine Fast Black, SE, SDE, VE	34,203	10,671
U378	Paper Scarlet (V.M.)	24,372	3,101
U385	Scarlet (V.M.)	29,634	3,363
U391	Wool Blue (V.M.)	23,020	6,854
U393	Wool Brown (V.M.)	40,736	6,333
U394	Wool Cerise SR	16,038	2,359
U395	Wool Green	20,255	5,488
U397	Wool Violet R, SL	12,584	3,429
U399	Wool Yellow (V.M.)	17,465	2,629
U423	Alizarin Pure Blue DPH	31,000	7,349
U440	Hansa Yellow G, 5 G, R	11,014	4,559
U460	Paratol Chrome Yellow L	17,336	1,238
U465	Paratol Scarlet 3 B	41,000	8,271
U470	Rosazeine B, B 5, 6 G	17,509	8,536
U510	Cresol Black (V.M.)	37,322	4,246
U526	Chrysolarine A	15,756	6,575
U553	Black BH, HB	21,239	4,789
U570	Developed Black B, N, R, W	36,475	9,501
U610	Erio Violet BC, RLC	21,345	6,117
U682	Sepia Black FW	10,527	2,367
U687	Solfigene Deep Black (V.M.)	61,949	9,509
U695	Blue (V.M.)	13,657	3,627
U701	Calcutta Blue 2	26,669	4,669
U708	Meridian Black AE, AN	15,157	3,316
U711	Omega Chrome Cyanine R	21,001	3,019
U716	Alpha Black JC, 6 BN	12,100	2,949
U731	Cachou (V.M.)	56,991	3,430
U744	Alizadine Black M	18,979	1,986
U770	XL Blue (V.M.)	10,047	2,126
	Total	1,683,921	323,511
	Class II. (100,000 *to* 200,000 *lb.*).		
34	Chrysoidine R	105,946	16,852
48	Alizarin Yellow	144,761	11,118
145	Orange II.	127,550	10,116
163	Azo Rubine	160,252	23,409
181b	Salicine Black (V.M.)	177,203	26,945
183	Eriochrome Black T	129,550	23,447
217d	Naphthylamine Black (V.M.)	122,581	12,240
217f	Amido Black (V.M.)	105,005	10,062
220	Palatine Black	148,203	15,169
220b	Wool Black (V.M.)	110,244	16,868
227	Brilliant Croceine	123,058	20,333
257	Sulfon Cyanine	128,944	21,118
266	Naphthylamine Black	152,141	21,903
269a	Naphthol Black (V.M.)	131,890	19,436
284	Bismarck Brown 2 R	170,882	31,241
304	Chrysophenine	148,406	40,466
333b	Diamine Black (V.M.)	171,211	19.634
424	Chicago Blue 6 B	116,560	32,417
436a	Dianol Black	112,095	12,635
442a	Direct Black (V.M.)	145,738	11,831
455a	Columbia Black (V.M.)	143,956	26,125
462f	Carbide Black (V.M.)	190,304	31,607
A169	Benzo Fast Black L	100.268	22,846
A382	Oxy Diamine Black (V.M.)	146,629	24,836
A387	Oxy Diaminogen (V.M.)	139,118	26,832
495	Malachite Green	178,831	43,363
543	Patent Blue	114,631	49,945
558	Victoria Blue R	109,627	33,117
565a	Wool Blue (V.M.)	173,904	18,406
606	Phosphine	101,858	30,442
659	Methylene Blue (V.M.)	185,738	72,619
698	Nigrosine, Soluble in Spirit (V.M.)	186,540	23,435
774	Alizarin Black S, SR, NR	136,461	9,936
782	Alizarin Brown (V.M.)	110,211	30,907
789	Anthracene Blue WR	107,778	13,622
807	Alizarin Black S	198,491	19,902
808a	Alizarin Green (V.M.)	124,095	58,491
838	Indanthrene Blue RS	187,379	56,532
U 64	Amine Black (V.M.)	146,163	14,390
U390	Wool Black (V.M.)	118,791	20,453
U799	Black (V.M.)	138,805	14,781
	Total	5,771,798	1,039,821
	Class III. (200,000 *to* 300,000 *lb.*).		
7	Naphthol Yellow	250,409	24,702
23	Tartrazine	265,781	53,137
134	Metanil Yellow	284,606	46,614
157	Diamond Black	285,047	37,055
173	Lithol Red R	214,448	18,550
174a	Scarlet	209,281	20,472
303a	Paper Yellow (V.M.)	264,143	45,320
436	Columbia Black	290,902	41,563
463	Cotton Black E	218,567	34,602
515	Methyl Violet	255,063	63,18[illegible]
536	Alkali Blue	286,531	117,365
748	Hydron Blue (G, R)	292,729	33,555
778	Alizarin (Synthetic)	202,392	20,465
806a	Alizarin Black (V.M.)	229,500	33,275
	Total	3,579,699	589,858
	Class IV. (300,000 *to* 400,000 *lb.*).		
	Lake Red C	306,607	9,495
274	Diaminogen	305,944	56,201
275	Diamond Black	351,582	55,020
363	Benzopurpurine 4 B	341,724	45,233
A396	Cotton Black (V.M.)	300,473	44,567
A432	Lake Red (V.M.)	349,380	11,682
700	Nigrosine, Sol. in Water	394,718	58,903
803a	Alizarin Blue (V.M.)	302,319	69,712
	Total	2,652,747	348,913
	Class V. (400,000 *to* 500,000 *lb.*).		
333	Oxamine Black	417,423	57,464
493	Auramine	449,276	107,887
842	Indanthrene Blue GCD	478,980	169,780
	Total	1,345,679	335,131
	Class VI. (*over* 500,000 *lb.*).		
462a	Direct Deep Black E	862,601	110,009
A 46	Zambesi Black (V.M.)	629,359	107,669
720	Sulfur Blacks (V.M.)	5,615,458	558,909
874	Indigo, Synthetic	8,507,359	1,090,733
	Total	15,614,777	1,867,320

Grand Total 42,839,052 lb. $7,448,263

THE CARGO OF THE SUBMARINE "DEUTSCHLAND."

On July 10th the mercantile submarine "Deutschland" arrived in Baltimore with 750 tons of medicinal and coal-tar dye products. It appears that the weight of dyes in the consignment was 125 tons, and that they consisted mainly of Anthracene and Alizarine derivatives, which are patented in Germany and have not yet been prepared in the United States. A circular prepared by the Badische Company of New York states that these dyes have been prepared in a highly concentrated form, in a few cases twelve times their normal strength. They are offered in America at the following prices, per lb. f.o.b. New York:—

Euchrysin G.X., $8.50; Rhodamine B. extra (1 lb. =5 lb. B.), $12; Safranine T, extra conc. (80 lb. =100 lb. T.K.), $7.35; Diamond Green G.K., $8.50; Anthraquinone Green, G.X.H.O., patented (2 lb. =3 lb. G.X.N.), $9.50; Anthra- quinone Violet, $11; Anthraquinone Blue Green, B.X.O., patented (2 lb. =3 lb. B.X.). $9.50; Cyananthrol R.B.X., patented (7 lb. =10 lb. R.B.), $16.50; Indanthrene Blue R.S. Powder. triple, $10.50; Indanthrene Blue. G.C.D. Powder, patented (8⅓ lb. =100 lb. paste). $56; Indanthrene Violet R.R., extra, Powder, patented (12½ lb. = 100 lb. paste), $70; Indanthrene Black B.B. Powder, patented (12½ lb. =100 lb. paste), $28; Anthracene Blue S.W.G. Powder, $15; Anthracene Blue S.W.G.G. Powder, $16; Anthracene Blue S.W.G.G. extra Powder, $16.50; Alizarine Blue S. Powder, $8.75; Anthracene Blue S.W.R. Powder, $15; Oxamine Blue A. extra (2 lb. =5 lb. A.), $5.15; Indigo White 50%, $4.50.

Vide Chem. Ztg., 1916, pages 610, 834 and 849.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—
English.—6*d.* each to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.
United States.—1*s.* each to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number date, name of patentee, and title of invention.
French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56 Rue Ferou 8, Paris (6e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

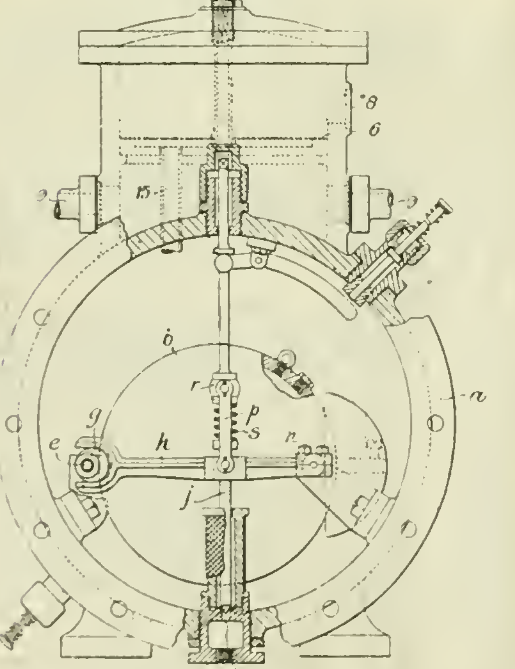
Patents.

Separating solids from suspension in liquids; Method of —— and apparatus therefor. W. J. Gee, London. Eng. Pat. 9365, June 25, 1915.

The liquid is fed into a vertical rotating cylindrical vessel provided with radial blades extending inwards, and an annular cover with a central opening for the admission of liquid and for the maintenance of a column of rotating liquid of fixed radial thickness. The lower half of the casing contains a filtering drum mounted on the same shaft and having a diameter greater than that of the opening in the cover, the lower parts of the radial blades being cut away to accommodate it. The heavier solids are deposited on the inner walls of the outer vessel and the lighter solids are deposited on the outer wall of the filtering drum, as the liquid passes through under pressure and is discharged by passages just within the periphery. When the layer of solids deposited on the filtering drum exceeds a certain thickness, the material is thrown off by centrifugal force and deposited on the walls of the outer vessel.—W. F. F.

Separating fluids of different specific gravities; Apparatus for ——. J. S. Gander, London. Eng. Pats. 12,635, Sept. 2, and 14.223, Oct. 7, 1915.

The mixture to be separated enters by the passage, 8, and passes through the filter, 6, and pipe, 15, to the separating vessel, *a*. A cylindrical float, *b*, which sinks in the lighter liquid and rises in the heavier, is mounted on a shaft, *e*, carrying a cam, *g*, so that when the float rises the forked lever, *h*, pivoted at *n*, is lifted. This lever is connected to the valve spindle, *j*, through links, *p*, sleeve, *r*, and spring, *s*, so that the heavier liquid is discharged through the passage, *m*, when the float rises. The lighter liquid rises and is discharged through the outlet, 9. The apparatus is suitable for separating oil and water, or by inverting it, for separating gases from oils or other liquids. To separate a mixture of gas, oil, and water, the mixture is passed first through the apparatus as described to remove water, and the remainder through a similar apparatus inverted at a higher level, to separate the gas and oil.
W. F. F.



Gases or gaseous substances; Process for the separation of suspended impurities from ——. W. E. Moulsdale, Liverpool. Eng. Pat. 14,806, Oct. 20, 1915.

Part of the gas to be treated passes by suction or pressure through a perforated pipe immersed in a froth-forming liquid in the bottom of the washing chamber. The main portion of the gas passes through the froth thus produced in a tortuous path formed by means of vertical baffle-plates. The gas with part of the froth passes to a separator comprising a chamber provided with vertical baffle-plates, and having a sprinkling device above to break up the froth and remove the solid material. A preliminary washing chamber may also be used for a rough separation, in which the froth is broken up by a sprinkling device.—W. F. F.

Condensing apparatus and the fittings for use therewith. Hick, Hargreaves & Co., Ltd., and J. Gunn, Bolton, Lancs. Eng. Pat. 16,918, Dec. 1, 1915.

The invention relates to steam condensing plant of the kind in which a common outlet for the water, vapour, and air is provided, the water being withdrawn by a pump and the vapour and air through a branch pipe by an ejector. Water is withdrawn by a small pipe connected with the discharge side of the water pump and passed through a cooling coil in the condenser to a spraying nozzle in the air and vapour discharge pipe, so that the water flows back to the main water discharge pipe of the condenser. The cooling coil is attached to the inner side of the inspection door or it may be within the condenser in front of the door.—W.F.F.

Condenser. G. L. Vail, Denver, Colo. U.S. Pat. 1,199,915, Oct. 3, 1916. Date of appl., July 2, 1912.

The condenser consists of a hollow cylinder provided with an inlet for the vapour and an outlet for the condensed liquid. The peripheral wall of the cylinder is formed of thin metal so that a pulsating movement is set up owing to the expansion and contraction caused by alternate heating and cooling. The extent of the inward pulsating movement is limited by a framework adjusted by set screws. The effect of the pulsating movement is to crack off and prevent the accumulation of scale on the exterior of the cylinder over which the cooling water flows.—W. H. C.

Condenser. B. S. McClellan, Chicago, Ill. U.S. Pat. 1,201,208, Oct. 10, 1916. Date of appl., Jan. 1, 1915.

The fluid to be cooled enters at the top of a pipe coil enclosed in a cylindrical casing and is transferred at the bottom into the space between the above casing and a surrounding concentric casing from which it is discharged at the top. The cooling fluid passes through the inner cylinder from end to end, in contact with the pipe coil. —W. F. F.

Mixing liquids and other substances; Apparatus for —— and for heating or cooling same during the mixing operation. J. C. Nicholl, Bradford. Eng. Pat. 101,731, Jan. 17, 1916. (Appl. No. 703 of 1916.)

The apparatus consists of an annular vat provided with stirring gear and jacketed both on the inside and outside.—W. H. C.

Mixing liquids; Method and apparatus for ——. J. A. Porter, St. Louis, Mo. U.S. Pat. 1,202,421, Oct. 24, 1916. Date of appl., July 30, 1915.

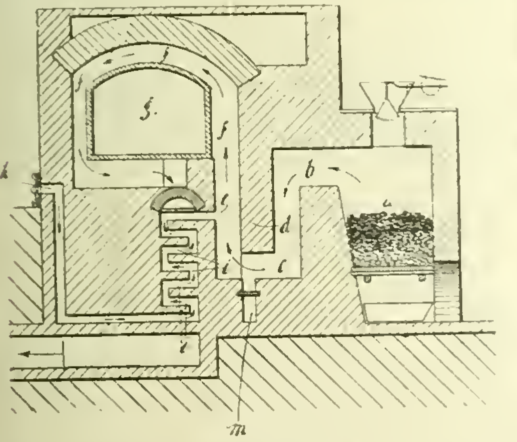
A predetermined proportion is removed from a stream of liquid, the portion so removed being proportional to the flow of the main portion of liquid. The portion of liquid removed is then mixed with any desired proportion of a reagent, and the mixture returned to the main stream of liquid.—W. H. C.

Kneading and mixing machine. R. Herbst and A. Bartosch, Halle, Germany. U.S. Pat. 1,201,298, Oct. 17, 1916. Date of appl., July 30, 1914.

The apparatus consists of a kneading trough into which one end of a bent kneading lever depends. The other end of the lever is connected by pins working in a grooved ball with a horizontal crank device.—W. H. C.

Furnaces C. H. Thompson, Amblecote, Worcester. Eng. Pat. 101,757. Mar. 21, 1916. (Appl. No. 4167 of 1916.)

A gas producer, demi-gas producer, or fire-mouth, *a*, is connected by a passage, *b*, to a chamber, *c*, provided with a partition, *d*. The gas passes thence to a combustion space, *f*, surrounding the muffle, *g*. Air enters by a suitable regulator at *h*, is heated by passing through a tortuous passage, *i*, having intermediate heating passages (not shown) through which the combustion gases pass in the opposite direction, and enters the combustion space through *c*. An additional supply of heated air may be introduced at *m*. The muffle may be replaced by an open flame furnace. The invention is applicable to the heat treatment of chemicals, such as the production of anhydrous barium oxide from the carbonate and tin oxide from the metal, the production of lead silicates and potters' glazes, the annealing of malleable iron castings, the enamelling of steel and iron hollow-ware sheets or the like, the close annealing of metal articles, and the firing of pottery, china, and the like.—W. F. F.



Furnace. J. McKenna, Assignor to The Fort Wayne Rolling Mill Corporation, Fort Wayne, Ind. U.S. Pat. 1,199,091, Sept. 26, 1916. Date of appl., Apr. 22, 1915.

The air for combustion is passed through a system of pipes contained in a brick chamber built in front of the combustion chamber and separated therefrom by a perforated wall. The chamber is provided with a separate stack and damper and is heated partly by radiation from the combustion chamber and partly by hot gases. The heated air is discharged into the combustion chamber through perforated pipes covered with coke breeze on the hearth of the combustion chamber. Fuel gas is supplied to the combustion chamber through a conduit which passes through the heating chamber and which is also in communication with the system of pipes.—W. H. C.

Kiln. J. Ralston, Grant Park, Ill. U.S. Pat. 1,200,132, Oct. 3, 1916. Date of appl., June 30, 1915.

The kiln is provided with two furnaces at opposite sides beneath the kiln chamber, and the products of combustion pass up spaces formed between the outer end walls of the kiln and inner walls spaced apart from the outer walls and extending upwards to a point near the roof of the kiln. The hot gases are then deflected downwards on to the floor of the kiln and pass away to the stack through openings in the side walls provided with dampers.—W. H. C.

Furnace. C. A. Cadwell, Assignor to The Electric Railway Improvement Co., Cleveland, Ohio. U.S. Pat. 1,200,466, Oct. 10, 1916. Date of appl., Jan. 26, 1914.

The furnace chamber is provided with a tapering lateral extension having adjustable transverse slits on its under side and a fuel-injecting nozzle at its opening. The fuel supplied to the nozzle is preheated by passing it through a coil embedded in the walls of the furnace but not in contact with the combustion gases. Part of the coil is flush with the top horizontal surface of the furnace wall, and may be protected wholly or partly, by lowering or raising the cover, so as to vary the heating of the fuel supply.—W. F. F.

Heating element [for evaporators]. P. J. Sullivan, East Orange, N.J. U.S. Pat. 1,199,315, Sept. 26, 1916. Date of appl., Aug. 18, 1913.

A heating element for an evaporator is formed of a series of compound tubes. The outer tube, through which the heating agent is passed, is formed with a constricted upper end so that it can slide upon the lower portion of the inner tube. The liquid to be evaporated is supplied to the inner tube, the upper portion of which, above the outer tube, is enlarged and perforated. The loose sliding joint allows for thermal expansion of the tubes, and any vapour from the heating fluid escapes and mingles with the vapour driven off from the liquid undergoing evaporation.—W. H. C.

Absorption; Process of —— and apparatus therefor. N. H. Hiller, Carbondale, Pa. U.S. Pat. 1,199,380, Sept. 26, 1916. Date of appl., Dec. 26, 1913.

The gas to be absorbed is drawn into the absorbing conduit by a jet of the liquid in which it is to be absorbed. The absorbing conduit is cooled externally, and a portion of the strong liquor is returned to the inlet end of the apparatus so that the latter may be maintained full of a mixture of gas and liquid.—W. H. C.

Absorption refrigeration apparatus. N. H. Hiller, Carbondale, Pa. U.S. Pat. 1,199,381, Sept. 26, 1916. Date of appl., Feb. 21, 1916.

The solution in which the gas is absorbed is heated in successive stages to progressively higher temperatures, the evolved gas passing from each section of the generator to the corresponding section of a multiple absorber and condenser. The weak liquor from the last section of the generator is passed into the first section of the absorber and so on from successive sections.—W. H. C.

Refrigerating apparatus; Surface condenser for ——. W. Schäfer, Dirmingen. Ger. Pat. 294,281, Nov. 17, 1914.

The lower part of the condensing coil is connected to one end, and the upper part to the other end of a tall U-tube, and the inlet pipe for the vapour to be condensed opens into the shorter limb of the U-tube just above the bend. The vapour enters under pressure and, in consequence of its low density, rises in the limb of the U-tube, displacing the condensed liquid therein, a column of alternate layers of vapour and liquid being formed. In consequence of the pressure of the vapour, a vigorous circulation is produced, upwards through the condensing coil and downwards through the other limb of the U-tube, and this results in efficient transmission of heat from the vapour to the walls of the condensing coil. A valved outlet pipe is provided at the bend of the U-tube for withdrawal of the condensed liquid.—A. S.

Heating and cooling liquids; Apparatus for ——. H. Feldmeier, Assignor to D. H. Burrell and Co., Little Falls, N.Y. U.S. Pat. 1,199,974, Oct. 3, 1916. Date of appl., July 21, 1914.

The liquid to be treated is contained in an elongated, trough-shaped vessel provided with a removable cover and a reciprocating agitator, and surrounded by an outer casing spaced apart from the trough. The heating or cooling liquid is sprayed on to the upper part of the exterior walls of the trough, trickles down, and collects in the lower part of the outer casing, and is then conveyed back to the spraying device.—W. H. C.

Liquids; Method and apparatus for drying ——. E. M. Johnson and E. J. Collings, Assignors to Mead Johnson and Co., Jersey City, N.J. U.S. Pats. 1,200,116 and 1,200,117, Oct. 3, 1916. Dates of appl., Mar. 8 and Oct. 9, 1915.

The solid constituents of liquids of varying adhesiveness are obtained in a mixture of given proportions by spraying the liquids successively on a drying roller and removing the dried material by scraping. The liquids are sprayed by rotating rollers dipping in troughs containing the liquids and arranged close to the drying roller in such order that the less adhesive liquids are applied first.—W. F. F.

Dryer. W. D. Althouse, Norristown, Pa. U.S. Pat. 1,201,131, Oct. 10, 1916. Date of appl., Nov. 15, 1915.

The material is carried by an endless belt through a horizontal chamber, of which the roof is higher at the receiving end than at the delivery end. Large heating flues are arranged on the floor at the receiving end and smaller flues near the roof, while the upper part of the travelling belt passes between the two. Air passes through the chamber, the flow being regulated by a curtain at the delivery end.—W. F. F.

Still. R. A. Waxler and E. Sapp, Lawrenceville, Ill. U.S. Pat. 1,200,281, Oct. 3, 1916. Date of appl., Nov. 30, 1915.

A number of vertical tubes are arranged in a heating chamber between the fire-box and the flue, and are connected with tanks above and below, which are out of contact with the chamber. Each tube is scraped internally, to remove deposits, by mechanically operated rods carrying perforated discs.—W. F. F.

Emulsifier. Method of emulsifying liquid. R. L. Williams, Brighton, Mass., Assignor to J. W. Davies, Reading, Mass. U.S. Pats. 1,200,559 and 1,200,560, Oct. 10, 1916. Dates of appl., Aug. 2, 1913 and Mar. 16, 1914.

A fatty liquid containing impurities is supplied to a rotating chamber by a pipe fitted with a valve which is controlled by the liquid when the latter reaches a predetermined level. The liquid is discharged from the chamber by its centrifugal force and is emulsified by passing it in a thin film at high velocity between closely adjacent surfaces. The impurities are retained against the inner wall of the rotating chamber.—W. F. F.

Filtering-belt. J. M. Callow, Assignor to The General Engineering Co., Salt Lake City, Utah. U.S. Pat. 1,201,021, Oct. 10, 1916. Date of appl., Mar. 4, 1916.

An endless travelling filtering-belt passes over two pulleys, the free portions being horizontal. Liquid is filtered through the lower portion and the caked material withdrawn from the upper portion by suction nozzles arranged close to and below the belt.—W. F. F.

Filter press. C. Sellenscheidt, Assignor to Filter- und Brautechnische Maschinenfabrik A.-G. vorm. L. A. Enzinger, Berlin. U.S. Pat. 1,202,109, Oct. 24, 1916. Date of appl., May 22, 1915. Renewed Aug. 16, 1916.

A number of similar discs, having ribbed and grooved faces, a central aperture, and central and peripheral flanges, are arranged one above the other within a casing, with discs of filter material between them. The grooves on the opposite faces of each disc communicate alternately with the central aperture and with the periphery of the disc. The liquid to be filtered is forced into the casing under pressure, passes into the grooves which communicate with the periphery of the discs, then through the filter discs and through the grooves on the opposite face to the conduit formed by the central apertures in the discs.—W. H. C.

Filters; Apparatus for the supply of compressed air, gas, steam, water under pressure, or the like to ——. A. Neumann, Reppen. Ger. Pat. 294,312, Nov. 17, 1915.

Compressed air, steam, or water under pressure is supplied to a filter-bed for cleaning purposes through a system of non-perforated pipes, of different lengths, each pipe being provided with a regulating valve, and with a nozzle at the end. The system of pipes is movable; for example, the pipes may project radially from a central hollow shaft, which can be rotated. The pressure of the air, steam, or water delivered through each pipe can be independently regulated, and by rotating the shaft, every part of the filter-bed is in turn brought under the influence of the cleansing medium.—A. S.

Separator; Centrifugal ——. N. J. Lloyd, Butte, Mont. U.S. Pat. 1,202,397, Oct. 24, 1916. Date of appl., Oct. 7, 1914.

The bowl of the separator has a series of circumferentially spaced openings for the discharge of the contents and is provided with a screwed-on cover having a series of notches which register with the openings in the bowl.—W. H. C.

Dryers. B. S. Harrison, Manhattan, N.Y., U.S.A. Eng. Pat. 101,941, June 19, 1916. (Appl. No. 8632 of 1916.)

See U.S. Pat. 1,191,075 of 1916 ; this J., 1916, 881.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coke-oven gases ; The equivalent of the observed heat value of the light oil [benzol] scrubbed from ——. J. W. Shaeffer. American Gas Inst., Oct., 1916. J. Gas Lighting, 1916, **136**, 397—398.

Results of inquiries sent to thirty by-product coke plants throughout the United States showed that the loss in B.Th.U. of the gas due to scrubbing out the light oil is only slightly greater than the heat value of the light oil removed. The heating value of the light oil, determined by calorimeter tests, was found to be 17,400 B.Th.U. per lb., to which was added 167 B.Th.U., the latent heat of vaporisation of benzol, giving 17,567 B.Th.U. as the gross heating value per lb. of light oil vapour. The corresponding value for pure benzene is 18,703 B.Th.U. On this basis the theoretical loss in heating value averaged 4·45%, whilst the actual loss determined by calorimeter tests averaged 4·62%. For an efficient scrubbing plant these figures would reach 5·8%. The loss observed in using the gas, due to removal of light oil, is considerably greater than the loss determined by calorimeter, owing to the difference between the gross and the net heating values, and to improper adjustment of the air supply to the burners for the scrubbed gas. An analysis of coke-oven gas before and after scrubbing is given. The true value of light oil in a gas lies in its effectiveness per unit volume ; 1·1% of light oil by volume furnishes 7·4% of the total heat developed by combustion of the gas.—J. E. C.

Sulphur ; Removal of —— *from spent oxide.* E. J. Murphy. American Gas Inst., Oct., 1916. J. Gas Lighting, 1916, **136**, 396—397.

The solubility of sulphur in various distillates (b.pt. from 150° to 200° C.) from water-gas tar was found to average 2·85 grms. per 100 c.c. at 20° C., the results being almost identical with those of Pelouze, who used coal-tar distillates. Extractions were also made on spent oxide, using a Gooch crucible in a Ford-Wiley-Soxhlet extractor. The results with various fractions showed that, on an average, 55·4% of the sulphur and tar was extracted, leaving 6·5% of sulphur in the extracted sample. Tests on the fouling properties of the extracted oxide, carried out on the Kuneberger method, showed an absorption of hydrogen sulphide comparing favourably with that of any good oxide.—J. E. C.

Gasoline standards.

The U.S. Bureau of Mines has, at the request of the Federal Government of the District of Columbia, prepared tentative specifications for gasoline, which have been submitted for criticism to refiners, motor engineers, and others, with a view to issuing final specifications. The specific gravity test is not included in the specifications. The requirements laid down in the draft are that the gasoline and its combustion products should not have a strong or disagreeable odour ; the gasoline should be free from water, sediment, acid, sulphur, etc., and should not contain an excessive percentage of unsaturated hydrocarbons, nor too high a percentage of highly volatile products which tend towards excessive evaporation losses and unnecessary danger in handling and storage. The gasoline should not contain any considerable percentage of heavy or non-volatile constituents which prevent the atomisation into engine cylinders of a mixture that can be completely burnt. The limiting percentages of the constituents mentioned will be laid down in the final specifications.

Paraffin base oils ; Cracking of ——. *The time factor and temperature factor under pressure.* G. Egloff, T. Twomey, and R. J. Moore. Met. and Chem. Eng., 1916, **15**, 523—529. (See also this J., 1915, 1080 ; 1916, 411, 920, 1098.)

A gas oil derived from Pennsylvania crude petroleum, yielding 95% distilling between 200° and 350° C., was cracked under a pressure of 150 lb. per sq. in. and at temperatures from 400° to 750° C., in a steel tube, 11·6 ft. long and 8 in. in diameter, through which the oil was passed at rates varying from 6 to 36 galls. per hour. Determinations were made of gasoline (to 150° C.), benzene, toluene, and xylene in the recovered oils, and also of unsaturated hydrocarbons in the gasoline and other fractions of the recovered oils. With an oil flow of 6 galls. per hr. the amounts of benzene, toluene, and xylene produced at 400° and 450° C. were 0·0 and 1·4, 1·5 and 3·1, and 1·6 and 3·2% by volume of the original oil, respectively. The maximum formation of these hydrocarbons collectively occurred at 750° C. and 36 galls. per hr. and amounted to 12·7% ; the maxima for benzene, toluene, and xylene individually were 6·6, 4·5, and 3·4 % at 650°, 750°, and 600° C. and 16, 36, and 16 galls. per hr. respectively. The maximum formation of gasoline —18·1% by volume of the original oil—occurred at 450° C. and 16 galls. per hr. and also at 500° C. and 30 galls. per hr. The percentage of unsaturated hydrocarbons in the gasoline fractions of the recovered oils ranged between 5·8 and 34·4.
—W. E. F. P.

Reagents for use in gas analysis. Relative advantages of use of sodium and potassium hydroxides in the preparation of alkaline pyrogallol. Anderson. *See* XXIII.

Method of measuring the viscosity of very viscous substances. Field. *See* XXIII.

Patents.

Coal or the like : Apparatus for washing ——. The Grange Iron Co., Ltd., and H. P. Hoyle, Durham. Eng. Pats. 15,827, Nov. 9, 1915, and 6223, May 1, 1916.

In an apparatus for washing coal, a reciprocating piston or an oscillating paddle with valves closing during the forward stroke and opening during the reverse stroke, is combined with a fixed, inclined mesh-plate or screen, the whole being arranged in a tank containing water. The piston or paddle is placed at an angle beneath the upper end of the screen, so that the agitation is progressively reduced towards the lower end. The coal is delivered from the screen over an adjustable weir, whilst the dirt falls into a pocket with a door balanced so as to discharge on reaching a certain weight.—J. E. C.

Coal-washing apparatus. E. G. Burks and N. Hayes, Birmingham, Ala. U.S. Pat. 1,201,143, Oct. 10, 1916. Date of appl., Aug. 16, 1915.

A series of overflow tanks is combined with jigging apparatus, fine coal passing to one tank and large coal to another. The overflow water from the fine coal tank is filtered through the large coal and the clear water is returned to the jigging apparatus, whilst unfiltered dirty water from the fine coal tank is returned to the "bone coal" elevator tank.—J. E. C.

Fuel blocks. H. H. Kelsey and A. C. B. Webb, London. Eng. Pat. 15,230, Oct. 28, 1915.

Fuel blocks suitable for camp stoves are composed of plaster of Paris 112 lb., paraffin wax or vegetable oils or fats 37 lb., with or without sugar 11 lb., and a suitable dye in crude glycerin as a vehicle. The mixture is melted, rolled into grooved slabs, and broken into blocks. The blocks may be ignited by attached celluloid strips, or waxed cotton, wick fabrics, or match-head composition.—W. F. F.

Spent tar bark, peat, and the like; Treatment of —— for use as fuel. J. Mackenzie, Middlesbrough. Eng. Pat. 101,730, Jan. 15, 1916. (Appl. No. 680 of 1916.)

Spent bark is compressed to remove moisture, mixed with coal tar pitch, with or without the addition of peat, sawdust, coal or coke dust, heated, and compressed into briquettes.—J. E. C.

Fuel; Composition ——. E. H. Smirk, Lytham, Lancs. Eng. Pat. 101,813, Jan. 26, 1916. (Appl. No. 1215 of 1916.)

Brewers' barm or yeast is mixed with coal or coke dust, small coal or coke, or other suitable pulverised carbonaceous material, and water to form a paste which is moulded into briquettes. Sawdust, peat dust, tanners' spent waste, dyers' waste, coffee husks, or spent hops may also be added. (See also Eng. Pat. 11,990 of 1915.) —W. F. F.

Powdered coal and analogous fuel; Process of burning ——. E. P. Roberts, Cleveland, Ohio. U.S. Pat. 1,200,028, Oct. 3, 1916. Date of appl., Dec. 10, 1915.

Coal dust, gas, or oil and an insufficient supply of air are admitted at one end of a combustion chamber and ignited. Subsidiary streams of gas and secondary air are admitted so as to deflect the main stream, compelling it to follow a sinuous path between the inlet and outlet. The secondary air completes the combustion.—J. E. C.

Heating [coke-oven walls and the like]; Art of ——. A. Roberts, Evanston, Ill. U.S. Pat. 1,200,871, Oct. 10, 1916. Date of appl., Aug. 5, 1915.

In a coke-oven wall or the like, the gases are caused to impinge repeatedly and violently against portions of the wall as they pass from inlet to outlet. The amount of impingement increases towards the outlet, giving an increased heat transfer, compensating for decreased temperature of gases, and securing uniform heating effect. —J. E. C

Gas; Apparatus for manufacture of ——. C. B. Tully, Westminster. Eng. Pat. 101,815, Jan. 27, 1916. (Appl. No. 1318 of 1916.)

In a plant manufacturing coal-gas and water-gas by separate independent means but withdrawing the products from both by a common exhauster, the water-gas element consists of generators operated in cyclic fashion, so as to supply an uninterrupted stream of water-gas. The steam, air, and snift valves are controlled by levers operated by a cam shaft driven through reduction gear by the steam engine operating the blower, in such a manner that two generators are always delivering water-gas whilst the third is being blown.—J. E. C.

Gas rich in carbon monoxide; Method of making ——. H. Foersterling, Perth Amboy, N.J., Assignor to The Roessler and Hasslacher Chemical Co., New York. U.S Pat. 1,200,719, Oct. 10, 1916. Date of appl., Nov. 9, 1912.

Carbon dioxide, steam, and air are passed through a body of incandescent coke, producing a gas rich in carbon monoxide. This gas is cooled, by using it to generate steam, and is then burnt. Carbon dioxide is separated from the products of combustion by a liquid absorbent, which on further heating liberates the carbon dioxide. The carbon dioxide, thus liberated, along with a portion of the steam produced, and air, is admitted into a mass of incandescent coke.—J. E. C.

Gas-producer. W. J. Lay, Melville, Saskatchewan, Canada. U.S. Pat. 1,200,857, Oct. 10, 1916. Date of appl., July 10, 1915.

In a gas producer, a water jacket is combined with an air-inlet casting; the water surrounds air-inlet pipes which communicate with the exterior air and the space above the water in the jacket.—J. E. C.

Gas; Process and apparatus for removing tar and other condensables from ——. W. C. Dayton, Assignor to G. H. Smith, Buffalo, N.Y. U.S. Pat. 1,200,442, Oct. 3, 1916. Date of appl., Feb. 5, 1914.

Gas is expanded under partial vacuum in a cylinder, then compressed to a predetermined degree, and discharged through a narrow slit, of such dimensions as to agglomerate the tar particles, into an expansion chamber in which separation of gas and liquid takes place.—J. E. C.

Ammonia; Process for returning condensed —— to distillation gases. K. Burkheiser, Dortmund. Ger. Pat. 294,130, Feb. 25, 1916.

The ammoniacal liquor is distilled, and the concentrated liquor thus obtained is brought in contact with the hot crude gas before the latter is treated for the recovery of ammonia by the direct or semi-direct process.—A. S.

Petroleum oils; Process and apparatus for converting heavy —— into light oils. M. J. Trumble, Los Angeles, Cal., U.S.A. Eng. Pat. 15,081, Oct. 25, 1915.

Petroleum oil is forced through a coil (heated to a sufficient degree to crack the oil), at such velocity and pressure as to convert the oil into a foam. The foam passes into a chamber in which the lighter vapours separate and are conducted to dephlegmating and condensing plant. The heavier products are collected and returned to the heating coil, thus forming a closed ring, the volume being maintained by the addition of fresh oil equivalent to the volume of light products condensed and removed.—J. E. C.

Petroleum; Process of and apparatus for distilling ——. A. S. Hopkins, Assignor to The Standard Oil Co., Neodesha, Kans. U.S. Pats. (A) 1,199,463 and (B) 1,199,464, Sept. 26, 1916. Date of appl., Dec. 18, 1915.

(A) Petroleum hydrocarbons, having boiling points above 500° F. (260° C.), are distilled from 650° to 850° F. (340° to 450° C.), and under a pressure of upwards of four atmospheres. The mixed vapours are led from the still to a reflux fractionating surface condenser in free communication with the still, the surfaces of the condenser being cooled by a regulated quantity of fresh stock of the petroleum, so that the latter is heated and a constant temperature maintained in the vapour. The heated stock is mixed with the distillate formed in the reflux condenser, and the mixture led to the still through the vapour outlet pipe. The vapours passing the condenser are carried off and separately condensed and collected. (B) The apparatus is composed of a still, an inclined dephlegmator leading in an upward direction from it, and a vertical cylindrical condenser shell acting as a reflux fractionating surface condenser, the lower end of the latter being in communication with the upper end of the dephlegmator so as to receive vapours therefrom and discharge condensed liquid into it. The shell is subdivided by internal partitions into upper and lower vapour compartments and intermediate condensing passages. Cold liquid is fed to the outer walls of the condensing passages, the feed being controlled by a valve and a thermostat. located in the upper vapour compartment, the thermostat operating means for regulating the valve. The cooling liquid is led through a transfer circuit to the upper end of the dephlegmator after it has traversed the condenser, and means are provided for carrying off and separately condensing the vapours leaving the upper vapour compartment. —B. N.

Refining method and apparatus [*for gasoline*]. A. N. Kerr. Tulsa. Okla. U.S. Pat. 1,199,903, Oct. 3, 1916. Date of appl., Feb. 19, 1916.

Casing head gasoline is distilled in a steam still under moderate pressure, and the distillation product is settled and cooled, the light volatile fractions being run off, down to approximately 96° B. (sp.gr. 0·62) in a finely divided form and absorbed in a low grade product, such as naphtha or the like, so as to enrich the latter. The product, from approximately 96 to 72° B. (sp.gr. 0·62—0·69), is run into a container, and the heavier distillate is graded in tanks at predetermined gravities.—B. N.

Motor spirit [*from petroleum*]; *Process for producing a new* ——. W. Landes, Wichita, Kans. U.S. Pat. 1,199,909, Oct. 3, 1916. Date of appl., Feb. 9, 1915.

Crude petroleum is forced from a tank, or tanks, through a nozzle, and is discharged in a minute stream into a casing co-axial with the nozzle. Steam is injected into the casing for preheating and initially expanding the oil while in the nozzle, the steam subsequently cutting through the stream of oil transversely to its path, thus again expanding the oil and dissipating the particles. The oil issues from the casing in an exceedingly fine mist into one end of an expansion chamber heated to approximately 180° F. (82° C.), thus further expanding the mist and causing instantaneous vaporisation of the highly combustible and volatile constituents of the petroleum. The homogeneous gas, thus produced, is allowed to travel slowly through the heated expansion chamber, to separate the heavier and more bituminous components, and the gas is conducted to a primary condenser, within which it is sprayed with a condensing medium. The gas is finally passed to a secondary condenser, and the resulting fluid, forming a highly combustible and volatile homogeneous fluid of low specific gravity, is conducted to a receiver. —B. N.

Coal gas; Method and apparatus for manufacturing ——. A. E. White, London. From Riter-Conley Manufacturing Co., Leetsdale, Pa., U.S.A. Eng. Pat. 16,891, Dec. 1, 1915.

See U.S. Pats. 1,167,119 and 1,167,150 of 1916; this J., 1916, 245.

Gas producers. P. A. J. Cousin, Loos-lez-Lille, France. Eng. Pat. 28,446, Dec. 9, 1913. Under Int. Conv., Dec. 9, 1912.

See Addition of Dec. 9, 1912, to Fr. Pat. 435,532 of 1911; this J., 1913, 647.

Recovery of aluminium chloride [*from oil-containing residues*]. U.S. Pat. 1,202,081. *See* VII.

Manufacture of a binding medium for tar-macadam roads. Ger. Pat. 294,481. *See* IX.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Light: Limits of the production of —— *by radiation: the so-called mechanical equivalent of light, and electric incandescence lamps.* A. Meyer, Beleuchtungstechn. Ges., Sept., 1916. Z. angew. Chem., 1916, **29**, Wirtschaftl. Teil, 618—619.

The author endeavours to find a relationship between the illuminating power of a radiant body similar to Stefan's law connecting the radiation of heat and temperature of a black body. The number of watts required to produce a luminosity of 1 spherical candle power (12·57 lumens) from a black body at various temperatures with an efficiency of 0·4—0·75 may be calculated. The minimum amount of power required is 0·0103 watt at 5300° abs. It is also possible to determine the efficiency of an illuminant if the temperature of a black body at which the latter exhibits the same energy distribution as the illuminant is known. The temperature of the filament in commercial electric lamps is not economical; a much greater efficiency is obtained at 4000° abs., but there is no advantage in a temperature above 6000° abs. Carbon has a greater efficiency than a truly black body, and lamps with a metallic filament *in vacuo* are far superior to carbon filament lamps. Metallic filament lamps filled with inert gas are less efficient than the corresponding vacuum lamps, but have the advantage that they may be operated with the filament at a higher temperature. The author has calculated the percentage of the energy applied to the lamp which is emitted in the form of optically useful light in lamps under normal conditions as follows:—Carbon filament, 0·35%; tantalum, 0·70%; tungsten, 1·05%; "half-watt" lamp, 2·55%. These figures are better than those for a black body, but are far removed from the efficiencies theoretically possible.—A. B. S.

Flame arc in chemical manufacture. W. R. Mott and C. W. Bedford. J. Ind. Eng. Chem., 1916, **8**, 1029—1035.

A flame arc operated at high amperage is, in proportion to power taken, the most efficient known light source for photochemical reactions such as the chlorination of hydrocarbons. The white flame arc is already extensively used in photo-engraving, blue-printing, and other photographic work, and has recently been applied to the testing of dyes for fastness (see this J., 1915, 1084). A single flame arc can be made ten to twenty times more powerful as to photochemical effect than any other single lamp except the high amperage enclosed arc, and is three times more powerful than the latter at the same amperage. The white flame arc, is more powerful than flame arcs of other colours for many purposes and is better suited for use with vessels of ordinary glass, which transmits nearly the whole of its active rays. The light of the white flame arc extends very little into the far ultra-violet (beyond 3000 Å) and is very similar to sunlight plus blue skylight. Its photographic effect on "solio" paper, within the limits of moderate arc voltages (40—80), can be expressed approximately by the expression, $KC^{1\cdot3}(V-23)$, where C is the current (continuous) in ampères, V is the arc voltage, and K is a constant, having the value 0·0085, with an average deviation of ±0·0009; the standard of reference (100) is the photographic effect of a 110-volt continuous current flame arc lamp operating at 25 ampères and 65 arc volts. A high-amperage enclosed arc lamp may be adapted for use with flame carbons, part of the current being shunted around the usual lamp resistance and solenoid and through a resistance capable of carrying 15—20 ampères at 55 volts without deterioration; in a similar arrangement for alternating current a reactance coil is inserted in the shunt circuit instead of the resistance. The white flame arc has been used successfully in connection with the chlorination of natural gas for the manufacture of chloroform.—A. S.

Patents.

Charcoal; Preparation of vegetable ——. A. H. Bonnard, London, T. E. Rule and J. Nicol, Liverpool. Eng. Pat. 10,622, July 21, 1915.

Vegetable charcoal is prepared by heating a carbonaceous material of vegetable origin in the presence of a carbonate or oxide of an alkaline earth metal, *e.g.*, calcium, to a bright red heat (about 1000° C.). At least 30% of chalk should be used, and after heating, the material is washed with hydrochloric acid until free from lime, and finally with water to free it from acid.—J. E. C.

Retort. J. L. Grafflin and H. M. Chase, Wilmington, N.C. U.S. Pat. 1,200,606, Oct. 10, 1916. Date of appl., Aug. 5, 1913.

A retort for dry distillation is fitted with a vapour outlet having an upwardly opening mouth near the bottom of the retort and a vapour outlet with a downwardly opening mouth at the top. —J. E. C.

Retort or still. H. MacRae and H. M. Chase, Wilmington, N.C. U.S. Pat. 1,200,634, Oct. 10, 1916. Date of appl., June 23, 1914.

A series of concentric heating coils is arranged within a retort, with spaces between them to receive a non-liquid material for distillation. The innermost coil surrounds a passage open at both ends and through which a current of gas is circulated towards the end opposite to the offtake.—J. E. C.

Retort carbon; Method for producing pure ——. E. Szarvasy, Budapest, Austria-Hungary. U.S. Pat. 1,199,220, Sept. 26, 1916. Date of appl., Feb. 12, 1915.

Methane is decomposed by passing it over fragments of carbon heated to a glowing condition. The fragments are kept moving and are removed after increasing in size, being replaced by a quantity of fragments of smaller size.—J. E. C.

Retort; Revoluble ——. W. Thomas, Nanaimo, B.C., Canada. U.S. Pat. 1,201,531, Oct. 17, 1916. Date of appl., June 4, 1915.

See Eng. Pat. 9156 of 1915; this J., 1916, 827.

Metallic filaments for incandescence electric lamps and for other purposes; Process for manufacturing ——. K. Nishimoto, Tokyo, Japan. U.S. Pat. 1,201,611, Oct. 17, 1916. Date of appl., May 21, 1915.

See Eng. Pat. 7829 of 1915; this J., 1916, 731.

Art of heating [coke-oven walls and the like]. U.S. Pat. 1,200,871. *See* IIa.

III.—TAR AND TAR PRODUCTS.

Benzene; Conditions for the formation of explosive mixtures of —— *with air.* Martini und Hüneke. Chem.-Zeit., 1916, **40**, 948—949.

Contrary to a common belief, mixtures of benzene vapour with air explode within wider limits than mixtures of petroleum spirit with air. In the case of petroleum spirit, mixtures containing from 2·4 to 4·9% were explosive, whilst for mixtures of benzene vapour with air the limits of explosibility were from 2·7 to 6·5%. Determinations of the partial pressures of the vapours at different temperatures showed that to be reasonably certain of avoiding the risk of explosion with benzene vapour by exceeding the upper limit of explosibility in the air in the benzol store, temperatures of at least 30° C. are necessary. Owing to its greater volatility petroleum spirit frequently forms mixtures at ordinary temperatures, which exceed the upper limit, and are therefore not explosive. Impure benzene left on the interior of cans evaporates very slowly, and in spite of careful blowing with air or steam, and exposure of the open can to the air for several days may still remain in sufficient quantity to form explosive mixtures with air.—C. A. M.

Naphthols; Discrimination between the two —— *by the titanyl sulphate reagent.* G. Denigès. Ann. Chim. Analyt., 1916, **21**, 216—217.

An intense green coloration is produced when α-naphthol (not more than 0·01—0·02 grm.) is shaken with 2—3 c.c. of the reagent suggested for certain alkaloids (see page 1234) but β-naphthol gives a blood-red colour under similar conditions; on diluting the liquids with acetic acid the colour given by α-naphthol becomes reddish-violet whilst that given by β-naphthol remains unchanged. If the naphthol is first dissolved in 10—20 drops of acetic acid, and 2—3 c.c. of the reagent is carefully added, to form a lower layer, a green ring surmounted by a reddish-violet layer is formed in the case of α-naphthol, and a blood-red ring in the case of β-naphthol. Naphthol esters behave like the free naphthols if they are warmed slightly with the reagent.—J. H. L.

Method of measuring the viscosity of very viscous substances. Feild. *See* XXIII.

Patents.

Phenol; Manufacture of ——. D. Tyrer, Stockton-on-Tees. Eng. Pat. 101,807, Jan. 12, 1916. (Appl. No. 522 of 1916.)

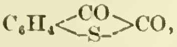
A method of obtaining sodium benzenesulphonate from the mixture of benzenesulphonic acid and sulphuric acid resulting from the sulphonation of benzene, consists in adding a quantity of a base forming an insoluble sulphate, sufficient to convert the acids into sulphonate and sulphate respectively, and to neutralise a quantity of nitre cake equivalent to the sulphonic acid, and then adding the above quantity of nitre cake. The quantities of base and nitre cake may be adjusted so as to produce *in situ* some of the caustic soda required for subsequent conversion of sodium benzenesulphonate into sodium phenoxide. For example, 100 parts of the sulphonation product, containing 85% of sulphonic acid, is treated with 2000 parts of a solution containing 244 parts of sodium bisulphate and 100 parts of finely powdered quicklime. The solution is filtered, treated with 145 parts of barium hydroxide, and again filtered. The resulting solution contains sodium benzenesulphonate and sufficient caustic soda to convert it into phenol. The solution is evaporated and the product fused.—J. E. C.

Benzyl chloride from toluene; Process of making ——. C. Ellis, Montclair, N.J., Assignor to Chadeloid Chemical Co., New York. U.S. Pat. 1,202,040, Oct. 24, 1916. Date of appl., Aug. 16, 1912.

A mixture of toluene vapour with sufficient chlorine to combine with 25—50% of the toluene is passed through a heated zone where it is subjected to a gradually increasing temperature above the boiling-point of toluene, the benzyl chloride is condensed, and the toluene afterwards condensed is freed from hydrogen chloride and again used in the process.—F. W. A.

2.3-Diketodihydrothionaphthenes ; Manufacture of ——. R. Stollé, Heidelberg. Ger. Pat. 291,759, Jan. 17, 1914. Addition to Ger. Pat. 281,046.

2.3-Diketodihydrothionaphthenes,



$$C_6H_4\left\langle\begin{matrix}CO\\S\end{matrix}\right\rangle CO,$$

are obtained by treating aromatic mercaptans with oxalyl chloride, and subjecting the resulting chlorides of formula, R.S.CO.CO.Cl, to the action of condensing agents. Methyl-2.3-diketodihydrothionaphthene, glistening yellowish-red leaflets, m.pt. 144° C., is obtained in this way from *p*-thiocresol.—A. S.

3-*Nitro*-1-*aminobenzene*-6-*sulphonic acid ; Manufacture of* ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 294,547, Feb. 6, 1915.

m-Nitroaniline is sulphonated at 120°—140° C. with the calculated quantity or a slight excess of fuming sulphuric acid, and the product is cooled and stirred with water. The sulphonic acid separates, and is filtered off and washed. It may be purified by means of its sparingly soluble sodium salt.—A. S.

Tar distillates ; Method of producing pure ——. M. Melamid, Freiburg, Germany. U.S. Pat. 1,201,601, Oct. 17, 1916. Date of appl., June 10, 1913.

See Addition of Sept. 30, 1912, to Fr. Pat. 443,650 of 1912 ; this J., 1913, 415.

Manufacture of a binding medium for tar-macadam roads. Ger. Pat. 294,481. *See* IX.

IV.—COLOURING MATTERS AND DYES.

Indigo ; Rapid volumetric determination of ——. S. M. Jones and W. Spaans. J. Ind. Eng. Chem., 1916, 8, 1001—1002.

The method consists in titrating the disulphonic acid of indigo with a solution of sodium formaldehyde-sulphoxylate in an atmosphere of hydrogen, the reduction of the indigo being accelerated by addition of sodium bisulphite, the effect of which is to liberate sodium sulphoxylate from the formaldehyde-compound. One grm. of indigo powder (or 2 grms. of 50 % paste or 5 grms. of 20 % paste) is sulphonated with 15 c.c. of sulphuric acid of sp.gr. 1·84 (2—4 hours at 55°—60° C.), and after cooling, the sulphonated product is diluted to 1 litre with water, filtered, and 50 c.c. of the solution and 50 c.c. of a 35 % solution of sodium bisulphite are placed in a 300 c.c. Erlenmeyer flask closed by a stopper carrying a thermometer, the stem of a burette, and an inlet and outlet tube for hydrogen. The solution is heated to 75° C., a vigorous current of hydrogen is passed through, and the indigosulphonic acid titrated with a solution of 1 grm. of sodium formaldehyde-sulphoxylate (Rongalite C) in 1 litre of water. The amount of sulphoxylate required is first determined approximately by a rapid preliminary titration. The formaldehyde-sulphoxylate solution is standardised by a determination carried out in exactly the same way with 1 grm. of C.P. indigo. (Compare Bloxam, this J., 1906, 735.)
—A. S.

Anthocyanins ; Investigation of the ——. *Parts XI.—XVIII.* R. Willstätter and others. Annalen, 1916, **412**, 113—251. (See this J., 1916, 300.)

The anthocyanins constituting the colouring matter of a further series of flowers and fruits have been investigated, and in confirmation of deductions drawn from previous work, it appears that in spite of the multiplicity of anthocyanins, the anthocyanidins or sugar-free colouring matters which they yield are few in number, in fact all the anthocyanins examined proved to be glucosides of pelargonidin, cyanidin, or delphinidin or their methyl ethers, differing in the nature, the number, and mode of combination of the sugar residues. From *Salvia sp.* the anthocyanin salvianin was isolated, which on hydrolysis gave 2 mols. of dextrose, malonic acid, and pelargonidin. As intermediate products the normal diglucoside salvinin (chloride, $C_{27}H_{31}O_{15}Cl$), and a beautifully crystallising compound salvin, containing apparently 2 mols. H_2O less than salvinin, were isolated. The formation of a monoglucoside was also detected, but it was not identical with pelargonenin, the monoglucoside isolated as an intermediate product of the hydrolysis of pelargonin to the sugar-free pelargonidin. From the chrysanthemum a new monoglucoside of cyanidin, chrysanthemin, was isolated. It gave a Bordeaux red crystalline chloride, $C_{21}H_{21}O_{11}Cl$. From the aster an isomeric but not identical monoglucoside of cyanidin was obtained to which the name asterin was given. Its chloride formed bronze brown prisms, differing in solubility and other particulars from chrysanthemin. A second monoglucoside, callistephin, was also isolated from the colouring matter of the aster. This substance proved to be a derivative of pelargonidin, but was not identical with the above-mentioned pelargonenin. The glucosides of cyanidin are widely distributed among the fruits, and were found in berries differing in colour from yellowish-red to deep blue. The investigation of the anthocyanins of the fruit of two species of *Prunus*, the cherry and the sloe, revealed the presence of two different diglucosides of cyanidin, keracyanin and prunicyanin respectively. The former bears a close resemblance to cyanin, whilst the latter has a similar relationship to mecocyanin, the anthocyanin of poppy petals. Both the fruit anthocyanins however are characterised as rhamnoglucosides, as distinct from the petal anthocyanins in which both sugar groups are dextrose residues. Apart from the rhamnose content, prunicyanin is probably quite similarly constituted to mecocyanin, which it resembles in solubility and reaction much more closely than keracyanin with which it is isomeric. Hitherto only one anthocyanin of delphinidin itself, viz., delphinin, had been isolated. A second, violanin, has now been obtained from the petals of the violet pansy, *Viola tricolor*, which are characterised by an unusually high content of colouring matter, amounting to one-third of the weight of the dried substance. On hydrolysis violanin gave rhamnose, dextrose, and delphinidin, and the opportunity was taken to study more closely the properties and characteristics of the latter, the chloride of which was shown to form four distinct hydrates of completely different crystalline habits. The anthocyanin of the cultivated petunia, *P. hybrida hort.*, is the diglucoside of a monomethyldelphinidin, to which the name petunidin is given. The anthocyanin, petunin, isolated as its chloride, $C_{28}H_{33}O_{17}Cl$, forms bronze glittering crystals, violet by transmitted light. Petunidin closely resembles its isomeride myrtillidin in giving an intense blue colour with ferric chloride, and phloroglucinol and a methylated acid on hydrolysis with sodium hydroxide. It differed from the latter in colour and solubility. Myrtillin, the monogalactoside of myrtillidin, was isolated from the bilberry, as bronze brown crystals of the chloride, having a greenish metallic glance. The colouring matter of the grape, œnin, which was previously described, and which was identified as the monoglucoside of a dimethyldelphinidin, œnidin, is now shown to be accompanied by small quantities of the diglucoside and the free anthocyanidin on the one hand, and by a monoglucoside of monomethyldelphinidin, which was actually isolated in a fairly pure condition from a closely related species, *Ampelopsis quinquefolia*, and is termed ampelopsin. A third anthocyanin of the vine species was isolated from *Vitis riparia.* All three anthocyanins give bluish-red colours in alcohol: they differ in reaction with alcoholic ferric chloride according to the positions of the unmethylated delphinidin hydroxyl groups. —G. F. M.

PATENTS.

[Azo] wool dyestuff; Red ——. W. Bergdolt, Leverkusen, Germany. Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,201,544, Oct. 17. 1916. Date of appl., Mar. 27, 1915; renewed Sept. 6, 1916.

NEW azo dyestuffs are claimed which dye wool yellowish-red to red shades fast to light and which give on reduction with zinc powder, and acetic acid an acidylated *m*-phenylenediaminesulphonic acid and 1.2-diamino-8-naphthol-6-sulphonic acid.—F. W. A.

Vat colouring matters and process of making them. M. H. Isler, Mannheim, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,201,968, Oct. 17, 1916. Date of appl., Feb. 11, 1914.

THE colouring matters obtained by heating an oxidised dibenzanthrone to a temperature above 100° C. in absence of an oxidising agent are brominated. The products yield blue vats with hydrosulphite and dye cotton green.—F. W. A.

Vat dyestuffs and process of making them. O. Bally, Mannheim, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1.202.260, Oct. 24, 1916. Date of appl., Oct. 21, 1914.

AN aminodibenzanthrone is treated with a substance capable of introducing a halogenated organic radical into the amino-group. *e.g.*, with *o*-chlorobenzaldehyde. The products dye cotton from a hydrosulphite vat red to claret shades. —F. W. A.

Diarylidobenzoquinones; Preparation of——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 292.176, May 28, 1914.

UNSYMMETRICAL diarylidobenzoquinones or diarylidochlorobenzoquinones, of value as vat dyestuffs, are prepared by the interaction of 2-amino-5-arylidobenzoquinones or 2-amino-5-arylidochlorobenzoquinones with aromatic amines. —A. S.

Anthraquinone series; Manufacture of condensation products [dyestuffs] of the ——. L. Durand, Huguenin. und Co. Ger. Pat. 294,117, May 25, 1913.

CŒRULEIN or the dyestuffs described in Ger. Pat. 257,084 are condensed with aromatic amino-compounds either directly or in presence of a solvent, and with or without moderate heating (*e.g.*, to 90°—100° C.). The resulting condensation products may be sulphonated or converted into salts. They are greener in shade than the original dyestuffs. The dyestuffs described in Fr. Pat. 458,681 do not behave in a similar manner, and it appears probable that only compounds of which the molecules comprise a quinonoid nucleus containing hydroxyl groups are capable of condensing with amines.—A. S.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Paper; Method for determining the strength of —— *when wet.* E. O. Reed. J. Ind. Eng. Chem., 1916, 8, 1003—1004.

STRIPS of the paper 15 mm. in width and of sufficient length to allow of a breaking length of 100 mm. in the testing machine, are immersed in water at 70° F. (21° C.) for exactly 20 min., and then immediately tested in a Schopper machine calibrated to read from 1 to 1000 grms. Strips cut from the sheet both in a longitudinal and in a transverse direction are tested. The results are markedly affected by variations in the temperature of the water and the time of immersion. Tables of results are given. There is no direct relationship between the dry strength and the wet strength of paper. To obtain high wet strength the paper should be made from long-fibre pulp beaten "wet" and well matted, and sized so as to render the fibres water-resistant. The test has proved of value for controlling the quality of blue and brown print paper, and should be useful also for determining the serviceability of other photographic papers, wrapping papers, paper textiles, paper used for bags for cement, lime, etc., and paper which is to be printed while wet. (See also Beadle and Stevens, this J., 1914, 639.)—A. S.

Sulphite-cellulose; Volatile organic compounds, especially essential oils, formed in the manufacture of ——. Z. Kertész. Chem.-Zeit., 1916, 40, 945—948.

THE residual liquors from the manufacture of sulphite-cellulose were prepared for fermentation by the following methods: 10 litres was mixed (1) with powdered chalk and aerated for 1 hour; (2) with 5 grms. of ammonium sulphate and aerated for 2 hours; (3) with 1 grm. of manganese sulphate and aerated for 3 hours. After neutralisation (in the case of 2 and 3) the liquids were filtered, mixed with 10 grms. of yeast, and fermented for 5 days, with frequent shaking, at 20° to 25° C. On the sixth day they were made slightly alkaline with lime and distilled. The following yields of alcohol (including methyl alcohol, acetone, and acetaldehyde) per litre were obtained:—(1) 8·94 c.c.; (2) 8·74 c.c.; (3) 8·68 c.c. By distilling the first sample in a column still without previous neutralisation, the resulting "sulphite spirit" contained formic and acetic acids and acetates, whilst sulphur (reduced from the sulphur dioxide by acetaldehyde and formic acid) separated in the still. The presence of these reducing substances may also cause a loss of sulphur dioxide during the boiling of the cellulose. On diluting sulphite spirit with water an emulsion is formed. With sulphuric acid it gives a red coloration (cymene, terpenes), and it shows the furfural reaction with aniline and acetic anhydride. From 1000 litres of liquid (obtained from the treatment of 100 kilos. of air-dried cellulose) the following constituents were separated:—Acetaldehyde, 0·06 kilo.; acetone, 0·20 kilo.; methyl alcohol, 0·53 kilo.; and alcohol, 6·32 kilos. The cymene and the terpenes are insoluble in water, while the furfural dissolves in the proportion of 11 : 100 at 13° C. This solubility of furfural accounts for the fact that the crude oil which collects on the surface of the liquid in the mixing reservoir is free from furfural, while the oil obtained in the manufacture of sulphite spirit contains it. A sesquiterpene, $C_{15}H_{24}$, boiling at 250° to 260° C. and having a sp.gr. of 0·925 at 21° C., and a diterpene, $C_{20}H_{32}$, boiling above 300° C. and with sp.gr. 0·950 at 21° C., were isolated.—C. A. M.

PATENTS.

Straw, fascine and other materials; Process and apparatus for manufacturing compressed fabric [e.g., mats] from ——. N. Gekoulin, Moscow. Eng. Pat. 101,741, Jan. 27, 1916. (Appl. No. 1336 of 1916.)

STRAW, rushes, etc., arranged in transverse bundles, are successively fed on a feed table to a vertically expanding box between two vertical walls of iron wires, where the material is compressed in two operations and subsequently mechanically hooked in a compressed state by means of hooks tightening opposite wires. The material may be mixed with cement, lime, or similar binding material before treatment, or the matting may be sprinkled with alkali silicate solution, compressed, and immersed in a solution of aluminium sulphate or lime.—J. F. B.

Acetylcellulose plastic composition; Process of making ——. W. G Lindsay, Caldwell, N.J., Assignor to The Celluloid Co., New York. U.S. Pat. 1,199,395, Sept. 26, 1916. Date of appl., July 10, 1915.

Acetone-soluble acetylcellulose is treated with a mixture of water, benzene, and methyl alcohol, and is allowed to stand at the ordinary temperature until it has gelatinised. *p*-Ethyltoluenesulphonamide and triphenyl phosphate are added, and the mixture is kneaded, heated, and pressed.—F. Sp.

Non-inflammable cellulose compound. W. G. Lindsay, Caldwell, N.J., Assignor to The Celluloid Co. U.S. Pat. 1,199,798, Oct. 3, 1916. Date of appl., Sept. 10, 1912.

Acetylcellulose and diphenylamine are dissolved in acetone, and the solution is allowed to dry and harden by evaporation.—F. Sp.

Acetylcellulose; Compound of —— *and process of making same.* W. G. Lindsay, Newark, N.J., Assignor to The Celluloid Co. U.S. Pat. 1,199,799, Oct. 3, 1916. Date of appl., Jan. 29, 1914.

A mixture is claimed containing, *e.g.*, 100 pts. of acetylcellulose, 10 to 40 pts. of triphenyl phosphate, and from 5—30 pts. of a liquid mono-hydroxy aliphatic alcohol containing more than two carbon atoms.—F. Sp.

Plastic composition [*from acetylcellulose*] *and process* [*for making same*]. W. G. Lindsay, Newark, N.J., Assignor to The Celluloid Co. U.S. Pat. 1,199,800, Oct. 3, 1916. Date of appl., Dec. 12, 1914.

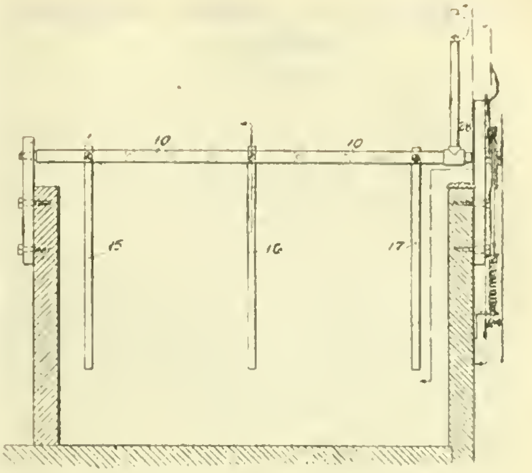
A plastic composition is made by drying a solution of acetone-soluble acetylcellulose, a solid substance, and a liquid of high boiling point, *e.g.*, fusel oil, in a mixture of a chlorinated hydrocarbon, *e.g.*, chloroform, and alcohol.—F. Sp.

Cardboard or pasteboard: Impermeable —— *and process of manufacture.* M. Serebrianyj, Moscow. Eng. Pat. 10,599, July 21, 1915.

An impermeable board is prepared from boiled and ground wood-pulp impregnated in the beater with 8·5 kilos. of "resinous glue" (extract from fir-wood) and 7 kilos. of rosin per 150 of wood-pulp. The resinous constituents are dissolved in alcohol, ether, or benzene in the form of a 20% solution before mixing with the pulp. Alternatively the pulp to be impregnated may be composed of about equal parts of rag-fibre, largely flax, and old document papers, and treated with 7 kilos. of "resinous glue," dissolved in a suitable solvent, per 150 kilos. of pulp. According to the degree of impermeability required, the proportions of impregnating materials may be varied from 1·5 to 70 kilos.—J. F. B.

Viscosity of paper stock; Mechanism for determining the ——. S. W. Webb. Winchester, Mass. U.S. Pat. 1,201,402, Oct. 17, 1916. Date of appl., Dec. 16, 1915.

An apparatus for measuring the viscosity or density of paper stock during a beating operation consists of a beater tub with a beater to cause a continuous flow of the paper stock through the tub, a rock shaft, 10, arranged across the stream of stock and carrying drags, 15, 16, 17, 18, an index on the shaft movable along a graduated scale, a wheel, 28, on the shaft, and a spring, 21, fixed at one end and attached at the other end to a flexible member secured to and tracking on the wheel.
—F. W. A.



Paper; Resinous emulsion for sizing ——. W. P. Thompson, Liverpool. From R. Lender, Neubabelsberg, Germany. Eng. Pat. 17,576, Dec. 16, 1915.

Coumarone and indene, occurring in the fractions of coal tar distillates boiling at 160°—185° C., are polymerised to resins by treatment with sulphuric acid. Five to ten parts of coumarone or indene resin is melted with one part of a natural saponifiable resin, oil, or fat until frothing ceases, and the mixture is emulsified by means of alkali, ammonia, or sodium silicate.—J. F. B.

Paper; Process for sizing ——. R. Clavel, Basle, Switzerland. Eng. Pat. 101,855, July 27, 1916. (Appl. No. 10,644 of 1916.)

Paper is sized by any of the usual sizing and fixing agents by drawing it through the upper part of baths in which the solutions are caused to foam so that the foam comes in contact with one or both sides of the paper. Foaming is produced by means of compressed air or gas diffusing from porous bodies such as pipes or plates of burnt clay or porous graphite. In the case of solutions of fixing agents which are not disposed to foam, foaming may be induced by the addition of saponin or other substances. When sizing with glue or casein, the foaming of the fixing bath may be produced by diffusing gaseous formaldehyde through water containing saponin.—J. F. B.

Thread from the cocoons of the silkworm: Process for obtaining ——. B. Loewe, Paris. U.S. Pat. 1,202,543, Oct. 24, 1916. Date of appl., June 18, 1912.

See Eng. Pat. 14,255 of 1912; this J., 1912, 1175.

Sulphite-cellulose manufacture; Process of treating waste liquor from ——. E. L. Rinman, Stockholm. U.S. Pat. 1,202,317, Oct. 24, 1916. Date of appl., Feb. 18, 1915.

See Ger. Pat. 285,752 of 1914; this J., 1915, 1139.

Method of refining wool grease. U.S. Pat. 1,201,042. *See* XII.

Process of making emulsions. U.S. Pat. 1,201,301. *See* XII.

VI.—BLEACHING ; DYEING ; PRINTING ; FINISHING.

Patents.

Bleaching fabrics in open form : Plant for ——. C. Taylor, North Adams, Mass. U.S. Pat. 1,201,388, Oct. 17, 1916. Date of appl., Jan. 21, 1916.

A plant for bleaching and washing fabrics in open form consists of an apron-member, a series of vats provided with squeezing rollers, a series of overhead conveying rollers, a boiling kier provided with a circulating pump, and a souring kier provided with circulating and washing means. The apparatus is arranged in line, with the squeezing and conveying rollers coupled with each other and adapted to operate as a unit, rotating in one direction or the other for conveying a continuous run of fabric in either direction.—F. W. A.

Bleaching and dyeing processes ; Apparatus for ——. A. Ross, London. Eng. Pat. 14,068, Oct. 5, 1915.

The bleaching or dyeing vat is provided with an exterior siphon or circulation pipe, for withdrawing the contents from the upper level in the vat through a flared mouthpiece for collecting froth, and returning them to the lower part of the vat. The flow of the liquid may be accelerated by the introduction of a jet of steam into one limb of the siphon, and, after the flow has been established, it may be accelerated by heating one or both of the exterior limbs without introducing a supplemental fluid. The siphon may be constructed so that its upper portion is supported on trunnions, on an axis lying below the level of the liquid in the vat, so that it may be filled, for starting purposes, by tilting this upper portion.—B. N.

Dyeing, washing, etc. ; Machines for ——. J. H. Milnes, Huddersfield, and The Simplex Patent Dyeing Machine Co., Ltd., Batley. Eng. Pat. 16,199, Nov. 17, 1915.

In a dyeing machine divided into two compartments by a perforated plate and having a central circulating tube with a steam supply, air is introduced below the perforated plate through a perforated pipe extending round the vessel and controlled by an air-injector operated from a branch of the main steam supply pipe, for the purpose of agitating the liquid and lifting the material.—J. F. B.

Colouring fibre : Process of ——. C. S. Bentley, Plattsburg, N.Y. U.S. Pat. 1,202,652, Oct. 24, 1916. Date of appl., Feb. 17, 1916.

A shaded colouring is imparted to fibre by impregnating the fibre with a solution of a colouring matter in a solvent which can be rapidly evaporated, and drying the treated fibre while it is suspended on an inclined impervious surface, the degree of angular inclination being varied during the drying process to regulate the action of gravity according to the graduation of colour desired.—F. W. A.

Dyeing ; Apparatus for shifting hanks of yarn in ——. P. Hahn, Niederlahnstein, Germany. U.S. Pat. 1,202,061, Oct. 24, 1916. Date of appl., Oct. 10, 1913.

See Eng. Pat. 16,738 of 1913 ; this J., 1914, 641.

Dyeing and printing with derivatives of naphthazarin ; Process for ——. G. Engi, Assignor to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,202,821, Oct. 31, 1916. Date of appl., June 18, 1913.

See Eng. Pat. 12,790 of 1913 ; this J., 1914, 196.

Pattern effects upon cotton fabrics : Process for the production of ——. G. Heberlein, Wattwil, Switzerland. U.S. Pat. 1,201,961, Oct. 17, 1916. Date of appl., Feb. 17, 1916.

See Eng. Pat. 100,483 of 1916 ; this J., 1916, 1057. The use of sulphuric acid of over 50½° B. (sp.gr. 1·538) is specified.

Electrolytic apparatus for laundry and other hygienic purposes. Eng. Pat. 101,820. *See* XI.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Sulphuric acid ; Proposed registering apparatus for the determination of the excess of oxygen in the exit gases from the lead chambers in the manufacture of ——. J. B. Pérégrin. Ann. Chim. Analyt., 1916, 21, 223—225.

Exit gas from the lead chambers is continuously drawn into a wooden chamber of about 30 litres capacity. A light rubber balloon of about 10 litres capacity, filled with hydrogen and suitably varnished to prevent diffusion, is suspended inside the chamber by a fine wire attached to one arm of a pivoted beam, and any rise or fall of the balloon due to changes in the density of the gas in the chamber, is recorded, by the other and longer arm of the beam, on a drum which rotates once in 24 hours.—J. H. L.

Hydrofluoric and hydrofluosilicic acids ; Separation of ——. J. G. Dinwiddie. Amer. J. Sci., 1916, **42**, 421—430.

In the titration of a solution of hydrofluoric acid with phenolphthalein as indicator, the presence of hydrofluosilicic acid as an impurity will produce an error in the proportion of 6 mols. of alkali consumed for each mol. of H_2SiF_6. Katz (this J., 1904, 562) has proposed a method for the separate estimation of these two acids in mixtures, based on a differential titration in aqueous solution and in presence of 50% alcohol with the addition of potassium chloride. If there were no complications the hydrofluoric acid would require the same amount of alkali in both titrations, while the hydrofluosilicic acid would consume in the second titration only one-third of the quantity required in the first, but Katz found that the hydrofluosilicic acid required considerably less than the theoretical amount of alkali in the second titration, and so a sliding correction was proposed to compensate for this error. Testing the method with pure hydrofluosilicic acid, the author found that the alcoholic titration required from 1 to 3% more than one-third of the alkali required in the aqueous titration, owing probably to the slight solubility of the precipitated potassium fluosilicate and its hydrolysis by the alkali. With known mixtures of hydrofluoric and hydrofluosilicic acids, the deficit attributed by Katz to the absorption of hydrofluoric acid by the precipitated potassium fluosilicate was observed, but in a smaller degree, viz., 1 mol. of hydrofluoric acid to 4 of hydrofluosilicic acid instead of 1 : 1 under the conditions recorded by Katz. Attempts to ascertain the error by determining the potassium in the precipitate or filtrate were unsuccessful because the precipitate contains an excess of potassium as well as free hydrofluoric acid. The addition of calcium chloride or calcium sulphate in order to fix the hydrofluoric acid as insoluble calcium fluoride before titration also yielded low results because the calcium fluoride was not sufficiently resistant to the free acid. Stolba's method (J. prakt. Chem., **102**, 2) for the determination of water in fluosilicates by igniting with a weighed quantity of magnesium oxide was found unsuitable, as concordant weighings could not be obtained. Greef's method for the determination of total fluorine in neutralised solutions of fluorides by titration with ferric chloride, using thiocyanate as indicator (this J., 1913, 992), gives accurate results provided rigidly uniform conditions are observed, especially as regards neutrality, but when combined with the Katz method for the titration of fluosilicates in presence of alcohol and potassium chloride, the results are subject to the same kind of error, due to the absorption of free hydrofluoric acid.—J. F. B.

Potash from alunite ; The recovery of ——. W. H. Waggaman and J. A. Cullen. Bull. 415, U.S. Dept. of Agric., 1916. 14 pages.

Complete separation of the potash from alunite, after ignition of the mineral, is difficult, and, as the material contains relatively little potash, cheapness and efficiency in the extraction are essential for successful commercial development. Eleven samples of light-coloured alunite were ignited at different temperatures, and the residues leached with water. A temperature between 750° and 800° C. was found to be best for the subsequent complete extraction of the potash with the minimum amount of water ; above 800° C., the potash was fixed, particularly in the presence of silica. Nothing is gained in the subsequent extraction by grinding the mineral finer than 60-mesh. It is suggested that it would be more economical to ship the mineral cast, thus taking advantage of the lower freight rate for raw material, instead of extracting at the mines, though the freight charges would even then leave a very narrow margin of profit on the products in normal times.—B. N.

Sodium peroxide ; Action of —— on the oxides of carbon. C. Zenghelis and S. Horsch. Comptes rend., 1916, **163**, 388—390.

Sodium peroxide reacts with carbon monoxide to give sodium carbonate only and with carbon dioxide to give sodium carbonate and oxygen. The second reaction produces less heat than the first, but is marked by a greater rise of temperature, probably owing to the formation of percarbonate as an unstable intermediate product (see Wolffenstein and Peltner, this J., 1908, 224). If a current of carbon dioxide be directed on a mixture of sodium peroxide and such readily oxidisable material as aluminium, cotton, wood, or sulphur, an extremely violent reaction sets in at once, sometimes resulting in an explosion, whilst a mixture of the peroxide and magnesium explodes violently under the same conditions, and iron burns to form sodium ferrate, Na_2FeO_4 ; zinc and copper react only on heating.—F. Sodn.

Sodium peroxide ; Chemical action of —— on hydrogen sulphide. C. Zenghelis and S. Horsch. Comptes rend., 1916, **163**, 440—442.

The action of sodium peroxide on hydrogen sulphide is extremely vigorous, the peroxide becoming incandescent even when air has been previously expelled from the containing tube by a current of nitrogen. The products of the reaction depend on the conditions, whether a smaller or larger quantity of air is present and whether the peroxide is given a preliminary heating. In nitrogen gas, sodium sulphide, polysulphide, thiosulphate, and sulphate are produced, and, with a strong current of hydrogen sulphide, a little free sulphur is deposited.—B. N.

Silver peroxynitrate : A new method for the study of ——. M. J. Brown. J. Phys. Chem., 1916, **20**, 680—700.

The author has devised an apparatus in which silver peroxynitrate was prepared of greater purity than heretofore by electrolysis of 5% and 20% solutions of silver nitrate with currents of various strengths. The silver content of the anode deposit is slightly lower than corresponds to $(Ag_3O_4)_2,AgNO_3$, possibly due to occluded mother-liquor, though this cannot be the sole factor. The impurity present may be $(Ag_3O_4)_2,H_2O$ or $Ag_2O_5.AgNO_3$. The author reviews the literature of the subject.—A. B. S.

Sulphur ; Action of —— on baryta in presence of water. L. Guitteau. Comptes rend., 1916, **163**, 390—391.

The orange solution obtained by boiling a mixture of barium hydroxide (2 parts), sulphur (1 part), and water (25 parts) appears to contain barium pentasulphide, BaS_5 ; but attempts to isolate the compound by concentrating the solution gave red prisms of the tetrasulphide, BaS_4,H_2O, mixed with sulphur and thiosulphate ; the pentasulphide is probably decomposed in accordance with the equation, $2BaS_5+3H_2O=BaS_4+BaS_2O_3+3H_2S+S$.—F. Sodn.

Mercuric sulphide ; Action of ammonium monosulphide on ——. A. Christensen. Ber. deut. Pharm. Ges., 1916, **26**, 261—266.

A colourless solution of ammonium sulphide becomes yellow owing to the presence of sulphur when poured on to many mercuric salts and on to yellow mercuric oxide. The precipitate in such cases always contains metallic mercury which was found to be equivalent in amount to the sulphur present in the ammonium sulphide solution, so that the reaction is due to the dissociation of the mercuric sulphide. The reaction is reversible, as the yellow solution at higher temperatures becomes colourless. Freshly precipitated mercuric sulphide on treatment with ammonium sulphide does not show the reaction.—T. C.

Removal of sulphur from spent oxide. Murphy. *See* IIa.

Physical character of precipitated lead molybdate and its importance in the determination of molybdenum and lead. Weiser. *See* XXIII.

New cyanide works in Glasgow. *See* Trade Report.

Patents.

Potash ; Process of producing —— [from greensand]. G. F. Von Kolnitz, Charleston, S.C. U.S. Pat. 1,201,396, Oct.17,1916. Date of appl., Jan.7,1916.

Greensand is preheated in an oxidising atmosphere to about 335° C. and then heated to a higher temperature in presence of calcium chloride and in a reducing atmosphere to form potassium chloride, which is recovered.—J. E. C.

Alkali ; Extracting —— from minerals. S. Peacock, Philadelphia, Pa., Assignor to Marden, Orth, and Hastings Co., Inc., New York. U.S. Pat. 1,202,215, Oct.24,1916. Date of appl., June 28,1915.

Minerals containing alkali metals (*e.g.*, potassium) are melted in a closed furnace under pressure of the volatilised alkali and thus converted into an amorphous mass soluble in alkali. Alkali in solution is added in quantity sufficient, together with that already present, to react with all the silica contained in the mass to form a soluble alkali silicate, which is separated by filtration. The filtrate is treated with milk of lime forming an insoluble calcium silicate and an alkali hydroxide, the latter being separated and recovered.
—J. E. C.

Potash salts: Apparatus for the continuous separation of liquid from granular material, especially ——. B. Schilde Maschinenfabr. und Apparatebau Ges. m.b.H., and S. Haun, Hersfeld. Ger. Gat. 294,275, Jan. 4, 1916. Addition to Ger. Pat. 289,774 (this J., 1916, 538).

An angle iron is fixed to each of the scrapers near the lower end, on the rear side. The longer horizontal arm of the angle iron presses on the heap of material during the forward movement of the scraper, and squeezes out the liquor.—A. S.

Rocks: Process for the treatment of volcanic ——. C. Massatin, Berlin, and A. Neumann, Charlottenburg, Germany. U.S. Pat. 1,202,556, Oct. 24, 1916. Date of appl., May 9, 1913. Renewed Aug. 9, 1916.

To render volcanic rocks of a vitreous character capable of exchanging their bases, they are treated with steam under pressure in the presence of alkalis.—J. H. J.

Salt from sea-water; Process for the extraction of ——. L. P. Basset. Fr. Pat. 477,928, July 8, 1914.

Sea-water is allowed to evaporate as a very shallow layer on an impervious floor on to which it is fed in such quantity that evaporation is completed each day, the salt being then removed; or, a continuous flow of sea-water is maintained over a gently sloping floor, so as to furnish a constant supply of strong brine by progressive evaporation, and the product is filtered and further evaporated; or, evaporation is wholly or partially effected by atomising in a current of air or by supplying sea-water in atomised form at a desired height above the evaporation floor.—F. Sodn.

Ammonium nitrate; Process of manufacturing —— *by treating with alcohol the mother liquor from the manufacture of sodium carbonate from sodium nitrate by the ammonia process.* A. Ricard. (A) Fr. Pat. 479,164, May 22, 1915, and (B) First Addition, dated June 9, 1915.

(A) The mother liquor containing ammonium nitrate and sodium nitrate is evaporated to dryness or until the temperature reaches 140° C., and the residue agitated with alcohol (95—98%) at 70°—80° C. Ammonium nitrate is thereby dissolved and recovered by cooling the solution and recrystallising, whilst the sodium nitrate, remaining insoluble, is returned to the ammonia-soda process. The proportion of ammonium nitrate in the crude liquors or original mother liquors may be increased by adding ammonium chloride, which reacts with the sodium nitrate present to give a precipitate of sodium chloride; or ammonium sulphate may be similarly employed. Chlorides and sulphates which accumulate in the mother liquors may be removed by treating the alcoholic solution with lead nitrate. The recrystallised product contains 95% of ammonium nitrate. (B) The mother liquor is agitated with alcohol at 70° C., so as to precipitate sodium nitrate, leaving a solution of ammonium nitrate from which the alcohol is recovered by fractional distillation and the nitrate by crystallisation; or, the proportion of alcohol is adjusted to give an alcoholic solution of ammonium nitrate superposed upon an aqueous solution of sodium nitrate, which latter is run off and returned to the ammonia-soda process.—F. Sodn.

Alumina; Process of preparing pure ——. A. Lambert. Fr. Pat. 477,988, July 10, 1914.

A mixture of bauxite, with sufficient calcium oxide or calcium carbonate to convert the aluminium present into calcium aluminate, is fused in an electric furnace, the powdered product heated with sodium carbonate solution, and the filtered solution of sodium aluminate treated by a known method to precipitate the alumina.
—F. Sodn.

Titanic oxide; Method of obtaining ——. L. E. Barton, Niagara Falls, N.Y., Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. 1,201,541, Oct. 17, 1916. Date of appl., Mar. 7, 1916.

Titanic oxide is obtained from titaniferous-ferruginous material by heating the material in presence of an alkali sulphide to form ferrous sulphide or ferro-sodium sulphide. The resulting product, containing also titanic oxide and alkali titanate, is incorporated with an aqueous bath and treated with sufficient chlorine to ensure decomposition and solution of the alkali sulphide and ferrous sulphide. The chlorine may be produced by adding sodium chloride to the bath and electrolysing.—J. E. C.

Aluminium chloride; Recovery of —— [*from oil-containing residues*]. A. McD. McAfee, New York. U.S. Pat. 1,202,081, Oct. 24, 1916. Date of appl., Mar. 2, 1915.

In working up the residues from the treatment of oil with anhydrous aluminium chloride, the latter is revivified by extracting the oil-containing residues with a volatile solvent and expelling the volatile solvent from the extract.—J. E. C.

Ammonia; Production of ——. F. Haber and R. Le Rossignol, Karlsruhe, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,202,995, Oct. 31, 1916. Date of appl., Aug. 13, 1909.

See Fr. Pat. 406,943 of 1909; this J., 1910, 488.

Zinc oxide: Process for the production of ——. E. Hunebelle, Paris. U.S. Pat. 1,201,586, Oct. 17, 1916. Date of appl., May 23, 1914.

See Eng. Pat. 14,226 of 1914; this J., 1915, 1009.

Sulphate, sulphite, and oxide directly from the sulphide of lead; Process for the manufacture of the ——. J. Gitsham, London. U.S. Pat. 1,201,955, Oct. 17, 1916. Date of appl., Mar. 21, 1916.

See Eng. Pat. 5299 of 1915; this J., 1916, 698.

Furnaces. Eng. Pat. 101,757. *See* I.

Process of recovering alkali [*in cement manufacture*]. U.S. Pat. 1,202,327. *See* IX.

VIII.—GLASS; CERAMICS.

Refractory materials. R. Hadfield. Faraday Soc., Nov. 8, 1916.

After reviewing the available information on refractory materials, the author describes briefly the properties of zirconia, which he considers will be of much importance in the future. Magnesite has been found useful for nozzles for steel ladles. The diameter of a magnesite nozzle remained unaltered at 1 in. even after 28 tons of steel had been poured through it, whereas that of an ordinary fireclay nozzle increased to 2 in. The most noticeable feature of the address is the tabulated list of 30 volumes and 74 papers dealing with the subject and five tables dealing with analyses of various refractory materials, including furnace sands. The address is illustrated with nine photomicrographs of refractory sands.—A. B. S.

Firebricks; The texture of ——. J. W. Mellor. Faraday Soc., Nov. 8, 1916.

The texture is one of the most important qualities of a firebrick, because if the chemical composition and refractoriness are satisfactory, the characters of the brick will depend on the texture, *i.e.*, on the proportions of coarse and fine grains and the spaces between them. These grains are composed of (a) felspathic and micaceous fluxes, (b) granules of clay proper, (c) grains of quartz, and (d) accidental impurities. When a clay is burned in a kiln the fluxes begin to melt at about 900° C. and then attack the surfaces of the clay and quartz grains. At a still higher temperature the clay and quartz react on each other and bind the material together into a solid mass of great strength. This fluxing or vitrification is a time reaction which is favoured by high temperature, by fineness of grain, and by pressure which brings the particles closer together. Consequently, the coarser the grain the higher the softening temperature and the refractoriness. Grog or burned clay, being coarser than raw clay, has a higher softening point, so that the refractoriness of a clay may be raised by adding grog made of the same clay. Coarse-grained materials are less liable to crack when exposed to sudden changes of temperature but they are mechanically weak and liable to rapid destruction by abrasion or corrosion. To resist the latter, fine-grained materials are essential. They may be less refractory, but true refractoriness is often of secondary importance and must be sacrificed to secure greater durability under furnace conditions. Machine-made firebricks are commonly regarded as inferior to those made by hand. This is largely due to unfair comparison, the material for the latter being more suitable than that supplied to the machines. Pugged clay is often irregular in texture and machine-made bricks are frequently manufactured from clay which has not been allowed to stand long enough to mature properly. Uniformity of texture is so essential that its importance cannot be over-emphasised. The texture may be judged by polishing one face of a brick or other article, and cementing a glass plate on it by means of hot Canada balsam.—A. B. S.

Grog and clay; Determination of —— in unburned firebricks. R. Lessing. Faraday Soc., Nov. 8, 1916.

THE grog and the clay may be separated by elutriating the sample with water, the flow of which is so adjusted that grog particles and the coarser constituents of the clay (sand, shale, carbonaceous substances, etc.) are left in the residue. The clay carried over by the water is separated by settling, and the coarse residue is dried and subjected to a grading test. Comparative tests with English and German retort mixtures showed that the latter are characterised by a larger proportion of grog (66%, as against about 35% in the English mixtures) and by absence of shale, coal, or other coarse impurities from the clay, indicating that the clay had been submitted to some preliminary purification.

Silica as a refractory material. C. Johns. Faraday Soc., Nov. 8, 1916.

SILICA sands used as refractory materials are employed in the form in which they are received from the quarries, but better results would be obtained if they were carefully graded. A refractory sand for furnace linings and hearths should assume its normal angle of repose when thrown into a highly heated furnace and should frit at the temperature of the furnace, but should not melt or soften unduly when the charge is introduced and the furnace is used. Pure silica is useless for these purposes as its softening point is too high. The following maxima of impurities are allowable:—2% alumina, ½% ferric oxide, ½% lime, ½% magnesia, and 0·15% alkalis. Alkalis are specially objectionable as they render the sand too fusible. Until two years ago it was customary to use Belgian sands almost exclusively for furnace work, partly because of their intrinsic value but chiefly because they were cheaper than English sands of corresponding character. The latter have now proved efficient substitutes. Silica bricks consist of particles of silica rock united by lime or other bond. These bricks are mineral aggregates of extreme complexity, notwithstanding the apparent simplicity of their composition, and their properties cannot be predicted with certainty from the results of the investigations at the Geophysical Institute at Washington on the binary system lime-silica (this J., 1907, 95). The variations in the physical properties of silica bricks are less due to differences in chemical composition than to undetected departures from correct manipulation in the various stages of manufacture. To eliminate these variations it is necessary to investigate the most suitable sizes of grains so as to obtain a satisfactory texture, and to determine the time-temperature curves of the burning, so as to ascertain what mode of heating is most suitable and to use a standard time-temperature curve as a guide for future work. The presence of 15—17% of magnetite in bricks which have been in use for some time coincides with a notable increase in the resistance of the brick to furnace conditions. The magnetite appears to be free and merely an indicator of other changes taking place in the structure of the bricks which improve their value.
—A. B. S.

Thermal conductivity of materials employed in furnace construction. E. Griffiths. Faraday Soc., Nov. 8, 1916.

THE author reviews the work of Wologdine (this J., 1909, 709), Marshall (Met. and Chem. Eng., Feb., 1914), Dougill, Hodsman, and Cobb (this J., 1915, 465), and B. Dudley (this J., 1915, 615), and is dissatisfied with each of their methods. He proposes a method in which ordinary sized specimens (such as firebricks) are heated by immersing one face in a bath of molten metal heated electrically so as to secure a uniform temperature throughout the face to be tested, and a flow calorimeter consisting of numerous turns of piping attached to a water supply of constant temperature and pressure is applied to the cooler face of the specimen. The rate of flow of the water is adjusted to produce an equal temperature rise in equal intervals of time. The temperature of the cooler face of the specimen is measured by means of differential couples of 6 pairs of copper-constantan immersed in the flowing water. The calorimeter is fitted with a guard ring which is separated from it by a narrow gap about 1 mm. wide filled with mica plates set on edge. This arrangement gave results which agreed with those obtained by placing the hot face of the specimen on an iron plate, which formed one of the walls of a large muffle, and determining the temperature of this face by means of a bare nickel copper-nickel couple cemented into it, but the use of a molten metal bath gave more concordant results. In working with thick samples it is necessary to allow ample time for equilibrium to be attained; this sometimes takes several days. Tests on a brick made of diatomite bonded with a little clay showed that the conductivity in C.G.S. units between 105° and 502° C. rose steadily from 0·000310 to 0·000461. Tests on a slag-wool mat (CaO 48, SiO_2 43 per cent.) showed a conductivity between 194° and 476° C. of 0·000191 to 0·000342. The conductivity-temperature graphs of both diatomite and slag wool were straight lines. By the same method, the conductivity of a mixture of basic carbonate of magnesium with 15 per cent. of asbestos (such as is used for covering steam-pipes) is about 0·00015 between 20° and 350° C. At the latter temperature the carbonate decomposes, and at a dull red heat the mixture falls to a loose powder of double the conductivity.—A. B. S.

Porcelain ; Constitution and micro-structure of ——. A. A. Klein. U.S. Bureau of Standards, Tech. Paper No. 80. J. Franklin Inst., 1916, 182, 683—685.

A MICRO-PETROGRAPHIC study was made of porcelains prepared to correspond to those made in the United States, England, Germany, France, Austria, Denmark, and Japan, the bodies being burned at various temperatures. Kaolin appears to be homogeneous at temperatures below 1200° C., but between 1200° and 1400° C. it dissociates completely into silica and amorphous aluminium silicate. At about 1450° C. the latter inverts into sillimanite (Al_2O_3,SiO_2). In mixtures of quartz and felspar, below 1340° C. the quartz dissolves slightly in the fused felspar ; at 1460° C. it is completely dissolved in mixtures of equal parts of quartz and felspar. In mixtures of kaolin and felspar, the kaolin is completely dissociated at 1340° C. At 1460° C., 10% of kaolin is entirely soluble in the fused felspar. With higher concentrations of kaolin the amount of crystalline sillimanite increases. In mixtures of quartz, clay, and felspar, at 1310° C. the felspar is present as glass, the clay is completely dissociated into silica and amorphous sillimanite with few crystals, and the quartz remains undissolved, but if these mixtures are burned at 1380°—1400° C. the quartz enters almost completely into solution and the sillimanite is converted into the crystalline form. No cristobalite or tridymite has been observed. The changes involved in burning commercial bodies are identical with those in bodies prepared in the laboratory. The constitution and microstructure of porcelain depend on the temperature of burning, and to a less extent on the time of heating.—A. B. S.

Method of measuring the viscosity of very viscous substances. Feild. *See* XXIII.

PATENTS.

Furnace for producing glass. D. S. Beebe, Assignor to The Vitrolite Co., Parkersburg, W. Va. U.S. Pat. 1,199,014, Sept. 26, 1916. Date of appl., Dec. 11, 1914.

A HORIZONTAL glass furnace is provided at the bottom with a central well or catch-basin towards which the floor of the furnace slopes. The capacity of the well is slightly greater than that necessary for the "green" material remaining after the fusion of a charge, the area of the well mouth being only a small fraction of the cross-sectional area of the furnace.—W. E. F. P.

Aluminous abrasives ; Process of treating certain ——. T. B. Allen, Assignor to General Abrasive Co., Niagara Falls, N.Y. U.S. Pat. 1,199,011, Sept. 26, 1916. Date of appl., Jan. 27, 1916.

AN artificially prepared, granular, aluminous abrasive containing iron, silicon, and titanium as impurities, is mixed with an oxygen-liberating salt and heated to between 1300° and 1500° C. to convert the impurities into a ferroso-ferric titanosilicate.—W. E. F. P.

Abrasives ; Manufacture of crystallised ——. T. B. Allen, Toronto, Ont., Assignor to General Abrasive Co., Inc., Niagara Falls, N.Y. U.S. Pat. 1,199,012, Sept. 26, 1916. Date of appl., July 24, 1916.

ALUMINA, melted in an electric furnace, is poured into preheated moulds and allowed to cool, the pouring temperature and degree of cooling being regulated according to the crystalline characteristics required in the finished product.—W. E. F. P.

Furnaces. Eng. Pat. 101,757. *See* I.

Kiln. U.S. Pat. 1,200,132. *See* I.

IX.—BUILDING MATERIALS.

Plaster of Paris. L. A. Keane. J. Phys. Chem., 1916, 20, 701—723.

WHEN gypsum ($CaSO_4,2H_2O$) is heated slowly and steadily with constant stirring, there is a halt in the rise of temperature at 99° C., and under some conditions another halt at 139° C. There is also an inversion into plaster of Paris, $(CaSO_4)_2,H_2O$, at 107° C. and 971 mm. mercury pressure, though the temperature may be raised to 200° C. for some hours without this inversion being complete. On prolonged heating at 110° C. complete conversion into anhydrite ($CaSO_4$) occurs. In the German practice in making plaster of Paris, the maximum temperature is 130° C., in American practice 200° C. is reached, and in English practice 110°—120° C. These differences are possible because of the influence of time and temperature on the rate of inversion and the slowness with which gypsum and plaster develop their true vapour pressures. The quality of the plaster undoubtedly varies with the temperature of formation. Only one modification of anhydrous calcium sulphate exists, but its properties vary with the degree of agglomeration and therefore with the conditions of formation. This is the essential ingredient in dead-burned plaster. On grinding the anhydrous sulphate it may be made to set, the rate of setting depending on the size of the particles. If the latter are only 0·005 mm. diameter, the dead-burned plaster will set rapidly. Typical flooring plasters (Estrichgips) are dead-burned plasters which have been finely ground. The true volume occupied by set, or crystallised, plaster is less than the sum of the volumes of the plaster and water used, but as plaster casts are porous the apparent volume is greater and therefore enables casts to take the form of the mould accurately. The setting of plaster may be retarded by adding flooring plaster, colloids, or any substance which will decrease the solubility of the gypsum. The setting may be accelerated by adding substances which increase the solubility of the gypsum.
—A. B. S.

PATENTS.

Lumber ; Process of curing ——. E. D. Sidman, Assignor to The Sidman Co., Rochester, N.Y. U.S. Pat. 1,199,120, Sept. 26, 1916. Date of appl., Mar. 3, 1911.

GREEN lumber is subjected to an atmosphere of 80°—95 humidity, at 60°—90° F. (15°—32° C.), until the moisture penetrates the wood and dissolves the detrimental substances ; the temperature is then increased to about 165° F. (74° C.) and the same humidity maintained until the solution of detrimental substances is expelled from the wood by expansion, after which the humidity is gradually decreased and the final drying effected at the higher temperature.—W. E. F. P.

Forms [moulds] for producing castings or objects from materials of any kind ; Compound or mixture from which to make ——. J. Ringel, Strassburg, Germany. U.S. Pat. 1,200,138, Oct. 3, 1916. Date of appl., May 21, 1913.

THE material is composed of dehydrated gypsum, 51, and puzzuolana, 96 to 183 parts, to which an indifferent material may also be added for the purpose of imparting body to the mixture.
—W. E. F. P.

Alkali ; Process of recovering —— [in cement manufacture]. H. S. Spackman, Ardmore, and E. L. Conwell, Chester, Pa. U.S. Pat. 1,202,327, Oct. 24, 1916. Date of appl., Mar. 15, 1916.

Alkali compounds are recovered from cement-making materials by calcining the latter at high temperatures by means of fuels containing sulphur in presence of sufficient water vapour to convert the volatilised potash into soluble sulphate, which is recovered from the cement-kiln gases.—J. E. C.

Tar-macadam roads ; Manufacture of a binding medium for ——. A. Studer, Neuchâtel, Switzerland. Ger. Pat. 294,481, July 4, 1915. Addition to Ger. Pat. 294,045 (this J., 1916, 1157).

A mixture of 15 parts of asphalt-mastic, 25 of asphalt rock ("crab"), and 10 of bitumen, together with a small quantity of tar, is boiled for about 2 hours, and 50 parts of tar which has been previously heated to 150° C. to expel benzol and light oils, is then incorporated with the mass.—A. S.

X.—METALS ; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Copper ; Electrolytic refining of ——. F. L. Antisell and S. Skowronski. Amer. Inst. of Metals, Sep., 1916. [Advance proof.] 11 pages.

The analysis of anodes of blister copper is given as: Cu, 99·25% ; Ag, 70·0 oz. per ton ; Au, 0·25 oz. per ton ; As, 0·060% ; Sb, 0·52% ; Ni, 0·050% ; Pb, 0·053% ; Fe, 0·058% ; Bi, 0·003% ; S, 0·004% : Se, 0·008% ; Te, 0·038% ; O, 0·100%. The electrolyte used in refining contains 16% of copper sulphate and 12% of free sulphuric acid ; nickel, cobalt, iron, zinc, and arsenic dissolve from the anodes and foul the electrolyte, whilst the other impurities pass into the slimes. The electrolyte is purified by crystallisation, or by electrolysis to recover the copper, nickel, and free acid. Silver, gold, platinum, palladium, selenium, and tellurium are recovered from the slimes. The cathodes are afterwards melted in reverberatory furnaces of 200—250 tons capacity, and the copper oxidised to bring it to the state of "set copper" containing 4 to 5 % of cuprous oxide, in order to get rid of sulphur, and then poled to reduce the cuprous oxide to 0·3 to 0·6%. A typical analysis of refined electrolytic copper is given as:—Cu, 99·93% ; Ag, 0·001% ; Au, 0·00001% : O, 0·045% ; S, 0·003% ; Fe, 0·0035% ; Ni, 0·0015% ; As, 0·0015% ; Sb, 0·0015%.—B. N.

Tin ores ; Analysis of ——. T. F. Golick. Eng. and Min. J., 1916, 102, 827.

The ore is fused with potassium carbonate and sulphur, the melt leached with hot water, filtered, and the filtrate evaporated with sulphuric acid till fumes appear. The residue is treated with hydrochloric acid (1 : 1), and hydrogen peroxide added to ensure complete conversion into stannic chloride. The solution is precipitated with hydrogen sulphide, and the washed precipitate treated, together with the filter, with a known excess of standard iodate in presence of 30% by volume of strong hydrochloric acid, the excess being titrated back with standard iodide (this J., 1915, 608). The reaction is represented by the equation $SnS_2 + KIO_3 + 6HCl = SnCl_4 + S_2 + KCl + ICl + 3H_2O$. (See also Hallett, this J., 1916, 1087.) —W. R. S.

Platinum production in Colombia. U.S. Comm. Rept., suppl. No 42A, Nov 13, 1916.

The platinum industry of Colombia has expanded very rapidly during the last few years ; in 1907 only 245 troy oz. of the metal was exported, whilst in 1915 the exports amounted to 11,046 oz., valued at $491,888. The whole production came from the Choco and was panned out of the gravels of small streams. The area of the platinum-producing zone is small ; it begins near the mouth of the Condoto River and extends a short distance north of the Rivers Nemotá, Bebaramá, and Neguá. The whole zone is about 90 miles long by 30 miles wide. During the latter part of last year a company was formed to exploit platinum-bearing lands on the San Juan River, and will shortly commence operations.

Gallium ; Electrolysis and purification of ——. H. S. Uhler and P. E. Browning. Amer. J. Sci., 1916, 42, 389—398. (See also this J., 1916, 544.)

Gallium was obtained in an arborescent form instead of in liquid globules, by electrolysing a solution of gallium hydroxide in caustic soda cooled to 0° C.; the cathode consisted of platinum wire sealed into a glass tube with 2 mm. projecting at the lower end. Photographs of the gallium trees and of the complete arc spectrum of gallium are reproduced and described. A very pure product was obtained by ten successive crystallisations of the cæsium-gallium alum. Zinc may be completely eliminated by volatilisation, by heating gallium in a current of dry hydrogen with the full heat of a Bunsen burner.—W. R. S.

Radium in carnotite ores ; Experiments on the concentration of ——. A. G. Loomis and H. Schlundt. J. Ind. Eng. Chem., 1916, 8, 990—996. (See also this J., 1916, 837.)

Most of the experiments were made with a low-grade ore containing 1·66% U_3O_8, 4·03% V_2O_5, and $4·88 \times 10^{-9}$ grm. Ra per grm. By heating 5 parts of the ore, ground to pass a 20-mesh sieve, with 4 parts by weight of crude sulphuric acid of 60° B. (sp.gr. 1·71) at 250°—300° C. for 15—30 mins., then stirring with water, and separating the insoluble matter in fractions by differential sedimentation, 87% of the radium was concentrated in the finer fractions and practically all of the uranium and vanadium was obtained in solution. Fusion of the ore with sodium bisulphate or with salt-cake, followed by treatment with water and differential sedimentation, gave a concentrate containing about 86% of the radium. The concentrate obtained by digestion with saturated aqueous sulphurous acid and subsequent differential sedimentation, contained about 85% of the total radium. In the product obtained after treatment with sulphuric acid, the radium concentration was from 20—28 times that of the ore, in the sodium bisulphate or salt-cake concentrate 15—20 times, and in the sulphurous acid concentrate 10—12 times. By digesting the sulphuric acid or salt-cake concentrate with excess of concentrated sulphuric acid, filtering and diluting with water, or by fusing with sodium and potassium carbonates, dissolving the radium-barium carbonate in hydrochloric acid, and precipitating with sulphuric acid, a crude sulphate was obtained containing 80% of the radium content of the ore at a concentration from 150 to 300 times the original value. In determining approximately the radium content of tailings, comparison should be made against standardised samples of tailings ; low results are obtained if ore samples be used as standard for comparison.—A. S.

Flotation process : An explanation of the ——. A. F. Taggart and F. E. Beach. Amer. Inst. Min. Eng., Sept., 1916. Met. and Chem. Eng., 1916, 15, 518—523.

From a practical and theoretical study of physical phenomena involved in flotation, viz., surface

tension, adsorption, adhesion, and viscosity, it is concluded that gas bubbles cling with greater persistence to sulphide than to gangue particles because of the smaller potential at the gas-sulphide contacts; that oil replaces water at sulphide surfaces, whereas the reverse occurs at gangue surfaces; and that water replaces gas more readily at oiled than at clean solid surfaces. The surface tension of water is lowered by the addition of any contaminant (oil), the latter becoming concentrated at the air-liquid surface. At a gas-liquid surface, adsorption lowers the surface tension and increases the viscosity, but at a liquid-liquid surface it produces a film having a viscosity higher than that of the bulk of either liquid. The viscosity of a film is markedly increased by the presence of finely-divided solid matter. The application of these conclusions to commercial flotation processes is discussed.
—W. E. F. P.

Antimony-gold ore; Flotation tests on an ——. E. R. Pilgrim. Eng. and Min. J., 1916, **102**, 820.

THE ore from the Sliscovich mine (Alaska) contains Au 0·1—0·2 oz., and Sb 18—40% as stibnite very intimately intermixed with quartz. Concentration by gravity having proved a failure, the ore was tested on a Case experimental machine, the separation of the gold and stibnite by flotation being successfully accomplished under the following conditions: pulp ratio, 1 : 6; size of ore, −60 mesh; proportion of wood creosote 0·2% and of acid 0·3%. The flotation concentrate carried 84% of the antimony, and the tailing 80—100% of the gold.
—W. R. S.

A new soda-lime tube. A new absorbent for carbon dioxide in steel analysis. Kelley. *See* XXIII.

Method of measuring the viscosity of very viscous substances. Feild. *See* XXIII.

PATENTS.

Removing oxide or rust from the surface of iron or steel; Electrolytic method for ——. P. Marino, London. Eng. Pat. 101,667, Oct. 7, 1915. (Appl. No. 5628 of 1916.)

THE iron or steel articles are immersed in an electrolyte, preferably heated, consisting of an aqueous solution of phosphoric acid, or of a phosphate to which phosphoric acid has been added; one terminal of a source of alternating current is connected to the articles, the opposite terminal being connected to a conductive plate of carbonaceous material also immersed in the electrolyte.
—B. N.

Composite ferrous and non-ferrous bodies: Process of forming ——. J. M. Roth, Pittsburgh, Pa. U.S. Pat. 1,199,429, Sept. 26, 1916. Date of appl., Mar. 2, 1916.

A CORE of ferrous metal is heated to welding temperature while disposed centrally in a vertical open-top mould, and molten non-ferrous metal is introduced after the wall of the mould has been cooled rapidly to below the melting point of the latter metal.—W. E. F. P.

[Steel] pipe; Method of and apparatus for annealing crystallised ——. H. A. Bardeen, Assignor to The Bardeen Corporation, Los Angeles, Cal. U.S. Pat. 1,201,134, Oct. 10, 1916. Date of appl., Feb. 11, 1915.

CRYSTALLISED drill pipe is heated to an annealing temperature by means of an alternating current in an apparatus provided with a treating platform so arranged as to prevent distortion of the pipe during heating. The pipe is subsequently rolled into an enclosed leer forming an extension of the platform, and slowly cooled.—W. E. F. P.

Case-hardening material and process of making same. M. Kirchhoff, jun., Chicago, Ill. U.S. Pat. 1,201,058, Oct. 10, 1916. Date of appl., Oct. 9, 1915.

LEATHER is heated in the presence of moisture until it becomes sticky or gluey, when the mass is dried and powdered. A mixture of the powder (100) with calcium hydroxide (5) and a sodium salt (5 parts by weight) is then compacted in a liquid-sealed retort and heated at 1400°—1500° F. (760°—816° C.) until charred.—W. E. F. P.

[Iron] magnetic material; Process of making ——. W. E. Ruder, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,201,633, Oct. 17, 1916. Date of appl., Apr. 6, 1916.

A MAGNETICALLY non-ageing material, having high permeability and low hysteresis loss, is prepared by annealing ordinary commercial iron at 760°—1200° C. (below the melting point) under oxygen-removing conditions and at atmospheric pressure or in a partial vacuum (2—2·5 mm. of mercury).
—W. E. F. P.

Soldering; Electric arc ——. E. H. Jones, London. Eng. Pat. 14,468, Oct. 13, 1915.

CARBON is added to mild steel electrodes, to be used for electric arc soldering, by a case-hardening process, or nickel, aluminium, or other metal is deposited on the electrodes by an electroplating process, so as to effect the ultimate union of the required proportion of added carbon or metal. An additional quantity of aluminium, in the form of powder, may also be added with advantage to the fusible coating during the soldering.—B. N.

Melting furnace. A. C. Ionides, jun., London. Eng. Pat. 15,322, Oct. 30, 1915.

A VERTICAL tubular furnace for melting scrap metal, communicates at the top with an annular encircling downtake flue, and is provided at its base with a crucible for receiving the molten metal. A feeding tube leads from the top of the furnace into the crucible. The latter stands on a base plate which may be lowered to remove the crucible from the furnace, or an outlet may be provided for running off the molten metal without removing the crucible from the furnace. The furnace may be heated by a self-burning mixture (see Eng. Pat. 15,455 of 1909).—W. R. S.

Electrolytic refining or extracting process. United States Metals Refining Co., Chrome, N.J., Assignees of F. R. Pyne, Elizabeth, N.J., and H. M. Green, Chrome, N.J., U.S.A. Eng. Pat. 100,318, April 19, 1916. (Appl. No. 5750 of 1916.) Under Int. Conv., Apr. 20, 1915.

AN electrolyte containing more than one metal constituent is electrolysed, using either soluble or insoluble anodes, and is allowed to stratify to a determined degree, the strata containing the concentrated primary and secondary constituents being led off separately. The relative concentrations of the constituents of the several strata are controlled by regulating the outflow of the separate portions. The portion containing the concentrated primary constituent may be returned to the electrolytic tank, or to other tanks, and the portion containing the concentrated secondary constituents is treated directly to eliminate from it the primary constituent, and may then undergo further treatment for the recovery of the secondary constituents. For example, in electrolytic copper refining the concentration of the copper is higher in the lower stratum of liquid and that of the secondary constituents is higher in the upper stratum. The upper stratum of liquid is transferred to a tank or tanks where it is electrolysed with insoluble anodes to recover the copper. (See also this J., 1915, 1096.)—B. N.

[Copper] alloy. J. Monville, Assignor to J. J. Ethier and W. Kline, Hubbell, Mich. U.S. Pat. 1,199,200, Sept. 26, 1916. Date of appl., Apr. 27, 1916.

An alloy containing approximately Cu 95·5, Fe 3, Sn 0·625, Zn 0·625, and Ni 0·25 %.—W. E. F. P.

Copper; Process of recovering —— from solution. G. A. Schroter, Denver, Colo., and W. C. Laughlin, Nogales, Ariz. U.S. Pat. 1,200,534, Oct. 10, 1916. Date of appl., Apr. 29, 1915.

The liquid is treated with a solution of calcium hydroxide and filtered, and the precipitate is calcined to render iron oxide insoluble and then treated with sulphuric acid to dissolve the copper oxide.—W. E. F. P.

Copper; Hydrometallurgy of ——. E. R. Weidlein, Thompson, Nev., Assignor to Metals Research Co., New York. U.S. Pat. 1,201,899, Oct. 17, 1916. Date of appl., Aug. 31, 1915.

A solution of copper sulphate, containing not more than 1·5 % Cu, produced by leaching ore, roasted matte, etc., with dilute sulphuric acid, is neutralised and then circulated, with a quantity of sulphur dioxide not exceeding the weight of copper present, through a precipitator maintained at 150° C. and under a pressure of 100 lb. per sq. in. The effluent from the precipitator is circulated in heat-interchanging relation with fresh in-going solution and then used for leaching a further quantity of ore.—W. E. F. P.

Metals [zinc]; Process of recovering ——. C. J. Reed, Glenside, Pa. U.S. Pat. 1,200,025, Oct. 3, 1916. Date of appl., Aug. 25, 1915.

In a process for recovering zinc from its aqueous solutions, the metal is electro-deposited in a cathode of mercury from which it is then redissolved and deposited upon an inert cathode. The solution of metal by local action from the amalgam anode is compensated by supplying thereto the requisite additional quantities of amalgam.—W. E. F. P.

Metals from their ores; Apparatus for extracting ——. J. C. Greenway, Warren, Ariz. U.S. Pat. 1,200,832, Oct. 10, 1916. Date of appl., Mar. 31, 1915.

The apparatus consists of a series of leaching tanks, each having an inlet and outlet for the solvent and a separate pump for circulating the latter repeatedly through the charge of ore in an upward direction. Means are also provided for passing the solution from each tank through a precipitator, for advancing a portion of the solution from one tank to the next in the series, and for shutting off any of the tanks from the supply connection.—W. E. F. P.

Cyaniding-tower. A. F. Tanner, Greenfield, Wis., Assignor to Ideal Continuous Cyaniding Process Co., Davenport, Iowa. U.S. Pat. 1,201,386, Oct. 17, 1916. Date of appl., July 14, 1915.

A series of inclined pans are mounted on a framework, one above another, with the lower end of each pan beneath the upper end of the succeeding pan. The lower end of each pan is of concave form, and a cylinder provided with lifting blades rotates across the concave portion and raises the material into the upper end of the pan above. Means are provided for varying the clearance space between the cylinders and the pans, and for heating the pans.—A. S.

Disintegrating ores and other materials; Apparatus for ——. A. Feust, New York. U.S. Pat. 1,202,278, Oct. 24, 1916. Date of appl., July 6, 1914; renewed Sept. 2, 1916.

The apparatus consists of a rotary, egg-shaped chamber, half filled with comparatively small crushing bodies (flints) of different sizes, and mounted horizontally upon hollow trunnions through which ore is admitted and discharged. The inlet is situated at the wide or hemispherical end, and during rotation the crushing bodies become arranged according to size, the larger ones occupying the wider part of the chamber.—W. E. F. P.

Concentrating ore by flotation; Method of ——. G. Gröndal, Djursholm, Sweden, Assignor to Beer, Sondheimer & Co., Frankfort, Germany. U.S. Pat. 1,202,512, Oct. 24, 1916. Date of appl., Jan. 18, 1916.

The flotation agent (oil) is atomised by a stream of heated gas under pressure, the arrangement forming an injector by means of which a large quantity of another gas (air) is drawn in and mixed with the gas-oil mixture. The gaseous mixture is then forced in an upward direction through one compartment of the flotation machine against a downward current of finely divided ore suspended in water.—W. E. F. P.

Ores; Concentration of ——. F. J. Lyster, Broken Hill, N.S.W., Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pats. (a) 1,203,374 and (b) 1,203,375, Oct. 31, 1916. Date of appl., July 8, 1916.

(a) The ore pulp is agitated and aerated in presence of a quantity of sodium chloride sufficient to facilitate the formation of a froth of concentrates. Another frothing agent and/or an alkaline hydroxide may also be added. (b) A froth of concentrates is obtained by agitating and aerating the ore pulp, with or without addition of a small proportion of a frothing agent, in presence of a sufficient quantity of an alkaline hydroxide, such as calcium hydroxide, to act as "a selectivity modifying agent."—A. S.

Electric welding; System of ——. D. H. Wilson, Franklin Township, N.J., U.S.A. Eng. Pat. 17,834, Dec. 21, 1915.

See U.S. Pat. 1,187,410 of 1916; this J., 1916, 849.

Tin and its salts; Electrolysis of ——. A. E. Battle, London. U.S. Pat. 1,202,149, Oct. 24, 1916. Date of appl., May 24, 1915.

See Eng. Pats. 14,514 and 15,602 of 1914; this J., 1915, 910.

Ores; Concentration of ——. A. O. Howard, Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pat. 1,203,341, Oct. 31, 1916. Date of appl., May 10, 1915.

See Eng. Pat. 5454 of 1915; this J., 1916, 895.

Sulphide ores; Separation of metallic ——. F. J. Lyster, Broken Hill, N.S.W., Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pat. 1,203,372, Oct. 31, 1916. Date of appl., May 8, 1913.

See Fr. Pat. 462,757 of 1913; this J., 1914, 320.

Ores; Concentration of ——. F. J. Lyster, Broken Hill, N.S.W., Assignor to Minerals Separation American Syndicate (1913), Ltd., London. U.S. Pat. 1,203,373, Oct. 31, 1916. Date of appl., July 14, 1915.

See Fr. Pat. 469,677 of 1914; this J., 1915, 35.

Furnaces. Eng. Pat. 101,757. *See* I.

XI.—ELECTRO-CHEMISTRY.

Patents.

Electrolytic apparatus for laundry and other hygienic purposes. E. Reuss, Leeds, and V. Roberts, Rawdon, Yorks. Eng. Pat. 101,820, Feb. 3, 1916. (Appl. No. 1628 of 1916.)

The apparatus is intended especially for use on board ship, and the electrolytic tank, with its supply tank and storage vessel, are suspended upon gimbals, or by a cross-bar and rods, or chains, or ropes, so that they may maintain their level position regardless of the motion of the ship. The electrolytic tank is provided with feed and delivery pipes on opposite sides, in addition to the ordinary nozzles, and the delivery pipe may be coiled upon a table from which the storage tank is suspended.—B. N.

Electrolytic apparatus. J. H. Levin, Newark, N.J. U.S. Pat. 1,199,472, Sept. 26, 1916. Date of appl., June 3, 1916.

Several bipolar electrodes are arranged to form a series of cells, with ducts, for feeding the electrolyte and taking off the gas, common to all the cells. A constriction is formed in the path of the electrolyte between adjoining electrodes by an insulating medium, whereby a resistance is created sufficient substantially to prevent the flow of the current from one electrode to another through the ducts. —B. N.

Liquids; Apparatus for treating [electrolysing] ——. C. P. Landreth, Philadelphia, Pa. U.S. Pat. 1,201,202, Oct. 10, 1916. Date of appl., July 14, 1914.

Horizontal sets of electrodes are arranged in a vertical casing alternately with cleaning blades of insulating material which are mounted on a vertical shaft so as to be in contact with the electrodes. The shaft is rotated by an electric motor which also drives a dynamo in circuit with the electrodes.—W. F. F.

Resistor; Electric ——. W. S. Hadaway, jun., New York. U.S. Pat. 1,200,352, Oct. 3, 1916. Date of appl., Sept. 5, 1911.

A nickel-chromium wire is encased in a continuous tube of the same alloy, the wire being insulated from the tube by a filling of aluminium silicate. The wire and casing are flexible, so that the resistor may be bent into any desired shape, and is manufactured in comparatively long sections, and then severed into lengths as required. It may be mounted and supported in any suitable manner, regardless of the conducting or non-conducting properties of the support.—B. N.

Separators for storage batteries; Treating ——. F. Wright, Assignor to Wright Storage Battery Co., Poughkeepsie, N.Y. U.S. Pat. 1,200,682, Oct. 10, 1916. Date of appl., Jan. 9, 1914. Renewed Mar. 14, 1916.

Wood strips, for use as separators in a lead storage battery, are saturated with dilute sulphuric acid by soaking them for several days, and are then assembled side by side between a pair of electrodes immersed in dilute sulphuric acid. An electric current is passed between the electrodes, to subject the strips to the purifying action of electrical osmosis, thus removing the objectionable impurities electrolytically, and rendering the strips porous, inert, and suitable for use in the battery. —B. N.

Furnace; Electric ——. (a) H. W. Gillett and J. M. Lohr, (b) H. W. Gillett, Ithaca, N.Y. U.S. Pats. (a) 1,201,224 and (b) 1,201,225, Oct. 10, 1916. Dates of appl., (a) Nov. 5, 1915, (b) Mar. 11, 1916.

(a) An electric arc furnace is formed of a shell enclosing a cylindrical, refractory, retaining hearth, built up of layers in which the heat-insulating power of each layer is greater than the next inner layer. The shell and hearth may be revolved by mechanical means on its horizontal axis, in one direction to a fixed point, and then in the reverse direction, to another fixed point. Electrodes, adjustable laterally and revolving with the body of the furnace, are introduced through the ends of the furnace, and are cooled by air, the supports for the means of adjustment and the cooling arrangements being electrically insulated from the shell. The body of the furnace is provided with an opening as a combined charging door and pouring spout, and provision is made for tightly closing it. (b) The cylindrical refractory hearth and the adjustable electrodes are mounted to rotate or oscillate about the regular axis of the hearth, and also to oscillate in endwise fashion about a horizontal axis substantially perpendicular to the regular axis, so that the latter describes a portion of a double cone.—B. N.

Cathode for electrolytic cells. F. G. Wheeler, Appleton, Wis., U.S.A. Eng. Pat. 15,759, Nov. 8, 1915. Under Int. Conv., Jan. 25, 1915.

See U.S. Pat. 1,152,772 of 1915; this J., 1915, 1060.

Electric furnace [for treatment of gases]. I. Moscicki, Lemberg, Austria-Hungary. U.S. Pat. 1,201,607, Oct. 17, 1916. Date of appl., May 29, 1913.

See Fr. Pat. 458,636 of 1913; this J., 1913, 1076.

Electric furnace. E. K. Scott, Belvedere, Assignor to Atmospheric Nitrates (Kilburn Scott Patents), Ltd., Manchester. U.S. Pat. 1,203,276, Oct. 31, 1916. Date of appl., Feb. 25, 1916.

See Eng. Pat. 3953 of 1915; this J., 1916, 476.

[Electrolytic] process for producing jelly. U.S. Pat. 1,199,457. *See* XIXa.

Method and apparatus for sterilising [water]. U.S. Pat. 1,200,165. *See* XIXb.

XII.—FATS; OILS; WAXES.

Vegetable and animal oils; Storage changes in ——. H. A. Gardner. J. Ind. Eng. Chem., 1916, 8, 997—998. (See also this J., 1912, 1041; 1914, 603.)

The effects of prolonged storage on a number of vegetable and animal oils are tabulated. In nearly all cases the saponification value, acid value, and specific gravity increased, and the iodine value and refractive index decreased. Lithographic linseed oil and lumbang oil, however, showed increased iodine values. The changes were less in oils which had been previously sterilised. Free acid formed rapidly in linseed oil emulsions.—A. S.

Beeswax and its adulterants; The viscosity of ——. U. Fabris. Staz. sperim. agrar. ital., 1916, 48, 595—603. Bull. Agric. Intell., 1916, 7, 881.

The viscosity index of beeswax, virgin and bleached, and of the chief substances used for its adulteration, was determined by comparing the rate of flow with that of nitrobenzene from a viscosimeter. The results showed great differences between the indices of the wax and of its adulterants, and the method is recommended for analytical use. The following figures represent the maximal and minimal values of the viscosity indices of the substances investigated: virgin beeswax 16·30, 15·23; white wax 17·53, 16·54; carnauba wax 43·03, 42·03; Japanese wax 21·12, 20·71; tallow 13·05, 12·39; stearin 8·50, 8·31; spermaceti 7·42, 6·74; paraffin and ceresin 6·69, 3·48.—E. H. T.

Linseed and Chinese wood oils ; Polymerisation of ——. Krumbhaar. Chem.-Zeit., 1916, 40, 937—938.

Samples of linseed and Chinese wood oils were heated at 200°, 260°, and 300° C. in a large closed vessel through which was passed a slow current of carbon dioxide. The effect of heating on the characters of the two oils was as follows :—

Temperature, ° C.	Duration of heating.	Acid value.	Saponif. value.	Viscosity (Engler) at 25° C. Linseed oil = 1.	Iodine value.	Refractive index at 25° C.	Sp.gr. at 25° C.
Linseed Oil.	hours.						
—	—	1·1	194·5	1·00	175·0	1·479	0·924
200	20	2·6	193·9	1·13	168·7	1·480	0·926
200	40	3·4	194·8	1·35	160·1	1·482	0·929
260	15	5·8	192·9	2·35	145·6	1·486	0·933
260	30	7·4	191·1	7·96	108·0	1·489	0·946
300	10	17·8	193·1	115·00	120·4	1·492	0·961
300	20	40·0	191·2	—	76·3	1·496	0·970
Chinese Wood Oil.							
—	—	2·0	193·2	2·5	160·3	1·515	0·942
200	2	1·9	191·8	4·0	149·7	1·468	0·949
200	4	1·9	190·1	80·5	134·5	1·446	0·954
	mins.						
260	10	1·9	190·5	4·5	156·8	1·511	0·946
260	20	1·9	189·1	112·0	145	1·504	0·957
300	5		gelatinised, with rise of temperature and decomposition.				

The acid value of linseed oil showed no appreciable increase in the periods of heating given to the Chinese wood oil. The viscosity at 300° C. became so pronounced that the oil would not run from the viscometer, but there was still no gelatinisation. This was attributed to the formation of free acids, which also appeared to be the cause of the different mode of alteration of the refractive indices of the two oils. The different behaviour of the oils on heating is therefore one of degree rather than of kind, and there is no ground for regarding the polymerisation process of linseed oil as essentially different from that of Chinese wood oil. These experiments support Wolff's theory of polymerisation (this J., 1913, 496).—C. A. M.

Patents.

Oils and the like ; Apparatus for extracting ——. E. O. Barstow and T. Griswold, jun., Midland, Mich. U.S. Pat. 1,199,861, Oct. 3, 1916. Date of appl., Dec. 24, 1914.

The apparatus consists of a closed chamber containing a rotary filter with a cylindrical filtering surface. The oil is supplied from relatively fixed sources to successive spaced portions of the filtering surface, while suction is separately applied to each area in turn.—C. A. M.

Lubricating grease; Manufacture of ——. R. Hülsberg, Troisdorf, Germany. U.S. Pat. 1,200,617, Oct. 10, 1916. Date of appl., Nov. 12, 1913.

Compounds of oil acids or fatty acids with alkaline earths are mixed with mineral oil, and the mixture boiled, by means of superheated steam or otherwise, at about 150° C. at a pressure of about 5 atmos.—C. A. M.

Oils ; Bleaching of ——. G. F. Diohn. Omaha, Nebr. U.S. Pat. 1,200,713, Oct. 10, 1916. Date of appl., Jan. 5, 1915.

A bleaching agent is prepared by impregnating comminuted charcoal with a solution of an alkali hydroxide, drying the product at a temperature ranging from 100° C. to dull red heat, and grinding the residue to a fine powder.—C. A. M.

Wool-grease ; Method of refining ——. J. O. Handy and R. M. Isham, Assignors to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pat. 1,201,042. Oct. 10, 1916. Date of appl., Apr. 22, 1916.

The free fatty acids in the grease are saponified and the soap separated from the unsaponified grease, petroleum spirit being added to prevent emulsification. Subsequently the grease is washed free from soap by means of an aqueous liquid such as a weak solution of salt.—C. A. M.

Drying-oil and process of making same. H. Rebs, Düsseldorf, Germany. U.S. Pat. 1,201,025, Oct. 17, 1916. Date of appl., June 24, 1916.

Thickened vegetable oil is mixed with a preponderating quantity of a mineral oil, free from paraffin, and boiling at about 300° C., or the vegetable oil may be mixed with the mineral oil and then thickened.—E. W. L.

Emulsions ; Process for making —— *and products thereof.* H. H. Hurt, Assignor to Robeson Process Co., New York. U.S. Pat. 1,201,301, Oct. 17, 1916. Date of appl., Jan. 27, 1916.

Permanent emulsions are obtained by thoroughly intermingling sulphite waste liquor preparations, either dried or not, with oils, such as drying oils (*e.g.*, linseed oil), and then adding a small amount of caustic soda.—E. W. L.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Acid values of boiled oils and varnishes ; Errors in the determination of ——. E. E. Ware and R. E. Christman. J. Ind. Eng. Chem., 1916, 8, 996—997.

The lead, manganese, cobalt, and zinc soaps of linseed oil are hydrolysed almost completely under the conditions existing during the determination of the acid value, and the same is true of the corresponding resinates. The error thus introduced in the determination of the acid value of boiled oils is, in many cases, not serious, as only a small quantity of metallic soap is present, but in the case of varnishes, where considerable quantities of metallic soaps or salts of resin acids may be present, the results obtained by the usual method cannot represent the true acid value of the oil vehicle.—A. S.

Method of measuring the viscosity of very viscous substances. Feild. *See* XXIII.

Patents.

Pigment and paint ; Zinc-containing ——. O. W. Pickering, Springfield, Mass., Assignor to Pickering Paint and Pigment Co. U.S. Pat. 1,201,093, Oct. 10, 1916. Date of appl., June 2, 1916.

A pigment composed of flocculent zinc aluminate is incorporated with a drying oil, with or without a drier.—C. A. M.

[Printers'] ink, and process of making same. E. G. Acheson, New York. U.S. Pat. 1,201,994, Oct. 17, 1916. Date of appl., May 23, 1916.

An amorphous pigment, *e.g.* carbon, is partially deflocculated in presence of water, and the deflocculated and non-deflocculated particles are transferred to an ink vehicle, to produce a composition suitable for use as a printers' ink.—E. W. L.

Phenol and formaldehyde ; Process for the manufacture of hollow shapes from ——. F. Pollak, Vienna. Eng. Pat. 14,490, Oct. 13, 1915.

The mixture of raw materials, or an intermediate product thereof, is centrifuged in a heated mould rotating around its own axis until a hard infusible condensation product has been formed.—C. A. M.

Coating composition. W. B. Jones, Perth Amboy, N.J., Assignor to General Bakelite Co., New York. U.S. Pat. 1,200,731, Oct. 10, 1916. Date of appl., Nov. 5, 1915.

The composition consists of a phenolic condensation product transformable by heat into an infusible substance, and a solvent therefor containing aniline in a proportion at least equal to that of the condensation product, with or without a cyclic hydrocarbon (xylene).—C. A. M.

Resinous emulsion for sizing paper. Eng. Pat. 17,576. *See* V.

Drying-oil and process of making same. U.S. Pat. 1,201,625. *See* XII.

XIV.—INDIA-RUBBER ; GUTTA-PERCHA.

Export of rubber solutions containing coal tar products.

The Director of the War Trade Department draws the attention of manufacturers and exporters of rubber solutions to the fact that the export of such solutions as contain coal tar products and derivatives is prohibited to all destinations, except under licence from that department. The War Trade Department will not be prepared to consider applications for licences to export such solutions containing any considerable percentage of benzol. Manufacturers are accordingly advised to put themselves in touch with the Department of Explosives Supplies, Ministry of Munitions of War, Storey's Gate, S.W., with a view to ascertaining the nature of the substitute for benzol which should in future be employed in the manufacture of rubber solutions.

Rubber testing at the Central Rubber Station at Buitenzorg (Java). O. de Vries. India Rubber J., 1916, 52, 717—719.

Vulcanisation tests are made of the rubber produced by the various estates which are members of the Station. Wide differences are found to exist between individual estates as regards the uniformity of their products ; in some cases the curves for successive samples are nearly coincident ; in others great differences in rate of cure are shown. The samples were cured with 7½% of sulphur at 148° C., and curves are given showing the relation between such samples and others cured with 5% and 10% respectively of sulphur. The 7½% mixings required nearly 1½ times as long a cure as the 10% mixings. In agreement with Spence's temperature coefficient of 2·67 (per 10° C.), the author finds that the cure is nearly twice as long at 140° C. as at 148° C.—E. W. L.

Vulcanisation tests ; Ceylon ——. Bull. Dep. Agric., Ceylon, No. 23. India-Rubber J., 1916, **52**, 720—721.

The investigation was concerned with the effect upon tensile strength, elongation, and rate of cure, of a number of factors in the preparation of plantation rubber. *Tensile strength.* Little effect was produced by varying the acid used in coagulation (acetic, 0·13 grm. ; formic, 0·07 grm. ; sulphuric, 0·10 grm. ; hydrofluoric, 0·04 grm. per 100 c.c. of undiluted latex ; or double these amounts) ; or by the addition of ammonia (0·0056%), sodium sulphite (0·2%), or formaldehyde (0·5%) to the latex before coagulation ; nor was there any notable difference between hand-made and machine-made sheet. Thick crêpe gave slightly better figures than thin, and sheet gave better results than crêpe. Spontaneously coagulated rubber gave very good values ; scrap from the trees gave very low results. The maximum strength of 64 samples was 2571 lb., the minimum 1607 lb. Two samples of fine hard Para gave respectively 2276 and 2312 lb. *Elongation.* Maximum, 919 ; minimum, 787%. Fine hard Para 893 and 880%. None of the factors had any very marked or constant effect. *Rate of cure* (rubber, 90 ; sulphur, 10%). Hand-made sheet cured quicker than machine-made ; thick crêpe cured quicker than thin ; sheet cured quicker than thin crêpe. In the smaller quantities given above, the nature of the acid had little effect on the rate of cure ; when the double quantities were used the sulphuric and hydrofluoric acid samples cured more slowly. Excess of formaldehyde lengthened the cure considerably ; ammonia and sulphite had no constant effect. Results are also quoted which show that the effect of washing sheet rubber, upon the three properties dealt with above, is practically negligible.—E. W. L.

Patents.

Composition. [Rubber mixing.] A. Nixon, Manchester. Eng. Pat. 16,883, Dec. 1, 1915.

A composition for solid tyres and "mechanical" rubber goods consists of india-rubber (Congo), 17 ; lithopone, 25 ; sulphur, 2½ ; glycerin, ¼ ; finely pulverised or ground stone (flint pebbles), 2½ parts.—E. W. L.

Vulcanisation of natural or artificial caoutchouc or caoutchouc-like substances ; Process for accelerating ——. S. J. Peachey, Manchester. Eng. Pat. 101,819, Feb. 3, 1916. (Appl. No. 1613 of 1916.)

Vulcanisation is accelerated by the addition to the mixing of nitrosophenol or its homologues. The time required to vulcanise a mixing consisting of rubber, 100, and sulphur, 10 parts, at 135°—145° C., is reduced from about 1 hour to about 30—35 minutes by the addition of 1 part of nitrosophenol.—E. W. L.

Hard-rubber composition. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., New York. U.S. Pat. 1,200,692, Oct. 10, 1916. Date of appl., June 16, 1910.

A plastic composition containing vulcanised rubber, with or without suitable filling materials, sulphur, and a condensation product of phenols and formaldehyde, is converted into hard-rubber (ebonite) by the action of heat.—E. W. L.

(A) *Vulcanised rubber; Agent for treating ——.* (B) *Rubber product.* (C) *Process of reclaiming rubber.* (A) H. B. Cox, Bedford Hills, N.Y., Assignor to H. Goldman, New York. (B) and (C) H. B. Cox. U.S. Pats. 1,202,758, 1,202,759, and 1,202,760, Oct. 24, 1916. Dates of appl., (A) Jan. 16, 1913, (B) and (C) July 29, 1914.

Vulcanised rubber is reclaimed by treating it with a solution of rubber resin in a hydrocarbon, or/and with a solution of "vulcanised gum" in such a rubber-resin solution.—E. W. L.

Fabrics used in conjunction with vulcanised india-rubber; Treatment of ——. W. E. Muntz, London. U.S. Pat. 1,203,241, Oct. 31, 1916. Date of appl., Feb. 19, 1914.

See Fr. Pat. 468,493 of 1914; this J., 1914, 974.

XV.—LEATHER; BONE; HORN; GLUE.

Myrobalans from Burmah. U.S. Cons. Rep., Oct. 27, 1916.

The chemical adviser to the Forest Research Institute, India, states that Burmese myrobalans or "pangia" fruits differ from Indian Chebulic myrobalans in composition and colour. In the air-dried Burmese material the tannin content was found to vary between 16 and 32 %, averaging 20—25 %, or about one-half that of Indian myrobalans. The non-tannin content ranged from 25 to 34 %, averaging 27—30 %, or about three times that of the Indian material. The colour is high. Tanning experiments with Burmese myrobalans gave a spongy and tough leather similar to that produced by the Indian myrobalans, and indicated that the Burmese product could be used in tanning butts for making army boots, etc., and for making black uppers of an inferior quality. They might also be used in conjunction with babul bark for making sole leather.

Patents.

Tanning materials; Manufacture of ——. Badische Anilin u. Soda Fabr. Ger. Pat. 291,457, Aug. 22, 1913. Addition to Ger. Pat. 262,558.

Salts of hydroxysulphonic acids of the benzene or naphthalene series are heated, preferably under pressure, with formaldehyde or substances capable of yielding it. The reaction products are obtained in the form of salts. The free acids are soluble, amorphous or syrupy substances, nearly or quite colourless, which convert animal skin into a serviceable leather. The alkali salts of the acids are easily soluble in water, give colorations with ferric chloride, and do not precipitate gelatin in neutral solution.—A. S.

Tanning. E. Stiasny, Headingly, and O. Schmidt, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,203,069, Oct. 31, 1916. Date of appl., Mar. 23, 1914.

See Addition of July 31, 1913, to Fr. Pat. 443,730 of 1912; this J, 1914, 209.

Method and apparatus for drying [adhesive] liquids. U.S. Pats. 1,200,116 and 1,200,117. *See* I.

Treatment of spent tan bark, peat, and the like for use as fuel. Eng. Pat. 101,730. *See* IIa.

Process for the reclamation of bichromates [from spent tanning liquors]. U.S. Pat. 1,201,392. *See* VII.

XVI.—SOILS; FERTILISERS.

Soils; Acidity and adsorption in —— as measured by the hydrogen electrode L. T. Sharp and D. R. Hoagland. J. Agric. Res., 1916, 7, 123—145.

Using a slightly modified form of the apparatus devised by Hildebrand (J Amer. Chem. Soc., 1913, **35**, 847—871), determinations of the H ion concentration in aqueous suspensions of many different soils were carried out, and they showed that in many cases the liquids were truly acid. The H ion concentration varied between $0{\cdot}2\times10^{-3}$ and $0{\cdot}2\times10^{-9}$. Since the values found varied only very slightly when widely varying proportions of soil and water were used, it was inferred that the H ion concentration of the suspension was approximately the same as that of the corresponding soil solution. Soils containing calcium in equilibrium with the HCO_3 ion and carbon dioxide gave a very slight alkaline reaction. The H ion concentration was not sensibly affected by alterations in the degree of fineness of the soil particles, but it was diminished when the soil had been heated previously. The lime requirement of a soil can be found by adding a standardised solution of calcium hydroxide to the soil suspension until a definite OH ion concentration is established. This electrometric titration method has yet to be developed, but that it is of value is shown by the fact that when calcium carbonate was added to different soil suspensions with an acid reaction in the amounts shown by the lime water titration to be necessary, approximately neutral liquids were obtained. The effect of adding the chloride of potassium, or sodium, or barium, to the soil suspension was to increase the acidity in each case nearly to the same extent, the barium salt producing a somewhat greater effect. The adsorption of OH ions by soil was also investigated. It was found that when 0·1 mgrm. of hydroxyl was added as $Ca(OH)_2$ to 50 c.c. of pure water, an OH ion concentration of $3{\cdot}8\times10^{-5}$ was produced; but in the presence of soil the same concentration could only be brought about by adding much greater quantities of alkalis. Investigating the action of soils on lime water, it was found that both positive and negative ions were removed simultaneously. The rival claims of the theories of adsorption, of base-exchange, and of the presence of free acids in soils are discussed in the light of recent researches, and the view is expressed that soil acidity is not necessarily related to ionic adsorption, but is fundamentally dependent on the equilibria of reactions yielding an excess of H ions.—E. H. T.

Soils; The alkaline reaction produced by acids in ——, viewed from the standpoint of plant nutrition. G. Masoni. Staz. sperim. agrar. ital., 1916, **49**, 132—149. Bull. Agric. Intell., 1916, **7**, 799—800.

Previous investigation having shown that the presence of citric, malic, or tartaric acids in chalky soils, caused the retention of iron in solution in spite of the alkaline reaction they give rise to, experiments were undertaken to see if they exerted a similar action on manganese compounds. The results were affirmative and showed that only the hydroxy-acids were active in this respect, citric and malic acids proving particularly effective. Tests were also conducted with pure calcium carbonate and manganese compounds (MnO, Mn_3O_4, MnO_2, the carbonate, and the sulphate), and the results demonstrated the undoubted capacity of the lime to cause the retention of manganese in solution. In a third series of experiments common soils were mixed with manganese sulphate or the dioxide. With small amounts of sulphate (2 mgrms. per 50 grms. of soil) only citric and malic acids caused an increased quantity of manganese to pass into solution, while for larger amounts (50 mgrms. per 50) any acid produced this effect. With manganese dioxide only citric and malic acids effected an increase in the amount of dissolved manganese. Thus, in presence of lime the compounds of manganese respond to treatment with acids in the same manner as those of iron. The *modus operandi* was to treat 25—50 grms. of the soil or prepared mixture with 50—100 c.c. of the acid in $N/10$ concentration. After shaking and standing for about 8 hours until the alkaline reaction had developed, the material was filtered and the filtrate examined for manganese. —E. H. T.

Lignoceric acid from rotten wood. M. X. Sullivan. J. Ind. Eng. Chem., 1916, **8**, 1027—1028.

FROM the products obtained by the dry distillation of rotten wood, a mixture of acids was isolated. After purification by means of the lithium salts, this was separated into two acids, melting respectively at 85° and at 78° C. (at 80°—82° C. after further purification). The latter acid was proved to be lignoceric acid, identical with that isolated by Schreiner and Shorey (this J., 1911, 40) from peat soil: and the former is probably inactive cerebronic acid. Sullivan (Science, 1913, **38**, 678) has found cerebrosides in mould from soil, and Levene and West (J. Biol. Chem., 1913, **15**, 193) have shown that lignoceric acid is an oxidation product of cerebronic acid derived from cerebrosides by hydrolysis.—A. S.

Azotobacter; Experiments on the growth of ——. A. Cauda. Staz. sperim. agrar. ital., 1916, **49**, 125—131. Bull. Agric. Intell., 1916, **7**, 801–802.

SALTS of phosphoric acid favourably affect the growth of azotobacter, and when applied in amounts containing equal quantities of P_2O_5, the potassium salts are more effective than those of calcium. High proportions of nitrogenous compounds act detrimentally and prevent the formation of the typical film in impure cultures; low proportions restore the activity of the organism on a solid medium. Calcium carbonate is very beneficial, particularly when phosphoric acid is also present. Of the magnesium compounds, applied at the rate of 1%, the sulphate and magnesium sodium phosphate caused fermentation to begin sooner than the oxide; magnesium chloride had no action. Azotobacter develop well on agar-humus and their multiplication proceeds better in the presence of *Streptothrix*, or of the blastomycetic form, than when alone. Different soils favour the activity to different extents; thus the organism is very active in compost and in tilled stubble soil: it is active in permanent rice-field soil and in irrigated meadow soil, but is nearly inactive in chalky vine soil and in the deeper layers of rice-field soil under rotation crops. Azotobacter flourish best in well-tilled soils containing humus and dressed with mineral fertilisers.—E. H. T.

Plate method of counting bacteria; A comparison between agar and gelatin as media for the ——. [Bacteriological examination of soils.] H. J. Conn and W. D. Dotterrer. New York Agric. Expt. Station, Tech. Bull. No. 53, 12—15, May, 1916.

A COMPARISON was made between soil-extract gelatin and asparaginate agar as plate media for counting the bacteria in soil (this J., 1915, 673). Dilutions of 1 in 100,000 and 1 in 200,000 were used. Each sample was plated in triplicate on each medium, and the plates were incubated at 18°—19° C. for one week in the case of gelatin and two weeks in the case of agar. The results showed that 33% of the plates of each medium gave counts which varied less than 5% from the average, while 21% of the plates of each medium varied over 15% from the average. This agreement proves that the nature of the medium is not the cause of the widely different numbers which are sometimes obtained.—J. H. J.

Phosphoric acid in soils; Method of extraction as affecting the determination of ——. H. Hale and W. L. Hartley. J. Ind. Eng. Chem., 1916, **8**, 1028—1029.

COMPARATIVE experiments showed that with $2N$-nitric acid (Brauer, this J., 1915, 42) as much phosphoric acid is extracted in 2 hours as in the official (American) method of extracting with hydrochloric acid of sp.gr. 1·115 for 10 hours. Moreover no interfering substances are extracted by the nitric acid, whereas a considerable quantity of organic matter is dissolved by the hydrochloric acid.—A. S.

Phosphorites; Investigations into the utilisation of —— in Russia. A. V. Kasakov, N. P. Koblikov, V. N. Kotchetkov, K. N. Chvezov, and I. V. Jakuchin. Report by D. N. Prianichnikov. Agronomic Instit. of Moscow, 1915, **5**, 1—100. Bull. Agric. Intell., 1916, **7**, 804—807.

Extraction of phosphoric acid from phosphorites. Previous work had shown that practically all the combined phosphoric acid was extracted if the minerals were steeped in a given quantity of water prior to the treatment with sulphuric acid. In 1914, in investigating the influence of the shape and the speed of the agitator used in the acid treatment, Kasakov found that the Getterman type of agitator was the best. Working with powdered phosphorites from Viatka, varying the acid concentration between 10 and 50%, and the speed of revolution between 300 and 1800 revolutions per minute, he found that the frothing, due chiefly to the escape of carbon dioxide, diminished as the speed increased; that there was an optimum speed at which all frothing ceased and the reaction reached its maximum energy; and that this speed could be determined with ease. Further, the method employed for mixing the materials has a marked influence upon the reaction; and the extraction is incomplete when the speed of rotation is insufficient, or if acid of 40% concentration or more be employed. Working on the same material, Kotchetkov and Koblikov found that the extraction could be increased from 73·77 to 95·67% by steeping the mineral in water, treating with the acid at 30° C., and then stirring the mass continuously throughout the whole period (10 mins.) of the reaction. In the investigation of the precipitation of phosphoric acid solutions by gypsum, Chvezov discovered that in addition to being influenced by the state of fineness of the solid, the speed of the reaction is increased when the amount of base present is augmented; but in this case the phosphoric acid of the precipitate—both total and citric-soluble—is diminished. Raising the temperature also decreases the solubility of the product in ammonium citrate. With the object of discovering a method of obtaining dicalcium phosphate more simple than that of precipitation, Kasakov treated degelatinised and degreased bones with aqueous solutions of phosphoric acid, and of sulphuric acid, both in varying concentrations. He obtained fair yields of phosphates with a solubility up to 91% in alkaline ammonium citrate, but similar experiments on phosphorites gave only negative results.

Cultivation trials with phosphates and phosphorites. To compare the fertilising effects of precipitated phosphate and superphosphate, Jakuchin grew millet and sugar-beets in black soil from South Russia, using as dressings superphosphate (16% P_2O_5), basic slag (16% P_2O_5), Palmer's precipitated dicalcium phosphate (37·94%

P_2O_5), and a precipitated phosphate containing 40% P_2O_5. The results obtained with the precipitated phosphates were as good as, and in some cases superior to, those obtained with superphosphate. The cultivation tests with phosphorites showed that some phosphates from the province of Saratov are partly assimilable by cereals.—E. H. T.

Patents.

Fertilising [tobacco plants]: Process of ——. C. Bosch, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,200,806, Oct. 10. 1916. Date of appl., Sept. 4, 1914.

The use of urea nitrate as a fertiliser for tobacco plants is claimed as producing a tobacco particularly free from obnoxious ash constituents and from marks on the dried leaves.—E. W. L.

[*Calcium*] *cyanamide; Process of granulating pulverulent products such as* ——. J. Roussel. Fr. Pat. 478.832, Feb. 22, 1915. Under Int. Conv., Mar. 24, 1914.

Powdered cyanamide is mixed with, say, 5% of a powdered agglutinating agent, such as clay, marl, or kaolin, with the optional addition of casein (0·25%), and the mixture treated, whilst stirring, with a fine spray of water.—F. Sodn.

XVII.—SUGARS; STARCHES; GUMS.

Glucose: Chemical composition of commercial [liquid] —— and its digestibility. J. A. Wesener and G. L. Teller. J. Ind. Eng. Chem., 1916, 8, 1009—1020.

The results of a large number of experiments on the fermentation of solutions of liquid glucose (starch syrup) are given. The proportions of maltose and dextrose in two samples of commercial glucose, as calculated from the cupric-reducing power and the yield of carbon dioxide on fermentation, were 11·7 and 17·2% of dextrose and 22·9 and 16·4% of maltose. There were also present difficultly fermentable reducing substances amounting to about 14% calculated as maltose or 8% calculated as dextrose, and unfermentable dextrins amounting to about 47%. The two last-named classes of substances can be rendered fermentable by hydrolysis with hydrochloric acid or with Takadiastase or pancreatin, or, less readily, with cold water malt extract, and appear to be normal intermediate products in the transformation of starch to dextrose by the action of acids or enzymes. There is no justification for the claim that commercial glucose contains unfermentable reducing substances which are reversion products formed by the action of acid on dextrose at a high temperature. It is concluded that commercial glucose consists of products which are wholly assimilable as food.—A. S.

Sugar factory effluents; Effects of the beet-saponin in ——. F. Schulz. Böhm. Zeits. Zuckerind., 1916, 41, 4. Chem.-Zeit., 1916, 40, Rep., 374.

The acid beet-saponin discovered by Kobert (this J., 1914, 937) is present in the effluents from the slicing machines and to a small extent in the diffusion water. It occurs in the form of calcium or magnesium salt in colloidal solution and can be separated almost completely by acidifying with a mineral acid. An injurious action on fish is to be observed only when the effluent from the slicing machines amounts to from 5—10% of the total effluent, or if the total effluent contains more than 5 mgrms. of the saponin per litre. Such a concentration is hardly ever attained in practice. The saponin, at the concentration mentioned, can be readily detected by the naphthoresorcinol test.—A. S.

Polarimetric determination of sugar [sucrose] in condensed milk. Brooks. *See* XIXa.

Patents.

Sugar juices; Process of treating ——. H. Wiese. Wallaceburg, Ontario. U.S. Pat. 1,200,787. Oct. 10, 1916. Date of appl., Oct. 25, 1912.

Sugar juice is treated with finely powdered calcium carbonate, heated to 70°—100° C., and filtered, then treated with a relatively small quantity of lime to destroy the glucose, carbonatated, reheated, and filtered.—J. H. L.

Saccharine juice; Process of refining ——. E. J. Ruckstuhl, Levert, La. U.S. Pat. 1,201,104, Oct. 10, 1916. Date of appl., Aug. 21, 1913.

The juice is forced at a high velocity into the upper part of a closed vessel, and compressed air is also injected into the upper part of the vessel and into the juice as it enters, so that foam is formed on the juice in the vessel. The foam, with the substances in it, is conducted from the upper part of the vessel.—J. H. L.

Filter-press, especially for filtering sugar juices and the like. E. Lehne, Klein Wanzleben. Ger. Pat. 294,310, Jan. 30, 1916. Addition to Ger. Pat. 291,316 (this J., 1916, 648).

The end plates of the filter-press are connected below by a fixed longitudinal connecting piece, on which the filter elements rest, and above by a removable connecting piece. One of the end plates is hollow and communicates with a channel formed in the lower connecting piece, into which the outlet passages from the filter elements discharge. The filtrate flows from the channel through the hollow end plate and is discharged through one of the hollow trunnions on which the press is mounted.—A. S.

Milk-sugar; Process of extracting —— from whey. J. G. Dietrich, McMinnville, Oreg. U.S. Pat. 1,201,027, Oct. 10, 1916. Date of appl., Feb. 26, 1916.

Whey is heated under pressure in absence of air, to coagulate non-sugar matters, then cooled to 60 F. (15·5° C.) or below, to retard bacterial growth, and filtered. The filtrate may be concentrated *in vacuo*, and pasteurised in hermetically closed receptacles.—J. H. L.

Exhausting materials in distilleries, sugar plants, and the like; Apparatus for ——. V. Raisin, Paris. U.S. Pat. 1,201,344, Oct. 17, 1914. Date of appl., May 7, 1913.

See Fr. Pat. 445.976 of 1912; this J., 1913, 156.

XVIII.—FERMENTATION INDUSTRIES.

Permeability; Selective ——: *Absorption of phenol and other solutions by the seeds of Hordeum vulgare.* A. J. Brown and F. Tinker. Proc. Roy. Soc., 1916. B, **89**, 373—379. (See also this J., 1912. 1119.)

When barley seeds were steeped for 2 days in aqueous solutions of aniline or phenol, the liquid entering the seeds contained in all cases about three times as much of the solute as the steeping solution, though the latter was in some cases nearly saturated. In similar experiments with aqueous acetic acid, as the concentration of the acid in the steeping solution was increased from 0 to 100%, its concentration in the absorbed liquid increased to a maximum of 80% (for a steeping solution of 50%) and remained constant at this value for all higher concentrations of the steeping solution, except for anhydrous acid, which was not absorbed at all. The weight of liquid taken up by barley seeds in any solution, when equilibrium has been attained, is less than, equal to, or greater than the weight which would be taken up in pure water, according as the concentration of the solute in the absorbed liquid is less than, equal to, or greater than that in the steeping solution. This is readily explicable on grounds of osmotic pressure. Comparison of data for a number of solutes reveals a close parallelism between the surface tension of their solutions and their capacity for entering the seeds. Gibbs' rule connecting surface tension and adsorption appears, therefore, to apply to the absorption of solutions by barley seeds, and the authors suggest that the selective permeability of the seed membrane is due to selective adsorption, a hypothesis which has been advanced on other grounds for membranes of the copper ferrocyanide type (see Tinker, this J, 1916, 657).—J. H. L.

Fermentation : Influence of phosphates on alcoholic —— at different OH'-concentrations. H. Euler and T. Tholin. Z. physiol. Chem., 1916, **97**, 269—278.

Fifty c.c. of 5 % dextrose solution was fermented for 150 mins. at 20° C. by 0·5 grm. of a bottom-fermentation yeast, and maintained neutral to phenolphthalein (p_H = about 8) throughout this time by frequent additions of $N/2$ sodium hydroxide. Under these conditions, and also when dried yeast was used in place of living yeast, added phosphates produced a retardation and not an acceleration of fermentation (cp. Harden and Young, this J., 1908, 870 ; 1909, 1157 ; 1912, 553). For example, addition of 0·5, 1·0, 2·5, and 5·0 % of phosphate (K_2HPO_4) caused reductions of 12, 22, 39, and 50 % respectively in the amount of carbon dioxide produced (*i.e.*, evolved, or fixed by the alkali). When, on the other hand, the fermenting liquid was maintained slightly acid (p_H = 4·5), addition of 2·5 % of phosphate accelerated the fermentation by 40 %. In sugar solutions containing yeast and added phosphates in presence of toluene, no accumulation of hexosephosphate takes place if the solutions are maintained neutral to phenolphthalein.—J. H. L.

Enzymes ; Composition and formation of ——. XII. H. Euler and E. Löwenhamm. Z. physiol. Chem., 1916, **97**, 279—290. (See also this J., 1911, 379, 973 ; 1912, 833.)

The rate of fermentation of sodium pyruvate by a bottom-fermentation brewery yeast, in solutions containing monosodium phosphate to maintain a constant reaction, was found to be increased, in some cases three- or four-fold, by the presence of toluene or chloroform. After the yeast had been dried at ordinary temperatures, to a moisture-content of less than 10 %, its fermentative power towards pyruvate was 60—90 % of its former value (both referred to dry substance), and was practically unaffected by toluene or chloroform ; the fermenting power of the dried yeast towards dextrose was only one-tenth of that of the fresh yeast. Attempts to increase the carboxylase-content of the yeast by cultivation in sugared nutrient solutions were unsuccessful, but an increase of 20 % was produced by cultivation in nutrient liquids containing sodium pyruvate, combined with aeration ; the invertase content of the yeast was at the same time doubled, whilst the fermenting power towards dextrose was reduced by 10 %.—J. H. L.

Beer : Fate of hexoses in the production of ——. F. Schönfeld and H. Krumhaar. Woch. Brau., 1916, **33**, 81—84, 145—147, 150—158.

In the fermentation of brewery worts the hexoses are fermented more rapidly, in proportion to their concentration, than maltose, probably because their smaller molecular magnitude enables them to diffuse more readily into the yeast cells. In worts made from malt alone, the hexoses, which commonly amount to about one-tenth of the total extract, are completely eliminated during the primary fermentation, whatever the type of yeast, and the beers normally remain free from hexoses during storage, for maltose is hydrolysed only within the yeast cells and the dextrose formed is probably at once fermented. The authors carried out fermentations of worts containing added dextrose, with top and bottom-fermentation yeasts, at the low temperatures customary in Germany, and determined as glucosazone the dextrose (hexoses) present at different stages. They conclude that in bottom fermentations complete elimination of dextrose during the primary fermentation is in general only attained when the amount initially present does not exceed 35—65 % of the total extract, according to the character of the yeast. In top fermentations at low temperatures, the amounts of hexoses which can be eliminated are as a rule somewhat less, though they vary considerably with the character of the yeast. At higher temperatures (*e.g.*, at room-temperature) the racial characters that distinguish different top-fermentation yeasts disappear in large measure, and all become capable of fermenting completely very large proportions of added sugar (no data are given relating to these conditions). The authors conclude further from the experiments, that if a wort is treated with sufficient dextrose to satisfy the fermenting power of the yeast, the maltose is scarcely or not at all attacked. The addition of sucrose to wort is considered to have substantially the same effect as that of dextrose, since the former is rapidly hydrolysed in presence of yeast, even of the most weakly attenuating types. The authors discuss the bearing of these results on the use of top-fermentation yeasts for the preparation of " sweet beers " and, on the other hand, of lager beers under German brewing conditions.—J. H. L.

Top fermentation yeasts. F. Schönfeld. Ver. deutscher Chem., Oct., 1916. Z. angew. Chem., 1916, **29**, 390.

Unsatisfactory results are sometimes obtained with top fermentation yeast and this is due to the fact that certain classes of these yeasts possess an extremely low power of fermenting maltose. Yeasts rich in maltase are formed in worts containing much maltose, whilst worts poor in maltose yield yeasts containing little maltase ; the quantity of zymase formed is in proportion to that of the maltase. Yeasts rich in maltase, however, in the presence of interfering substances such as large quantities of dextrins, proteins, etc., tend to lose their hydrolytic properties and give bad results. —W. P. S.

Volatile organic compounds, especially essential oils, formed in the manufacture of sulphite-cellulose. Kertész. *See* V.

Chemical composition of commercial [liquid] glucose and its digestibility. Wesener and Teller. *See* XVII.

Influence of alcoholic concentration and temperature on the biochemical synthesis of α-methylgalactoside. Aubry. *See* XX.

Patents.

Yeast : Process of manufacturing ——. L. Lavedan, New Orleans, La. U.S. Pat. 1,201,062, Oct. 10, 1916. Date of appl., Feb. 12, 1916.

In the propagation of yeast, the scum or froth containing the yeast is continuously skimmed off the fermenting liquid, and separated, *e.g.*, by centrifuging, into yeast and liquid, and the latter is continuously returned to the fermenting vessel. The yeast is aerated during propagation and separation from the scum.—J. H. L.

Diastatic product: Apparatus for producing ——. J. Takamine, New York. U.S. Pat. 1,201,385, Oct. 17, 1916. Date of appl., Jan. 28, 1913.

A horizontal rotary drum with projecting baffle-plates fixed longitudinally to its inner walls, has within it a fixed pipe disposed longitudinally and fitted with spraying nozzles, and also fixed conduits for admitting and withdrawing air. The spraying nozzles are directed towards the rising side of the drum, and the orifices of the air inlet and outlet conduits face the opposite side.—J. H. L.

De-alcoholising liquors; Process for ——. L. A. Rosenblatt, San Francisco, Cal. U.S. Pat. 1,201,873, Oct. 17, 1916. Date of appl., Mar. 22, 1916.

Wine or other liquid, heated to about 80° C., is de-alcoholised by the copious injection of steam at such a pressure that the amount of steam condensed in the liquid is sufficient to maintain the volume of the latter practically unchanged.—J. H. L.

Composition fuel. Eng. Pat. 101,813. *See* IIa.

Yeast extract and process of manufacturing the same. U.S. Pat. 1,200,011. *See* XIXa.

XIXa.—FOODS.

Bread; Determination and distribution of moisture in ——. H. L. Wessling. J. Ind. Eng. Chem., 1916, 8, 1021—1022.

The moisture content of a loaf does not diminish uniformly from the centre to the crust, but is fairly constant excepting near the crust. To ascertain the true moisture content of a loaf, the sample should consist of one-quarter of a loaf when the latter is covered on all sides by crust or of one-half when the loaf has been baked in contact with another loaf and hence is only partly covered by crust. The method recommended for the determination of the moisture is practically the same as the German method (Arb. Kaiserl. Gesundheitsamte, 1915, 48, 605). The sample is weighed as quickly as possible in a tared dish on a torsion balance, then heated at a temperature not exceeding 60° C. until practically dry, allowed to stand exposed to the air for a few hours, weighed, ground to a fine meal, and the remaining moisture determined on a 2-grm. sub-sample by drying in a vacuum oven at 100° C.—A. S.

Agar plates; The number of colonies allowable on satisfactory ——. [*Bacteriological examination of milk.*] R. S. Breed and W. D. Dotterrer. New York Agric. Expt. Station, Tech. Bull. No. 53, 3—11, May, 1916.

Milk containing about a half million bacteria per c.c. was used as the liquid in which the organisms were to be counted. Dilutions of 1 in 100, 1 in 1000, and 1 in 10,000 were sown on agar plates in triplicate, and incubated at 20° C. for five days. Those plates which gave closely agreeing results were used to compute the average, and those plates which differed by more than 20% from the average were rejected. Altogether the colonies on 1435 plates were counted. The results showed that plates containing more than 30 and less than 400 colonies were in close agreement as to the final result. Plates having less than 20 and more than 400 colonies frequently departed widely from the average. The plates with too low counts gave high final results, owing probably to the greater effect of chance contamination with air organisms, while the plates with too high counts usually gave low final results, owing to colonies not developing when overcrowded. Most of the plates were examined again after two days' incubation at 37° C., and the results obtained confirmed the preceding ones. Another series of experiments was made in which counts by the plate method were compared with counts by the microscope method. The plate counts averaged 4250 colonies per c.c., and the microscope counts of bacteria and clumps 5590 per c.c., a very close agreement for such widely different methods.—J. H. J.

Sugar [*sucrose*] *in condensed milk: Polarimetric determination of* ——. R. O. Brooks. J. Ind. Eng. Chem., 1916, 8, 1022—1024.

The following method has given results in agreement with factory data, and has also proved accurate when tested with unsweetened condensed milk to which a definite quantity of pure sucrose has been added. 50 grms. of the sample is diluted to 100 c.c. and 26 c.c. ($=13$ grms. of sample) is diluted further to about 40 c.c., and Fehling's copper sulphate solution added, drop by drop, with stirring, until the proteins and fat are precipitated (about 1·5 c.c. is sufficient). The precipitate is filtered off and washed with water until the filtrate amounts to exactly 100 c.c. The polarimetric reading of the solution is taken in a 200 mm. tube. For the invert reading, 50 c.c. of the filtrate is mixed with 5 c.c. of concentrated hydrochloric acid, allowed to stand over-night, made exactly neutral to phenolphthalein with strong alkali solution, then acidulated with one drop of 10% hydrochloric acid, diluted to 100 c.c., filtered, and the polarimetric reading taken in a 200 mm. tube. The observed direct reading is multiplied by 2 and the observed invert reading by 4, and then the sucrose calculated by Clerget's formula, using the factor 141·7.—A. S.

Butter; Effect of feeding on the composition of ——. *Decorticated ground nut cake and decorticated cotton cake.* H. T. Cranfield. Analyst, 1916, 41, 336—339.

The addition of decorticated ground nut cake to the rations of cows did not materially affect the composition of the butter fat obtained from the milk yielded by the animals, except that there was a slight increase in the proportion of unsaturated glycerides. This cake is more suitable for winter feeding as it tends to produce a soft butter, whilst cottonseed cake may be used in the summer since its use does not alter the composition of the butter fat. (See also this J., 1915, 1108; 1916, 938.) —W. P. S.

Palm kernel cake. C. Crowther. J. Board Agric., 1916, 23, 734—749.

Palm kernel cake has been used to a small extent as a cattle food for some 60 years, but as it was considered to be indigestible, not very palatable to stock, and to deteriorate rapidly in storage, the extension of its use was precluded. An experimental investigation showed that the difficulty due to the unattractive flavour and aroma of the cake disappears if the cake is mixed with other foods in such amount that the cake does not exceed 50% of the mixture; addition of molasses, spices, etc., is useless for the purpose. The keeping qualities of palm kernel cake appeared to equal those of other kinds of cakes with the exception of linseed and soya cakes. Direct determination of the digestibility of palm kernel cake and extracted meal in an experiment with two sheep showed that these foods rank as the most digestible at the farmer's disposal; in this respect, the cake is worth 35%, and the meal 23%, more than Egyptian undecorticated cottonseed cake. Feeding experiments with five cows indicated that the use of the cake increased the fat-content of the

milk to a slight extent and had an appreciable influence on the composition of the butter-fat obtained from the milk; the saponif. value was increased by over 4 units, the iodine value decreased to a similar extent, the Reichert-Wollny value showed an increase of 0·5 to 1·7, and the Polenske value an increase of 0·26 to 0·57.
—W. P. S.

Vitamines and lipoids in margarine and butter. J. De Ruiter. J. Ind. Eng. Chem., 1916, **8**, 1020—1021.

The author determined "lipoids" by shaking with hydrochloric acid of sp.gr. 1·19, then separating the acid, diluting with water, filtering off the precipitated "lipoids," washing with acid water, and drying at 100° C. The substances thus extracted give an ash rich in phosphorus. The content of "lipoids" in various substances, determined in this way, was as follows:—sesamé oil, 0·1 grm. per 100 c.c.; arachis oil, olive oil, cod-liver oil, refined coconut oil, and filtered butter fat, traces; butter, 0·4; "klappa" ("vegetable butter"), 0·75; "planta" ("vegetable butter"), 0·475; margarine, 0·975 grm. per 100 c.c. Since Osborne and Mendel have shown that certain substances, apparently of lipoid nature, are necessary in human food to maintain health and growth, attempts were made to increase the content of lipoids in "vegetable butter." Wheat bran was treated with dilute lime water for 24 hours, and the liquor then removed by pressing, shaken with a molten mixture of refined coconut oil and arachis oil, the emulsion mixed with one-fifth of its quantity of skim milk, allowed to ripen, and the fat separated, and worked up into "vegetable butter." The "bran butter" prepared in this way contains 1·125 grms. of lipoids per 100 c.c., and the liquor separated from the fat can be worked up into a kind of cheese containing a considerable proportion of the wheat albumins.—A. S.

Sugar in meat products, particularly extracts; Determination of ——. W. B. Smith. J. Ind. Eng. Chem., 1916, 8, 1024—1027.

For the clarification of meat extracts previous to the determination of sugar by means of Fehling's solution, the most satisfactory results are obtained by use of an excess of picric and phosphotungstic acids, followed by a minimum of hydrochloric acid. In the case of meat, 50 grms. of the finely divided sample (fairly free from fat) is boiled with about 150 c.c. of water for 15 or 20 mins., cooled, treated with from 1 to 5 grms. of picric acid and 15—20 c.c. of 20% aqueous phosphotungstic acid, then made up to 250 c.c., exclusive of fat, and filtered. 150 c.c. of the filtrate is diluted to 160 c.c. with 8 c.c. of concentrated hydrochloric acid and 2 c.c. of water, filtered, and the reducing sugars are determined by Bertrand's method (this J., 1907, 60) in portions of the filtrate, before and after inversion; 20 c.c. of filtrate = 3·75 grms. of sample. In the case of meat extracts, 5 grms. is dissolved in 25 c.c. of water, the solution treated with 4—6 grms. of picric acid and 40—60 c.c. of 20% aqueous phosphotungstic acid, diluted to 100 c.c., and filtered; 60 c.c. of the filtrate is treated with 3 c.c. (or more, if necessary) of concentrated hydrochloric acid, made up to 66 c.c., filtered quickly, and the reducing sugars determined in the filtrate as above; 20 c.c. of filtrate = 0·909 grm. of sample. By this method the total reducing sugar may be determined within 0·1%, and reducing sugar in presence of sucrose within 0·1 or 0·2%.—A. S.

Animal proteins; The phosphorus-content of —— *after de-mineralisation.* L. Lindet. Bull. Soc. Chim., 1916, 19, 395—399.

It has previously been shown in the case of commercial casein that samples which have been coagulated by rennet and washed without acidification contain considerably more calcium and phosphoric acid than samples which have been precipitated by dilute acids, and it is evident that analyses of proteins containing phosphorus may lead to erroneous conclusions if no precautions have been taken to eliminate pre-existing mineral phosphates. The method employed by the author in the examination of animal proteins consists in extracting the matters soluble in water or dilute saline solutions, precipitating the soluble proteins by phenol in presence of 0·2% acetic acid, and collecting and drying the precipitate. This is decomposed by boiling sulphuric acid, the nitrogen determined in one aliquot portion and the calcium and phosphoric acid in the other after neutralisation with solid ammonium carbonate. The residue insoluble in water or salt solution is freed from fat by extraction with petroleum spirit, then exhausted with 0·2% acetic acid and decomposed with boiling sulphuric acid; the calcium and phosphoric acid are determined in this residue and calculated as percentages of the nitrogenous matter. Examined in this manner, the proteins of white of egg were found to contain no organic phosphorus. From the yolk of egg, after separating the fat and the vitellin, a protein was obtained resembling the protein of the white in that phosphorus was present only as calcium phosphate but differing in rotatory power. The purified vitellin, after exhaustion with fat-solvents and dilute acetic acid, contained phosphorus equivalent to 3·60—3·72% P_2O_5. The proteins of ox-blood contained no organic phosphorus; gelatin and osseïn also contained only mineral phosphate. The soluble proteins of beef-fibrin, liver, and brains were free from organic phosphorus but the insoluble proteins of beef showed 0·25%; calf's liver, 1·0; ox liver, 1·26; sheep's brain, 1·59, and ox-brain, 1·82% P_2O_5 in organic combination, calculated on the total proteins. Of the flesh of fish, both the soluble and insoluble proteins contained only mineral phosphates.—J. F. B.

Pectin gels; Consistence of ——. J. B. McNair. J. Phys. Chem., 1916, **20**, 633—639.

Pectin, acid (organic), and sugar are the principal factors in fruit jelly making; these three substances, independently or combined, increase the viscosity. Mixtures of any two or all three of the substances have viscosities greater than the sum of the individual viscosities. Jelly will form from a solution containing 3% of pectin and 65% of sugar. Besides increasing the viscosity, the sugar appears to act as a dehydrating agent. The pectin used in the experiments was obtained by boiling lemon rinds with alcohol, then heating the rinds with water at 110° C., filtering the aqueous extract, treating the filtrate with twice its volume of alcohol, collecting the precipitate, washing it with alcohol and ether, and drying it over sulphuric acid.
—W. P. S.

Chemical composition of commercial [liquid] glucose and its digestibility. Wesener and Teller. *See* XVII.

Patents.

Preserving meat and other food products; Process for ——. F. Penza, Marseilles, France. Eng. Pat. 101,824, Feb. 8, 1916. (Appl. No. 1838 of 1916.)

Milk is warmed to 35° C. and clotted, and the clot stirred vigorously until a flocculent precipitate is produced which is collected and consolidated to a paste. A cloth, dipped in the whey from the clot, is wrapped round the paste which is allowed to drain for a few days until it has become glutinous. It is then cut into shreds which are treated with boiling water so as to obtain an elastic mass of hydrated casein. This plastic mass is used to form a coating round the meat to be preserved, which has been freed previously from pathogenic organisms.—J. H. J.

Food products. W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,199,121, Sept. 26, 1916. Date of appl., Apr. 3, 1915.

A starchy food, such as potato, is subjected to the action of a hot oleaginous fluid, and is subsequently degreased by means of a solvent. Any solvent remaining in the product is removed by heating under reduced pressure.—J. H. J.

Jelly; Process for producing ——. J. S. Ellithorp, jun., Palatine Bridge, N.Y. U.S. Pat. 1,199,457, Sept. 26, 1916. Date of appl., June 12, 1916.

Fruit or vegetable juice containing pectin, with added sugar, is subjected to the action of an electric current.—J. H. J.

Yeast extract and process of manufacturing the same. A. Nilson, Chicago, Ill. U.S. Pat. 1,200,011, Oct. 3, 1916. Date of appl., June 12, 1916.

Yeast is heated with dilute mineral acid (hydrochloric acid) below 100° C., to rupture the cells and extract their soluble constituents, and the extract is neutralised, *e.g.*, with sodium carbonate.—J. H. L.

Powdered-milk product. S. A. Vasey, London. U.S. Pat. 1,202,130, Oct. 24, 1916. Date of appl., Mar. 25, 1916.

See Eng. Pats. 2772 and 7766 of 1915; this J., 1916, 649.

Process of extracting milk-sugar from whey. U.S. Pat. 1,201,027. *See* XVII.

XIXb.—WATER PURIFICATION; SANITATION.

Patents.

Purifying liquids; Method and apparatus for ——. O. L. Weil, Port Huron, Mich. U.S. Pat. 1,199,514, Sep. 26, 1916. Date of appl., Dec. 31, 1915.

A liquid containing dissolved impurities which can be precipitated by heating, is passed into the lower portion of a horizontal vessel containing vertical revolving arms. The vessel is closed and the air in the upper portion is kept highly heated. The arms carry up films of liquid into the heated atmosphere, and the impurities are precipitated on the arms. As the arms sink into the impure liquid again the film of purified liquid on them floats off on the surface of the colder liquid, and is removed while hot.—J. H. J.

Sterilising [water]; Method and apparatus for ——. C. F. Burgess, Madison, Wis. U.S. Pat. 1,200,165, Oct. 3, 1916. Date of appl., Oct. 30, 1913.

The electrodes of a battery are held in contact with bibulous material containing sodium chloride. When the electrodes are placed in water, it is rendered locally conductive, and sodium hypochlorite is produced by the current; this diffuses through the water and acts as a sterilising agent. —J. H. J.

Feed of chemicals or like substances to water or other fluids; Regulating and proportioning the ——. Regulating and proportioning the feed of dry or granular chemicals in water-mains. G. G. Earl and A. B. Wood, New Orleans, La. U.S. Pats. (A) 1,200,324 and (B) 1,200,325, Oct. 3, 1916. Dates of appl., May 10, 1911, and May 3, 1916.

(A) The chemical in solution is fed into the main conduit from a completely filled vessel, the discharge from which is regulated by a partition or diaphragm in the vessel, moving in accordance with the difference between the static and total pressures of the fluid in the main. The chemical solution is stored in a reservoir, the flow from which is controlled by a second similar vessel and partition as above. The two vessels are connected by a valve which acts in response to the movements of the two partitions. (B) In an apparatus of similar construction to that described above, a separate flow of fluid is used to convey the dry chemicals, and is regulated to be proportional to the flow in the water-main by means of a valve governed by the two pressures derived from both flows.—J. H. J.

Softening and purifying water. C. Massaciu, Berlin-Tempelhof, and A. Neumann, Reppen, Germany. U.S. Pat. 1,202,557, Oct 24, 1916. Date of appl., Aug. 31, 1915.

The water is filtered through a porous, amorphous material of igneous origin, which has been steamed and contains water of hydration and removable alkali; by this means dissolved calcium compounds are retained in the filter.—J. H. J.

Sewage effluents; Method of accelerating the deposition of solids in ——. R. P. Bolton, New York, Assignor to A. Williams and E. F. Tweedy. U.S. Pat. 1,202,474, Oct. 24, 1916. Date of appl., Nov. 25, 1914.

The effluent is introduced into a vessel so as to expel all the air, the vessel is then closed and a pressure applied greater than that existing in the liquid. This pressure is removed suddenly, and the process is repeated until the suspended matter has been freed from gases and has settled.—J. H. J.

Destructor furnaces and the like; Working and construction of ——. E. C. R. Marks, London. From Maschinenbau-Anstalt Humboldt, Cöln-Kalk, Germany. Eng. Pat. 14,850, Oct. 20, 1915.

The charging apparatus is situated above the furnace and consists of two spaced rollers rotating in opposite directions and capable of being shifted laterally so as to permit of the passage between them of bulky material. The refuse falls on to the back portion of the grate, and is pushed forward mechanically when required, the clinker already in the front part being pushed out through the opened door in front. The air supply is a forced draught from below the front part of the grate, and the air as it passes up through the hot clinker, is preheated before it passes to the back portion of the grate. The damper controlling the air supply is connected by means of a shaft and bevel gearing with the rollers of the charging chamber, and regulated by them. When clinker is being discharged, the damper is closed, and it is not opened again fully until the back part of the grate has received the full charge.—J. H. J.

Water-purifier; Automatic electric ——. G. E. Erickson, New York. U.S. Pat. 1,199,253, Sept. 26, 1916. Date of appl., Dec. 28, 1915.

Method and apparatus for mixing liquids. U.S. Pat. 1,202,421. *See* I.

Process for the treatment of volcanic rocks. U.S. Pat. 1,202,556. *See* VII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Strychnine in Nux vomica; Determination of ——. H. R. Jensen. Pharm. J., 1916, 97, 458—461.

A comparison of the methods of separation of strychnine and brucine in *Nux vomica* by oxidising with nitric acid at 20° C. and at 50° C. (B.P. 1914) respectively, indicated that at the lower temperature the average of the gravimetric results for strychnine, which varied ± 2·1% among themselves, was 10·3% higher than at the higher temperature. In three well-established cases the results by the B.P. process were 9·9% to 11·7% too low for an extract and 14·5% to 17·2% too low for the powder as compared with those obtained by oxidising at the lower temperature. With mixtures of pure alkaloids oxidaton with cold nitric acid gave a mean result of 99·6% (corr.) whilst oxidation with warm nitric acid gave a mean loss of 3%. In all cases the basic value of the alkaloidal residue, estimated by titration, using cochineal as indicator, was very low compared with the gravimetric result. This was found to be due to the contamination of the alkaloidal residue with either strychnine nitrate or a similar strychnine compound to an extent not under control. Hence an uncorrected gravimetric result may indicate a strychnine content 1·1% to 6·2% too high, the uncorrected volumetric result giving correspondingly greater errors too low. By combining the gravimetric-volumetric results the margin of error is reduced to ± 2%. On leaving the final chloroform solution of the alkaloid residue overnight, before distilling, particularly after oxidation with warm nitric acid, large white needle crystals of the contaminating substance, m.pt. about 305° C., separated out. These were sparingly soluble in chloroform and in the sodium sulphate-sodium nitrate solution obtained in the course of analysis, were devoid of basic properties and of optical activity, and were apparently a dimorphic form of strychnine nitrate.—T. C.

Alkaloids of phenolic function (morphine and derivatives, cupreine, adrenaline, etc.); General reaction of vegetable or animal ——. G. Denigès. Ann. Chim. Analyt., 1916, **21**, 213—216.

ALKALOIDS containing phenolic hydroxyl groups resemble other phenols in producing a coloration with titanium dioxide dissolved in concentrated acids (cp. Hauser and Lewite, Ber., 1912, **45**, 2480; Lenher and Crawford, this J., 1912, 956). The reagent is prepared by heating natural titanium dioxide (rutile) with concentrated sulphuric acid for some hours near the boiling point. A very small quantity dissolves, and after cooling and standing the clear liquid is decanted from the residue. The following colorations are produced on shaking some particles of the substances named, or a few drops of their solutions, with 2—3 c.c. of the reagent:—morphine, blood-red; apomorphine, reddish-violet; oxydimorphine, wine-red (intermediate in tint between the former two); cupreine, orange, resembling the colour of alkali bichromate solutions; hordenine and tyrosine, deep orange; adrenaline, reddish-brown (very sensitive test). Quinine (methylcupreine) and codeine (methylmorphine) do not react in the cold, but they may be demethylated by heating with the reagent. Proteins containing tyrosine give an orange coloration on warming gently.—J. H. L.

Thalleioquin. A. Christensen. Ber. deut. Pharm. Ges., 1916, **26**, 247—261. (See also this J., 1915, 979.)

QUININE, monobromoquinine, and dehydroquinine, and substances such as quinine dichloride, and quinine oxychloride, derived from quinine by saturating the vinyl group, all produce the green colouring matter, thalleioquin, when chlorine water followed by ammonia is added to their slightly acid solutions, whilst 5-dichloro-6-ketocinchonine oxychloride, formed by the action of 3 mols. of chlorine on quinine, gives thalleioquin on addition of ammonia only. Thalleioquin on drying loses ammonia, leaving 5.6-diketocinchonine hydrochloride, $C_{19}H_{21}O_3N_2Cl$, and hence is a loose combination of this latter substance with ammonia. 5-Chloro-6-hydroxycinchonine oxychloride, $C_{19}H_{22}O_2N_2Cl_2$, obtained by the action of 2 mols. of chlorine on quinine, yields thalleioquin on treatment with any oxidising agent, a substance able to combine with chlorine, and ammonia, whilst 5-chloro-6-hydroxyquinoline (*o*-chloro-*p*-hydroxyquinoline) similarly treated yields thalleioquinoline.—T. C.

a-Methylgalactoside; Influence of alcoholic concentration and temperature on the biochemical synthesis of ——. A. Aubry. J. Pharm. Chim., 1916, **14**, 289—294. (See this J., 1914, 272.)

THE maximum yield of methylgalactoside is obtained when the initial concentration of methyl alcohol in the reaction mixture is about 20—30 grms. per 100 c.c., and the temperature is kept near 20° C.; 65% of the galactose present is converted into galactoside in the course of a few months. With more concentrated alcohol, and at higher temperatures, the synthesising enzyme is destroyed fairly rapidly, though it is more stable than a-glucosidase.—J. H. L.

Saw palmetto, a phytochemical study of the fruit of Sabal serrulata. C. A. Mann. Bull. Univ. Wisconsin, No. 767, 1915. Amer. J. Pharm., 1916, **88**, 517—518.

THE so-called volatile oil obtained from the fruit (berries) of *Sabal serrulata* consists of a mixture of esters and fatty acids; the esters result from the condensation of free fatty acids naturally present in the fruit with ethyl alcohol formed by the fermentation of the sugars. Larger quantities of esters are formed when the fruits are preserved in alcohol. The fresh fruits yield a mere trace of volatile oil consisting of lower fatty acids and free from esters. Lipase is present in the fruits but plays no part in the formation of the esters. —W. P. S.

Vanillin in vanilla extract; Determination of ——. A. W. Dox and G. P. Plaisance. Amer. J. Pharm., 1916, **88**, 481—484.

THE vanillin is precipitated by treating its hydrochloric acid solution with thiobarbituric acid which may be readily prepared from malonic ester and thiourea; the precipitate consists of 3-methoxy-4-hydroxybenzalmalonylthiourea. Twenty-five c.c. of the vanilla extract is dealcoholised and then diluted to 50 c.c. with lead acetate solution; after standing for a few hours at 37° C., the mixture is filtered, 40 c.c. of the filtrate is treated with a quantity of concentrated hydrochloric acid sufficient to make the volume up to 50 c.c. and the acidity 12%, the lead chloride is filtered off, and 40 c.c. of this filtrate is treated with thiobarbituric acid in 12% hydrochloric acid solution. The precipitate is collected after 18 hours, washed with 50 c.c. of 12% hydrochloric acid, then with 20 c.c. of water, dried at 98° C., and weighed. The method cannot be applied to artificial extracts coloured with caramel, since the latter contains furfural derivatives, and thiobarbituric acid is a precipitant for all aromatic aldehydes. The presence of caramel is indicated by the brown colour of the filtrate after clarification with lead acetate; in the absence of caramel this filtrate is straw coloured. The acidified filtrate also yields a precipitate with phloroglucinol if it contains caramel.—W. P. S.

β-Santolinenone; Constitution of ——. L. Francesconi and N. Granata. Gaz. Chim. Ital., 1916, **46**, II., 251—256.

THE hydroxylamino-derivative of β-santolinenone (this J., 1915, 197) is best obtained by heating *Santolina chamæcyparissus* oil (this J., 1911, 1332; 1912, 202) with hydroxylamine hydrochloride in alcohol-ether solution in presence of sodium bicarbonate, and isolating the hydroxylamino-derivative in the form of its crystalline oxalate, m.pt. 161° C. The free base melts at 63°—64° C., and gives a nitroso-derivative when oxidised with mercuric oxide. β-Santolinenone has properties resembling those of pulegone; its behaviour with hydroxylamine hydrochloride and the properties of the hydroxylamino-derivative indicate that the ketone contains the grouping $(CH_3)_2C:C.CO$, and the authors conclude that it is probably a derivative of *m*-cymene.—A. S.

Salol and acetanilide in a mixture of the two; Determination of —— and of salol and phenacetin in their mixtures. B. Salkover. Amer. J. Pharm., 1916, **88**, 484—485.

The method depends on the fact that whilst salol, acetanilide, and phenacetin are all very soluble in chloroform, only salol is readily soluble in petroleum spirit; 100 c.c. of petroleum spirit dissolves only 0·015 grm. of phenacetin and 0·022 grm. of acetanilide. A weighed quantity of the mixture is shaken in a stoppered flask for 30 minutes with a measured volume of chloroform, an aliquot portion of the solution is then filtered into a weighed flask, the chloroform is evaporated, and the residue dried at 60° C. to constant weight. This gives the amount of salol and acetanilide, or of salol and phenacetin present. Another portion of the sample is then treated similarly with petroleum spirit; the residue obtained in this case is dried at 50° C., and represents the salol, but the weight of the residue must be corrected for the solubility of acetanilide or phenacetin (see above) depending upon which of these substances is present in the mixture. The presence of talc, starch, gum acacia, gum tragacanth, etc., does not interfere with the method.—W. P. S.

Arsenobenzene derivatives; Prevention of the injurious effects observed after the injection of ——. J. Danysz. Comptes rend., 1916, **163**, 535—538.

It has already been shown (this J., 1916, 1034) that the unpleasant symptoms which manifest themselves after from several minutes up to several hours after the injection of arsenobenzene derivatives are due to the formation of a precipitate in the capillaries in presence of many salts, particularly calcium phosphate. This precipitate is usually gradually dissolved owing to the formation or presence of certain bases in the blood derived from amino-acids, so that no eventual serious consequences occur. If a series of injections is made at intervals of 3 to 4 hours, the intolerance manifested after the first injection usually diminishes gradually with each subsequent injection, the amount of precipitate formed diminishing, so that each injection is prophylactic for the successive one. In certain cases, however, the toxic symptoms gradually increase with each successive injection so that serious complications arise, generally terminating fatally after 2 to 5 days, after convulsions and coma. The two forms of intolerance are of the same nature and differ only in degree. It is thus possible to determine the susceptibility of a patient to toxic after-effects of arsenobenzene derivatives by commencing with small injections and noting if the toxic symptoms decrease or increase with the second injection. In the latter case treatment must either be suspended or attempts made to immunise the patient by the injection of very small doses at intervals.—T. C.

Russian belladonna. Chem. and Drug., Dec. 2, 1916.

The cultivation of belladonna in Russia has been carried on with success since 1914. The leaves gave 28·23% of extract, containing 2·11% of hyoscyamine, and the stems 20%, containing 1·62% of the alkaloid. The whole herb yielded 24·37% of extract, with 1·88% of hyoscyamine. The hyoscyamine extracted from the leaves had m.pt. 110°—111° C., and specific rotation +22·12°.

Montserrat bay oil.

An experimental plot in Montserrat was planted with bay trees in 1908, and the gathering of leaves began in 1911, when the yield of leaves was about 14 lb.; it gradually increased to 19 lb. in 1912, 28½ lb. in 1913, and 39 lb. in 1914. There has also been an increase in the yields of oil, which was in 1912 16·7, in 1913 18·3, and in 1914 19·5 oz. per 100 lb. of leaves. There was no definite indication that a particular period of the year is most suitable for harvesting. The average quality of the oil has declined somewhat in recent years, as shown by the following figures:—

	1912.	1913.	1914.
Specific gravity	0·9484	0·9460	0·9342
Phenol content, %	55·5	56·2	5[illegible]·5

No change was observed in the phenol content of a sample of bay oil which had been kept for 2½ years, but there was a slight increase of specific gravity, probably due to the polymerisation of myrcene.

The flame arc in chemical manufacture. Mott and Bedford. *See* IIb.

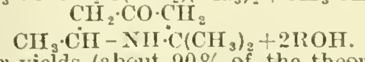
Volatile organic compounds, especially essential oils, formed in the manufacture of sulphite-cellulose. Kertész. *See* V.

Application of the method of constant boiling-point mixtures to the qualitative analysis of mixed organic liquids. Atkins. *See* XXIII.

Patents.

Vinyldiacetoneamine and its salts; Manufacture of ——. A. T. King, F. A. Mason, and S. B. Schryver, London. Eng. Pat. 101,738, Jan. 26, 1916. (Appl. No. 1208 of 1916.)

The interaction of an acetal of the type, $CH_3{\cdot}CH(OR)_2$ with diacetoneamine or its salts, or with acetone saturated with ammonia, produces vinyldiacetoneamine or its salts according to the equation



$$CH_3{\cdot}CO{\cdot}CH_2{\cdot}C(NH_2)(CH_3)_2+CH_3{\cdot}CH(OR)_2 = \begin{array}{c} CH_2{\cdot}CO{\cdot}CH_2 \\ CH_3{\cdot}CH-NH{\cdot}C(CH_3)_2 \end{array} +2ROH.$$

Better yields (about 90% of the theoretical) are obtained in much shorter times than by previously published methods. In the examples given the oxalate is obtained by heating together diacetoneamine acid oxalate and diethyl-acetal in solution in normal butyl alcohol for 3 hrs. or in ethyl alcohol for 7 hrs.—B. V. S.

2-Chloroisopentane; Process of producing ——. O. Graul, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,202,282, Oct. 24, 1916. Date of appl., Mar. 13, 1913.

A mixture of petrol hydrocarbons, chiefly pentane and isopentane, is chlorinated, hydrogen chloride is split off from the separated monochloropentanes by a suitable reagent, and the olefines obtained are treated with hydrogen chloride. The 2-chloroisopentane thus formed is separated, the residue treated with an isomerising agent, and more 2-chloroisopentane produced by the action of hydrogen chloride. The processes of separation, isomerisation, and treatment with hydrogen chloride may be repeated until practically the whole of the olefine is converted into 2-chloroisopentane.—E. W. L.

Tobacco [*; Removing nicotine from* ——]. W. Kraus, Berlin-Charlottenburg, Germany. U.S. Pat. 1,201,831, Oct. 17, 1916. Date of appl., Nov. 30, 1915.

See Eng. Pat. 2394 of 1915; this J., 1915, 852.

Compounds containing carbon and hydrogen; Producing ——. A. Mittasch and C. Schneider, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,201,850, Oct. 17, 1916. Date of appl., Feb. 11, 1914.

See Fr. Pat. 468,427 of 1914; this J., 1914, 984.

Propylene; Production of —— *from acetylene and methane.* A. Heinemann, London. U.S. Pat. 1,202,385, Oct. 24, 1916. Date of appl., Mar. 16, 1915.

See Fr. Pat. 458,397 of 1913; this J., 1913, 1086.

Vaccin culture and the like and the preparation thereof. C. J. H. Nicolle. Tunis. U.S. Pat. 1,202,567, Oct. 24, 1916. Date of appl., Dec. 13, 1913.

See Eng. Pat. 26,535 of 1913; this J., 1914, 666.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Martens' density meter [polarisation photometer]; A modification of ——. E. Goldberg. Ver. deuts. Chemiker, Oct. 1916. Z. angew. Chem., 1916, **29**, 394.

By inserting a small glow lamp under the photometer table in place of the reflecting prism and replacing the opal at the end of the illumination tube by white paper, the usual powerful lamp being of course dispensed with, a much stronger, and even illumination of the negative is obtained and densities as high as 3 can be read without difficulty.—B. V. S.

Halation on photographic plates. E. Goldberg. Ver. deuts. Chemiker, Oct., 1916. Z. angew. Chem., 1916, **29**, 391.

In previous methods of determining tendency to halation the usual plan has been to measure the exposure necessary to produce a definite ring or halo round a point or line of light. The author measures the amount of fog produced in a protected part of the plate, surrounded by exposed parts. To avoid the necessity of giving exact exposures, an exposure is made simultaneously on the same plate through a neutral wedge, and the points in the wedge image corresponding with the other parts of the plate are determined. A table gives a comparison of the efficiency of various anti-halation plates and methods, and shows that a red backing between the sensitive film and the support is the most efficient.—B.V.S.

The flame arc in chemical manufacture. Mott and Bedford. *See* IIb.

Method for determining the strength of paper when wet. Reed. *See* V.

Patents.

Photographic pictures; Process for making —— *by the use of negatives formed on an opaque base.* A. E. L. Hudson, Pontypridd, Glamorgan. Eng. Pat. 14,511, Oct. 14, 1915.

An opaque base such as white paper is used as the support for the sensitive coating for roll films. For plates the negative paper is mounted on stiff cardboard by use of a medium which dissolves in the developer. Printing from negatives taken on this paper is done by reflected light.—B. V. S.

Photographs in natural colours; Production of ——. J. Szczepanik and F. Habrich, Dresden, Germany. Eng. Pat. 20,396, Sept. 9, 1913. Under Int. Conv., Sept. 9, 1912.

See Ger. Pat. 264,207 of 1912; this J., 1913, 1033.

XXII.—EXPLOSIVES; MATCHES.

Trinitrotoluene; Nitration of toluene to ——. I. W. Humphrey. J. Ind. Eng. Chem., 1916, **8**, 998—999.

Experiments on the nitration of mononitrotoluene under varying conditions showed that better yields of pure trinitrotoluene are obtained by nitrating at a somewhat lower temperature than prescribed by Langenscheidt (this J., 1912, 1147) and by using 98% sulphuric acid. A yield of 87·1% of the crude product, and 76% of crystallised trinitrotoluene of m.pt. 80·3° C., was obtained by using for each part of mononitrotoluene 9·5 parts of a mixed acid composed of 82% of sulphuric acid, 16% of nitric acid, and 2% of water, the mixture being heated for 2½ hours at 120°—125° C. (See also Hoffman, this J., 1916, 655.)—A.S.

Nitro-explosives; Mixtures of ——. M. Giua. Gaz. Chim. Ital., 1916, **46**, II., 272—277. (See also this J., 1915, 984.)

α-Trinitrotoluene and picric acid when melted together do not form a chemical compound. The eutectic mixture melts at 55° C., and contains about 34% of picric acid. Camphor, which diminishes the sensitiveness of many explosives, does not form a chemical compound when fused with α-trinitrotoluene, at least up to a concentration of 80% of camphor; the eutectic mixture contains about 43% of camphor and melts at about 52° C.

The differences in the published statements as to the melting point of α-trinitrotoluene (compare Rintoul, this J., 1915, 61) are ascribed to differences in the method of determination, especially in the rate of heating. It is urged that in specifications the exact conditions under which the melting point is to be determined should be stated. It would probably be more satisfactory to use the determination of the solidifying point instead of the melting point as a test of purity.—A. S.

Patents.

Explosives. Perchlorate Safety Explosives, Ltd., and F. G. L. Johnson, London. Eng. Pats. 14,866, Oct. 20, 1915, and 1180, Jan. 31, 1916.

Ammonium perchlorate is incorporated with resin (4 to 8%, or 16%) in a finely divided condition or dissolved in a suitable solvent. Part of the ammonium perchlorate may be replaced by potassium perchlorate, and mineral oil or wax and zinc or aluminium powder may also be introduced in approximately equal proportions.
—C. A. M.

Detonators [*; Damp-proof* ——] *and method of preparing the same.* E. Burkard, Cologne, Germany. Eng. Pat. 16,405, July 9, 1914.

The detonator is charged as usual with a suitable nitro compound and a priming such as mercury fulminate, lead azide, etc., and is then protected from damp or other atmospheric influences by means of an unperforated covering cap, upon which is placed an easily ignitable priming material not readily affected by the atmosphere and in sufficient quantity to perforate the inner cap. If necessary, this small charge is protected by a perforated cap. As an alternative, a small detonator or percussion cap is introduced into the closed cap to start the detonation.—C. A. M.

Nitroglycerin; Process for separating —— from acid mixtures containing the same. A. Hough, Choisy, Quebec, Canada. U.S. Pat. 1,202,065, Oct. 24, 1916. Date of appl., Oct. 26, 1914.

The nitroglycerin and the acid mixture by means of which it was produced are introduced into a tank containing a large excess of acid mixture and water, which becomes saturated with nitroglycerin. The mixture in the tank may consist of sulphuric and nitric acids in the proportion of about 9 : 1, with about twice the volume of water, so as to form a liquid of sp.gr. about 1·3: or it may consist of sulphuric acid with about the same amount of water and about 5% of nitric acid. The separated nitroglycerin is drawn off from the bottom of the tank, whilst part of the acid liquid is periodically withdrawn at a point above the level of the nitroglycerin and replaced by water to compensate for the alteration in the proportions caused by the introduction of further quantities of nitroglycerin and acid.—C. A. M.

Matches; Ignitible compound for ——. G. Jonas, Brussels, Belgium. U.S. Pat. 1,201,191, Oct. 10, 1916. Date of appl., Mar. 25, 1912.

Powdered barium chlorate, with or without a cuprous compound insoluble in water, is incorporated with the other non-adhesive constituents of the paste, and the mass mixed with water and with the adhesive constituents.—C. A. M.

Explosive. T. Hawkins, Balmain, Assignor to Powerite Explosive Co., Ltd., Sydney, N.S.W. U.S. Pat. 1,202,712, Oct. 24, 1916. Date of appl., Nov. 11, 1915.

See Eng. Pat. 16,505 of 1915; this J., 1916, 656.

XXIII.—ANALYSIS.

Soda-lime; A new tube for ——. A new absorbent for carbon dioxide in steel analysis. G. L. Kelley. J. Ind. Eng. Chem., 1916, 8, 1038—1039.

The soda-lime tube is 5 in. high and 1 in. internal diameter, enlarged at the bottom to form a flat base, 1⅛ in. internal diameter. A capillary tube passes through the side, where it is sealed in, at a height of 2 in., and inside the tube is bent at right angles and extends down the centre to within ⅛ in. of the base. The tube is closed at the top by a rubber stopper carrying a piece of capillary tubing. A small amount of absorbent cotton is placed at the bottom of the tube under the end of the capillary tube, then a ¾ in. layer of calcium chloride, and another thin layer of cotton. The tube is nearly filled with soda-lime, which is covered by a third layer of cotton.

A new absorbent for carbon dioxide, termed "soda asbestos" is prepared by mixing a solution of 500 grms. of sodium hydroxide in 500 c.c. of water with 1 kilo. of pulverised sodium hydroxide, and adding shredded asbestos gradually, with stirring, until the mixture appears not to be capable of wetting more asbestos. The mass is heated at 150°—180° C. for 4 hours, with addition of more asbestos from time to time, then cooled and ground till most of it passes a 10-mesh sieve. A quantity of this absorbent sufficient to fill the tube described above, will absorb 8—10 grms. of carbon dioxide.—A. S.

Gas analysis; Reagents for use in ——. V. Relative advantages of use of sodium and potassium hydroxides in the preparation of alkaline pyrogallol. R. P. Anderson. J. Ind. Eng. Chem., 1916, 8, 999—1001. (See also Anderson, this J., 1916, 559; Shipley, 1916, 1003.)

The author summarises the available information as to the relative advantages and disadvantages of sodium and potassium hydroxides for the preparation of the alkaline pyrogallate reagent, and concludes that the potassium reagent is superior in regard to time for complete absorption and ease of manipulation, whilst the sodium reagent is better in regard to cost of materials and specific absorption. The saving of time by using the potassium reagent, however, far outweighs the advantage due to the lower cost of the sodium reagent, even with the present abnormal price of potassium hydroxide. —A. S.

Lead molybdate; Physical character of precipitated —— and its importance in the determination of molybdenum and lead. H. B. Weiser. J. Phys. Chem., 1916, 20, 640—662.

Lead molybdate, precipitated from ammonium molybdate solution by the addition of lead nitrate solution, is more granular and much less bulky than when lead acetate solution is used as the precipitant; the precipitate obtained with lead acetate may, however, be rendered granular by adding a small amount of nitric acid to the ammonium molybdate solution. Freshly precipitated lead molybdate is fairly soluble in nitric acid, and slightly soluble in ammonium acetate and sodium acetate solutions, but the solvent action of the small amount of nitric acid used to obtain the precipitate in a condition suitable for filtration may be counteracted by subsequent neutralisation. In the presence of an excess of ammonium molybdate, lead molybdate forms a colloidal solution; the addition of nitric acid reprecipitates the lead molybdate. To determine molybdenum in a soluble molybdate, a quantity of the salt corresponding to about 0·4 grm. MoO_3, is dissolved in 180 c.c. of water, a few drops of nitric acid are added, and, to the boiling solution, 1% lead nitrate solution is added, drop by drop, until the addition of a further drop causes the milky mixture to become visibly clearer. The boiling is continued for another 3 mins., another drop, or more, of lead nitrate solution is added, followed by ammonia until the mixture is neutral to litmus paper. The precipitate is collected, washed with 2% ammonium nitrate solution, dried above 100° C., and ignited at a dull red heat, and weighed. $PbMoO_4 \times 0{\cdot}2616 = Mo$. This method may be used, conversely, for the determination of lead. —W. P. S.

Viscosity of very viscous substances; Method of measuring the ——. A. L. Feild. U.S. Bureau of Mines, 1916. Techn. Paper 157. Met. and Chem. Eng., 1916, 15, 541.

The method—originally devised for measuring the viscosity of blast-furnace slags at temperatures up to 1600° C., but also applicable to glass, asphalt, pitch, varnishes, clay slips, etc.—is based on the fact that when the outer of two concentric cylinders separated by a liquid is rotated at a constant angular velocity, a torque proportional to the viscosity of the liquid is exerted upon the inner cylinder. This torque is measured accurately by suspending the inner cylinder by means of a calibrated steel or phosphor-bronze suspension, and at the same time weighting and damping the suspended system so that its motion about its axis of rotation obeys laws similar to those governing the motion of a damped d'Arsonval galvanometer. The liquid under observation is subjected to a uniform shear, without deformation; and a single run with the apparatus furnishes data for a temperature-viscosity curve over the desired range. Extreme accuracy in reading is obtained by means of a mirror and galvanometer scale, but for many practical purposes a pointer and graduated arc are sufficiently precise. The results may be expressed in terms of specific viscosity referred to that of water, or in terms of absolute C.G.S units.—W. E. F. P.

Organic liquids; Application of the method of constant boiling-point mixtures to the qualitative analysis of certain mixed ——. W. R. G. Atkins. Analyst, 1916, 41, 334—335.

In the case of certain mixtures it is difficult, if not impossible, to purify a constituent so that its identity may be established by a determination of its boiling point. It is possible, however, to add another liquid with which the unknown liquid will form a mixture of constant boiling point, and so identify a small amount of it in a mixture. A list of such mixtures, their boiling points and compositions, may be found in Young's "Fractional Distillation." For example, to ascertain the composition of a mixture smelling of alcohol, a small quantity of pure benzene was added and the mixture distilled from a flask fitted with a Young's still head. The temperature rose rapidly to the boiling point of the binary mixture of methyl alcohol and benzene (58·35° C.) and halted there for some time. Thus the presence of methyl alcohol was established. There was another slight halt in the temperature rise at 64·8° C. (ethyl alcohol, benzene, water), a slight turbidity appearing in the column, followed by a rise to 68·25° C. (benzene and ethyl alcohol), and then to 78·3° C. (ethyl alcohol). The mixture in question therefore consisted of methyl and ethyl alcohols with a trace of water. Again, the presence of a small amount of methylethyl ketone in a mixture of acetone and benzene was detected by distilling off most of the acetone, adding a small quantity of water, and continuing the distillation. A fraction distilled at about 73° C., the boiling point of the constant-boiling mixture of methylethyl ketone and water. Other instances are given indicating that the method is applicable to a wide range of mixtures.—W. P. S.

Discrimination between the two naphthols by the titanyl sulphate reagent. Denigès. *See* III.

Rapid volumetric determination of indigo. Jones and Spaans. *See* IV.

Method for determining the strength of paper when wet. Reed. *See* V.

Proposed registering apparatus for the determination of the excess of oxygen in the exit gases from lead chambers in the manufacture of sulphuric acid. Pérégrin. *See* VII.

Separation of hydrofluoric and hydrofluosilicic acids. Dinwiddie. *See* VII.

Determination of grog and clay in unburned firebricks. Lessing. *See* VIII.

Thermal conductivity of materials employed in furnace construction. Griffiths. *See* VIII.

Analysis of tin ores. Golick. *See* X.

Viscosity of beeswax and its adulterants. Fabris. *See* XII.

Errors in the determination of acid values of boiled oils and varnishes. Ware and Christman. *See* XIII.

Comparison between agar and gelatin as media for the plate method of counting bacteria. [*Bacteriological examination of soils.*] Conn and Dotterer. *See* XVI.

Method of extraction as affecting the determination of phosphoric acid in soils. Hale and Hartley. *See* XVI.

Determination and distribution of moisture in bread. Wessling. *See* XIXa.

Number of colonies allowable on satisfactory agar plates. [*Bacteriological examination of milk.*] Breed and Dotterer. *See* XIXa.

Polarimetric determination of sugar [*sucrose*] *in condensed milk.* Brooks. *See* XIXa.

Determination of sugar in meat products, particularly extracts. Smith. *See* XIXa.

Determination of strychnine in Nux vomica. Jensen. *See* XX.

General reaction of vegetable or animal alkaloids of phenolic function (morphine and derivatives, eupreine, adrenaline, etc.). Denigès. *See* XX.

Determination of vanillin in vanilla extract. Dox and Plaisance. *See* XX.

Determination of salol and acetanilide and of salol and phenacetin in mixtures. Salkover. *See* XX.

A modification of Martens' density meter [*polarisation photometer*]. Goldberg. *See* XXI.

Patents.

Depth of colour of various substances, liquid or solid; Apparatus for measuring ——. G. G. Scurfield, Sunderland. Eng. Pat. 16,876, Dec. 1, 1915.

A tintometer is used in which the observation tubes dip into the liquids which are being compared. It consists of a stand carrying an adjustable mirror reflecting light into two observation tubes carried by a block fixed to the upper part of a graduated telescopic upright pillar. One observation tube dips into a larger tube with glass bottom resting on a glass plate supported by the stand just above the mirror. This outer tube contains one of the liquids to be compared; the depth of liquid used is adjusted by movement of the upper part of the upright pillar and is read off on the scale in any suitable units. The other liquid is contained in a smaller glass-bottomed tube fixed to the other observation tube and is of fixed depth or adjustable only between narrow limits. The instrument may be monocular in which case the observation tubes converge upwards, or binocular when they are parallel. The calibration of the scale will depend on the particular use for which the instrument is intended. In one example the scale shows the amount of caramel to be added to a given quantity of the tested liquid to produce the required tint.—B. V. S.

Mechanism for determining the viscosity of paper stock. U.S. Pat. 1,201,402. *See* V.

Trade Report.

Contraband of War.

A Royal Proclamation, dated November 23rd, 1916, made the following additions to, and amendments in, the contraband list :—

The following articles are now declared absolute contraband :—Silk in all forms and the manufactures thereof; silk cocoons. Artificial silk and the manufactures thereof. Quillaia bark. Zirconium, cerium, thorium, and all alloys and compounds thereof. Zirconia and monazite sand.

The following alteration is made in the contraband order of October 14th, 1915 :—

For item 4, "emery, corundum, natural and artificial (alundum) and carborundum in all forms," there shall be substituted "emery, corundum, carborundum, and all other abrasive materials, whether natural or artificial, and the manufactures thereof."

Glue, gelatin, and substances used in the manufacture thereof are to be treated as conditional contraband.

New cyanide works in Glasgow. Pharm. J., Nov. 25, 1916.

It is announced that the Cassel Cyanide Co. is erecting large works in Glasgow for the production of cyanides on an extended scale. The company has fixed a contract, extending over five years, to supply the whole of the cyanide requirements of the gold mines of South Africa.

Journal of the Society of Chemical Industry.

No. 24, Vol. XXXV. DECEMBER 30, 1916. No. 24, Vol. XXXV.

Official Notices.

CROSS AND BEVAN ESSAY PRIZE OF £20 AND LATHAM RESEARCH GRANT OF £300.

The Council have pleasure in announcing that a gift of £20 has been made by Messrs. Cross and Bevan as a prize for an essay on "The Interconnection of Economic Botany and Chemical Industry."

A further sum of £300 has also been presented by their friend, Mr. T. P. Latham, of Weybridge, to be paid in three annual instalments to such one of the competing essayists as may be judged to be of conspicuous ability, as a grant towards his expenses, on the condition that he apply himself, during three years, to research of approved character on a subject cognate with that discussed in his essay.

The immediate object of the donors is to promote the study of economic botany with special reference to its bearing on chemical industry, giving the widest possible interpretation of the relationship.

They desire, under the auspices of the Society, to assist in forming public opinion in this direction and to discover and further the career of a student of promise who may wish to devote himself to work in such a field.

The Essay Prize will be open to all members of the Society who are British subjects. The Research Grant will be limited to competitors under 25 years of age at the time of sending in the essay.

Essays are to be submitted to the Council of the Society not later than the close of the year 1917. The awards will be made promptly. Neither the prize nor the first grant will be given unless the essayist or essayists shall be deemed to have real merit. The Latham Research Student will be required to submit a report at the close of each year, to satisfy the Council that he has made and is likely to make proper use of the grant.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY.

The first volume of the Reports of the Progress of Applied Chemistry is now in active preparation, and will, it is hoped, be published shortly. It will cover recent progress to the end of June, 1916. The second volume will deal with the period up to the end of 1917, and subsequently it is proposed to issue the Reports annually.

The Reports will present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. It has not been found practicable to treat every section of the Journal classification. Agricultural chemistry, the chemistry of foods, and analysis are fully dealt with in the admirable series of Reports issued annually by the Chemical Society, and for the present there will be no sections on general plant and explosives.

The following is a list of the subjects which will be dealt with, together with the names of the experts who are contributing to this volume:—

Fuel—J. W. Cobb.

Gas, destructive distillation, tar products—E. V. Evans.

Mineral oils—A. W. Eastlake.

Colouring matters and dyes—G. T. Morgan.

Fibres, paper, dyeing, printing—Julius Huebner.

Acids, alkalis, salts, etc.—H. A. Auden.

Glass, ceramics, cement, etc.—J. A. Audley.

Metals, metallurgy—W. R. E. Hodgkinson.

Electro-chemistry—J. T. Barker.

Fats, oils, waxes—G. H. Warburton.

Paints, pigments, varnishes, resins—R. S. Morrell.

Indiarubber—H. P. Stevens.

Leather, glue, etc.—J. T. Wood.

Sugar, starches—J. G. Macintosh.

Fermentation—A. R. Ling.

Sanitation, water purification—F. R. O'Shaughnessy

Fine chemicals, medicinal substances, essential oils—F. L. Pyman.

Photographic materials and processes—B. V. Storr.

The price of issue will be, to members, 2s. 6d. (plus 6d. postage), and non-members, 5s. (plus 6d. postage). As the issue is to be a limited one, those desirous of securing copies are requested to fill in the order form attached to the cover of the Journal, and return it to the Secretary at an early date.

Editorial.

THE CHEMIST AND THE ENGINEER.

The relationship between the chemist and the engineer in our chemical industries has for a long time been a subject of much discussion. Our President, in his address to the London Section (see this J., 1916, 1185), has expressed it as his conviction that "the engineer should be taught sufficient chemistry to be able to appreciate the chemist's point of view, and the chemist should know enough of engineering to realise that with the engineer thus trained he can leave the practical application of the processes he devises in the laboratory and supervise in the chemical works." It is generally agreed that cordial co-operation between the chemist and the engineer, each having some knowledge of and sympathy with the sister science, forms the best basis on which to found a successful chemical industry. In the discussion which followed this address the claims of the "chemical engineer" were put forward by several speakers—but what is a chemical engineer? Is he more than the engineer who knows sufficient chemistry to appreciate the chemist's point of view? It has been advocated in some quarters that the ideal chemical engineer would be one who had been thoroughly trained both in chemistry and in engineering: but, as has been frequently pointed out, the student has not the time nor the means to devote to this extended training, and even supposing he had, there are very few who possess the type of mind which is capable of acquiring a thorough grasp of the two sciences. Such a training would, in all probability, result in our industries being provided with a few men who had the makings of the best type of chemical engineer, and a large number of men insufficiently grounded in either of the subjects—a type which must be avoided at all costs.

The only possible form of training for the man destined to be come a chemical engineer would seem to be thorough instruction in engineering, together with sufficient grounding in chemistry to bring him into sympathy with the problems which will face him in the chemical works. We must look to our engineering colleges to produce this type of man in the numbers which present-day chemical industry demands—numbers which must increase largely in the near future if the hoped-for development of these industries is to take place. A man trained on these lines will be fitted to pass to the works where he will receive his real training in the science of chemical engineering—the experience which can only come from daily contact in the works with the innumerable problems which arise in the translation of chemical reactions from the laboratory to the factory, and in the solution of these problems it is essential that he should collaborate with the chemist, who has devised the process or is controlling its progress.

Reverting to the question of the relations between the chemist and the engineer, it is interesting to note that in an address to the Derby Society of Engineers on November 20th, Mr. L. Archbutt instanced metallurgical operations and processes involving destructive distillation as those which the chemist was best fitted to take charge of. Surely these are just the processes in which co-operation between the chemist and the engineer is most needed, for the engineering problems involved are just as great as the chemical problems. The danger of leaving the control of such processes in the hands of either the chemist or the engineer has been clearly brought out on more than one occasion and is so obvious as to require no further emphasis here. In some industries the work of the chemist may be of more importance than that of the engineer, whilst in others the chemical problems are of a subordinate nature, but it must now be recognised as an established fact that there is no branch of chemical industry in which collaboration and co-operation between the chemist and the engineer is not necessary.

AN APPEAL TO MEMBERS.

The extraordinary conditions which have prevailed during the last two years have resulted in the awakening of an increased interest in and appreciation for the value of science, and particularly of chemistry, in the industrial life of the nation. The public generally is beginning to realise that chemical industry, in its broadest sense, is not confined to a few evil-smelling factories, but that it is the life-blood of our very existence. The work of the Society of Chemical Industry and the value of its Journal have been brought to the notice of many who, in former days, were unaware even that such a Society existed; there are still very many, however, who have no knowledge of its labours, but who would undoubtedly derive value from membership of the Society if its advantages were put before them. The Society, too, needs the support of all those interested in chemistry as applied to arts and manufactures. Every member is therefore requested to use his endeavours to persuade all those whom membership can benefit, to join the Society, and the Secretary will be glad to send application forms to any member, or to any prospective member, when requested to do so.

Liverpool Section.

Meeting held on Friday, November 3rd, 1916.

MR. JOHN GRAY IN THE CHAIR.

THE USE OF PEAT IN GAS-PRODUCING PLANTS.

BY E. C. C. BALY.

The problem of the economic utilisation of peat has many times been discussed in this country, but as far as one is able to judge from results little or no advance has been made beyond the somewhat obvious notion of utilising peat in some way as a fuel. In general all attempts on such lines may be said at the outset entirely to have failed, and indeed considerable sums of money have been lost in fruitless endeavours to find a satisfactory solution on those lines. The essential difficulty of the utilisation of peat is to be found in its enormous bulk in relation to its thermal efficiency. Add to that the very high water content of freshly cut peat and the trouble and peculiar difficulties involved in the effective drying of the torves, and then I feel that the failures which have been reported are such as any modern man of science would fully have expected. As a result of these failures and moreover of the adverse reports of various important committees of investigation the reputation of peat bogs is under a serious cloud, and there are few men who would consider themselves blessed by fortune were they given the freehold of a very large tract of the very best bog.

In spite of all that has been said the problem is a fascinating one. Every one is fully aware of the vast tracts of peat bog in these islands, and the successful utilisation of the hundreds of millions of tons of peat very obviously would add most considerably to the economic resources of the country.

I may say categorically that the problem has been solved and the object of this paper is to illustrate how it has been solved. In brief the solution lies in the utilisation of the peat in gas-producer plant, and its success lies in the fact that all difficulties involved in the drying of the torves are eliminated.

Before dealing with large peat producer plants in which further economy is obtained by the recovery and utilisation of by-products, I will briefly describe the plant at Messrs. Hamilton Robb's works at Portadown in Ireland, which has been in use for five years. This plant is as simple as possible in design and no effort is made to recover any of the by-products. Inasmuch as it is found to be economical under these conditions it is worth a few words of description. It is a suction plant, that is to say the air is drawn through the producers by means of a fan.

There are two producers, each with a capacity of 200 h.-p., and there are two Crossley gas engines of 120 h.-p. and one of 150 h.-p. The gas drawn from the producer before being used must be freed from tar and dust. This is effected by passing it through scrubbers down which copious streams of water are passed. These wash waters from the scrubbers pass through a labyrinth where the insoluble tar collects and is removed. All the soluble products are however lost. There is a small gasometer installed in order to minimise the periodic action of the gas engines. At present nothing is done with the tar.

The peat is obtained from a bog about 12 miles away where it is air-dried. The torves are brought down by barge and after being elevated by a simple device are fed direct into the top of the producers.

For the working cost of the plant I am indebted to a paper by G. Fletcher (Journ. Department of Agriculture, Ireland, 1915, **16**, 33). The figures given are as follows :—

Cost of running per week on coal.

	£	s.	d.
8·5 tons anthracite at 35s.	14	17	6
19 tons steam coal at 17s.	16	3	0
	31	0	6

Cost of running per week on peat.

	£	s.	d.
50 tons peat at 6s.	15	0	0
Extra labour		15	0
Saving	15	5	6
	31	0	6

These figures however were obtained in 1912.

In view of the fact that all the valuable by-products are not utilised it must be confessed that the above return of cost is eminently satisfactory.

Now the by-products from peat producer gas are peculiarly valuable, especially when Irish peat is used, owing to the relatively high percentage of nitrogen in the peat. As is well known the institution of the recovery of the nitrogen as ammonia from coal gasified in producers is due to Ludwig Mond, who substituted for the simple suction plant producers fed with a blast of steam and air, the mixture of steam and air being previously heated. This naturally modifies the composition of the producer gas obtained owing to the fact that the reaction temperature is lower from the presence of the steam. This results in a greater predominance of the reaction $C+2H_2O=CO_2+2H_2$ over the reaction $C+H_2O=CO+H_2$. An average sample of the gas from a coal is CO 11 %, H_2 24 %, CH_4 3 %, CO_2 17 %, N_2 45 %. It is possible in a Mond plant with a ton of coal containing 1·2—1·6% of nitrogen to obtain over 100 lb. of ammonium sulphate and 150,000 cb. ft. of gas with a calorific value of 150 B.T.U. per cub. ft.

Now, in the Mond gas plant when coal is used the producer is fed with a blast of air saturated with steam at 85°, which has previously been heated to a temperature of 250°. This method requires some slight modification when peat containing moisture is used, but this modification is simple enough. The problem has been investigated by Frank and Caro, and by others, and the broad results of their work may be found in various papers in the Zeitschrift für angewandte Chemie, and other journals (Z. angew. Chem., 1907, **20**, 1592; 1910, **23**, 1844; Chem.-Zeit., 1911, **35**, 207, 505, 515). The literature on the subject is however somewhat clouded, partly by there having been a long controversy as to whether any ammonia is formed synthetically when moist nitrogen is passed over glowing peat, and also by a very highly suggestive reticence on the part of the authors as to actual details. It is however quite clear that peat producer plants have been working and are still being worked in Germany and elsewhere with extraordinary success.

It is obvious I think that for successful economic work it is necessary that the plant be fed with peat which has not been specially dried. The cost of introducing a drying process would be prohibitive owing to the great bulk of the peat to be handled. This however is entirely unnecessary since it has been proved conclusively that the ordinary air-drying such as is obtained by stacking the torves in the usual way is amply sufficient. It is perfectly possible to utilise peat containing as much as 70% of moisture in a Mond plant, and this is fundamentally important since it allows peat which has been air-dried in the winter months to be used without any further drying.

It has in fact been found that the nitrogen is recovered as ammonia more easily with a wet peat than with a dried peat. The process is however slower with a wet peat than with a dried peat. If a dried peat is fed into the producer the following processes take place. In the upper layers the peat is completely dried and this takes place rapidly enough. As the peat sinks in the producer it reaches the second or combustion zone where it is decomposed in presence of the steam and air with formation of ammonia, tar, etc. It then reaches the coking zone of much higher temperature, where the combustion is completed, leaving only the ash as a white powder. If on the other hand a wet peat is used the time taken in the drying process in the upper layers in the producer is longer, with the result that the zone of combustion is reduced in thickness. The peat passes too rapidly through this zone and does not give up all its nitrogen. It enters the coking zone and then forms a nitrogen-containing coke in which the nitrogen is fixed. Moreover in addition to a small yield of ammonia a poor quality of gas is obtained owing to the smallness of the second or combustion zone.

The difficulty is surmounted by increasing the temperature of the drying zone from 100—120° C. (which it shows normally) to 250° C. This in general is sufficient to set free the whole of the nitrogen as ammonia by the action of the steam on the peat. This temperature rise is obtained by preheating the air-steam blast to 450° C. instead of 250° as is sufficient in a coal-fed producer. This gives an intensive combustion of the coke, an increase in the size and temperature of the combustion zone, together with an almost quantitative recovery of the nitrogen as ammonia, an increase in the thermal efficiency of the gas and also a good quality of tar. The amount of steam used should not exceed half the weight of the peat gasified and its partial pressure should fall below 250 mm.

There is no need to enter into the details of the process of the removal of the dust, tar, and ammonia from the gas. These are more or less standardised and may be found in any work on producer gas manufacture, the processes being very similar whether coal or peat is being used. Attention may however be drawn to one point, namely, the use of a certain quantity of the gas produced in order to heat the preheaters used for the steam-air blast. This is not done in the case of coal-fed producers.

The following figures are typical of the results obtained by the above process with peat containing 50—60 % of water. One ton of theoretically dried peat gives altogether from 88,000 to 92,000 cb. ft. of gas. Of this 39,000 cb. ft. is used in the preheaters, leaving 49,000 to 53,000 cb. ft. in excess. From this excess are developed 700—750 h.-p. hours. Further, from 70—85 % of the nitrogen is obtained as ammonia and the yield of tar is from 3—6 %.

As regards the cost the only published figure I have found, which was given at the inception of the process in 1907, is 1/17th of a penny per h.-p. hour (*loc. cit.*). At a later date (1911) Caro gives some figures which illustrate the size of one of the German works. In the Schweger bog works in December, 1911, the output of electrical energy was 430,000 kilowatt hours, which represents a plant capable of producing 6000 kilowatts. Each ton of theroetically dried peat in these works gave 1000 h.-p. hours and 90 lb. of ammonium sulphate. It is further stated that the cost of working was nothing as all expenses were paid out of the by-products. Peat containing up to 70 % of water was used.

When one comes to consider the enormous deposits of peat in these islands I trust I have said sufficient to justify my statement that the time has now come entirely to revise our ideas as to the value of peat.

I have said nothing as regards the peat tar. There is no doubt that the Germans have been in the habit of distilling this tar and recovering valuable substances therefrom. Caro states that the tar from the Schweger works is distilled, and yields 15 % of paraffin wax and 50 % of neutral oils. This statement is characteristically vague, but fortunately we have the results obtained by G. T. Morgan in the distillation of tar from the plant at the Portadown works referred to above (Econom. Proc. Royal Dublin Society, 1915, 2, 161 ; see this J., 1916, 247). Briefly the results obtained by Morgan were as follows. The moist tar contains about 30 % of water and yielded about 50 % of volatile oils, and a residue of non-volatile bituminous pitch. The volatile oils consist of acidic oils, neutral oils, and waxes. The first are obtained by washing the volatile oils with sodium hydroxide and reprecipitation by the addition of mineral acid to the alkaline extract. The acidic oils consist of polyhydric phenols of very high germicidal power (Morgan and Scharff, Eng. Pat. 19,253, 1911 ; this J., 1915, 448). The neutral oils yield on distillation fractions boiling above 250° which deposit on cooling considerable quantities of an almost colourless wax, with a melting point of 35°—40° C.

In addition to the tar there are the soluble and volatile organic compounds which include methyl alcohol and acetic acid, as well as pyridine bases.

Finally there is the ash which varies considerably with the peat and lies between 5 and 15 %. Analyses of various samples of peat ash have shown that they contain aluminium, calcium, magnesium, and iron as carbonate, sulphate, silicate, and phosphate. The alkali metals are also present, especially potassium. These facts at once suggest the use of the ash as a dressing for land. As Morgan points out this will partake of the restoration to the soil of those very mineral constituents absorbed therefrom by the peat vegetation.

Discussion.

The Chairman recalled the fact that van Grooven was the first to make known the production of ammonia from peat by the action of steam ; the yield of ammonia from peat was very similar to that obtained in work with which he had been connected many years ago, namely, on Scotch shale. The cost of production of power from peat given by Professor Baly, 1/17th of a penny per horse-power hour, was attractively low. As regards the drying process, he knew that a good deal of money had been sunk in it, and he understood that in Scotland experimental plant had been erected and was working. He would like to know if it was likely to lead to success. The production of paraffin wax from peat had been tried some time ago but had come to nothing. The quantity of peat available in Great Britain was enormous, and if there was any possibility of getting supplies and working them in the manner that had been outlined those peat bogs would be of immense value to-day.

Mr. A. T. Smith said that it was very gratifying to know that a problem which had presented many difficulties was on the point of being solved. The great difficulty was to get the peat in such a condition that water would leave it. The ordinary method of air-drying was not satisfactory.

Dr. E. F. Armstrong said that if peat were used as fuel the extra cost of handling it would have to be met by using the by-products. He thought however the figures Professor Baly had given needed drastic criticism. The cost of the producing plant was four times as large as that of a Lancashire boiler, even if peat could be got at 6s. a ton from the bog to the works. He understood that the figures had been given to Professor Baly by others, but he could not help feeling that advocates of this sort did their cause a great deal of harm by putting forward doubtful figures.

Mr. Polack understood that a large plant had been erected in the neighbourhood of Dumfries, but that it had been closed down since the war. It had a producer of 40 tons' capacity but it had to be started by coal, and he believed that during the two years previous to the war no trial run had lasted long enough to get rid of the coal that had been used for starting, so that no fair judgment could be formed of it.

Mr. Mansbridge said that the question of having the factories close to the sources of the peat was a great factor in the economical use of peat. In those neighbourhoods labour also was cheap. In the West Midlands they could sell all the peat that they could cut in the summer for 20s. a ton, but in the north of England there was not enough peat. Unless the by-products could be made to pay the cost of everything, the use of peat would not be successful.

Mr. Carruthers Thompson thought that even in districts where peat was plentiful, and where it would be necessary to send 25 miles for coal, it would still be cheaper to cart coal than use the peat even although it was hard and could easily be dried. He thought the peat used at Portadown was more the peat from the surface ground. Hard solid peat was not obtained at a depth of less than 30 feet. At Dumfries the peat had to be brought a distance of 3½ miles, but in many places where there was plenty of good peat there were no industries, and to get the necessary materials there would entail so great a cost that it would be impossible to compete with coal even at its present price.

Professor Cadman said that valuable data had been issued and valuable work carried out on that particular problem by the Research Department of the Canadian Government. The problem would become very much more important when the distribution of power in this country had been reorganised. When the reorganisation in distribution of power took place the manufacture of power on a large scale in peat centres would surely follow. Small coal might be left in the mines in this country but it would be used when power was properly distributed.

Professor Baly said that in England no one had really considered peat for producer plant. The figures he had quoted were for works erected directly on the bog, except those at Portadown. On the bog he saw there was no difficulty in cutting down 30 feet to where the peat was black instead of brown as on top. One point he had forgotten to mention was the relative amount of gas used in the Mond plant for heating the superheater, which was put in between the preheater and the producer itself. The difference between the works he had seen and a certain works in Italy was that the Irish peat had an average water content of 50 % and the Italian peat had only 15 %, so that in Ireland double the weight of peat had to be used. Each ton of theoretically dried peat gave 88,000 to 92,000 cubic feet of gas. If 39,000 feet of that were used in the superheater it should leave 49,000 to 53,000 to produce 1000 h.-p. per hour from two tons of wet peat. In the case of coal, where good coal was used in a good producer 150,000 cubic feet of gas was obtained, equalling 3000 h.p., weight for weight, therefore 1 ton of coal is equivalent to 6 tons of peat with 50 % of water.

Everyone wanted to see the erection of works on the peat bogs. When the question of the redistribution of power came to be considered these proposals would be of serious moment. One of the secrets of Germany's success in this war had been the fact that they had made use of their peat bogs and the by-products. Professor Baly said that he could not take any responsibility for the figures he had given: they had been published in an Irish journal. He had heard that the Dumfries works had failed from many other causes than the failure of peat. It was not necessary to pay anything for water in the Hamilton Robb works. If there was no river near a works the question of water was of importance. The total amount of water however used in the Mond plant was really very small, as it was all conserved in one way or another. The figures for the cost of power had been calculated for a works actually on a bog.

Manchester Section.

Meeting held at the Grand Hotel, Manchester, on Friday, November 3rd, 1916.

MR. J. H. HOSEASON IN THE CHAIR.

THE TRANSPORT OF CORROSIVE LIQUIDS BY WATER.

BY H. N. MORRIS.

The transport of sulphuric acid and other corrosive chemicals has always been a difficult problem for the chemical manufacturer. No chemist would say that the problem of transport on land was satisfactorily settled. The glass carboy is so fragile, that breakages by rail and by road are a source of continual trouble not only to the manufacturer, and to the road carrier, whose lorries or motor vehicles are damaged, but also to the railway companies whose rolling stock is injured.

It is true that railway and road tanks are used for the conveyance of strong sulphuric acid where there are conveniences for loading directly from storage tanks at makers' works, and for discharging into storage tanks at the consumers' works. This method of delivery is, however, unsuitable for users or manufacturers of sulphuric acid who have no railway sidings, and for those users who require the acid for electrical or other purposes where a pure acid is necessary, nor can it be used for the transport of nitric or hydrochloric acid. Tanks have also been used for transport by canal, and tank boats of special design, provided with partitions arranged to prevent the dangerous shifting of the centre of gravity by the oscillation of the acid, have been constructed, and one patent for an acid tank for canal transport is referred to by Lunge in the last edition of his work on "Sulphuric Acid and Alkali," Vol. I., Part 3. But so far as I have been able to ascertain, these tank boats are not used to any large extent in this country, nor are they suitable for sea transport, with which I propose to deal here.

Riveted or welded steel and iron drums have been used in rapidly increasing numbers since the beginning of the war, especially for the carriage of oleum, the crystalline nature of which makes carboys unsuitable; but strict precautions are necessary if unpleasant results are to be avoided.

The glass carboy remains the safest and the best vehicle for conveyance of ordinary sulphuric acid and practically the only one for the conveyance of nitric and hydrochloric acids. So serious a view did the railway companies take of the risks of carrying these corrosive liquids by rail, that early in 1911 they asked the interested chemical manufacturers of the country to meet their chemists and traffic managers to discuss means of reducing the risks and damage (see Chemical Trade Journal, 1911, p. 508). As a result of these conferences a new set of regulations dealing with the traffic was framed. A carboy was defined as a globular bottle of not more than 12 gallons capacity made of glass not less than ⅛ in. thick. Methods of packing and loading sulphuric, nitric, and hydrochloric acids were given, and no doubt some improvement has resulted, but not what was anticipated by the railway companies.

If the troubles of the railway companies are so great, how much greater must be the difficulties of transport of these corrosive liquids by sea, when leakages of the packages or so-called explosions caused by pressure generated in the drums or cases means damage not only to other cargo, but to the ship itself together with the passengers and crew. Some companies will not carry in any form of package, and the business of necessity goes to Germany or some other country from which the steamship companies will carry. In respect of this class of traffic no uniform rules and regulations have been adopted by the steamship companies. Some companies require that sulphuric, nitric, and hydrochloric acids must be carried in small glass bottles (Winchesters) with ground glass stoppers, and that these must be packed in wooden cases in sand or whiting in sufficient quantity to absorb the acid which would leak out if a breakage occurred. Others require that the acids should be in earthenware jars, each of about 2 gallons capacity, provided with screw stoppers and indiarubber washers, and that one, two, three, or four of these should be packed in a wooden case with whiting. Both these methods are very costly, the acid contents in some cases representing only a small fraction of the value of the packages. Other companies will only carry sulphuric acid in small wooden cases lined with lead and each containing about 200 lb. of concentrated acid. If the scrap lead is of value to the consumer this method may be economical, but not otherwise, and lead is of course unsuitable for the conveyance of any other acid than sulphuric.

Last but not least in importance, some companies carry sulphuric acid in wrought iron or steel barrels. It is in this kind of package that large quantities of sulphuric acid have been brought over to this country from America during the last two years with results that have brought the matter before the general public.

In September, 1915, a question was asked in the House of Commons by Mr. Bryce as to whether quantities of sulphuric acid essential to the production of high explosives had been purchased in America, and whether owing to defective methods of shipment there had been loss and delay. In reply it was stated that shipments had been made from America; that in the case of the earlier ships a certain amount of loss was due to the kind of iron drums used; that the best type of drum available was used when the earlier shipments were made, and that the defects in the drums used had been remedied.

It is evident that great care must be exercised in the use of such iron packages. Only strong sulphuric acid or oleum can be carried in them, and even then slight impurities in the acid are liable to cause internal corrosion which on a long voyage would cause evolution of gas, and internal pressure or leakage. It is true that with precautions as to the purity of the acid and the strength and quality of metal used for the drums, and careful examination of each drum and each rivet, the risk of transport in iron or steel drums may be reduced. But it is necessary to provide against accidents. A weak rivet may not be detected before use. The shifting of the ship's cargo may cause one drum to leak, and a leakage of acid from one drum on to the outside of another, if not immediately detected, would cause corrosion and consequent leakage of other drums.

If the drums are used for one journey only, and are sufficiently strong, and flawless, the risks are reduced to a minimum. But how are the shipping companies to satisfy themselves that this is so? They cannot send a representative to test each drum before the acid is filled into it; and the outside appearance may be misleading, whatever kind of guarantee they may have from the manufacturer or consignor.

This is a question that affects the other cargo carried in the ship, and even the ship itself and the safety of the crew if the consignments of acid are large. Experiences vary considerably in this respect. Whilst I could give some cases in which acid has been shipped in iron drums several thousands of miles, and continually over a number of years with few and insignificant leakages, it could hardly be said that this was a general experience. I could give one case for example in which shipments had been continued for 5 years without accident. At the end of the period very severe damage was caused owing to what was called an explosion of a drum which caused the steamship company to decline further traffic of the same kind. My own experience since the commencement of the war has been most unsatisfactory. It has been far more difficult to obtain drums of suitable quality of iron or steel, and of a satisfactory make; and in the case of supplying acid from one Eastern port to another in large quantities, difficulties have arisen not only on account of the quality of the drums it has been possible to purchase, but also because no steamship company would carry except at impossible rates, and deliveries have had to be made in unusually large consignments, the acid remaining stored in the drums in some cases for several months. The only conclusion one can arrive at is that iron or steel drums are not safe for the transport of sulphuric acid over long distances by sea. The question is, can any better method be devised—any method by which the risks are eliminated or reduced to a minimum and the cost of transport made more reasonable?

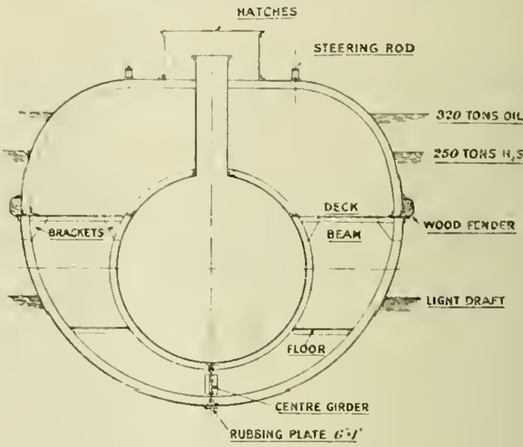
As an attempt to do this, I have to bring forward a proposal for the transport of corrosive liquids by means of a sub-aqueous tank,[*] to be towed by ordinary liners or by special tug, and which I think will prove to be not only safe to the steamship companies, but for large quantities of liquids and over long distances, cheaper than any of the methods above referred to.

It is about 10 years since the Standard Oil Company first tried an experiment of towing one of the oil barges from the United States to this country. Since then much progress has been made in this method of transport of oil. Tank steamers carrying their usual cargo of petroleum products have regularly towed barges or tanks without any serious disadvantages. Not only have oil barges been towed in this way, but almost wholly-submerged tanks which, of course, are towed with less strain on the towing cable, and at a greater speed. This method of oil transport was described in detail in a paper on "Oil Storage" by Herbert Barringer at a recent meeting of the Institution of Petroleum Technologists.[†]

There would seem to be no difficulty in carrying out the towing of corrosive liquids in tanks, if suitable tanks and towing arrangements are used.

The vessel that I will describe now in detail, and which I will call the sub-aqueous acid tank, consists of two shells or tanks one within the other, the inner one being eccentric with the outer. The inner tank which carries the corrosive liquid is suitably stayed or braced to the outer one so that it remains in a fixed position, and the space between the two tanks or shells is capable of being sealed and may be wholly or partly filled with water or air to determine the flotation. This tank will float in water and can be submerged wholly or partially as desired by regulating the water in the outer casing. The form of outer casing may be constructed in accordance with any known practice for efficient flotation, and offering least resistance to traction. From the inner shell or tank and projecting through the outer shell in a vertical direction is a pipe or pipes or other form of opening, through which the corrosive liquid to be conveyed is charged or discharged to or from the inner casing, and of course this is provided with a sealed cover. These are the essential features of the sub-aqueous acid tank.

The particular type or design of tank which I have to describe is capable of conveying 250-ton lots of concentrated sulphuric acid. It is, as will be seen from the drawings, 119 ft. 6 in. long by 16 ft. beam, and 13 ft. 6 in. depth; having an internal shell to contain the sulphuric acid, 100 ft. long by 8 ft. diameter. The vessel is transversely divided by four oil-tight bulk-heads at frames 4, 24, 44, and 64. The bulk-heads divide the inner shell into three compartments each 33 ft. 4 in. long and 8 ft. diameter. The forward compartment is shown on the drawing between bulk-heads 44 and 64. The whole of the inner shell is divided into three compartments, and for the transport of ordinary sulphuric acid is lined with lead. This has the effect of keeping the acid free from iron, which is most important for some industries, and makes the generation of gas from the action of sulphuric acid on iron impossible. As the action of sulphuric acid on lead is very slight, there would be only a slight depreciation on the tank.



Transverse Section.

Each of the inner compartments is provided with oil-tight hatches to the inner and outer shells, and is filled or emptied by means of air pressure or hand pumps through pipe lines passing through the hatches. Water-tight air valves are fitted to each compartment to allow for expansion. No steering would be necessary on the open sea where there is little traffic, but if desired the arrangement shown on the drawing can be used. It is a combined towing and steering arrangement. The tow rope is attached to the towing iron, which works a cross-head or quadrant through shock-absorber springs. From this quadrant there is a connection through steering rods and chains to the rudder quadrant. If the sub-aqueous tank goes to one side the rudder is pulled to the other side, and in this way the tank follows the towing vessel.

Barringer in his description of a sub-aqueous oil tank stated "that no means were provided

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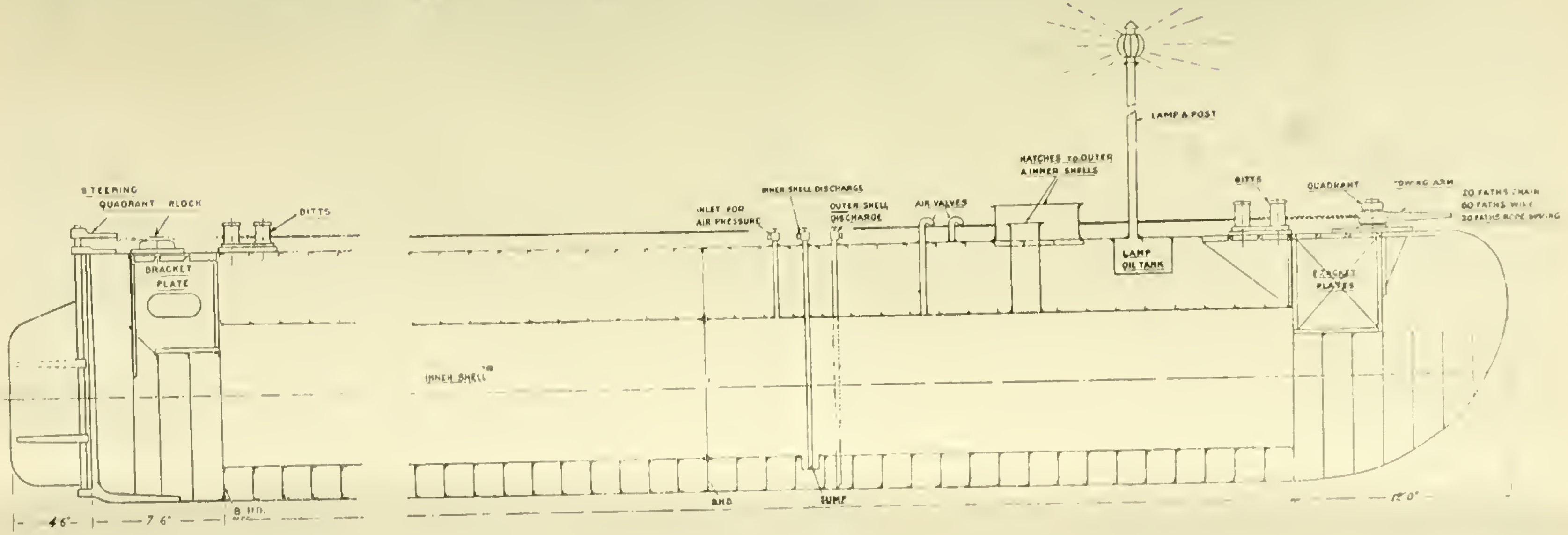
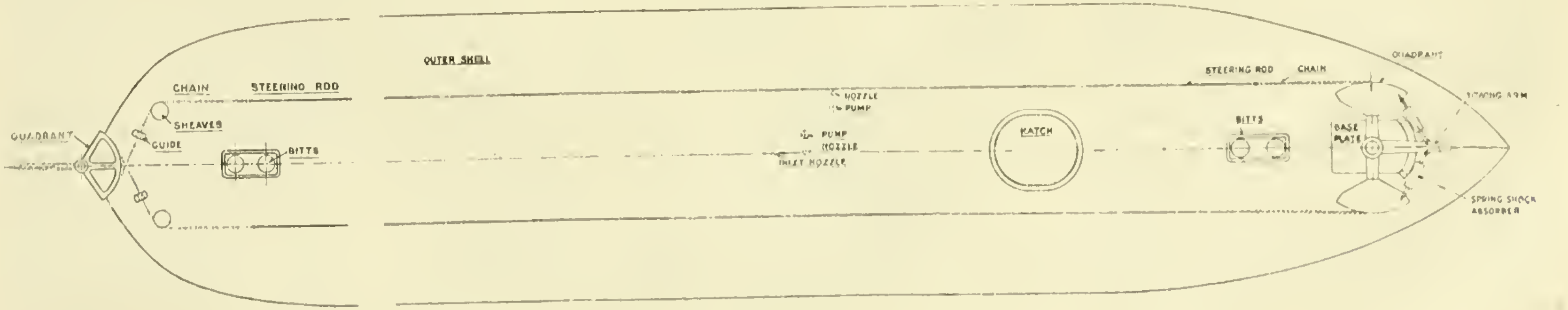
[*] See Eng. Pat. 8370 of 1916.

[†] J. Inst. Petrol. Tech., 1916, **2**, 122—158.

Suggested Arrangement of Barge to Carry 250 Tons (Liquid of 1·84 S.G.). Longitudinal Section.



Plan.



for steering her at all. She was towed with a bridle and the resistance forward to any lateral movement was very slight. A special towing winch was provided which automatically paid out and picked up the tow line according to the strain on it." At the same time he said there were difficulties connected with its navigation in enclosed waters. There, the tow line was brought up much shorter, and when she came into really narrow waters she was taken in charge by a tug. In the case of the much smaller acid tank I am describing, a rudder controlled by a tiller for use in a river or canal ought to be sufficient.

The only danger which I can see in sub-aqueous transport by means of towing is one to which Barringer referred in connection with oil transport. It is the possibility of the breakage of the tow-line and the loss of the tank that is being towed. In such an event the tank might float about, and be a danger to shipping generally. But this is provided against by the use of a light which is kept burning throughout the voyage. It is shown on the drawing. A tank is provided, charged with sufficient oil to keep the light burning for the whole time of the voyage, so that it would be immediately noticed if anything happened to the tow line.

A wooden fender belting, which is shown on the drawing, takes the wear and tear alongside of wharves; and a rubbing plate on the bottom of the structure takes the wear whilst aground. The lower portion of the outer shell is cemented inside to prevent wear; and the whole of the steel work is coated inside with anti-corrosive paint and outside with anti-fouling composition.

The vessel would be about 130 tons weight and would give a draft of about 4 ft. 6 in. when empty. The metacentric height would be 8 in., which is good stability. When loaded with 250 tons of liquid in the inner shell the draft would be about 10 ft. 9 in. and the metacentric height 1 ft. 8 in., which is very stable. If both the inner and outer tanks were filled so far as was safe with oil of sp.gr. 0·8, the contents would weigh 320 tons and the draft would be 12 ft. 6 in. and the metacentric height 3 in.

This sub-aqueous acid tank, as I have shown, will carry 250 tons of ordinary concentrated sulphuric acid. It could be used equally well for oleum, which would solidify but could be easily melted by passing steam into the outer case until the contents of the inner tank were liquid. In this case it would be better not to line with lead, but to use stronger iron.

It could also be used for hydrochloric acid if the lead lining were covered with a uniform coating of bitumen. It could be used for the conveyance of nitric acid if lined with aluminium. As the inner tank is divided into three compartments three different acids or corrosive liquids could be transported at once.

If the corrosive liquids are carried to a port where petroleum or any other oil is produced or from which it is exported, both the inner and outer shell could be filled with oil for the return voyage. If this were not possible a call might be made on the return journey at some port where oil of some kind could be loaded as cargo for the port from which the vessel started. I see no reason why the outer shell, if well dried, should not be used for any form of dry grain such as rice or seed which could be emptied by suction at the destination.

In order to deal with the question in as practical a manner as possible, I have calculated costs based upon a journey by sea of 1600 miles taking a full load of 250 tons ordinary sulphuric acid one way, and returning with petroleum oil of sp.gr. 0·8, which, filled into the inner tanks and into the outer tanks up to a safe level would be 320 tons.

I think that any steamship company ought to be willing to take such a tank in tow as it would involve no risk of any kind to them, but would only cause the boat to make a lower speed, say 10 knots instead of 12, or 8 instead of 10, and thus for a journey of 1600 miles add one day's expenses to the voyage. Although this could be made profitable and safe traffic for any steamship company, I have based the following calculations upon the assumption that a tug is employed of sufficient power to tow with safety the tank I have described with its contents of acid or of oil. I have assumed also that this is for use in the East, and that the bad weather of the monsoon period would put the vessel out of use for 3 months of the year. The vessel weighs 130 tons and the contents (maximum) 320 tons; total, 450 tons. In order to tow this at, say, 9 knots speed a tug of 600/700 I.H.P. would be necessary. It is almost impossible to estimate the cost of such a tug to-day, and I assume that one could be hired for 9 months out of the year for a rent of £1000, exclusive of running costs

I have taken the depreciation on the sub-aqueous tank, which in pre-war times would cost about £2000 and to-day about £5000, at £1000 per annum.

Estimate of a year's work.

Journey, 1600 miles—

Outward trip	250 tons sulphuric acid
Homeward trip	320 tons petroleum oil

Average speed, say 8 knots.

A single voyage would take $8\frac{1}{2}$ days, and allowing 3 days in port at each end, one round trip would take 23 days and the consumption of coal would be about 190 tons.

Running for 9 months of the year would allow—

11 trips with 250 tons sulphuric acid	2750 tons
11 trips with 320 tons oil	3520 tons
Total tonnage carried	6270
The cost of running the tug for a year would be in wages, stores, upkeep, repairs, etc.	=£1400
Coal, 11 trips at 190 tons=2090 tons, at 20/-	= 2090
Rent of tug for 9 months	= 1000
Depreciation and interest on tank	= 1000
Total cost of running, exclusivo of Port dues	£5490
Calculated on 6270 tons	=17/6 per ton.

This freight is on the net weight of the acid and oil carried, and not on packages. If any steamship company would consent to carry acid for the trip that I have taken as an illustration, viz., about 1600 miles, they would ask not less than £2 a ton gross freight on acid carried in earthenware jars in cases. Owing to the weight of the packages being nearly equal to that of the acid contained in them the actual freight on the acid would be, say, £4 a ton; and if the jars and wooden cases were not of value to the consumer, there would be an additional loss in packages which might bring the cost of transport to £6 a ton.

If the steamship company agreed to carry in iron drums, which is a remote possibility, the freight would probably be the same for the 1600 miles' journey, but the drums would not be safe to use for more than two journeys. As the drums cost to-day about £6 per ton of acid and half of this would have to be written off as depreciation, the cost of transport in iron drums would be £5 per ton.

The war has caused many changes affecting the chemical trade and it will cause many changes still. All the regulations of steamship companies respecting the transport of corrosive chemicals have been put aside. We shall start after the war with a clean sheet. It is for the chemists to devise the best methods of packing and carrying acids and other corrosive liquids—the most economical for the manufacturers, and at the same time the safest for the shipping companies. I give this as one suggestion for the serious consideration of both manufacturers and steamship companies. It is undoubtedly safe for everyone concerned. The only question is whether it is economical. It is not suitable for very small quantities, but for short distances, 100-ton or even 50-ton tanks might be used economically, and there are not many countries where it would not be possible to dispose of 250 tons of either sulphuric acid or mixed consignments. The tank can be used for many acids and other chemicals. I have mentioned sulphuric acid, oleum, hydrochloric acid, and nitric acid, but I might add carbon bisulphide, alcohol, benzol, toluol, or naphtha, which, although they cannot all be classed as corrosive, are more or less dangerous for a steamship company to carry.

In conclusion I wish to express my thanks to Mr. N. K. Turnbull for the assistance he has given me as an engineer in the details of the tank described, and to Lieut. G. K. Turnbull, R.N.V.R., for the valuable criticisms and suggestions his wide experience at sea has enabled him to give.

Discussion.

Dr. J. Grossmann thought it possible that the main cause of difficulty in carrying corrosive liquids in iron or steel drums was owing to the different qualities of iron and steel used in the construction of drums themselves. In the presence of acid, steels or irons of different composition produced at the points of contact electric currents, thus setting up corrosion. He had proved this to be the fact in the case of nitric acid stills, and had been able to prevent corrosion occurring between the running-off pipe and the body of the retort by the adoption of cast-iron studs instead of wrought iron studs in the process of moulding and casting. If some precaution were not taken with regard to the barge suggested, the sea water might similarly produce galvanic action on the inner tube, and this would make the carriage of different acids at the same time a matter of considerable risk.

Mr. L. E. Vlies hoped that Mr. Morris did not propose to transport fuming sulphuric acid in lead-lined vessels, as it was his experience that sulphuric anhydride had a decided action on lead.

Mr. W. F. A. Ermen laid stress upon the difficulty of transport to countries like Brazil, where a kilo. of crude hydrochloric acid of 23 % strength cost 1s. 6d. at a works 200 miles in the interior. The acid was delivered in jugs which were practically useless afterwards. The only way to get pure sulphuric acid was *via* Rio de Janeiro, where it was allowed to pass in 500-grm. bottles at a cost of 2s. 6d. per bottle.

Mr. J. D. Paton mentioned that by the use of the "Schoop" process it was practicable to apply a covering of lead or aluminium 1/200th of an inch thick and this was a possible solution of the lining for the storage tank of the vessel described.

A Representative of one of the Indian Shipping Companies stated that they had for many years past carried large quantities of acids to India in jars embedded in whiting in cases on deck and in 'tween decks under certain conditions and there had been no serious complaints. He was of opinion that there would be considerable difficulty in persuading shipowners to undertake towage of a craft of the kind described as far as Bombay.

Mr. K. H. Vakil considered that a further difficulty would arise from the fact that India had very little liquid products to send back in return for the acid if it were delivered in fairly large quantities. It was possible that the outer shell of the barge might be used for the conveyance of Indian vegetable oils, the freight for which at present was exceedingly high.

Mr. Morris, in reply, said there was not likely to be any leakage of the acid into the outer shell, particularly with a strong inner shell lined with lead. In any event if such a leakage did occur it was far better to have it in a tank that was towed behind a tug or liner. He did not see how galvanic action could take place unless there was a leakage either of the lining or of the inner tank itself. He did not regard a lead lining as necessary for the transport of oleum; the iron structure would be sufficient. The tank would not have the same length of life perhaps as one with lead lining carrying ordinary 95 % sulphuric acid, but nevertheless it would have a long life if the inner vessel was made strong enough. It had been proved by 10 years' experience with oil tanks that there was very little danger of a properly handled "tow" fouling the propeller of the towing vessel. Whilst he saw no reason why corrosive liquids should not be transported safely and economically over such distances as from this country to India, he thought the proposition was specially applicable to the carrying of such liquids from India itself to different Eastern ports where probably a return cargo of petroleum could be shipped. If acid was sent to a port where there were vegetable oils, then vegetable oils could be brought back.

Industrial Notes.

FRENCH CHEMICAL INDUSTRY.

A report has been issued recently on the work of the *Office des Produits Chimiques et Pharmaceutiques*, which was established in France in October, 1914, as a branch of the Ministry of Commerce. The objects of the Office were to make a census of French chemical and pharmaceutical products, take the necessary steps to assure that their production was not interrupted, and encourage the increased production of existing industries or establish new manufactures where it was thought desirable. The organisation and direction of the Office were entrusted to Professor Béhal, who had the assistance of a "Comité de direction" presided over by the Minister of Commerce, and numerous technical committees to deal with specific industries.

On the outbreak of war, the general mobilisation resulted in the closing of a number of chemical works, and immediate steps were taken to put these again into operation. The supply of the various raw materials for the chemical industries constituted an important function of the Office, and the supplies available after the requirements of the Ministry of War had been satisfied, were distributed as equitably as possible among the various consumers. The Office has also been called upon to advise on the subject of imports and exports of chemical products.

In collaboration with the War Minister, the Office has encouraged the development of existing industries and the establishment of new ones, with a view to making France independent of foreign countries. In the manufacture of dyestuffs, for instance, the production has now reached about 150 tons a month, and is increasing progressively. In this connection, reference may be made to the Compagnie Nationale de Matières Colorantes et de Produits Chimiques, which has recently been established with a capital of 40,000,000 francs, divided into 80,000 shares of 500 fr. each. This company will, it is understood, work in collaboration with British Dyes, Ltd., and will later have the use of certain explosives factories which have been established since the outbreak of war.

The annual consumption of dyestuffs in France is estimated at about 10,550 tons, made up as follows:—Substantive dyes, 2250 tons; acid dyes, 2500 tons; sulphide dyes, 4250 tons; basic dyes, 700 tons; indigo and other vat dyes, 600 tons; alizarin colours, 250 tons. The total value of these amounts to over £1,000,000.

The general re-organisation of French chemical industry is also receiving the consideration of the Office des Produits Chimiques, which has appointed technical committees to deal with questions such as patents and trade marks, transport, solvents, dyes, pharmaceutical products, synthetic perfumes, etc.

THE SWISS DYE INDUSTRY.

The coal-tar dye industry in Switzerland dates from the year 1859, when the manufacture of Perkin's Mauve was started by the firm of Geigy, one year after the foundation of the British industry. The Swiss firm, established at Basle in 1764, had been engaged since 1856 in extracting natural colouring matters from woods, etc. The manufacture of fuchsin, discovered by Verguin in 1859, was started in Basle by the firm of Gerber-Keller in 1860, and was soon followed by the production of other dyes, many of which are due to the researches of Swiss chemists, Cornu, Graebe, Sieber, Durand, Sandmeyer, Schmid, etc. In 1866 there were four important dye factories in Switzerland, namely, those of Geigy, Gerber-Keller, and Clavel in Basle, and of Petersen in Schweizerhalle. In 1868 a fifth company was established near Geneva, but it ceased to make dyes in 1905. The firm of Petersen ceased to exist in 1908.

At the present time the industry is concentrated in Basle and is in the hands of four companies: the Geigy works in 1914 employed about 700 persons. The Société pour l'Industrie Chimique was founded in 1884 and has a capital of ten millions francs; it took over the business of Clavel, and in 1898 absorbed the Fabrique de Couleurs d'Aniline ci-dev. A. Gerber et Cie., and in 1908 the Basle Chemical Works. In 1914 the firm employed about 2900 persons; since its inception it has paid dividends equivalent to 367½% of its capital, representing an average annual distribution of nearly 12%. The Société Anonyme Durand et Huguenin, founded in 1871, has a capital of 800,000 francs, and the Fabrique de Produits Chimiques ci-dev. Sandoz, established in 1886, is capitalised at between two and three million francs; the latter firm employed about 350 persons in 1914.

Switzerland ranks second to Germany among the dye-producing nations. In 1875 the value of the output of this industry was about 7,000,000 francs. In 1896 Swiss dye exports were valued at 13,910,000 fr.; in 1900, 15,342,000 fr.; in 1905, 20,014,000 fr.; in 1910, 25,414,000 fr.; in 1912, 25,753,000 fr.; and in 1915, about 29,000,000 fr. In connection with these figures it should be remembered that the value of the unit weight of dye produced is now only about 60% of what it was in 1896, so that the increase in quantity manufactured is much greater than is indicated by the figures of value. More than half the exports in 1915 went to England.

The manufacture of synthetic indigo was commenced in 1911 by the Société pour l'Industrie Chimique; in that year the exports were valued at 375,000 fr., in 1912 at 1,509,000 fr., and in 1913 at 3,910,000 fr.

REFRACTORY MATERIALS.

Proc. Faraday Soc., Dec., 1915.

The meeting of the Faraday Society held on November 8th was devoted to a general discussion on refractory materials. The meeting opened with an address by the President (Sir Robert Hadfield), and a paper by Dr. J. W. Mellor on "The Texture of Firebricks," abstracts of which appeared in the last issue of this Journal (p. 1218).

Prof. W. G. Fearnsides stated that though there was a great lack of scientific data to help makers of certain types of refractory material, the foremen bricklayers and furnacemen had a great deal of valuable information, which only required to be collected and converted into scientific form. Makers who had obtained some measure of success, and users who submitted the materials to unusual stresses, should work together in overcoming each other's difficulties; if, in addition, the competent scientist also assisted, progress in the refractory-making industry would be much more rapid. Prof. Fearnsides then referred to the pioneer work in the micrographic study of refractory materials, done some fifty years ago by H. C. Sorby, in rubbing down preparations from silica bricks and firebricks to a fair state of transparency. In determining the texture of any brick, the thin slice method can easily be applied. There is great difficulty in attaining a technique that will make evident the character of the "binder." With new-made silica bricks, and especially with firebricks, the determination of the intrinsic structure is not easy; with slices of normal thinness (0·002 to 0·001 inch) newly formed minerals are in such minute crystals that they generally appear as a felted mass. Characteristic inversions of quartz to tridymite and crystobalite in silica brick are comparatively easy to observe, and from structures revealed by the petrographic microscope the heat treatment which a silica brick has received can be judged with fair accuracy. Valuable information could be obtained from an examination of micro-preparations cut from the bricks of the linings of large furnaces at the end of their run.

Dr. R. Lessing having described his method for determining grog and clay in unburned firebricks (this J., 1916, 1219), Dr. H. G. Colman gave a brief account of the work on refractory materials carried out by the Joint Committee of the Institution of Gas Engineers and the Society of British Gas Industries. After determining the conditions prevailing in gas-retort settings, the Committee has drawn up provisional specifications for retort material, ordinary firebrick, and silica brick. Investigations are now in progress on the effect of pressure on the refractoriness of materials, the relative effects of an oxidising and reducing atmosphere, and the influence of the fine flue dust carried into the hot setting on the life of the materials employed. (See this J., 1912, 642.)

Mr. J. A. Howe stated that the Geological Survey was preparing a report on British refractory materials, and for that purpose had divided the country into field areas, taking samples from each and classifying these. Over 1500 samples have been secured, and the collection of the raw material is almost completed. The classification of the data and the examination of the samples is already well advanced.

Mr. T. Crook mentioned that the Empire was well provided with resources of the less common refractories, *e.g.*, graphite in India and Canada, chromite in Rhodesia and India, magnesite in Victoria, South Africa, and British Columbia, bauxite in India and British Guiana, and zircon in Natal.

The use of silica as a refractory material in steel manufacture was next dealt with by Mr. C. Johns (see this J., 1916, 1219).

Mr. A. Cliff spoke on the manufacture of refractory materials, mentioning certain directions for possible improvement; one was in re-working up of old material—one of the best means of eliminating expansion and contraction. He had overcome temporary difficulties due to supply of materials by fastening working surfaces of chromite, magnesite, etc., to ordinary fire- or silica-bricks. He urged the co-operation of the chemist and the craft in carrying out organised investigations of chromite, magnesite, graphite, and other refractory materials.

Mr. E. P. **Page**, speaking of the classification of refractory materials, said that a simple method was to divide them into acid, basic, and neutral materials, according to their chemical composition and behaviour. This classification was somewhat arbitrary, because a clay such as china clay would be expected from its composition to be neutral, whilst experience showed that was not the case. It was customary to include all refractory clays in the acid class. The essential property of a refractory was stability at the temperature to which it was exposed, with sufficient reserve of stability to resist externally applied chemical and mechanical influences. In practice it was generally necessary to sacrifice a certain degree of refractoriness *per se* in favour of increased refractoriness against other influences.

Dr. W. **Rosenhain** spoke of the necessity for paying attention to the highest class of refractories in view of the very high temperatures now employed in metallurgy, especially in the electric furnace. Highly purified zirconia was a very valuable material. A crude zirconia (about 75% ZrO_2) fell far short of pure zirconium dioxide in refractoriness, but bricks made of it would resist temperatures up to about 1600° C. It was much improved by removing the iron oxide by treatment with hydrochloric acid. To get the best results it was necessary to shrink the material at a much higher temperature than it would have to stand eventually. Zirconia bricks as purified for optical purposes fritted above 2000° C. The cracking of refractory materials was caused by forces involving nothing but determinable constants, and the coefficients of thermal endurance could be worked out, as had been done for glass.

Prof. T. **Turner**, speaking of the relation between porosity and packing of grains, pointed out that round grains do not necessarily give an open and sharp ones a close packing. Small, round particles in the interstices of larger round ones gave the closest grain.

Dr. R. S. **Hutton** mentioned that the properties of completely shrunk magnesia were quite different from those of ordinary calcined magnesia, and that the shrinking could be economically effected electrically.

Dr. W. H. **Hatfield** spoke of the work to be done on the resistance of refractories to slag erosion, and gave examples of the great disparity in behaviour of different grades of silica brick.

Prof. F. G. **Donnan** urged the necessity for a standard quantitative specification for silica bricks.

Dr. P. G. H. **Boswell**, in a paper on "Refractory Sands," said that these might be divided into three chief classes: (*a*) high silica sands (98·99% or more SiO_2); (*b*) high silica and alumina sands, bearing up to 20% Al_2O_3, as kaolin, etc., and little else but silica; (*c*) sands for greensand moulding, with a strong and highly refractory natural clay bond. All class (*a*) sands hitherto imported may be replaced by British sands. We have also valuable deposits of class (*b*), but as regards the sands of class (*c*), which are used for high-temperature steel moulding, the best foreign sands have not been equalled by known British products. The author indicated certain directions along which research on British and foreign refractory sands was desirable, and concluded by urging co-ordination in the work of all those interested in the subject.

Mr. W. C. **Hancock** mentioned the application of certain organic dyes in etching refractory materials. This method, in conjunction with that of Prof. Fearnsides, would be of great value in elucidating internal structure.

Mr. E. **Griffiths** then read a paper on "The Thermal Conductivity of Materials used in Furnace Construction" (see this J., 1916, 1219).

Dr. J. A. **Harker** mentioned that zirconia, if fine enough, would stand being plunged into water whilst at a white-heat temperature.

Mr. W. **Donald** wrote that substitutes for Austrian magnesite bricks were being made by adding about 8% of ferric oxide to Greek magnesite, which was too pure. He suggested that when dolomite was used in basic steel furnaces, active calcium ferrates might be formed, the result being destructive to the magnesite foundation.

Mr. A. **Reynolds** wrote, suggesting that if magnesite nozzles were used for steel ladles, minute particles might get carried forward into the moulds. The higher oxides of iron appeared to increase the refractoriness of bricks exposed to oxidising atmospheres.

Mr. C. R. **Darling** drew attention to a suggestion, made some years ago, that furnaces should be lagged with a highly insulating substance. Experiments by Fitzgerald and by himself had confirmed the great saving anticipated.

PATENT LAWS AND THE DYE INDUSTRY IN ENGLAND.

BY E. F. EHRHARDT.

Pamphlet published by H. T. Woodrow & Co., 3, Cook Street, Liverpool.

(*Abstract.*)

That the dye industry does not flourish in Great Britain has been attributed, among other things, to the stupidity of British manufacturers that they did not engage chemists, the chemists have been blamed for not possessing the plodding industry of the German chemists, patentees have been blamed for dog-in-the-manger tactics, and the patent-law blamed for favouring foreign inventors, and so on, but in the author's opinion none of these statements affords a true explanation, and the real reason for the position of the industry has not recently been put forward.

The lack of success of the British dye industry is to be attributed to the fact that in this country there is no belief in Patent protection; in the Courts, in the Patent Office, amongst manufacturers, and in the general public, there is no belief in the advantage to the public of an adequate protection to inventors by Letters Patent. The inventor who seeks to patent his invention is regarded not as a benefactor seeking his rightful reward, but as a rather lucky person who has happened upon something new, and who, then, in a dog-in-the-manger spirit, desires to keep it to himself. It is thought to be in the public interest to thwart the inventor in every way possible, to cut down his protection as far as may be, and if possible to destroy it altogether.

Every change that has been made in Patent law and administration in recent years is to the disadvantage of the inventor. If there were a real active belief that by the system of granting patents for inventions, benefits would accrue to the public generally, this would not be the case. The efforts of the statesmen dealing with patent law and the officials of the Patent Office would be directed to extending patent protection rather than to whittling it down as much as possible. There is no case of this.

What can be patented is defined by the Statute of Monopolies in the words, "any manner of new manufacture," but many inventions that might well be protected by patent can be excluded by deciding that they are not "manufactures." For example, the discovery that dichlorobenzene was a better agent than any hitherto used for protecting furs and woollen materials from the attacks of moths, has been denied patent protection. The Patent Office decided that to use dichlorobenzene exactly as camphor has been used is not a manufacture. In so far as some particular method of applying the dichlorobenzene were necessary, that could be protected, but merely to put the dichlorobenzene in the wardrobe with the furs, that could not be protected. An appeal was taken to the Law Officer of the Crown, but the decision of the Patent Office was upheld.

The expense of taking up inventing as a matter of business is very considerable, and the capitalist can only hope for an adequate return if, whenever some of his chemists succeeded in perfecting a paying invention, adequate patent protection could be obtained for it. With the great uncertainty that exists with regard to the validity of any English patent, and the almost universal attitude towards patents that exists in this country, the investment necessary to establish a research laboratory would be almost certainly doomed to failure. That is the reason why this kind of investment has not found favour in this country, although elsewhere it has been adopted with very great success.

In order to combat the dog-in-the-manger spirit that is supposed to animate patentees, machinery has been devised by which a patentee can be compelled to grant a licence. What compensation should be regarded as adequate? The answer is contained in the words of the Letters Patent, "that the inventor should have the entire benefit of his invention." If he is compelled to grant licences he should not thereby forego any benefit from the invention. There might be cases in which the licensee could see an advantage to himself by having a licence without diminishing the reward of the inventor. In such cases a compulsory licence might well be granted.

The author disputes the existence of an unjustifiable dog-in-the-manger spirit, and denies that any such spirit has injuriously affected the colour industry in this country, instancing the fact that many licences have been granted by German firms, whilst others have been offered but not taken up in this country. English manufacturers are not blamed for refusing the licences offered them, any more than are English capitalists for not taking up the business of inventing colours. It is due to the uncertainty of the Patent law, which makes either of these investments too precarious for a wise man to contemplate.

What is required, in the first place, is a realisation of the enormous importance of inventions for the national prosperity, and indeed, possibly, for the national existence, and secondly more universal recognition is required, that inventions are a property which need just as jealous protection as land and houses or wealth in any tangible form. Without the possibility of obtaining nitric acid from the air, and so being independent of saltpetre from Chili, it would have been impossible for Germany and her Allies to have continued this present war so long. The patent for Schönherr's furnace and his process of making the oxides of nitrogen was only granted in the English Patent Office after a severe *ex parte* contest on an appeal, with the assistance of Counsel.

To avoid the very heavy expense of litigation in patent cases, the author suggests abolishing as a defence in Patent lawsuits the allegation that the patent is invalid, for any reason whatever. Let the question of infringement, a simple question of fact, be the only issue, the validity of the patent standing proved by its grant. If anyone desires to dispute the validity of a patent let him do so before he commences to infringe, independently of any infringement proceedings, by petition for revocation, which in the first place should be addressed to the Patent Office, and this right to attack a patent as invalid should lapse five years after the grant of the patent. Patent applications are subjected in the Patent Office to a most stringent search; after they have passed through this ordeal everyone who desires it should have an opportunity of making good any objections to the validity of the patent within a period of five years after the grant. After that the patent should stand, and not be liable to an attack. The question of infringement should always be a question for the courts, and simply a question of fact. In the case of product patents this would be so simple a matter that infringements would hardly occur.

If this plan were adopted it would throw a good deal more responsibility on the Patent Office. The last Patent Act made the Patent Office responsible for the conformity between provisional and complete specification. Now if the Patent Office passes the complete, the objection of lack of conformity cannot be raised. The result has been, in many cases, that the provisional specification is practically abolished. The Patent Office appears to evade the responsibility by simply using all its influence to prevent any alterations being made as between provisional and complete, and it is a rare thing now in dyestuff patents to find a real provisional specification followed by a complete specification. It would appear a bad change for the inventor that the responsibility for the validity of his patent should be thrown upon the Patent Office, and indeed it is essential that the Patent Office must be animated by the feeling that it is its duty, whenever a real invention has been made and brought to its notice, to see that the utmost possible protection should be granted for that invention. The Patent Office seems to regard the interests of the inventor and of the public as antagonistic, and to endeavour to limit as much as possible what the patentee can retain for himself, and what he must leave to the public. This is the wrong spirit, for it is to the interests of the public that inventions should be made, and when made inventions should be adequately protected.

It is also suggested that the duration of Letters Patent should be longer. It is seldom that a patent can be worked at a profit for three or four years after the invention, so that the patentee only enjoys the monopoly for about ten years. Twenty years for the nominal duration of Letters Patent instead of 14 is none too long.

Radical alterations are desirable in the practice at the Patent Office in several respects. The manner in which the search and the correspondence with the inventor in connection with the search is carried on seems to be most irritating. Although Letters Patent date from the date of application, so that whether the search takes a short time or a long time, the duration of the protection is in no way affected, a time limit is placed upon the negotiations between the Office and the inventor. The greater part of the time is occupied by delays on the part of the Office. Every patentee desires to get his patent as quickly as he can, and he will not delay doing all that he can to reply to the Patent Office and remove the objections of the officials. For the Office to take three or four times as long dealing with the inventor's letters as the inventor takes to deal with the Office letters, and then to demand extra fees because agreement is not yet attained, is almost intolerable.

There is also an enormous waste of energy involved in the present system of going through a search for all the applications that are filed. It is probably less than 20% of the applications that survive the payment of the second fee that falls due at the end of the fourth year. By the time this fee is payable the inventors, in four cases out of five, have realised that their invention is of no use, and will not spend another £5 to keep the patent already granted in force. If the search were postponed, except when the patentee particularly applied for it, for four years, more than half the work of the Patent Office could be saved, and again, if the specifications which the inventors themselves recognised as useless were not published until they had undergone the search, the volume of trashy patents would be very much diminished. This would simplify subsequent searches.

Too much is expected from printed specifications. When the grant of patents came to be restricted to inventions the term of 14 years was chosen because it was twice the usual term of apprenticeship, the inventor was supposed to teach his apprentices the invention. By the time they had served their apprenticeship they were to be as expert as himself, but he would be able to engage the services of the first set of apprentices for a further seven years, and have no competition to fear from them, and at the end of 14 years two sets of his apprentices could produce the invention, and so it might become generally known. Now, the specification is supposed to take the place of training apprentices, the specification is supposed to put others in a position to manufacture according to the invention as well as the inventor. This is expecting impossibilities, in the case of complicated chemical manufacture. It is sometimes possible by a printed description to give all the information necessary to a chemist to prepare the patented article with a little practice, as well as the inventor himself, but this is exceptional. The office of the specification should be regarded as more for identifying the invention than of teaching others how to carry the invention into practice. At the best the specification can only describe what the inventor knows at the time when the specification is written. This in the case of chemical invention is nearly always laboratory experience. The invention is made and worked out in the laboratory, and if of sufficient promise is patented from the laboratory; then comes sometimes very difficult work to carry out the invention in the factory. It is sometimes years before a regular manufacture can be begun, and then month by month improvements suggest themselves, and at each alteration or extension of the plant these are embodied until the patentee who is manufacturing can do very much better than anyone starting with the specification drawn up when first the invention was made. Too much importance is attached to the idea that the specification should teach others after the patent has lapsed how to carry out the invention. The people to be mainly considered in connection with the grant of Letters Patent are the inventor and the consumer of the invented article, not the competitors of the inventor, and especially not competitors that may arise after the patent lapses. If this country were to adopt the policy of giving generous protection to inventors there would soon be a large number of manufacturers who would be patentees and would feel interested in patent rights being respected. That is the only spirit upon which the vital extensions ot the dye manufacturing industry in this country can be based. No industry was ever established anywhere by compulsory licences or compulsory working. No healthy industry can be established by taking inventions without recompense to the inventor. The dye industry above all others is being constantly fed by a stream of inventions. Where inventions are most secure property there the industry will flourish. Make chemical invention pay and there will be plenty of chemists of plodding industry to do the work and manufacturers not too stupid to employ them.

Journal and Patent Literature.

Patent Specifications may be obtained by post by remitting as follows:—

English.—6*d.* each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

United States.—1*s.* each, to the Secretary of the Society, who has to furnish the U.S. Patent Office with the following data:—Patent number, date, name of patentee, and title of invention.

French.—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56, Rue Ferou 8. Paris (3e.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Filtration and/or percolation of liquids. C. Yeoman, London. Eng. Pat. 14,287, Oct. 8, 1915.

Liquid to be filtered is supplied automatically in proper quantity to a filtering funnel. The liquid is contained in an inverted bottle or the like, preferably supported on an adjustable stand, and having its neck immersed in the liquid in the funnel. Alternatively the container may be supported on a collar resting on the receiving vessel. When the funnel fits tightly into the neck of the receiver, air escape openings may be provided or a filter pump may be used. The outlet of the container may be slanting and it may be provided with a valve. The container may be connected to a supply tank and may be surrounded by a heating coil.—W. F. F.

Exhausting air and non-condensable gases; Apparatus for ——. A. E. L. Scanes. Ashton-on-Mersey. Eng. Pat. 15,771, Nov. 8, 1915.

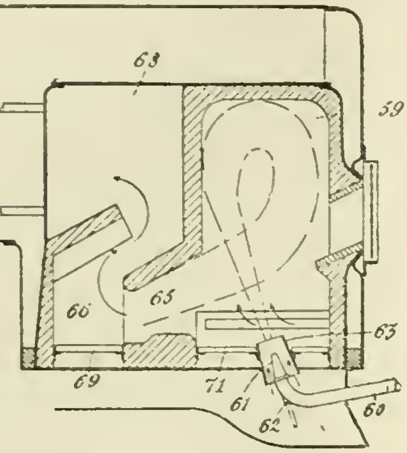
The air is aspirated by a steam ejector and the mixture of air and steam is delivered to the final stage of a multiple-stage water ejector. A by-pass is provided so that any air which is not carried forward by the final stage of the water ejector passes back to the first or second stage of the water ejector and is compressed and driven forwards.
—W. H. C.

Vacuum: Centrifugal apparatus for the stepwise production of a ——. J. H. Storm, jun., Amersfoort, Holland. Eng. Pat. 101,935, May 18, 1916. (Appl. No. 7114 of 1916.)

Exhausting drums, as described in Eng. Pat. 21,508 of 1914 (this J., 1915, 999), are arranged in series, and rotated on a common shaft. The first drum of the series discharges into the open air and draws air from a casing which surrounds the second drum of the series, and so on to the last drum which draws air from the space in which a vacuum is to be produced.—W. H. C.

Furnaces fed with pulverulent fuel. K. H. V. von Porat, Stocksund, and Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. Eng. Pat. 16,298, Nov. 18, 1915.

Powdered fuel is blown through the pipe, 60, and nozzle, 61, steam is injected through the pipe, 62, and air is induced through the pipe, 63. The fuel jet is deflected by the walls of the chamber, 59, forming a loop, to the outlet, 65. A grate, 69, for solid fuel, or a gas burner, is provided for igniting the mixture of powdered fuel and air, which then passes through a curved channel, 66,



to the combustion chamber, 68. Before the use of powdered fuel is commenced, firing by means of solid or liquid fuel on the grate, 71, may be used. Alternatively the fuel may be injected into a lateral chamber before passing into the mixing chamber, 59, to prevent pre-ignition. A deflecting screen may be arranged at the entrance to the mixing chamber or a deflector may divide the mixture into two parts.—W. F. F.

Shaft-furnaces and kilns. R. Thiele, Höxter-an-der-Weser, Germany. Eng. Pat. 101,937, May 30, 1916. (Appl. No. 7662 of 1916.)

The kiln is provided with two grates, situated side by side, which receive a horizontal reciprocating motion by means of shafts passing air-tight through packing boxes and connected by pitmans with cranks set at an angle of 180° to each other on opposite sides of the driving shaft. The grates are formed with a central grid portion having bars set at an oblique angle to the direction of motion, and end plate portions having teeth and perforations, and are so arranged that only the plate portions pass beneath the open bottom of the kiln. The outlet shoot is provided with an air lock having two doors which are opened alternately by mechanism.—W. H. C.

Liquid fuel furnaces. W. A. White, New York. Eng. Pat. 101,947, July 11, 1916. (Appl. No. 9767 of 1916.)

The furnace has a double-walled, hollow front in the centre of which a spraying device for the liquid fuel is set. Air is admitted to the hollow front, which is provided with tangential ribs to impart a whirling motion to the air before it enters the combustion chamber through an annular opening which surrounds the front of the spraying device.—W. H. C.

Mixing machines for granular or pulverulent substances. G. Porteous, Leeds. Eng. Pat. 17,659, Dec. 17, 1915.

To prevent "bridging," the chambers of the mixing machines are constructed with gradually increasing cross-sectional area from the top to the bottom.—W. H. C.

Mixing machines. T. Monk, London. Eng. Pat. 102,007, Mar. 9, 1916. (Appl. No. 3526 of 1916.)

A trough having a hemicylindrical bottom is pivoted on a longitudinal horizontal shaft so that it may be tilted. Inclined blades with lateral projections are mounted to rotate with the shaft, and alternate fixed radial members are threaded on the shaft and secured at their opposite end to the trough. Locking devices are provided to fix the trough in its tilted position when required.—W. F. F.

Generation of steam and the heating of liquids generally. P. St. G. Kirke, London. Eng. Pat. 17,842, Dec. 21, 1915.

The heating tubes are filled with packing pieces so formed that they present faces inclined, preferably at a right angle, to the main direction of the gases through the tubes.—W. H. C.

Dust separator for granular materials. T. Robinson and Son, Ltd., C. J. Robinson, and T. J. Stevenson, Rochdale. Eng. Pat. 102,010, Mar. 25, 1916. (Appl. No. 4423 of 1916.)

In a dust separator of the type described in Eng. Pat. 8592 of 1906, the hopper for the granular material is provided with radial plates projecting inwards to prevent rotation of the material delivered from the spreader plate, and thus permit higher speeds to be used without loss of material over the edge of the hopper.—W. F. F.

Electrolytic tank; Acid-proof and ——. R. T. Wales, Sewaren, N.J. U.S. Pat. 1,202,457, Oct. 24, 1916. Date of appl., Apr. 1, 1914.

The tank is composed of a substantially rigid supporting bed, with a course of brick thereon spaced apart, and a bottom lining wall composed of blocks laid in acid-proof cement. Side lining walls and partition walls are built up of similar material, with an exterior rigid wall spaced apart from the side walls. Material, such as pitch, is disposed in the spaces between the side walls, and in the spaces throughout the course of brick upon the bed, the latter material communicating with the pitch between the side and exterior walls. —B. N.

Centrifugal extractor; Electrically operated ——. W. Bartholomew and C. H. Allen, Assignors to Troy Laundry Machine Co., Ltd., Chicago, Ill. U.S. Pat. 1,203,567, Nov. 7, 1916. Date of appl., Feb. 20, 1913.

In a centrifugal extractor, a rotating basket is provided with a cover which is locked in closed position during rotation. A bolt carried by the cover is reciprocated by its opening and closing, and is prevented from moving into its open position by the interposition in its path of the armature of an electro-magnet. The circuit of the electro-magnet is independent of the circuit of the motor driving the extractor and is controlled by the rotating basket.—W. F. F.

Air or other gaseous fluids; Utilising the energy of moving bodies of ——. G. J. Gawley, Fleet, Hants. Eng. Pat. 15,914, Nov. 11, 1915.

A disc is provided with a spiral rib on one face forming a spiral groove; this rib fits accurately into the groove on the face of another similar ribbed disc. The central point of the spiral is provided with a hand-operated valve and the terminal point with a non-return valve. When the two discs are separated, a vacuum is formed in the spiral groove, and when the central valve is opened air enters, acquires kinetic energy in traversing the groove, and may be used at the outer end for doing work.—W. F. F.

Heating liquids; Method and apparatus for ——. The British Westinghouse Electric and Manufacturing Co., Ltd., London, Assignees of L. W. Chubb, Pittsburgh, U.S.A. Eng. Pat. 100,796, June 28, 1916. Under Int. Conv., June 30, 1915. (Appl. No. 9111 of 1916.)

The liquid container, *e.g.*, a steam boiler, is coated internally with aluminium, and a small amount of electrolyte such as a mixture of boric acid and borax is added to the liquid so as to produce an asymmetric electric conducting film on the aluminium. An electrode is placed in the liquid, and a difference of potential of about 300 volts is maintained between the liquid and the container. The rate of transfer of heat from an external heater to the liquid is thereby increased. If an alternating electromotive force is applied, the electrode is provided with a similar film. —W. F. F.

Heating gases; Means for ——. J. Weber, Essen, Germany. U.S. Pat. 1,203,944, Nov. 7, 1916. Date of appl., Mar. 13, 1916.

The apparatus comprises a pair of furnace chambers, opposite each other, and each divided into upper and lower compartments. An inclined rotary drum extends from the upper compartment of one chamber to the upper compartment of the other, and a second rotary drum, inclined in the opposite direction, extends between the two lower compartments; the drums have projections on their inner surfaces. Solid particles are fed into the upper end of the upper drum and are discharged from the lower end on to a roller with recesses on its surface; the roller delivers the solid particles into the upper end of the lower drum. The gas to be heated passes upwards through the two drums in succession.—A. S.

Evaporation of fluids; Apparatus for the ——. F. P. Bergh, J. Loebinger, and H. C. Neuberger, Assignors to General Reduction Co., New York. U.S. Pat. 1,204,121, Nov. 7, 1916. Date of appl., Apr. 14, 1911; renewed Apr. 10, 1916.

The apparatus consists of a polygonal chamber provided at one side near the top with a spraying device which projects a spray of liquid across the chamber. Heated air or gas is admitted lower down the chamber, and passing upwards through the spray effects the evaporation. The gas escapes through a pipe near the top of the chamber above the spraying device, and the concentrated liquid collects in the lower conical portion of the chamber.—W. H. C.

Gaseous mixtures; Apparatus for the separation of ——. H. van Fleet, Ardmore, Pa., Assignor to American Air-Liquefying Co., New York. U.S. Pat. 1,204,521, Nov. 14, 1916. Date of appl., Apr. 18, 1914.

A gaseous mixture is supplied to a "header" at its opposite ends and passes through horizontal coiled pipes to a second "header." The gas is wholly or partly liquefied in the pipes and the liquid passes to a receiver. A helical coil connected to the top of the second "header" surrounds the two "headers" and the horizontal pipes, and is connected to a third "header." All these parts are wholly or partly submerged in one of the liquefied constituents of the mixture, and separate means are provided for conveying liquefied gas from the receiver and the third "header."—W. F. F.

Drying vegetable materials. H. Brune, Neustadt, Germany. U.S. Pat. 1,204,845, Nov. 14, 1916. Date of appl., Feb. 13, 1913.

Wet vegetable materials are mixed with previously dried similar material and the mixture pressed to extrude moisture.—W. F. F.

Separating, cleaning, or emulsifying liquids; Machines for ——. B. E. D. Kilburn, London. From J. W. Davies, Boston, Mass., U.S.A. Eng. Pat. 16,090, Nov. 15, 1915.

See U.S. Pats. 1,200,559 and 1,200,560 of 1916; this J., 1916, 1208.

Filter; Rotary ——. R. P. Akins, Assignor to Colorado Iron Works Co., Denver, Colo. Reissue No. 14,214, Nov. 14, 1916, of U.S. Pat. 1,059,327, Apr. 15, 1913. Date of appl., July 28, 1916.

See this J., 1913, 740.

Evaporator. J. Harris, Sheffield, and D. H. Thomas, Morriston, Wales. U.S. Pat. 1,203,614, Nov. 7, 1916. Date of appl., Nov. 29, 1915.

See Eng. Pat. 23,414 of 1914; this J., 1915, 894.

Evaporation and distillation of liquids; Method of ——. C. T. Thorssell, Gottenborg, Sweden. U.S. Pat. 1,204,716, Nov. 14, 1916. Date of appl., Sept. 8, 1914.

See Eng. Pat. 9295 of 1914; this J., 1915, 538.

Tube-mill. J. S. Fasting, Frederiksberg, Denmark, Assignor to F. L. Smidth and Co., New York. U.S. Pat. 1,204,554, Nov. 14, 1916. Date of appl., Apr. 28, 1915.

See Eng. Pat. 7160 of 1915; this J., 1916, 291.

Apparatus for expressing liquid from materials containing the same. Eng. Pat. 101,782. *See* IIa.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Galvanic fuel cells at high temperatures. Baur and others. *See* XI.

Patents.

Spiral [coal] separators. F. Pardee, Hazleton, Pa., U.S.A. Eng. Pat. 102,106, May 3, 1916. (Appl. No. 6359 of 1916.)

In a spiral separator as used in coal breakers for removing slate and "bone" from the coal, divergent creases are formed on one or more of the plates forming the runways, the creased surfaces leading to uncreased gravitative surfaces on the same plates. The creased portion of the runway may be perforated.—J. E. C.

Vertical retorts; Discharging apparatus for ——. S. Glover, St. Helens, and J. West, Southport, Eng. Pat. 102,093, Aug. 8, 1916. (Appl. No. 3731 of 1916.)

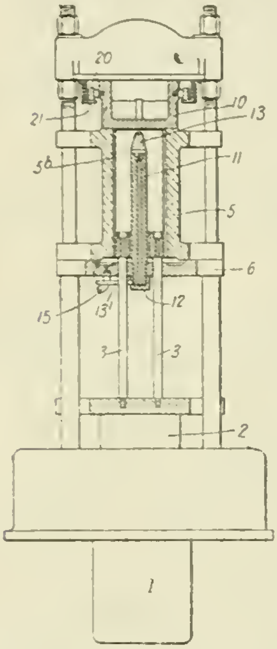
In discharging apparatus for vertical retorts, an oscillating trough forming the water seal is fitted with a raised portion acting as a stop to ensure that the trough shall carry coke with it when moving in one direction, this raised portion being so shaped as to prevent coke falling behind its forward end.—J. E. C.

Retort. Process of obtaining coke and by-products from coal. H. P. Bostaph, Detroit, Mich. U.S. Pats. (A) 1,204,646 and (B) 1,204,647, Nov. 14, 1916. Date of appl., Jan. 19, 1916. (A) Renewed Sept. 16, 1916.

(A) A retort for the destructive distillation of coal consists of an outer shell and an inner central duct, the space between being divided into narrow wedge-shaped compartments by radial divisions. Heat is applied at the outer edges, and the gases of distillation are withdrawn by way of the central duct. (B) Coke is produced from coal by subjecting the coal in relatively thin masses to heat directed against one edge of the mass and withdrawing the products by suction from the opposite edge. The greatest thickness of the mass should not exceed four inches.—J. E. C.

Peat: Process for expressing liquid from ——. Apparatus for expressing liquid from materials containing the same. J. W. Hinchley, London. and G. Gorton, Bexhill-on-Sea. Eng. Pats. (A) 3998, Mar. 13, 1915, and (B) 101,782, Mar. 13, 1915. (Appl. No. 14,576 of 1916.)

(A) A MIXTURE of peat composed of the upper and lower layers of bog, containing a substantial quantity of fibre, is subjected, without preliminary heat treatment and at ordinary temperature, to a pressure of about 1000 lb. per sq. in., preferably in a hydraulic press. The pressure is reduced to about 200 lb. per sq. in., and steam or hot air at this pressure is forced through in a direction at right angles to the movement of the press. A final pressure of 1100 to 1500 lb. per sq. in. is then applied to express as much of the remaining liquid as possible. The resulting cake may be used as fuel, or carbonised for the production of by-products. (B) A press suitable for the process described in (A) comprises a hydraulic cylinder, 1, ram, 2, and rods, 3, supporting an annular piston, 4. The inner walls of the pressing cylinder, 5, have longitudinal grooves covered by a wire gauze strainer, 5b. A cover, 10, carries rollers, 20 which run on rails, 21, so that it may be removed when the cylinder is to be charged. Steam or hot air is admitted by the passage, 11, to the conical outlet, 13, which is perforated and covered with a wire gauze strainer and perforated cap. Steam and condensed water are discharged through the strainer, 5b, and pipe, 15. During the preliminary compression expressed liquid is discharged through the strainers, 5b, and 13, and pipes, 15, 13¹. In a modification, the pressing cylinder is provided with an additional annular grooved wall with strainer, and an additional annular steam nozzle, both reaching nearly to the top of the cylinder. Three annular concentric pistons are then used, while the communicating space at the top equalises the pressure. The steam-tube, 11, is secured to the support, 6, by a screwed cap, 12, to minimise the height of the press.—W. F. F.



Regenerative [gas retort] furnace. Drakes Ltd., and W. A. Drake, Halifax. Eng. Pat. 101,983, Jan. 3, 1916. (Appl. No. 7 of 1916.)

THE hot waste gases pass downwards through a vertical flue and through a series of separated superposed horizontal flues into another vertical flue provided with a regulating damper at its outlet to the chimney. The air to be heated passes from a horizontal flue upwards on both sides of and between the heating flues into horizontal outlet flues provided with a regulating damper or dampers at their inlet ends. The heated air then passes to the combustion chamber.—W. F. F.

Gas producer. L. Nelson, Wellington, N.Z., Assignor to A. S. Cambridge, Auckland, N.Z. Eng. Pat. 16,088, Nov. 15, 1915. Under Int. Conv., May 20, 1915.

IN a producer of rectangular or oval cross-section, acting on the down-draught principle, a pipe of oblong section is suspended from the top equidistant from the sides and above the combustion zone. The tarry vapours from the upper layers pass into this pipe along with the air or air and steam supply. The tarry vapours and air are thus conducted to the combustion zone in which the tarry matter is decomposed. The grate is supported on brick pedestals to take the weight of the fuel off the grate as much as possible.—J. E. C.

Gas producer. C. D. Nordensson, Springfield, Ohio, Assignor to G. A. Southwell, Chicago, Ill. U.S. Pat. 1,203,246, Oct. 31, 1916. Date of appl., Feb. 25, 1916.

IN a down-draught gas producer, a mixture of air and vapour is admitted from a vaporiser to the upper portion of the fuel bed and to an intermediate part. An inverted V-shaped fuel deflector is fitted at the bottom of the fuel chamber and the gases produced pass round the lower edge of the deflector to an exit pipe.—J. E. C.

Liquid fuel. F. C. Axtell, New York. U.S. Pat. 1,204,638, Nov. 14, 1916. Date of appl., Sep. 5, 1916.

A LIQUID fuel consists of a mixture of about 20 vols. of kerosene, 10 vols. of light hydrocarbon distillate, 10 vols. of alcohol (95% vol.), and 4 vols. of anhydrous fusel oil.—J. E. C.

Petroleum; Process of reducing crude ——. C. Forward, Urbana, Ohio. U.S. Pat. 1,202,823, Oct. 31, 1916. Date of appl., Mar. 23, 1916.

HYDROCARBON oil is atomised by superheating vapours in a suitable chamber in which a uniform pressure of 50 lb. and upward and a uniform temperature of 400° F. (about 200° C.) and upward is maintained by the injected vapours. The liquid and volatile products are drawn off separately at such a rate as to maintain the conditions in the chamber. The liquid products pass into one or more succeeding chambers, and undergo similar treatment for the recovery of additional volatile oils.—J. E. C.

Hydrocarbons; Treating —— and products therefrom. W. M. Cross, Kansas City, Mo., Assignor to Gasoline Products Co. U.S. Pat. 1,203,312, Oct. 31, 1916. Date of appl., Jan. 9, 1915.

A CONVERTER is partially filled with hydrocarbon oil so as to leave a vapour space above the main body of oil. A portion of the oil is circulated through a series of heated pipes and returned to the converter, a vapour pressure out of proportion to the temperature being produced. The vapours are removed and condensed.—J. E. C.

Oil; Apparatus for purifying ——. O. J. Shiner; M. E. Shiner, administratrix, Assignor to T. A. Murphy, Bayonne, N.J., L. B. Wight, Washington, D.C., and M. A. Davidson, Elizabeth, N.J. U.S. Pat. 1,203,119. Oct. 31, 1916. Date of appl., May 1, 1913.

THE invention comprises a series of closed tanks for treating oil with acids or other chemicals and washing it. The oil is conveyed through the tanks in a continuous stream.—J. E. C.

Lignite; Process of treating ——. C. Melhardt, Starnberg-Munich, Germany. U.S. Pat. 1,205,007, Nov. 14, 1916. Date of appl., Jan. 20, 1915.

SEE Eng. Pat. 24,299 of 1914; this J., 1916, 526.

Water-gas and like products: Producers for ——. H. S. Jones, London. From Dellwik-Fleischer Wassergas Ges., Frankfort, Germany. Eng. Pat. 18,218, Dec. 31, 1915.

See Ger. Pat. 287,616 of 1914; this J., 1916, 246.

Oils: Apparatus for the distillation of ——. S. J. Ross and H. Schofield, London. U.S. Pat. 1,204,492, Nov. 14, 1916. Date of appl., Dec. 22, 1915.

See Eng. Pat. 15,538 of 1914; this J., 1916, 298.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Coal; Low-temperature distillation of ——. H. A. Kuhn, Pittsburgh, Pa. U.S. Pat. 1,204,780, Nov. 14, 1916. Date of appl., Feb. 29, 1916.

Coal is distilled in a retort having two distinct zones. In the first (vertical) zone a primary distillation of coal dust is effected, the solid residue being conveyed through the second (horizontal) zone. The chambers are heated externally by a current of hot gases at a temperature varying from 900° to 1200° F. (about 480° to 650° C.). —J. E. C.

Gas [heating] furnace. J. Lehmann, Bochum, Germany. Eng. Pat. 101,077, May 4, 1916. Under Int. Conv., July 30, 1915. (Appl. No. 6439 of 1916.)

In a gas heating furnace the gas or combustion air is admitted to one end of a recessed channel on the inside of the furnace wall. Combustion takes place when the gas or air leaves the conducting channel, and a longer flame is produced. If desired both the gas and the air may be introduced into separate channels formed in the furnace wall. —J. E. C.

Filaments for incandescence electric lamps; Process of manufacturing ——. F. Baumann, Assignor to Wolframlampen A.-G., Augsburg, Germany. U.S. Pat. 1,205,080, Nov. 14, 1916. Date of appl., Mar. 8, 1913.

See Fr. Pat. 457,096 of 1913; this J., 1913, 1002.

Attachment for miners' electric safety lamps for detecting firedamp and other combustible gases. Eng. Pat. 15,094. *See* XXIII.

Improvements in photometers, especially sector photometers. Eng. Pat. 15,663. *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Sulphurous acid esters: Aromatic ——. M. M. Richter. Ber., 1916, **49**, 2339—2345.

Aromatic esters of sulphurous acid were obtained by the action of thionyl chloride on phenols in presence of sufficient pyridine to combine with the hydrogen chloride formed, the reaction being carried out in a suitable neutral solvent, such as carbon bisulphide, ether, or benzene. The reaction products, freed from pyridine hydrochloride by filtration, gave, on evaporating the solvent *in vacuo*, an analytically pure sulphite. Diphenyl and the ditolyl sulphites are yellowish liquids having a faint sulphurous odour. They are remarkably stable towards water and alkalis, and can be distilled *in vacuo* with but slight decomposition. The dinaphthyl sulphites are white crystalline substances which become discoloured on keeping. The β-sulphite is very sensitive to water, the α-isomeride, on the other hand, stable. Di- and hexa-chlorodiphenyl sulphites were obtained as crystalline substances, which water immediately decomposed into the free phenol and sulphurous acid. The hexabromo-compound appeared to be more stable.—G. F. M.

Patents.

Pitch and the like: Method of and apparatus for handling ——. J. C. Mann, West Bromwich, and H. W. Robinson, Rugeley. Eng. Pat. 101,988, Jan. 15, 1916. (Appl. No. 652 of 1916.)

A steam-jacketed spreader delivers the pitch or the like on to a conveyor which passes through a trough of water and is also cooled by jets of water. The brittle material is broken into fragments at the end of the conveyor, for example, by an eccentric roller.—F. W. A.

Toluene and benzene from xylene and cymene; Production of ——. W. F. Rittman, New York. Eng. Pat. 13,100, Sept. 13, 1915. Under Int. Conv., July 7, 1915.

See Fr. Pat. 479,786 of 1915; this J., 1916, 1103.

IV.—COLOURING MATTERS AND DYES.

Coal tar colours; Physiological and pharmacological studies on ——. *Fat-soluble dyes.* W. Salant and R. Bengis. J. Biol. Chem., 1916, 27, 403—427.

The action of the following dyes was investigated: Benzeneazo-β-naphthylamine (Yellow AB), tolueneazo-β-naphthylamine (Yellow OB), benzeneazobenzeneazo-β-naphthol (Sudan III), benzeneazo-β-naphthol (Sudan I), benzeneazodimethylaniline (Butter Yellow), benzeneazophenol (Oil Yellow), benzeneazoresorcinol (Sudan G), and aminoazobenzene (Spirit Yellow); these were administered subcutaneously, intraperitoneally, intravenously, and by mouth to rabbits, and, in a few cases, to cats and rats. The effect of renal disturbance on the elimination of the dyes was determined by the administration of zinc malate and of chenopodium oil. It was found that the dyes were eliminated in the urine and in the bile, but that the elimination in the urine was usually inhibited in poisoning with zinc or chenopodium oil. The greater part of the dyes was deposited in the adipose tissues; staining of the nervous tissue, the kidney, and muscle was also noticed in some of the experiments. Dye was still present in the blood 15 hours after the intravenous injection of 25 mgrms. of benzeneazoresorcinol per kilo. of animal. Two of the compounds of benzeneazophenol and benzeneazoresorcinol, which were isolated from the urine of rabbits, proved to be conjugated with glucuronic acid. The toxicity of the various dyes was not pronounced even when large doses were administered.—W. P. S.

Patents.

Azo-dyestuffs: Manufacture of chromium compounds of —— *containing groups capable of being chromed, and process of dyeing therewith.* O. Imray, London. From Soc. of Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,156, Nov. 2, 1915.

New chromium compounds of *o*-hydroxy-diazo-compounds are obtained by boiling an aqueous solution or suspension of an *o*-amino-phenol or -naphthol derivative with chromium oxide or a salt thereof, and diazotising the chromium compound obtained; on coupling the product with a dyestuff component, chromium compounds of *o*-hydroxyazo dyestuffs ("half-chrome" compounds) are obtained which yield fast tints on animal fibres from an acid bath on after-chroming, or may first be treated with chromium oxide or a salt thereof to saturate with chromium all groups capable of being chromed. (Reference is directed in pursuance of Sect. 7, Sub-sect. 1, of the Patents and Designs Act, 1907, to Eng. Pat. 26,460 of 1912 ; this J., 1913, 905.)—F. W. A.

Wool dyestuffs : Brown ——. M. Becke and W. Suida, Vienna, Assignors to Farbw. vorm. Meister, Lucius, und Brüning, Hoechst, Germany. U.S. Pat. 1,196,122, Aug. 29, 1916. Date of appl., July 8, 1916.

BROWN dyestuffs for wool are obtained by the action of *p*-phenylenediaminesulphonic acid on benzoquinone or a halogen derivative thereof. Dyeings of great fastness to washing and to light are obtained : the fastness is increased by subsequent treatment with chromates or copper salts. *Examples :* (A) 123 parts of chloranil, 188 parts of 1.4-diaminobenzenesulphonic acid, and 272 parts of sodium acetate crystals are ground intimately for about 24 hrs. ; (B) 51 parts of benzoquinone, 188 parts of 1.4-diaminobenzenesulphonic acid, 98 parts of sodium bichromate, and 95 parts of sodium carbonate crystals are ground together.—F. W. A.

Colour-lakes fast to light. E. Meckbach, Cologne, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,203,642, Nov. 7, 1916. Date of appl., May 14, 1915.

LAKES of great fastness to light and purity of colour are claimed containing in combination, a basic dye, *e.g.*, an alkylated dehydrothiotoluidine, aluminium, and either a polyhydroxyanthraquinone colouring matter, an aminoanthraquinonesulphonic acid, or an aminohydroxyanthraquinonesulphonic acid.—F. W. A.

Nitrosamines of primary aromatic amines ; Manufacture of alkali salts of ——. A. G. Bloxam, London. From Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. Eng. Pat. 15,884, Nov. 10, 1915.

SEE Ger. Pat. 292,118 of 1915 ; this J., 1916, 1151.

[*Anthracene*] *vat dyes ; Producing* ——. O. Bally and R. Metzger, Mannheim, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,204,639, Nov. 14, 1916. Date of appl., Dec. 1, 1913.

SEE Eng. Pat. 5248 of 1913 ; this J., 1914, 194.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Paper-making materials ; Restrictions on imports of ——.

THE President of the Board of Trade has informed the Paper Commission that the Government have decided that the imports of paper materials must, from 1st January next, be placed on the same footing as the imports of paper, that is to say, the imports of paper-making materials must be reduced by one-half instead of one-third as at present. The licences issued by the Commission for importation in respect of the supply already allowed for the two months January and February, 1917, will be reduced accordingly (see this J., 1916, 280).

PATENTS.

Threads [*artificial silk*] *; Apparatus for making* ——. C. S. Althouse, Reading, Pa. U.S. Pat. 1,202,766, Oct. 31, 1916. Date of appl., July 10, 1914.

THREADS are produced from cellulose solutions in an apparatus consisting of a reservoir from which the solution flows through a centrifugal separator which cleanses it without interrupting the flow. The solution then passes to a nozzle from which it issues in filaments and falls into a coagulating liquid contained in a funnel, the stem of which is provided with means regulating the discharge of the liquid. A second funnel, placed below the first, receives the filaments and coagulating liquid, and has an outlet of greater capacity than the first, so that a pulling effect is produced on the thread as it passes through with the coagulating liquid.—F. SP.

Cellulose esters ; Process for the manufacture of ——. F. Collischonn, Frankfort, and F. Ruppert, Mainz-Mombach, Assignors to Ver. für Chem. Industrie in Mainz, Germany. U.S. Pat. 1,201,260, Oct. 17, 1916. Date of appl., Aug. 29, 1913.

CELLULOSE esters (particularly cellulose acetate) insoluble in acetone, are converted into esters soluble in acetone, by heating them to 90°—110° C. in a solution containing water but no other substance having a hydrolytic action on cellulose esters, until a sample dissolves to a clear solution in acetone, but not in ethyl acetate.—F. SP.

Acetylcellulose plastic compounds ; Process of making ——. W. J. Lindsay, Caldwell, N.J., Assignor to The Celluloid Co., New York. U.S. Pat. 1,203,756, Nov. 7, 1916. Date of appl., June 8, 1915.

PLASTIC compositions are made from acetone-soluble acetylcellulose by mixing it with *p*-ethyltoluene-sulphonamide, with or without triphenyl phosphate, adding a mixture of ethyl acetate and methyl alcohol, allowing the excess of solvent to evaporate, and working the mass in the usual way.—F. SP.

Paper-making process. D. Kelleher, Assignor to Hind and Dauch Paper Co., Sandusky, Ohio. U.S. Pat. 1,203,008, Oct. 31, 1916. Date of appl., July 10, 1916.

A SCREEN surface is immersed in a body of pulp solution, and suction is applied to one side of the screen over a narrow area while the other side only is in contact with the pulp ; the narrow suction area is shifted relatively to the screen and the pulp solution in a direction at right angles to the length of the suction area, so that the suction acts on portions of the screen successively ; the shifting of the suction area is repeated successively so long as the screen is in contact with the pulp solution, and the action of the suction may be continued while varying the depth of immersion of the screen in the pulp. Lastly the screen is removed with the deposited pulp and the latter is subjected on the screen to the action of air for drying.—J.F.B.

Paper containers ; Stock for —— *and process of producing same. Moisture-proof paper-stock and method of producing.* C. A. Bickett, Cincinnati, Ohio. U.S. Pats. (A) 1,203,302 and (B) 1,203,303, Oct. 31, 1916. Dates of appl., (A) June 14, 1913, and (B) Apr. 1, 1915.

(A) STOCK for making paper containing vessels is prepared by uniting two sheets of paper by means of an adhesive which is immiscible with the waterproof material applied to the exposed surface of one of the sheets, so that the proofing material is prevented from penetrating to any considerable depth in the thickness of the proofed sheet. The proofing material may be applied only to portions of the treated sheet, the remaining portions being left free for the application of an adhesive. (B) The stock consists of a plane-faced sheet of paper coated on one face with a fluid, moisture-proof material, such as paraffin, except on those portions where it is desired subsequently to apply printing or an adhesive for forming the containers, in such a manner that the paraffin does not penetrate to the opposite face of the sheet.—J. F. B.

Pulp for paper and the like; Process of producing ——. R. B. Embree, Kingsport, Tenn. U.S. Pat. 1,203,511, Oct. 31, 1916. Date of appl., June 3, 1916.

Wood is shredded by separation of its fibres lengthwise until reduced to portions sufficiently small to be readily soaked. The shredded wood, thoroughly moistened, is rubbed between stones to reduce it to fibrous strands in suitable condition for pulping; the material is treated with a solution to neutralise tannic acid without reducing the binding matter and finally converted into a pulp for the production of coarse paper.—J. F. B.

Rosin [paper] sizing composition. J. A. De Cew, Montreal. U.S. Pat. 1,203,857, Nov. 7, 1916. Date of appl., Oct. 12, 1911.

Approximately 1% of a rubber product is dissolved in an alkali resinate.—J. F. B.

Waterproofing composition [for fabrics]; Non-inflammable ——. J. O. Persons, Norfolk, Va. U.S. Pat. 1,201,056, Nov. 7, 1916. Date of appl., Apr. 26, 1915.

Carbon tetrachloride is added to a solution of rubber cement in quantity at least equal to that of the rubber-solvent employed, to make it non-inflammable. Suitable proportions are: rubber cement, 10—15; spirits of turpentine, 4·5—7; paraffin wax, 2—4; gasoline, 20—40; carbon tetrachloride, 40—75 parts.—J. F. B.

Sulphite liquor; Process of making an adhesive from waste ——. J. A. De Cew, Montreal. U.S. Pat. 1,203,856, Nov. 7, 1916. Date of appl., Feb. 17, 1913.

Waste sulphite wood-pulp liquor is concentrated *in vacuo* with an excess of magnesium oxide, and magnesium chloride is added to the product in proportion equivalent to the amount of magnesium oxide remaining in excess, to form magnesium oxychloride.—J. F. B.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching processes for thick, full-bleached cotton; Experiments with various ——. M. Freiberger. Z. angew. Chem., 1916, 29, 397—400.

Cold- or warm-bleached cotton, especially the former, in case it has not been soured, tends to become yellow. Even if a satisfactory white has been produced by cold bleaching and subsequent souring, its keeping qualities are unsatisfactory. A very pure white was obtained with warm hypochlorite solution without the materials showing any tendency to turn yellow. Over-bleaching, whether it was caused by an increase in the active chlorine of the bleach solution or by raising the temperature of the bath or the duration of its action, destroyed the white and its stability. Warm over-bleaching is not so deleterious as cold. It is better to increase the time of action of the bleaching solution than to raise its temperature above a certain limit. Souring improves the white produced by alkaline bleaching and its stability, although cotton so treated takes up more Methylene Blue than unsoured material. From this it follows that the affinity of the Methylene Blue mordants for the basic dyestuff afford no correct measure of the tendency of soured or unsoured materials to turn yellow. Much better results are obtained by using a hypochlorous acid bath at a higher temperature. The amount of Methylene Blue mordants produced in acid bleaching are not related to the stability of the white in the same manner as in the hypochlorite treatment; the more Methylene Blue mordants are present in the material treated with hypochlorite, the more it tends to become yellow, whereas the Methylene Blue mordants formed in acid bleaching only lead to yellowing in a less degree, if at all, and the amounts of these mordants in the finished material are not directly proportional to the stability of the white. It is possible that not only the substances not removed by bowking or destroyed by hypochlorite, but also those produced by warm alkaline bleaching as well as the Methylene Blue mordants are converted into substances which do not tend to become yellow. The action of hypochlorous acid improves even material bleached with warm hypochlorite solution, and undoubtedly the best process is to treat fabric with warm hypochlorite and then with an acid bleaching bath, when a pure white of satisfactory stability is obtained. Comparison of two white bleached materials of apparently equal value showed that the sample which had been treated in a cold alkaline bleaching bath and subsequently soured became four times as dark on storing and steaming and twice as dark with Methylene Blue as the sample treated in a warm alkaline and then in a warm acid bleaching bath.—F. W. A.

Patents.

Proofing canvas and like textile fabrics; Process for ——. J. Inglis, Dundee. Eng. Pat. 101,894, Jan. 13, 1916 (Appl. No. 573 of 1916), and June 14, 1916 (Appl. No. 8403 of 1916).

Colour shades of regular or irregular character are produced by proofing canvas and like textile fabrics with two solutions of "cupra-ammonia," to one of which is added an inorganic agent, *e.g.*, a chromate, and to the other an organic agent, *e.g.*, gallic or tannic acid. The two solutions may be applied separately or after admixture.
—F. W. A.

Waterproofing fibrous materials; Process of —— *and product.* W. W. Carter, Needham, Assignor to The Newton Co., Newton, Mass. U.S. Pat. 1,202,803, Oct. 31, 1916. Date of appl., Oct. 22, 1914.

Fibrous materials are waterproofed by impregnating with a molten insoluble soap mixture containing a soap possessing tough and elastic properties when solid and another soap introducing qualities of softness and flexibility, and allowing the soap to solidify in the fibres. A molten mixture of one part of the lead soap of oleic acid to nearly two parts of Chinese wood oil soap is specially claimed.—F. W. A.

Dyeing hairs, furs, etc.; Process for ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 294,184, July 9, 1915.

The material is treated with a solution of a triaminodiphenylamine or a homologue thereof or of a corresponding sulphonic acid, with or without an oxidising agent. Suitable triaminodiphenylamines are obtained by condensation of phenylene- or toluylenediamines or their sulphonic acids with chlorodinitrobenzene, and subsequent reduction.
—A. S.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. F. Fresenius and A. Zimmer. Ger. Pat. 294,572, Dec. 24, 1914. Addition to Ger. Pats. 291,138 and 293,232 (this J., 1916, 834, 1057).

The use of ammonium, potassium, or sodium molybdate, together with aromatic hydroxy or amino compounds, with or without addition of metallic salts, for dyeing leather, silk, cotton, wood, and paper, and for the preparation of water-, oil-, and lake-colours, is claimed.—A. S.

Wool-like effects on cotton fabrics ; Production of ——. Heberlein und Co., Wattwill, Switzerland. Ger. Pat. 294,571, July 18, 1914. Addition to Ger. Pat. 290,444 (see Fr. Pat. 468,821 of 1914 ; this J., 1914, 959).

The material is treated with sulphuric acid of 49°—51° B. (sp.gr. 1·514 to 1·546), washed, mercerised without tension, and again washed. —A. S.

Printing fabrics with colours which "run" or "bleed." W. Roessingh, Veenendaal, Holland. Ger. Pat. 294,666, June 16, 1914.

The printing paste contains a dyestuff or dyestuffs, an alkali or alkaline substance, and a reducing substance capable of converting the dyestuffs into leuco-compounds, and in addition a developer, *i.e.*, a substance or substances capable of combining with diazo compounds in alkaline solution to form insoluble azo dyestuffs. This paste is printed on the fabric, which, if necessary, may be first soaked in water or in a dilute solution of a thickening agent : the printed material is steamed to produce the leuco-compounds, then passed through a slop padding machine to cause the developer to "run" or "bleed," and afterwards through a diazo solution.—A. S.

Manufacture of chromium compounds of azo dyestuffs containing groups capable of being chromed, and process of dyeing therewith. Eng. Pat. 15,456. *See* IV.

VII.—ACIDS ; ALKALIS ; SALTS ; NON-METALLIC ELEMENTS.

Bleaching powder supplies. Committee appointed.

The Ministry of Munitions has appointed a representative Committee, called the Bleaching Powder Users Committee, under the chairmanship of Colonel Alan Sykes, M.P., to advise and consult with the Munitions Department as to the needs of the users of bleaching powder. All users of bleaching powder who are experiencing difficulties in obtaining their supplies are requested to communicate with the Secretary of the Committee at 4, Norfolk Street, Manchester.

Waste lyes from the potash industry : Removal of sulphates from ——. H. Hof. Chem.-Zeit., 1916, **40**, 893.

It is pointed out that the process claimed in Ger. Pat. 270,620 of 1912 (this J., 1914, 422) for the removal of sulphates from the waste lyes by means of calcium chloride has been previously investigated by Schwarz (Dingl. Polyt. J., 1876, **219**, 345—360), who proved that the precipitate obtained when magnesium chloride is present consists of gypsum, not syngenite ($K_2SO_4,CaSO_4,H_2O$). By agitating waste lyes containing potassium and magnesium sulphates with finely powdered anhydrous calcium sulphate, some syngenite was formed, but even after 24 hours only about one-half of the soluble sulphate had been precipitated.—W. R. S.

Oxidising agents ; Potential changes on illumination of ——. T. Swensson. Z. physik. Chem., 1916, **91**, 624—636. J. Chem. Soc., 1916, **110**, ii., 518.

The author has studied the influence of ultra-violet light on the oxidation potential of a solution of potassium bichromate and sulphuric acid. Solutions of potassium bichromate and sulphuric acid were placed in quartz vessels and the potential measured against a platinum electrode in the usual way. The solution was then subjected to the light from a mercury lamp, and the potential again measured after the light had been removed. The potential rapidly rises when the solution is illuminated, and on removing the light it slowly falls again. The same effects are observed whether the platinum electrode is present in the solution when it is illuminated or not. The cause of the large change in potential is in some way due to a mutual action of the bichromate and sulphuric acid, since both potassium bichromate solution and sulphuric acid when submitted alone to the action of the light only give a lowering of the potential, whereas chromic acid solution gives a slight increase. Experiments with $N/1$-, $N/2$- and $N/3$-solutions show that the increase of potential is independent of the concentration. In the case of a solution of 1 mol. of potassium bichromate and 4 mols. of sulphuric acid per litre, the increase in the potential by illumination is 0·2280 volt.

Mercury salts : Volumetric determination of ——. *Evaluation of mercuric chloride compresses.* G. Adanti. Boll. Chim. Farm., 1916, **55**, 553—554. J. Chem. Soc., 1916, **110**, ii., 579—580.

The method is based on the reduction of mercury salts to metallic mercury by means of formaldehyde in presence of potassium hydroxide. The mercury is treated with excess of a standard iodine solution, the excess of the latter over the amount required to convert the mercury into mercuric iodide being determined by titration with standard sodium thiosulphate solution. The method is rapid and gives very exact results, and is carried out as follows. One gram of the mercuric salt or of the mercuric chloride compress is treated with a little water and, if necessary, sodium chloride to dissolve the mercuric salt, the solution being made up to 250 c.c. Fifty c.c. of the liquid is mixed in a beaker with 5 c.c. of formalin (about 40% aqueous formaldehyde solution) and 10 c.c. of 33% sodium or potassium hydroxide solution, and the whole heated on a water-bath for a few minutes and then allowed to cool. The liquid is now neutralised with acetic acid and the precipitated mercury collected and washed. Filter and precipitate are shaken with 100 c.c. of water slightly acidified with acetic acid and exactly 20 c.c. of $N/10$ iodine solution until all the mercury has passed into solution as mercuric iodide, and the excess of iodine is estimated ; 1 c.c. of $N/10$-iodine $=0·01$ grm. of mercury or 0·01355 grm. of mercuric chloride.

Lead arsenates. Equilibrium in the system PbO, As_2O_5, H_2O. C. C. McDonnell and C. M. Smith. J. Amer. Chem. Soc., 1916, **38**, 2366—2369. (See also this J., 1916, 1154.)

The three-component system PbO, As_2O_5, and H_2O can be easily investigated as far as mono- and di-lead arsenates are concerned, but the system as such cannot be followed beyond di-lead arsenate owing to the insolubility of lead hydroxide. Ammonia seemed particularly suitable as a base to produce the desired alkalinity. The use of ammonia in such a system introduces a fourth component, but by keeping its concentration constant, the system will behave like a three-component one. The results obtained are given in a table and graph. They show that the action of dilute ammonia on di-lead ortho-arsenate proceeds as follows :—(1) Transposition to tri-lead ortho-arsenate, the supernatant solution remaining constant at the $(NH_4)_2HAsO_4$ stage until transformation is complete. (2) Formation of solid solutions ranging from tri-lead arsenate to a basic arsenate (molecular ratio $PbO, As_2O_5 = 3·253$), beyond which no further change occurs. About 100 grms. of tri-lead arsenate was prepared by treating di-lead arsenate with the theoretical amount of $N/10$ ammonia, as calculated from the data given. The product contained a small amount of water not expelled at 110° C. It is an amorphous powder with a sp.gr. of 7·00 at 15°/4° C. Crystallised tri-lead arsenate (anhydrous) prepared by fusion had a sp.gr. of 7·30 at 15°/4° C.—T. H. B.

Vanadic acid; Reduction of —— by hydriodic acid. G. Edgar. J. Amer. Chem. Soc., 1916, **38**, 2369—2377.

According to Ditz and Bardach (Z. anorg. Chem., 1915, **93**, 97) the reduction of vanadic acid by hydriodic acid at the ordinary temperature proceeds irregularly, but the amount of iodine liberated corresponds approximately to the reduction of quinquevalent to trivalent vanadium. Their results were, however, probably vitiated by the effects of atmospheric oxidation, for on allowing the reaction to take place in an atmosphere of hydrogen, the author found that reduction to the quadrivalent condition is quantitative even when the concentration of acid is three times and that of iodide four times that used by Ditz and Bardach. The mechanism of the reaction between vanadic acid and the halogen acids, and the influence of various factors upon the equilibrium is discussed, and it is considered that the conflicting results of different investigators are due to neglect to take into consideration the effect on the reaction of the concentration of the halogen ion, the concentration of the VO^{+++} ion, the discharging potential of the halogen ion, and removal of the liberated halogen from the solution (usually by boiling, evaporation, extraction, or by reaction with a metal).—T. H. B.

Tungsten derivatives; Analysis of certain —— O. R. Sweeney. J. Amer. Chem. Soc., 1916, **38**, 2377—2383.

Peculiar difficulties are met with in the analysis of "complex inorganic acids," particularly in connection with the separation of phosphoric and vanadic acids from molybdic and tungstic acids. It was found that in presence of a tungstate arsenic is expelled only with great difficulty from an arsenate even when heated in a stream of dry hydrogen chloride. By heating at a temperature a few degrees below that at which volatilisation of tungstic acid takes place, however, all the arsenic can be removed. An antimonio-tungstate when treated in a similar manner, also gave concordant results. When dry hydrogen chloride was passed over a sodium vanadio-tungstate the vanadium volatilised as a red vapour condensing to a reddish-brown liquid (the oxychloride). The residue was, however, soon reduced to a brownish mass, no longer attacked, but by introducing chlorine gas along with the hydrogen chloride the vanadic acid was rapidly and completely expelled. The appearance of the red vanadium oxychloride proved a delicate test for vanadium. When this no longer showed, it was always found that the vanadic acid had been completely expelled. For estimating the vanadium after volatilisation, the volumetric method using potassium permanganate was found best suited to the conditions of the experiments. It was proved that no loss occurred on evaporating a strong hydrochloric acid solution of vanadium.—T. H. B.

Tungsten; New derivatives of ——. J. B. Hill. J. Amer. Chem. Soc., 1916, **38**, 2383—2391.

The action of chlorine on tungsten metal to form the hexachloride is catalysed to a remarkable degree by the presence of a small amount of platinum black. In presence of the latter 20 grms. of pure tungsten was converted into the hexachloride in 1½—1¾ hours, whereas in absence of platinum, seven hours was required to convert 10 grms. of tungsten. By the action of sodium-amalgam on the hexachloride the author obtained the compound, $W_6Cl_{12}.2HCl,9H_2O$, resembling the molybdenum derivative, $Mo_3Cl_6.HCl,4H_2O$ prepared by Rosenheim and Kohn (Z. anorg. Chem., 1910, **66**, 1). The alkaline solution of this compound oxidises readily and from the solution, stable hydrates of trivalent and quadrivalent tungsten were obtained.—T. H. B.

Yttrium; Purification and atomic weight of ——. B. S. Hopkins and C. W. Balke. J. Amer. Chem. Soc., 1916, **38**, 2332—2347.

The ignition of the sulphate to oxide is not a satisfactory method for determining the atomic weight of yttrium, since the result may vary widely according to length of time and temperature of ignition; the anhydrous sulphates are extremely hygroscopic, and there is uncertainty in regard to the complete expulsion of the sulphuric acid. In preparing pure yttria the three methods of purification may be summarised thus: (a) Fractional precipitation with potassium chromate is effective for removing considerable quantities of other rare earths from yttrium, but will not remove all the erbium or holmium. (b) Fractional precipitation with dilute ammonia solution is tedious, and does not produce pure yttria. (c) Fractionation with sodium nitrite is both a rapid and effective means of freeing yttrium material from admixtures of erbium and holmium. The hydrates $Y_2(SO_4)_3.8H_2O$ and $YCl_3,6H_2O$ were found to be too variable for use in atomic weight determination. The atomic weight of yttrium was determined by the ratio $Y_2O_3 : 2YCl_3$, using material from six different fractions. The average of the values obtained is 88·9.—T. H. B.

Conductivity water; Preparation of ——. J. Kendall. J. Amer. Chem. Soc., 1916, **38**, 2460–2466.

One distillation of tap water from various sources, after addition of a few c.c. of Nessler reagent, using Jena glass vessels and a block tin condenser, yielded water of specific conductivity $0{\cdot}9 \times 10^{-6}$ at 25° C. By redistilling in silica vessels water of specific conductivity $0{\cdot}2$ to $0{\cdot}6 \times 10^{-6}$ at 25° C. was obtained, but on standing the conductivity rapidly increased to and remained constant at $0{\cdot}8$ to $0{\cdot}9 \times 10^{-6}$ at 25° C., the specific conductivity of a saturated solution of carbonic acid under atmospheric conditions (see this J., 1916, 269). A lower permanent specific conductivity for water than $0{\cdot}8$ to $0{\cdot}9 \times 10^{-6}$ at 25° C. cannot be obtained unless strict precautions are taken to prevent access of air. It is suggested that in preparing water for conductivity experiments the aim should be to exclude all impurities other than carbonic acid, an exact correction being made for the latter.—T. C.

Graphites; Oxidation products of various ——. A. Lang. Montan. Rundschau, 1916, **19**, 1—3. J. Chem. Soc., 1916, **110**, ii., 561.

The use of molten alkali for the purification of graphite is liable to cause changes in its constitution, and hydrochloric and hydrofluoric acids, etc., are to be preferred for the purpose. Oxidation of graphite by means of permanganic acid gives graphitic acids of variable composition, and more uniform results are obtained with a mixture of concentrated sulphuric and nitric acids and potassium chlorate. There are two graphitic acids occurring in leaflets, distinguishable from one another in colour and composition. The graphitic acids from Acheson, Ceylon, and Russian blast-furnace graphite are yellow, whilst those from Siberian, Italian, Corean, and cast-iron graphite are green, the former being richer in carbon and poorer in oxygen than the latter. Artificial, non-intumescent graphites give graphitic acids of approximately the same composition as the intumescent natural variety. Cast-iron graphite, however, forms an exception, as it approximates in its behaviour to the natural non-intumescent varieties. The colour of the graphitic acids diminishes in intensity in the light. Prolonged washing transforms them into a colloidal modification, whilst on further oxidation or long-continued heating at 120—130° C. they assume a darker, earthy-brown colour. In both cases disintegrative oxidation occurs.

Carbon and nitrogen; Combination of —— at the ordinary temperature. A. P. Lidov. pp. 4. Charkov. 1916.

In presence of catalytic iron, the interaction of carbon and air (freed from carbon dioxide) in the cold consists first in the gasification of the solid carbon with formation of the simplest nitrogen-carbon compounds, namely, active α- and inert β-monocyanogen. The oxygen of the air does not take part in the initial stage of the process; this result agrees with those of the author's earlier experiments with pure oxygen in the cold, which showed that under such conditions carbon does not undergo the slightest gasification. In the second phase of the process, the α-monocyanogen is oxidised to the stable α-oxan, OCN, and possibly to peroxan, O_2CN.—T. H. P.

Carbon; Oxidation of —— by air at low temperatures in presence of iron and other metals. A. P. Lidov. Reprint, pp. 11, Charkov, 1916.

Experiments have been made on the oxidation of finely divided carbon in the air at low temperatures in presence of lead, nickel, iron, and other metals. Charcoal activated with lead does not lose its activity for a very long time, whereas that activated with nickel or iron loses it rapidly, probably because the metal precipitated on the surface of the charcoal undergoes conversion into its higher oxide. The specific gravity of the gas giving a precipitate in barium hydroxide solution and obtained by the oxidation of carbon activated by means of lead is always less than that obtained from carbon activated with nickel or iron and is, on the average, very near to the specific gravity of oxan.—T. H. P.

Natural limestones; Carbon dioxide from ——. A. P. Lidov. pp. 35. Charkov, 1916.

A number of samples of calcspar, aragonite, friable limestones such as chalk, dense limestones such as marble, etc., have been decomposed with acid and the specific gravity of the evolved gas measured. Variable results were obtained, the values for the gas from calcite being exceptionally low. In explanation of this phenomenon, it is suggested that many limestones contain a more or less considerable proportion of α-oxan, OCN, in addition to the combined carbon dioxide; owing to its ease of formation, α-oxan may exist in wide distribution.—T. H. P.

Colloidal iodine. H. Bordier and G. Roy. Comptes rend., 1916, **163**, 567—569. (See this J., 1916, 962 and 1058.)

Iodine, dissolved in pure water, is in the colloidal state, but is in the form of "amicrons" too small to be seen by the ultramicroscope. The presence of gelatin, in suitable proportions, has the effect of facilitating the union of the amicrons into larger particles visible in the ultra-microscope. By submitting the pseudo-solution of iodine in gelatin to a potential difference of 62 volts, the particles are displaced towards the positive electrode and are therefore charged negatively; the discharge of most of the particles is complete and the iodine resumes its crystalline form. In the presence of a small quantity of sodium thiosulphate, however, the discharge is not completed, although the particles are displaced towards the positive electrode, but a deep red-brown coagulum is formed showing masses of agglomerated granules without any appearance of crystalline form.—B. N.

Separation of lithium from other alkali metals. Palkin. *See* XXIII.

Patents.

(A) *Sulphuric acid; Process of making —— and catalyser therefor.* (B) *Process of making sulphuric anhydride.* (C) *Contact material.* (A) and (B). C. Ellis, Montclair, N.J., (C) C. Ellis, Montclair, and H. M. Weber, East Orange, N.J., Assignors to Ellis-Foster Co. U.S. Pats. 1,201,111, 1,204,112, and 1,204,143, Nov. 7, 1916. Dates of appl., (A) Jan. 29, 1916, (B) Dec. 6, 1915, (C) Dec. 17, 1915.

(A) In the manufacture of sulphur trioxide by passing sulphur dioxide and oxygen over a catalyst, the catalyst consists of an intimate mixture of active voluminous chromium oxide and an oxy-compound of an easily fusible heavy metal, which is capable of absorbing sulphur dioxide and acts as binding agent for the chromium oxide but does not combine with it. (B) The catalyst consists of a mixture of voluminous chromium oxide and tin oxide, one of them being in excess of the amount required for the production of tin chromate, and one of the oxides being catalytically active. (C) The catalyst consists of a porous mixture of chromium oxide and an activating agent; this may be obtained for example by heating together a mixture of ammonium bichromate and tin chloride, or a mixture of chromium and tin oxides with an organic substance.—B.V.S.

Nitrous gases; Process of converting —— into concentrated nitric acid. O. Jensen, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,197,295, Sept. 5, 1916. Date of appl., May 27, 1916.

Nitrosulphonic acid, obtained by absorbing nitrous gases in concentrated sulphuric acid, is denitrated by passing it down a tower containing acid-resisting material, where it meets dilute (60%) nitric acid vapour and air (or oxygen) entering at the base. By condensing the vapours leaving the tower, red fuming nitric acid is obtained, and this is decolorised by blowing air through it. The nitrous gases so liberated, together with the uncondensed vapours from the denitrating process, are passed into water, and the dilute nitric acid obtained is used for further denitration. In this way concentrated nitric acid is produced directly from nitrosulphonic acid, and the resulting sulphuric acid is of about 80% strength, so that it requires but little further concentration to make it available for absorbing fresh quantities of nitrous gases.—E. H. T.

Hydrochloric acid, sodium sulphate, and magnesium sulphate; Process of obtaining ——. W. C. Kerr, Catonsville, Ind. U.S. Pat. 1,203,357, Oct 31, 1916. Date of appl., Apr. 4, 1914.

A mixture of nitre cake and magnesium chloride, in the proportion of two molecules of the former and one of the latter, is heated, with a little water, to about 200° C. Hydrochloric acid is evolved and a mixture of sodium and magnesium sulphates remains.—B. V. S.

Zinc sulphate; Manufacture of ——. Metals Recovery, Ltd., and R. W. E. MacIvor, Westminster. Eng. Pat. 12,799, Sept. 7, 1915.

Ores containing zinc and lead sulphides and admixed iron are ground in presence of concentrated zinc sulphate liquors, and separated into fine sands and slimes. The ferruginous sands are roasted to convert the zinc into sulphate, and if the iron content be low, ferric oxide, obtained preferably from the residue of a previous roast, is added to the charge, to accelerate the oxidation of sulphur dioxide to the trioxide, thereby increasing the yield of zinc sulphate. The roasted and partially cooled material is extracted with dilute sulphuric acid in a leaching tank or rotating barrel, whereby both basic zinc sulphate and zinc oxide go into solution. The iron in the leach liquor may be removed by treatment with zinc oxide and injecting heated air; the precipitated ferric hydroxide helps to bind the residual lead ore and to improve it for subsequent treatment in the blast furnace. If much iron be present in the ore, an excess of acid is used for leaching, the iron in the solution is oxidised to the ferric state, and unroasted slimes are added and well stirred in: $Fe_2(SO_4)_3 + ZnS \quad 2FeSO_4 + ZnSO_4 + S$. This action is carried out under an excess pressure of ½—1 atmosphere and in presence of an excess of zinc sulphide. The zinc sulphate liquor may be evaporated and the residue roasted and extracted with dilute acid to eliminate the iron; or it may be treated with more acid, evaporated to yield mono- or di-hydrated zinc sulphate, the mother liquor rich in iron being used for treating raw slimes; or it may be purified from iron by the action of the zinc oxide contained in the sulphated roast.—E. H. T.

Sodium perborate: Electrolytic production of ——. Deutsche Gold- und Silber-Scheidenanstalt, vorm. Roessler, Frankfort, Germany. Eng. Pat. 100,152, Mar. 1, 1916. Under Int. Conv., Mar. 10, 1915. (Appl. No. 3804 of 1916.)

In the electrolytic production of sodium perborate the cathode may be composed of substances such as lead, iron, nickel, copper, or carbon which, *per se* or as compounds, have a decomposing action on the perborate. Except in the case of nickel, it is necessary to protect the cathode at the surface of the liquid by a coating such as platinum or varnish, or by a rubber sleeve.—B. V. S.

Sodium and potassium salts; Separation of ——. H. P. Bassett, Catonsville, Assignor to The Spar Chemical Co., Baltimore, Md. U.S. Pat. 1,194,465, Aug. 15, 1916. Date of appl., Mar. 8, 1915. (See also this J., 1914, 484.)

To a solution containing, *e.g.*, 90 pts. of sodium sulphate and 10 pts. of potassium sulphate, sodium chloride is added in equimolecular proportion to the potassium salt, and the liquid is evaporated until sufficient sodium sulphate has separated to leave an amount of potassium chloride in solution equal to 40% of the total dissolved salts. The mother liquor is then treated with sodium nitrate (in amount equimolecular to the potassium chloride), and the solution is evaporated, whereby sodium chloride and sulphate crystallise out from the hot liquid; and these are used for the treatment of a new batch of the mixed sulphates. The potassium nitrate left in the mother liquor is crystallised out, leaving sodium chloride, sodium nitrate, and about 15% of potassium nitrate in solution; it is separated, re-dissolved in water, added to the original solution of mixed sulphates (so that equimolecular proportions of sodium sulphate and potassium nitrate are present), and on evaporating, potassium sulphate crystallises, which is removed and washed with hot water. The wash water, containing chiefly sodium nitrate, together with the mother liquor from the potassium nitrate crystallisation, is added to the solution containing 40% of potassium chloride, instead of fresh sodium nitrate. The reagents are thus used over and over again, the only materials separated being sodium sulphate from the first evaporation and potassium sulphate from the last.—E. H. T.

Alumina; Crystalline fused —— and the manufacture thereof. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,192,709, July 25, 1916. Date of appl., Dec. 1, 1914.

A charge of aluminous ore, *e.g.*, bauxite, with or without a small proportion of carbon, is heated to a temperature several hundred degrees above its melting point, in an electric furnace, and is then run off into a shallow mould in which it quickly solidifies. The solid product is ground and consists of alumina crystals (mostly 0·01 to 0·3 mm., with an average diameter of about 0·1 mm.) and a uniformly distributed "residual basis," composed mainly of compounds of titanium, iron, and silicon, derived from impurities in the ore. It is superior to ordinary crystalline fused alumina as an abrasive.—F. Sodn.

Sulphuric acid chamber. J. Harris, Sheffield, and D. H. Thomas, Morriston, Wales. U.S. Pat. 1,203,615, Nov. 7, 1916. Date of appl., Mar. 27, 1916.

See Eng. Pat. 6026 of 1915; this J., 1915, 1249.

Nitrate of lime and similar substances; Process of granulating —— without dephlegmation and dust. A. Holter, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,203,740, Nov. 7, 1916. Date of appl., Jan. 6, 1914.

See Fr. Pat. 466,963 of 1914; this J., 1914, 865.

Lead oxide; Method and apparatus for producing ——. E. Barthelmess, Neuss, Germany. U.S. Pat. 1,204,537, Nov. 14, 1916. Date of appl., Apr. 25, 1914.

See Fr. Pat. 466,129 of 1913; this J., 1914, 593.

Formates; Process of making ——. G. Bredig, Karlsruhe, Assignor to R. Koepp und Co., Oestrich, Germany. U.S. Pat. 1,204,933, Nov. 14, 1916. Date of appl., Dec. 1, 1914.

See Eng. Pat. 801 of 1915; this J., 1915, 1143.

Recovery of the salts contained in the waste gases from Portland cement kilns. Ger. Pat. 294,539. *See* IX.

VIII.—GLASS; CERAMICS.

Patents.

Refractory materials; Process for making ——. C. B. Stowe, Lakewood, Ohio. U.S. Pat. 1,205,056, Nov. 14, 1916. Date of appl., Oct. 6, 1916.

A basic refractory material is made by mixing magnesium carbonate with iron oxide and water and moulding into bricks, etc., which are afterwards burned so as to expel the carbon dioxide and cause the chemical combination of the magnesia with the iron oxide, with the formation of magnesioferrite, MgO,Fe_2O_3. After once burning the material may be crushed to powder, re-made into bricks, and these burned at a still higher temperature.—A. B. S.

Refractory bricks; Manufacture of ——. T. Twynam, Redcar. Eng. Pats. 15,163, Oct. 27, and 16,237, Nov. 18, 1915.

Finely ground raw magnesite, dolomite, or limestone, or a mixture of these is mixed with half its weight of chrome iron ore, not too high in silica, and with water in a pug-mill, and then made into bricks and burned at 1600° C. The bricks shrink very slightly in burning and withstand the action of water for a long time. Equal parts of dolomite, magnesite, and chrome ore also make good, hard bricks, and other proportions may be used so long as there is not less than 20 or more than 80% of chrome ore present. The components must be very intimately mixed.—A. B. S.

Silicon carbide refractory articles. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,204,211, Nov. 7, 1916. Date of appl., May 6, 1913.

Silicon carbide in grains of various sizes between 14- and 150-mesh, so as to give an apparent density of not less than 2·3 when pressed, is mixed with one-ninth of its weight of a binder (*e.g.*, clay) inert to the carbide and having a vitrifying temperature of at least 1500° C., so as to produce articles having, after burning, an apparent density of not less than 2·3.—A. B. S.

Casting earthenware articles: Process of making slips for ——. C. J. Kirk, New Castle, Pa. U.S. Pat. 1,203,011, Oct. 31, 1916. Date of appl., Dec. 29, 1913.

Ball clays, water, and soda salts in suitable proportions are thoroughly mixed in a blunger, and china clays, flint, and felspar are then added in the required proportions.—A. B. S.

Enamel composition. R. Rickmann, Cologne-Marienburg, Germany. U.S. Pat. 1,203,409, Oct. 31, 1916. Date of appl., Feb. 25, 1913.

A white opaque enamel consisting of a difficultly soluble potassium antimoniate combined with an enamel is claimed.—A. B. S.

Crystalline fused alumina, and manufacture thereof. U.S. Pat. 1,192,709. *See* VII.

IX.—BUILDING MATERIALS.

Patents.

Heat insulating material; Manufacture of ——. J. Cuthbertson, London. Eng. Pat. 17,949, Dec. 23, 1915.

Sheets of corrugated paper are rolled into a tube or piled so as to form a slab of the desired thickness and immersed (with or without pressure) in a mixture of two volumes of sodium silicate solution (75° T., sp.gr. 1·375) and one volume of graphite at 95°—100° F. (35°—38° C.). The impregnated paper is taken out, drained, dried in a stove, and then cut to the desired shapes, fitted together to form pipes, etc., and covered with canvas so as to produce waterproof joints.—A. B. S.

Concrete; Treating ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,189,551, July 4, 1916. Date of appl., Oct. 17, 1911.

A composition for waterproofing concrete and rendering it resistant to alkali is made by mixing Jelutong or Pontianak rubber resin or other unsaponifiable resin with a colloidal thickener, such as polymerised tung oil or the aluminium soap of fish oil or of Chinese wood oil, and with waxes and sulphonated oils, the whole being brought to a suitable viscosity by means of a solvent such as benzene or carbon bisulphide. For example a mixture of heat-treated Jelutong resin 25, ceresin 2, oil-soluble compound from cotton-seed oil and sulphur chloride 8, tung acids 10, Japan drier 1, benzol 30, and benzine 24 parts, may be used. Rubber may be substituted for the cotton-seed product when the material is to be applied to strongly alkaline cements, the rubber being previously dissolved in the tung oil by the aid of heat. For structural steel, a viscous material which will bond both with the steel and the concrete is needed. It may consist of heat-treated Pontianak resin 25, recovered rubber 10, wax 5, "candle tar" 5, gilsonite 5, and coal naphtha 50 parts, together with sufficient Portland cement or other filler to make a heavy bodied coating mixture. The concrete may be coated by means of a brush or spray, or small articles may be dipped in the composition. A flat coating may be produced by spraying a solution of Pontianak resin in benzol and adding one-third part of tung oil and 1/24th part of Japan drier and (if desired) 1/12th part of ceresin. For coating acid-tanks, a solution consisting of equal parts of Pontianak rubber resin and tetra- or penta-chloronaphthalene may be used. Where the concrete is liable to destruction by moulds, etc., the coating composition may contain creosote or other antiseptic material.—A. B. S.

Wood; Process of treating ——. H. M. Newton, Minneapolis, Minn. U.S. Pat. 1,203,038, Oct. 31, 1916. Date of appl., May 21, 1914.

Wood is impregnated with a fluid preservative, such as creosote, and part of the latter is afterwards removed from the outer layer of the wood by treatment with steam and by suction, so as to prevent subsequent "bleeding."—A. B. S.

Portland cement kilns; Recovery of the salts contained in the waste gases from ——. F. Schott, Heidelberg. Ger. Pat. 294,539, Jan. 5, 1915. Addition to Ger. Pat. 291,070 (see U.S. Pat. 1,064,550; this J., 1913, 753).

According to the chief patent the hot waste gases were cooled by passing through a boiler and a feed water preheater before passing to the filter chamber to remove the fine dust. In the present patent the interposition of a drum dryer between the preheater and the filter chamber is claimed. The temperature of the gases is thereby reduced to about 60° C., and the life of the filters is prolonged.—A. S.

Cement; Process for burning —— *in shaft kilns.* G. Polysius, Eisengiesserei und Maschinenfabr., Dessau. Ger. Pat. 294,609, June 20, 1914.

The kiln is supported on pillars spaced apart and connected by segments fitted with vertical grate-bars. A cone is mounted to rotate either centrally or eccentrically within the space surrounded by the grating thus formed, and may also be caused to travel in such a manner that its axis traverses the surface of a cone. Below the cone is a fixed or rotary horizontal grate. The cement clinker is broken up by the rotating cone and forced out between the grate-bars.—A. S.

Organic tissue [wood]; Process of protecting —— *from the attacks of destructive organisms.* L. H. Everhart, Baltimore, Md., U.S.A. Eng. Pat. 102,100, Apr. 5, 1916. (Appl. No. 4984 of 1916.)

See U.S. Pat. 1,182,760 of 1916; this J., 1916, 692.

Bituminous substance [for paving]; Process of manufacturing an improved ——. C. Richardson, New York. U.S. Pat. 1,198,769, Sept. 19, 1916. Date of appl., Aug. 24, 1914.

See Eng. Pat. 9838 of 1915; this J., 1916, 891.

Tiles, roof-sheets, and the like; Manufacture of ——. E. R. Sutcliffe, Leigh. U.S. Pats. 1,204,085 and 1,201,086, Nov. 7, 1916. Dates of appl., Oct. 2, 1914, and Apr. 4, 1916.

See Eng. Pat. 22,423 of 1914; this J., 1915, 179.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Trading in war material.

In pursuance of the powers conferred on him by Regulation 30a of the Defence of the Realm (Consolidation) Regulations, 1914, the Minister of Munitions has ordered, under date 2nd November, that the War Material to which the Regulation applies shall include War Material of the following classes and descriptions, namely:—Aluminium and alloys of aluminium, unwrought and partly wrought, including ingots, notched bars, slabs, billets, bars, rods, tubes, wire, strand, cable, plates, sheets, circles, strip. Aluminium scrap and swarf, aluminium alloy scrap and swarf, remelted aluminium scrap and remelted aluminium alloy scrap and swarf. Granulated aluminium, aluminium powder, "bronze," "flake," and "flitter."

Gases in ingots of mild steel ; Distribution of the ——. P. Goerens and L. Collart. Ferrum, 1916, **13**, 145—151. Z. angew. Chem., 1916, **29**, Ref., 471—472.

The authors have found that the gases present in ingots of mild steel are not uniformly distributed, a larger proportion being found in the centre of the ingot than near the outer surface ; this difference is greater in Thomas steel than in Siemens Martin steel, and appears to be due chiefly to accumulation of carbon monoxide in the interior of the ingot. A considerable proportion of the carbon monoxide in the gas extracted from steel is formed by interaction between oxide inclusions and carbon, and analysis of the extracted gas (see this J., 1916, 845) affords a valuable means of ascertaining the degree of deoxidation of the metal. The average amount of gas per c.c. of metal was found to be: Siemens-Martin steel, 6·6 c.c. (CO 4·2, CO_2 0·8, H 1·5, N 0·1 c.c.) ; Thomas steel, 8·0 c.c. (CO 5·2, CO_2 0·8, H 1·6, N 0·4 c.c).
—A. S.

Boron ; Determination of —— in boron-steel. C. Aschman, jun. Chem.-Zeit., 1916, **40**, 960—961.

The steel (1 to 3 grms.) is dissolved in dilute sulphuric acid in a flask beneath a reflux condenser, care being taken to avoid too large an excess of acid. The solution is transferred to a distillation flask, and the flask is connected with an inverted condenser, the end of which passes through a cork in a receiver containing a solution of 0·5 grm. of pure ammonium carbonate in 20 c.c. of water, with a few drops of ammonia. The outlet tube from the receiver dips into a beaker of water. The distillation flask is heated on a sand bath until nearly the whole of the liquid has distilled. The apparatus is then allowed to cool a little, 10 c.c. of absolute methyl alcohol (free from acetone) introduced, and the liquid distilled. This operation is repeated five times, a slow current of air being passed through the apparatus for some minutes after each addition of methyl alcohol, and for 15 minutes after the final distillation. The distillate is evaporated in a platinum basin containing 1 grm. of ammonium phosphate and the residue is gradually ignited in an electric oven and kept at about 1000° C. until the boron phosphate, BPO_4, becomes constant in weight.—C. A. M.

Silver ; Preventing the "spitting" of ——. W. Stahl. Metall u. Erz, 1916, **13**, 297—299. Z. angew. Chem., 1916, **29**, Ref., 470.

When silver which has been precipitated from a sulphate solution by iron, is refined, the molten metal takes up not only atmospheric oxygen but also oxygen liberated by decomposition of adhering silver sulphate, so that the tendency to "spit" on cooling is enhanced (see also this J., 1916, 604). The following method of preventing "spitting" and obtaining sound castings is recommended. After the usual melting operation, the slag is removed, the molten silver covered with a layer of wood charcoal, and the crucible closed with an iron cover. A pole of birch or alder wood is introduced through a hole in the cover. The gases (hydrocarbons, carbon monoxide, etc.) evolved deoxidise the silver and neither they nor their oxidation products dissolve in the molten metal. After some minutes, the pole and cover are removed, a further quantity of charcoal added, and the silver heated to the pouring temperature, and cast in a mould which has been coated with a mixture of oil of turpentine and rosin.—A. S.

Tank resistance in electrolytic [copper] refining; An analysis of ——. L. Addicks. Met. and Chem. Eng., 1916, **15**, 566—571.

The amount of copper recovered in electrolytic refining processes, per kilowatt-hour, is found to depend not only on current efficiency, current density, and the like, but also on the items that constitute tank resistance. This is made up of the resistance of the electrolyte, metallic conductors, contacts, slimes, etc., and counter E.M.F. and in the case of a twin tank system, an analysis of the tank resistance is given as :—electrolyte, 55·1 % ; metallic conductors, 16·2 % ; contacts, 14 % ; slimes, etc., 9·7 % ; and counter E.M.F., 5 %. The conductors, carrying the current to and from the electrodes, must be made as short as possible, whilst the cross-section involves a balance between first cost, the cost of power, and sometimes strength. The cheapest cross-section is stated to be that for which the interest on the copper investment just equals the cost of the power lost by the voltage drop, the current density being usually in the neighbourhood of 500 ampères per sq. in., and a graphical method is given for determining the most economical cross-section for copper conductors. The cathode loops, it is stated, are often made so small as to have a current density far above the economical range. The contact resistances are primarily caused by adsorbed air and secondarily by oxide or other foreign matters on the contact surfaces. Loose gravity joints are stated to form one of the largest sources of waste power, and this loss may be attacked by decreasing the number of contacts, increasing the acting pressure by plugs, clamps, and by the shape of the members, and improving the condition of the surfaces by brightening, oiling being found of advantage in maintaining cleanliness whilst not interfering with the contact. The abnormal resistance to the transfer of the current between the electrodes and the electrolyte is caused by poor circulation of the electrolyte, foul anodes, etc. In general, counter E.M.F., ohmic resistance, and the screening effect of slimes have to be dealt with. The first is partly produced by insufficient circulation of electrolyte; ohmic resistance is largely produced by an adsorbed gas film on each electrode, and the addition of materials, such as gelatin, for the production of smooth deposits acts in a marked way in diminishing the resistance. A well-defined high-grade anode forms a loose granular slime offering but little resistance. The resistance of the electrolyte is regulated by the distance between the electrodes, and the composition and temperature of the electrolyte. During recent years, the better control has gradually reduced the thickness of the liquid column from 2 in. to 1·5 in. It is not customary to have more than 13% of sulphuric acid and between 2·5 and 3% of copper sulphate in the electrolyte. The liquors are usually heated to 135° F. (57° C.), and the temperature drops about 20° F. (11° C.) in passing through the system, but in modern plants generally two tanks only are placed in series and the temperature inequalities are not so marked.—B. N.

Spelter ; Manufacture of pure ——. F. Juretzka. Chem.-Zeit., 1916, **40**, 885—886, 894—896.

Pure spelter (99·7—99·9 % Zn) is obtained from refined metal (Pb 1, Fe 0·03 %) by distillation at low temperatures. Electrically heated furnaces are much more advantageous for this purpose than the ordinary gas-heated muffle furnaces, as the temperature can be closely adjusted. A central condensing system is more economical than muffles fitted with condensers, and enables the process to be carried out under reduced pressure. The yield of pure metal is 70—75 %. Alloys made from pure spelter and containing zinc as principal constituent with smaller quantities of aluminium, copper, tin, or iron, are being used successfully as substitutes for copper alloys.—W. R. S.

Passive state of metals. C. W. Bennett and W. S. Burnham. Z. Elektrochem., 1916, 22, 377—398.

THE results obtained by previous investigators, discussed in detail, are claimed to justify the view that passivity in all cases is caused by oxidation, but the existing theories are regarded as insufficient to account for the facts observed. It is submitted that the true cause of passivity is the formation of a higher oxide (compare Armstrong and Colgate, this J., 1913, 391) which is adsorbed by the metal to form a protective layer more noble than the metal itself. Very small amounts of oxide are considered sufficient to bring about passivity, and in most cases probably the oxide formed is stable only in the adsorbed state. The disappearance of passivity at high temperatures is thus accounted for by the decomposition of the oxide which accompanies diminished adsorption, and the slow change of E.M.F. as passivity develops is explained by the fact that the potential of the oxide produced has its maximum effect only when passivity is complete; other facts, such as those observed by Heathcote (this J., 1907, 899) are shown likewise to accord with the theory. When iron is rendered passive in nitric acid, it is supposed that $Fe^{\cdot\cdot}$ ions are produced and oxidised to $Fe^{\cdot\cdot\cdot}$ ions, and that then some of the $Fe^{\cdot\cdot\cdot}$ ions are further oxidised (probably to give the oxide FeO_2) and the higher oxide is adsorbed; the effect of vigorous stirring is to circulate the $Fe^{\cdot\cdot\cdot}$ ions before further oxidation can take place, and the metal therefore remains active. The protective oxide in the case of chromium is not higher than the trioxide CrO_3, for the metal becomes passive in a solution of chromic acid; it is probably the dioxide CrO_2. Lead was rendered passive without the appearance of a visible oxide film, but it is thought that the process is essentially similar whether an obvious coating is produced or not.—F. SODN.

PATENTS.

Iron ores; Process of gravity liquid separation of ——. A. J. Moxham, Wilmington, Del. U.S. Pat. 1,203,897, Nov. 7, 1916. Date of appl., Mar. 25, 1914.

IRON ore, of a composition susceptible to alteration by heat, is calcined in an inert atmosphere without reduction, and then concentrated by means of a liquid having a sp.gr. above that of the silicious constituents of the ore and containing one or more ingredients decomposable by the reduced ore. —W. E. F. P

Solder [for aluminium, etc.] and process for making the same. E. E. P. J. P. S. J. de St. Laurent, Twickenham, and The Aluminium Solder Co., Ltd., London. Eng. Pat. 13,856, Sept. 29, 1915.

THE grades of solder specified are: "hard," consisting of Zn 6·9, Sn 2·5, Al 0·6; "medium," Sn 2, Zn 5; and "soft," Sn 2, Pb 1, Zn 5 parts by weight. The metals are melted separately and then mixed together, the operations being conducted in covered graphite crucibles lined with a mixture of alumina and charcoal in the proportions of 7 to 2.—W. E. F. P.

Electro-amalgamating machine. J. Ogden, Philadelphia, Pa. U.S. Pat. 1,202,006, Oct. 17, 1916. Date of appl., Mar. 14, 1916.

A CONICAL cathode is contained in the lower part of an electrolytic tank, and a series of rotary anodes are mounted, on a shaft, above the cathode. The anode plates are secured at an angle to the shaft, so as to intercept material passing in a downward direction, and some of the anodes are formed of a portion substantially parallel with, and adapted to prevent accumulation of material on, the surface of the cathode. Means are provided for returning the pulp from the bottom of the tank to the top, and for circulating the ore solution between the anodes and cathode.—B. N.

Tungsten; [Electrolytic] production of metallic ——. F. G. Keyes and R. B. Brownlee, Assignors to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pats. (A) 1,202,534 and (B) 1,202,535, Oct. 24, 1916. Dates of appl., (A) July 6, 1914, and (B) Apr. 10, 1915.

(A) TUNGSTEN trioxide is heated to approximately 2000 C. to produce an electrically conductive lower oxide or mixture of oxides, and this is then rendered fluid and maintained in this condition by heat produced by the Joule effect in an inert atmosphere. The fluid oxide is electrolysed, using a rotating cathode of pure tungsten, and a highly refractory anode consisting of a sintered rod of pure tungsten. (B) The anode is composed of a sintered mixture of tungsten powder and lower tungsten oxides cast into the form of a bar.—B. N.

Tin scrap; Detinning ——. W. J. Phelps, Baltimore, Md., Assignor to Phelps Can Co., Weirton, W. Va. U.S. Pat. 1,202,886, Oct. 31, 1916. Date of appl., June 19, 1914.

THE scrap is heated to cherry redness, in a chamber protected from free access of air, to oxidise and volatilise the tin coating without appreciably oxidising the steel base. The latter is then cooled out of contact with air.—W. E. F. P.

Metal alloy. T. B. Brix, Assignor to American Alloys Co., Newark, N.J. U.S. Pats. (A) 1,203,180 and (B) 1,203,555, Oct. 31, 1916. Dates of appl., Feb. 2, 1915, and Oct. 17, 1914.

(A) A non-ferrous alloy containing not less than 55% of nickel or metals of the nickel group, not more than 30% of chromium or metals of the chromium group, not more than 10% of silicon, and one or more metals, *e.g.*, copper, to facilitate melting and render the product homogeneous. (B) An alloy containing 60—80% of nickel or metals of the nickel group, 10—25% of chromium or metals of the chromium group, and copper and/or manganese, with or without addition of tungsten.—W. E. F. P.

Cobalt-chromium alloys. E. Haynes, Kokomo, Ind., U.S.A. Eng. Pat. 100,431, Jan. 5, 1916. (Appl. No. 192 of 1916.) Under Int. Conv., May 10, 1915. (See U.S. Pat. 1,150,113; this J., 1915, 968.)

THE alloys contain cobalt and chromium in such proportions as to render them resistant to corrosion by acids, etc., and iron (or nickel) sufficient to soften them without impairing their non-corrodibility. They are substantially free from carbon and other metals.—W. R. S.

Alloy. J. T. Dwyer, St. Louis, Mo. U.S. Pat. 1,203,991, Nov. 7, 1916. Date of appl., July 26, 1916.

THE alloy consists of lead 60—90 (preferably 88), antimony 10—40 (12), and phosphorus 0·001—0·05 (0·02) %.—W. R. S.

Furnaces for calcining copper ores and the like. J. G. Squire, Newcastle-on-Tyne. Eng. Pat. 101,998, Feb. 18, 1916. (Appl. No. 2424 of 1916.)

A MULTIPLE-HEARTH furnace of circular cross-section has concentric flues beneath the floor of each calcining chamber which produce concentric heat zones increasing or decreasing in intensity from the centre to the periphery of the hearths. A central rotating shaft carries four hollow rabble-arms on each floor to agitate the ore, and air is supplied through the rabble-arms and perforated rakes to aerate the ore. Circumferential flues are provided around the calcining chambers to heat the air supply; cold air is introduced if desired through the central shaft. The rakes on the rabble-arms are set at various angles. The supply of hot and cold air to each hearth can be controlled independently by a two-way valve so as to maintain the desired temperature in each chamber. The central hollow shaft is adjustable to vary the distance of the rakes relatively to the hearths. —W. R. S.

Ore treatment; Agitator for ——. *Dehydrator.* C. Robinson, Mount Vernon, N.Y., Assignor to Metallurgical Engineering and Process Corporation. U.S. Pats. (A) 1,204,069 and (B) 1,204,070, Nov. 7, 1916. Dates of appl., (A) Oct. 1, 1910 (renewed Mar. 30, 1916); (B) Aug. 16, 1912.

(A) The lower part of a tank is divided into a series of trough-shaped compartments, and along the bottom of each trough is a transverse pipe with a series of holes through which jets of gas under pressure are forced. Above the pipe is a vertical, transversely elongated tube, and above the upper end of this tube is an inclined baffle-plate. The mixture of ore and solution in the troughs is carried upwards through the vertical tubes by the gas under pressure, and a portion of the mixture is deflected by the baffle-plates into the adjacent compartment. (B) An apparatus for washing and dehydrating ores comprises a tank containing a rotary, horizontal filtering-drum partially submerged in the washing-solution, an adjustable ore-feeding trough with a narrow longitudinal slot extending transversely across the upper surface of the drum, and a device for removing material from the surface of the drum after it emerges from the tank.—W. R. S.

Metals [*zinc*] *from their ores; Process of extracting* ——. S. E. Bretherton and F. L. Wilson, Berkeley, Cal. U.S. Pat. 1,204,843, Nov. 14, 1916. Date of appl., Dec. 23, 1912.

To extract zinc from zinc sulphide ores, the ore is pulverised, roasted to convert the zinc into basic sulphate, treated under pressure with a solution containing ammonia and carbon dioxide to dissolve the zinc, and the solution separated and heated to precipitate the zinc as a basic carbonate.—W. F. F.

Heat treatment [*of metals*]. W. J. Wrighton, Assignor to Leeds and Northrup Co., Philadelphia, Pa. U.S. Pat. 1,188,128, June 20, 1916. Date of appl., June 15, 1915.

See Eng. Pat. 100,679 of 1916; this J., 1916, 1161.

Ore-roasting furnace. J. Harris, Sheffield. U.S. Pat. 1,203,613, Nov. 7. 1916. Date of appl., July 30, 1914.

See Eng. Pat. 21,897 of 1913; this J., 1914, 1058.

Manufacture of zinc sulphate. Eng. Pat. 12,799. *See* VII.

XI.—ELECTRO-CHEMISTRY.

Hydro-electric power and chemical industry; Tasmanian ——. F. H. Campbell. Proc. Soc. Chem. Ind. of Victoria, 1916. 419—429.

The electric power scheme of the Tasmanian Government has been in operation since May last. The main water-storage basin is the Great Lake, and the present output is about 10,000 HP, but this could be increased to 25,000 HP without extra storage; to 70,000 HP by increasing the water storage at the Great Lake and making use of the upper waters of the River Ouse; and to 150,000 HP by utilising Lakes Echo and St. Clair also as water-storage basins. The minimum charge for current (at Hobart) has been fixed at £2 per HP year for users of 10,000 HP and upwards of 24-hour power, *i.e.*, about 0·073d. per unit; and a special discount is offered for a period of 12 months to those establishing new industries. The probable consumption of hydro-electric power in Tasmania in the near future, say within the next three years, is estimated as: public and domestic utilities in Hobart, 2500 HP, zinc ore reduction processes, 40,000 HP, manufacture of caustic soda and bleaching powder, 1500 HP, production of calcium carbide and possibly cyanamide, 4500 HP., manufacture of steel and ferro-alloy from scrap iron and steel in electric furnaces, 1000 HP, and for power and heating purposes in the manufacture of cement, 500 HP. Of the industries suggested, the electrolytic production of zinc is proposed by several companies. The electrical extraction of zinc has been attempted on three main lines:—(A) the partial roasting of the ores, with leaching, purification and electrolysis of the solution, the chief difficulty being the accumulation of impurities in the liquor; (B) electrolysis of fused zinc chloride, the chief difficulty being the production on a large scale of a salt free from oxychloride; (C) smelting with coal in an electric furnace, the objection to this being the large quantity of zinc dust produced. The method proposed, that of the Anaconda Copper Co., is to roast the ore, the residue being then leached with dilute sulphuric acid, freed from iron and manganese by limestone and the noble metals by zinc, the solution being finally electrolysed between insoluble lead anodes and zinc or aluminium cathodes. The deposited zinc is melted and cast into ingots. In the Gillies process, zinc sulphate is electrolysed between a rotating cylindrical zinc sheet as cathode, and lead anodes, with a woollen diaphragm for separating the gases. Other industries proposed are the electrolytic manufacture of aluminium, the production of nitric acid by the oxidation of ammonia or by the action of steam on cyanamide or by direct synthesis, the electrical smelting of iron, the preparation of per-salts, the use of chlorine prepared electrolytically for detinning scrap, and the manufacture of permanganate and aniline.—B. N.

Overvoltage tables. Part I. Cathodic overvoltages. Part II. Anodic overvoltages. E. Newbery. Chem. Soc. Trans., 1916, **109**, 1051—1066 and 1066—1078.

The overvoltage (*i.e.*, the excess of back electromotive force over that of an oxygen or hydrogen electrode in the same electrolyte) has been determined for the following anodes and cathodes:—Gold, platinum, copper, silver, lead, zinc, nickel, cobalt, tin, gas carbon, artificial graphite, pure iron, carbon steel (5% carbon), chromium steel (10% chromium), and tantiron, in $N/1$ sulphuric acid and $N/1$ caustic soda, and, in addition, the cathodic overvoltages with aluminium, mercury, tungsten, antimony, bismuth, surfaces of copper and nickel plated with silver, and zinc and lead amalgamated with mercury. Pure electrolytic copper has generally a higher cathodic overvoltage than the commercial metal, and, if variation of the voltage leads to variation of the product (*e.g.*, in the reduction of nitrates), the greatest care must be taken in the preparation of the electrode in order to secure concordant results. Lead is capable of acquiring a very high cathodic overvoltage, but this is easily reduced, especially by impurities in the metal and subjection to too high a current density. The cathodic overvoltage of zinc is as great or greater than that of lead, and is increased by high current density; in acid and alkali it is increased with time. Zinc is preferable to lead as a cathode for powerful reductions when a fairly strong current is required, but against these advantages it is brittle and liable to be attacked by the electrolyte when no current is flowing. Nickel is a good substitute for platinum as a cathode where a low overvoltage is required, and in alkali the overvoltage is more constant than in acid. Mercury, as a cathode, has the most variable overvoltage of all the electrodes tried; amalgamation raises the overvoltage of all metals. Tungsten is remarkable for the steadiness of its overvoltage, its small variations with time and current density, and the speed with which it attains its maximum. All the iron alloys have very low cathodic overvoltages in acid and alkali, and, with the exception of tantiron, are but slightly affected by time and current density changes. Perforated sheets of tantiron or gauze of chromium steel wire could probably be used with advantage in large scale work as cathodes for high-efficiency reductions in acid electrolytes. Whilst the overvoltage must be taken into account in electrolytic reductions and oxidations, yet the metal often exerts a specific effect on the reaction which may be of equal or greater importance than the overvoltage. This is especially the case with nickel, copper, or platinum, which sometimes effect reductions better than metals, such as zinc or lead, with greater cathodic overvoltages. If there is no such specific action, the electrode with the highest overvoltage may be depended on to give the best current efficiency when very powerful reductions are required. If the reduction proceeds easily with a cathode of low overvoltage, then a higher overvoltage results in waste of energy and the overheating of the solution, without any gain. Amongst the anodes, platinum most nearly approaches the ideal for all cases; its overvoltage is very constant, and high enough to effect powerful oxidations. Copper becomes passive in alkali, and has a low and constant overvoltage, but it cannot be used for long periods as it is slowly attacked. Silver may be used for oxidations in some cases in the presence of substances which reduce the silver oxide formed, and the disintegration is then considerably less than in pure electrolytes. Lead is a very suitable electrode for powerful oxidations in dilute acid, but in alkali it is liable to form plumbates. Pure nickel readily becomes passive in alkali, and the overvoltage is low and constant, but impurities cause it to become partially active; good quality nickel plating stands as well or even better than nickel sheet. In alkali, pure iron readily becomes passive, but tantiron, nickel steel, and chromium steel take this condition in acid much more readily than iron. Nickel steel (containing 36% nickel) has an anodic overvoltage intermediate between those of pure iron and nickel, and is very resistant to the anions in acid and alkali, whilst chromium steel is more liable to disintegration and oxidation. The overvoltage of tantiron is higher than that of pure iron, and both have considerably higher overvoltages in acid than in alkali. The anodic overvoltages, as a whole, are much higher than the cathodic, and none of the electrodes are capable of giving an anodic overvoltage of less than 0·4 volt for any length of time. Moderated oxidations are thus very difficult to obtain, and in the electrolytic treatment of organic compounds there is a tendency to give highly oxidised products, or even to destroy the substance, with formation of carbon dioxide. Gas carbon, at low current densities, is stated to be perhaps the most suitable anode in many cases for moderate oxidations, but even with this electrode the overvoltage is slowly increased. For small scale work, iridium anodes may sometimes be used in acid electrolytes, as this metal has a low and very constant anodic overvoltage (0·5 volt in N/1 sulphuric acid). For general work, the following appear to be the most suitable anodes: lead for dilute sulphuric acid or sulphate solutions, graphite for chloride solutions, pure nickel or high nickel steel for alkali solutions or fusions.—B. N.

Fuel cells; Galvanic —— at high temperatures. E. Baur, A. Petersen, and G. Füllemann. Z. Elektrochem., 1916, **22**, 409—414.

The electromotive force of the following voltaic cells at temperatures between 700° and 1300° C. was determined:—CuO, Cu_2O | Electrolyte | C; PbO, Pb | Electrolyte | C; Fe_3O_4, FeO | Electrolyte | CuO, Cu_2O; FeO, Fe | Electrolyte | CuO, Cu_2O; NiO, Ni | Electrolyte | CuO, Cu_2O; PbO, Pb | Electrolyte | CuO, Cu_2O. The electrolytes employed were borax, glass, and porcelain, and a detailed description of the construction of the cells is given.—G. F. M.

Potential changes on illumination of oxidising agents. Swensson. *See* VII.

Patents.

Electric furnace. W. J. Wrighton, Philadelphia, U.S.A. Eng. Pat. 100,093, Feb. 21, 1916. (Appl. No. 2584 of 1916.) Under Int. Conv., Feb. 19, 1915.

See U.S. Pat. 1,165,055 of 1915; this J., 1916, 261. A nickel-chromium alloy may be used as resistance-conductor, alundum cement as the non-vitreous refractory material, and a mixture of clay and asbestos fibre for the refractory backing layer.

Furnace; [Electric] induction ——. J. R. Wyatt, Assignor to The Ajax Metal Co., Inc., Philadelphia, Pa. U.S. Pat. 1,201,671, Oct. 17, 1916. Date of appl., Jan. 24, 1916.

The furnace comprises a pool to contain molten metal, and a closed channel lying mainly or wholly beneath the pool. The channel is formed of substantially straight portions, communicating with one another at their lower ends at an acute angle, and at their upper ends with the body of the pool at opposite sides near its periphery. The channel is surrounded by a transformer, and current is induced through the molten metal in the channel as secondary; the "motor-effect," which is greatest at the acute angle, drives the molten metal up through the body of the pool on the outer sides of the channel, and a downward flow of molten metal takes place along the inner sides of the channel, stirring the metal in a general upward direction. The connecting portions between the channel and the pool are curved on the inner sides, the curved portion approximating in section to a circle through the axis of the transformer winding tangent to the straight channel portions. —B. N.

Furnace; Electric ——. I. Hechenbleikner, Charlotte, N.C., Assignor to Southern Electro-Chemical Co., New York. U.S. Pat. 1,202,837, Oct. 31, 1916. Date of appl., Feb. 7, 1914.

The body portion of the furnace, in which the greater part of the reaction is adapted to take place, is cylindrical, and is provided with an expansible water-jacket formed with disconnected parts enclosing the sides and bottom in a continuous manner. Above the cylindrical part is an uncooled tapered masonry portion, in the form of a frustum of a cone, and provided with integral extensions on the sides, through which electrodes project downwards into the body portion. The electrodes are provided with water-jackets supported by, and extending partially into, the extensions. The tapering portion is continuous with a top cylindrical portion, formed with an integral conduit extending laterally. The body portion is provided with separated tap-holes, with two water-cooled jackets, in the form of a frustum of a cone telescoping one within the other, for each hole. The smaller end of the outer jacket is arranged to embrace the larger end of the other; a trap on the outer jacket projects over the inner one, and is adapted to hold the inner jacket in position.—B. N.

Furnace; Electric-arc ——. C. O. A. Dövle, Notodden, Norway, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,204,319, Nov. 7, 1916. Date of appl., Jan. 10, 1914.

The vibrations of the U-shaped electrodes, due to the vibratory action set up by the movement of the arc along the electrodes, are prevented by water-cooled braces, each of which is attached to and projects through the walls of the furnace, some distance from the point where the electrode enters, and is also attached to a point on the electrode midway between the inner end of the electrode and the furnace wall.—B. N.

Battery; Galvanic ——. E. McGall, Orange, and M. D. Malcomson, Assignors to New Jersey Patent Co., West Orange, N.J. U.S. Pat. 1,201,481, Oct. 17, 1916. Date of appl., Aug. 12, 1914.

A colloidal gelatinous electrolyte is used containing one or more caustic alkalis, such as sodium hydroxide, and organic materials, together with another inorganic material, such as a silicate, for increasing the capacity and conductance.—B. N.

Ozone; Apparatus for producing ——. J. Steynis, Bay Shore, N.Y., Assignor to Steynis Ozone Co. U.S. Pat. 1,201,380, Oct. 17, 1916. Date of appl., Mar. 11, 1915.

See Fr. Pat. 478,133 of 1914; this J., 1916, 1163.

Electrolytic manufacture of light metals and reaction products thereof; Apparatus for the ——. E. A. Ashcroft, London. U.S. Pat. 1,204,234, Nov. 7, 1916. Date of appl., Mar. 12, 1912.

See Eng. Pat. 1003 of 1912; this J., 1913, 199.

Acid-proof and electrolytic tank. U.S. Pat. 1,202,457. *See* I.

Method and apparatus for heating liquids. Eng. Pat. 100,796. *See* I.

Electrolytic production of sodium perborate. Eng. Pat. 100,152. *See* VII.

XII.—FATS; OILS; WAXES.

Patents.

Oils; Separation of ——. S. Cornell, Pawling, N.Y. U.S. Pat. 1,202,969, Oct. 31, 1916. Date of appl., Jan. 22, 1916.

A mixture of oils of mineral and animal or vegetable origin is emulsified by steam. The frothy emulsion rises and comes in contact with a heated surface, liberating the volatile hydrocarbon oil.—J. E. C.

Catalysts [for hydrogenating oils]; Process of revivifying ——. H. J. Morrison, Assignor to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,203,233, Oct. 31, 1916. Date of appl., June 12, 1914.

Spent material containing a metallic catalyst is subjected to sufficient pressure to expel the bulk of the fat and to leave a coherent cake. The rest of the organic matter can then be removed by ignition, and the metal recovered in a catalytically active form.—C. A. M.

Cleansing compound for use in the bath or for like uses. J. Farley, Hertford. Eng. Pats. 15,643, Nov. 5, 1915, and 4634, Mar. 29, 1916.

Commercial methylated spirit or absolute alcohol (2 parts by weight or 14 to 20 fl. oz.) is mixed with pure saponified oil or fat, preferably vegetable (8 parts or 25 to 40 oz.), and pine oil (8 parts or 35 to 40 oz.), or paraffin oil (35 to 40 oz.), or a mixture of pine oil (2 parts) with paraffin oil (6 parts).—C. A. M.

Apparatus for purifying oil. U.S. Pat. 1,203,419. *See* IIa.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Patents.

Lead carbonates (basic); Manufacture of ——. J. A. Schaeffer, Joplin, Mo., and J. R. MacGregor, Chicago, Ill., Assignors to Picher Lead Co., Joplin. U.S. Pat. 1,203,911, Nov. 7, 1916. Date of appl., May 2, 1916.

Carbon dioxide is passed into a mixture of "fumed litharge," acetic acid, and water until the basic lead carbonate formed has the desired composition.—E. H. T.

Printing composition [ink]. F. A. Putnam, Melrose, Mass. U.S. Pat. 1,203,779, Nov. 7, 1916. Date of appl., Dec. 20, 1912.

A gum is digested in oil and the mixture incorporated with a metallic pigment and a non-metallic (aniline) colouring matter, these having contrasting colours, so that the one leaves a light imprint on dark substances and the other a dark imprint on light substances.—C. A. M.

Phenol-aldehyde resins soluble in oil; Method of manufacturing —— *and varnishes therefrom.* L. Berend, Amöneburg, Germany. U.S. Pat. 1,205,081, Nov. 14, 1916. Date of appl., June 1, 1915.

See Eng. Pat. 15,875 of 1914; this J., 1915, 805.

Rosin sizing composition. U.S. Pat. 1,203,857. *See* V.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI.

Colour lakes fast to light. U.S. Pat. 1,203,642. *See* IV.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Vulcanisation [of rubber substitutes, etc.]. A. O. Bourn, Bristol, R.I. U.S. Pat. 1,203,966, Nov. 7, 1916. Date of appl., Jan. 7, 1916.

Wood creosote is mixed with rubber substitutes and rubber compounds, with or without the addition of partially vulcanised oils or regenerated rubber, and the mixture is vulcanised.—C. A. M.

Vulcanising process [for rubber]. H. R. Murdock, Naugatuck, Conn., Assignor to Rubber Regenerating Co. U.S. Pat. 1,204,374, Nov. 7, 1916. Date of appl., May 4, 1916.

Rubber is mixed with vulcanising material containing lead and sulphur, and a reagent (zinc sulphate) capable of transforming the lead and sulphur, during the vulcanising process, into light-coloured compounds insoluble in water, and the mixture is vulcanised.—C. A. M.

Non-inflammable waterproofing composition for fabrics. U.S. Pat. 1,204,056. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Patents.

Imitation leather: Material adapted for use in the manufacture of —— *and method of making such material.* A. E. Alexander, London. From The Duratex Co., Newark, N.J., U.S.A. Eng. Pat. 102,114, May 22, 1916. (Appl. No. 7260 of 1916.)

See U.S. Pats. 1,190,806 and 1,190,807 of 1916; this J., 1916, 935.

Dyeing hairs, furs, etc. Ger. Pat. 294,184. *See* VI.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI

XVI.—SOILS ; FERTILISERS.

Sulphur in soils : Oxidation of —— as a means of increasing the availability of mineral phosphates. J. G. Lipman, H. C. McLean, and H. C. Lint. Soil Sci., 1916, **1**, 533—539. J. Chem. Soc., 1916, **110**, i., 781.

To study the effects of sulphur, weekly (later fortnightly) estimations of acidity and of soluble phosphoric acid were made in soils alone, in soils + sulphur, in soils + rock phosphate, and in soils + sulphur and rock phosphate. The soils employed were pure sea sand, a red silt loam, and a medium loam. The results show that considerable amounts of sulphuric acid are formed from the sulphur and that the acid acts on insoluble phosphates with production of phosphoric acid available to crops. The character of the soil plays an important part in stimulating or retarding oxidation of sulphur. The best results were obtained in the red silt loam which, at the end of fifteen weeks, contained nearly 2 grms. of citrate-soluble and nearly 1 grm. of water-soluble phosphoric acid, when 5 grms. of sulphur and 15 grms. of rock phosphate were added. In sand the amounts of soluble phosphoric acid produced were about one-fifth of the amounts in the red soil.

Salts ; Antagonistic action of —— in plants. J. G. Maschhaupt. Verslag. Landbouwkund. onderzoek. Rijkslandbouwproefstat., 1916, **19**, 60 pp. J. Chem. Soc., 1916, **110**, i., 781.

In the author's experiments natural conditions were attained by growing the plants (maize) in earth contained in pots with perforated bottoms through which the roots passed into the prepared solutions below. Under these conditions solutions of the chlorides of sodium, potassium, and magnesium and magnesium sulphate, above certain concentrations, were strongly poisonous, calcium chloride to a much less extent. Even with concentrations of 3/25M the toxic action of sodium and potassium chlorides was annulled by the addition of only 10 c.c. of calcium chloride solution (3/25M) to 1138 c.c. of their solutions ; the magnesium solutions required considerably more. The antagonism found by Osterhout between sodium and potassium chlorides, and between sodium chloride and magnesium sulphate was not confirmed with certainty, and in any case it is very small compared with that of calcium chloride. The calcium salts have a special function which can be undertaken by no other salt. The work of other investigators on this point, in particular that of Loew and Hansteen, is discussed. The contradictions there found may be explained on the ground that these authors drew their conclusions from quite different plant types, and it is not permissible to generalise on results obtained from one species, any more than to assume any parallelism in the antagonistic salt action in plants and animals. A feature common to all antagonistic action, however, is that it is a colloidal reaction, and the calcium ion undoubtedly has a special function in this respect, both in the animal and vegetable kingdoms. In practical agricultural investigations, when the plants are growing in the natural soil, great difficulties, underestimated by Loew and his collaborators, are experienced, particularly since sufficient knowledge is lacking of the way in which the roots exert their functions.

General conceptions of intoxication [*of enzymes*]. Jacoby. *See* XVIII.

Determination of nitric nitrogen. Scales. *See* XXIII.

Patent.

Phosphate rock : Treatment of ——. E. S. Bishop, Pittsburgh, Pa., Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,204,238, Nov. 7, 1916. Date of appl., Aug. 10, 1914. Renewed Feb. 1, 1916.

Phosphatic rock is made available for plant food by mixing it with the chloride of a strong base, *e.g.*, of an alkali metal, and sufficient silica to combine with the metal of the chloride and with some of the calcium of the rock, and then heating in steam to a temperature below that at which sintering takes place, the hydrogen chloride evolved being recovered.—E. H. T.

XVIII.—FERMENTATION INDUSTRIES.

Prohibition of use of wheat in manufacture of beer, etc.

It has been reported to the Board of Trade that, in consequence of the scarcity and the high price of barley, purchases of wheat have recently been made by brewers for use in their business. The Board of Trade have accordingly made an Order, the effect of which is to prohibit the use of wheat in the manufacture of beer and similar liquors. The Order came into force on 27th November. The use of any grain for the production of spirits, without the authorisation of the Ministry of Munitions, was prohibited by an Order dated 10th May last.

Formaldehyde as a prototype of diastase. Theory of diastatic action. G. Woker. Ber., 1916, **49**, 2311—2318.

Proceeding from the supposition that diastase and peroxidase are identical substances, the theory is developed that the actions of diastase and peroxidase are attributable to the same group in the molecule, viz., an aldehyde group which can form on the one hand an unstable aldehyde hydrate with water, giving rise to the hydrolytic reaction, and on the other hand a secondary peroxide structure, of the type ·CH(OH)·O·OH, with hydrogen peroxide. The author has already shown that formaldehyde may be regarded as typical of peroxidase and catalase (Ber., 1914, **47**, 1024), and it was therefore expected, from the above theory, that it should also be a prototype of diastase. The point whether formaldehyde and diastase behave analogously when tested by the usual method of diastase determination, was therefore investigated both from the point of view of the disappearance of starch, and of the formation of sugars or dextrins, and a general parallelism was found, though not so close as that between peroxidase and formaldehyde. Notably it was observed that an increase instead of a decrease of viscosity occurred during the action of formaldehyde on starch, and that a relatively high concentration of aldehyde was necessary before any sugar formation occurred. Nevertheless starch hydrolysis was undoubtedly produced, since the blue iodine reaction disappeared, and an osazone was actually isolated from the product.—G. F. M.

Oxidase reactions ; Relation of —— to hydrogen ion concentration. G. B. Reed. J. Biol. Chem., 1916, **27**, 299—302.

The concentrations of acid which inhibit oxidases are much lower than stated by previous investigators, who have not usually taken into account the effect of protein or other amphoteric electrolytes in reducing the acidity when definite amounts of acid have been added to the oxidase mixture. Certain oxidases, such as those of the potato and apple, are inhibited by hydrogen ion concentrations as low as 5 to 7×10^{-4}. The activation of certain oxidase reactions by the addition of exceedingly

small amounts of alkali may thus be due to the reduction of the hydrogen-ion concentration.
—T. C.

Intoxication [of enzymes]; General conceptions of ——. M. Jacoby. Biochem. Zeits., 1916, **76**, 275—296. J. Chem. Soc., 1916, **110**, i., 778–779.

Urease is rendered inactive by minute amounts of mercuric chloride to which, whatever the quantity, no accelerative action can be ascribed. The enzyme inactivated by the mercury salt can be reactivated by potassium cyanide. A relatively large amount of this salt is necessary to diminish the activity of the urease, but medium quantities cause a distinct, though not very large increase in its activity. An aqueous solution of the enzyme is inactivated by nickel oxide (insoluble in water); after separation from the nickel oxide it can be reactivated by potassium cyanide. Urease rendered inactive by mercuric chloride cannot be reactivated by glycine, whereas if rendered inactive by nickel oxide it can be reactivated by small quantities of this substance. The scission of urea by bacteria is inhibited both by mercuric chloride and potassium cyanide, neither substance exerting a stimulating action in very small concentrations. Bacteria of which the ureaclastic activity has been destroyed by the mercury salt, are not rendered reactive in this respect by potassium cyanide. The doses of nickel oxide, mercuric chloride, and potassium cyanide which stop the ureaclastic action do not kill the bacteria. Bacteria which act on urea do not act on methylurea, thiourea, or acetamide. The author distinguishes between two types of toxic action; substances exerting the one type of action kill the ferment, whereas those belonging to the other only inhibit the fermentative action.

Patent.

Alcohol-free beers; Process of making practically ——. C. Reiter, Bayrischzell-Hochkreut, Germany. U.S. Pat. 1,201,315, Nov. 7, 1916. Date of appl., Apr. 6, 1914.

See Eng. Pat. 23,003 of 1913; this J., 1915, 846.

XIXa.—FOODS.

Cocoa powder; Detection of excess of cacao shell in ——. Chem.-Zeit., 1916, **40**, 969—970.

The following official (German) directions are given for the detection of cacao shell in cocoa powder. A preliminary microscopical examination will show whether the powder contains an undue proportion of shell, and if such is the case the crude fibre content of the sample is determined; if, owing to the fineness of the powder, the microscopical examination is inconclusive, the insoluble phosphates present must be determined in addition to the crude fibre. Since the results obtained are expressed as percentages of the dry fat-free powder, the moisture and fat are also determined. *Moisture.* Five grms. of the cocoa powder is mixed in a flat basin with 20 grms. of ignited sand and dried at 105° C. to constant weight, or nearly so, but the drying should not be prolonged for more than 4 hours. *Fat.* Five grms. of the cocoa is placed in an asbestos filter tube, 4 cm. in diameter (the asbestos is supported on a small filter plate having holes about 1 mm. in diameter), the lower end of the tube is inserted into a hole in a rubber stopper closing a filter flask, and the filter tube is filled with ether. As soon as the ether begins to drop into the flask, suction is applied, a further quantity of ether is added, and so on, using about 10 c.c. of ether each time, until 100 c.c. of ethereal extract has been collected. This ethereal solution is evaporated, and the residue of fat weighed. *Crude fibre.* The residue remaining in the filter tube is freed from ether and, together with the asbestos, is transferred to a flask and boiled for 1 hour under a reflux condenser with 200 c.c. of 1·25% sulphuric acid. The mass is then collected on an asbestos filter, washed with hot water, again transferred, with the asbestos, to the flask, boiled for 1 hour with 200 c.c. of 1·25% potassium hydroxide solution, then collected on an asbestos filter, and washed. This treatment with acid and alkali is repeated. The mass of crude fibre obtained finally is washed with alcohol and ether, transferred to a platinum basin, dried at 105° C., and weighed. The contents of the basin are then ignited, and the residue again weighed; the difference between the weights gives the quantity of crude fibre. The asbestos used for the filters should be treated previously with boiling dilute sulphuric acid, then with dilute potassium hydroxide solution, washed, dried, and ignited. If the amount of crude fibre found exceeds 6%, calculated on the dry, fat-free cocoa powder, the sample contains a quantity of shell in excess of that which should be present. *Phosphates.* Twenty grms. of the cocoa is incinerated at a low temperature, the carbonised mass is collected on a filter, washed with water, and the filter and its contents are ignited to a white ash to which the filtrate is added and evaporated to dryness. After gentle ignition, the residue is treated with a few drops of hydrogen peroxide and 10 c.c. of 25% hydrochloric acid, the mixture is evaporated to dryness, the residue treated with hydrochloric acid and hot water, and the solution filtered. The filtrate is nearly neutralised with sodium hydroxide solution, using methyl orange as indicator, then heated on a water-bath for 5 mins., a further small quantity of alkali is added so that the solution still remains slightly acid, and the precipitated iron and aluminium phosphates are collected on a filter; the filtrate and washings are diluted to 100 c.c. To determine the soluble phosphates, 10 c.c. of this solution is mixed with 30 c.c. of neutral 10% calcium chloride solution, a few drops of phenolphthalein solution are added, and the mixture is titrated with *N*/10 sodium hydroxide solution until a distinct red coloration is obtained; the mixture is now maintained at 15° C. for two hours and the slight excess of alkali is titrated. Under these conditions, 1 c.c. of *N*/10 alkali solution is equivalent to 4·75 mgrms. of PO_4. The insoluble phosphates are determined as follows:—30 c.c. of trisodium citrate solution (200 grms. of the salt dissolved in 300 c.c. of water) is placed in a flask, cooled in ice-water, and then exactly neutralised, using phenolphthalein as indicator. The filter containing the precipitate of iron and aluminium phosphates is introduced into the flask, the mixture is heated on a water-bath for 20 mins., then cooled in ice-water, and titrated with *N*/10 sodium hydroxide solution; in this case, 1 c.c. of the alkali solution is equivalent to 9·5 mgrms. of PO_4. The results of both determinations are calculated into percentages of the cocoa powder. With a cocoa powder free from excess of shell, the quantity of insoluble PO_4 will not exceed 1% of the total PO_4.—W. P. S.

Vegetable ivory meal; Composition, digestibility, and feeding value of ——. C. L. Beals and J. B. Lindsay. J. Agric. Res., 1916, **7**, 301—320.

Vegetable ivory nuts (*Phytelephas macrocarpa* seeds) have the following average composition:—moisture, 11·39; ash, 1·08; protein, 4·63; fat, 0·92; crude fibre, 6·89; non-nitrogenous substances, 75·09%. Large quantities of the nuts are imported and used principally for making buttons, and the waste material (sawdust, chippings, and turnings) of this manufacture is ground to a meal which may be used for feeding cattle. The meal is tasteless, odourless, and very hard, being almost gritty to the touch. About 92·5%

of the non-nitrogenous substances consists of mannan, a polymer of mannose (cf. J. L. Baker and T. H. Pope; this J., 1900, 556), and the energy equivalent of the meal compares favourably with that of other carbohydrate foods. Sheep eat vegetable-ivory meal readily when it is mixed with other grains, and it is digested thoroughly; about 84 % of the dry substance and 92 % of the non-nitrogenous substances is digested by these animals. Cows will eat the meal when it is mixed with other foods, but refuse to eat it by itself; its use increases the quantity of milk yielded by cows, but its value is not quite equal to that of maize meal in this respect.—W. P. S.

Physiological and pharmacological studies on coal-tar colours. Fat-soluble dyes. Salant and Bengis. *See* IV.

Relation of oxidase reactions to hydrogen ion concentration. Reed. *See* XVIII.

Determination of nitric nitrogen. Scales. *See* XXIII.

Patents.

Colour concentrate for edible fats. C. Ellis, Montclair, N.J. U.S. Pat. 1,203,594, Nov. 7, 1916. Date of appl., Dec. 16, 1915.

A butter colouring composition consists of the liquid portion of butter fat saturated with a yellow dye and sterilised.—W. P. S.

Egg product; Powdered —— and process for making the same. G. C. Contant, New York. Assignor to J. Decker, jun., Montclair, N.J. U.S. Pat. 1,203,983, Nov. 7, 1916. Date of appl., Jan. 22, 1916.

Whites of eggs are separated from the yolks, stirred until of uniform consistence, sugar is then added, the mixture dried at a temperature below 212° F. (100° C.), and powdered.—W. P. S.

XIXb.—WATER PURIFICATION; SANITATION.

Determination of nitric nitrogen. Scales. *See* XXIII.

Patents.

Still [for water]; Triple purification ——. D. P. Moore, Assignor to J. S. Merrill and G. H. Draper, Washington, D.C. U.S. Pat. 1,204,300, Nov. 7, 1916. Date of appl., Feb. 17, 1916.

A water still comprises an evaporator, a distilled water reservoir, and a condenser arranged one above the other. Vapour tubes extend from the evaporator, through the reservoir, to the condenser and project into the lower ends of the condenser tubes. An air heater is provided in the evaporator, and a number of tubes conduct the heated air into the vapour tubes, so that the vapour and heated air mix in the vapour tubes and condenser tubes.—W. P. S.

Drying and sterilising air; Process for ——. R. P. van Calcar, Oegstgeest, and J. Ellerman and H. J. Martijn, The Hague, Netherlands. U.S. Pat. 1,203,941, Nov. 7, 1916. Date of appl., Dec. 29, 1911.

The process is essentially the same as that described in Eng. Pat. 21,159 of 1913 (this J., 1915, 245), but distinct layers of a soluble drying substance and an anti-hardening material are used.—A. S.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Cinchona alkaloids; Degradation of the ——. A. Kaufmann, E. Rothlin, and P. Brunnschweiler. Ber., 1916, 49, 2299—2310.

The possibility of the synthesis of quinine from meroquinene or cincholoipone, the common degradation products of all the cinchona alkaloids, renders the preparation of one or other of these substances in satisfactory yield a matter of technical interest. The three following methods were accordingly worked out for the preparation of cincholoipone from cinchotin (dihydrocinchonine):—(1) By boiling with sodium acetate and 50 % acetic acid, cinchotin was isomerised to the "toxin" cinchoticin, which was isolated as its benzoyl derivative in white needles, m.pt. 124° C., in 95—100 % yield. This on oxidation with chromic acid gave cinchoninic acid and benzoylcincholoipone, but the yield amounted to only 10 % of the theory. (2) Benzoylcinchoticin gave with dimethyl sulphate an addition product which on oxidation with permanganate gave formylmethylanthranilic acid and benzoylhomocincholoipone, a reddish-yellow oil which on hydrolysis was converted into homocincholoipone hydrochloride. (3) The best results were obtained by the action of an acid chloride on the isonitroso-derivative of benzoylcinchoticin. This was obtained in nearly theoretical yield by the action of amyl nitrite on the sodium derivative of the ketone in alcoholic solution, and was isolated as white needles, m.pt. 175°—177° C. On shaking its alkaline solution with *p*-toluene sulphochloride, quantitative decomposition into cinchoninic acid and benzoylcincholoipone nitrite occurs. The latter distilled at 160°—165° C. *in vacuo*, and gave cincholoipone on hydrolysis with barium hydroxide or 70 % sulphuric acid.—G. F. M.

Alkaloidal chemistry; Mercuric acetate as an oxidising agent in ——. J. Gadamer, F. Kuntze, R. Kondo, and Schulemann. Arch. Pharm., 1915, 253, 274—289. J. Chem. Soc., 1916, **110**, i., 736—737.

The author finds that in alkaloidal chemistry mercuric acetate has not only a qualitative, but also a quantitative value, since the resulting sparingly soluble mercurous acetate can be collected and weighed. N-Methylbulbocapnine yields a di-dehydro-derivative when oxidised in dilute acetic acid by mercuric acetate at the ordinary temperature:

$$C_{20}H_{21}O_4N + 2Hg(C_2H_3O_2)_2 = C_{20}H_{19}O_4N + 2CH_3COOH + Hg_2(C_2H_3O_2)_2.$$

A deeper-seated oxidation also proceeds to some extent, and this becomes more marked when the oxidation is effected on the water-bath, the amount of mercurous acetate obtained indicating a consumption of 3 mols. of mercuric acetate. By oxidation in a similar manner at the ordinary temperature, *d*-canadine is converted into berberine, and corydaline also loses four atoms of hydrogen. In the latter case the oxidation proceeds in two stages, a di- and a tetra-dehydrocorydaline being obtained. Since the optical activity of the alkaloid disappears with the first pair of hydrogen atoms, the two asymmetric carbon atoms in corydaline would appear to be contiguous. The oxidation of *r*-laudanosine by mercuric acetate yields the same products as Pyman obtained with manganese dioxide and dilute sulphuric acid (Chem. Soc. Trans., 1909, **95**, 1266; see also Eng. Pat. 314 of 1909; this J., 1909, 913), namely, veratraldehyde and 4.5-dimethoxy-2-β-methylaminoethyl-benzaldehyde. The non-nitrogenous substance, $C_{14}H_8(OCH_3)_4$, mentioned by Pyman, is produced in considerable quantity, and appears to be tetramethoxydibenzyl, $C_{14}H_{10}(OCH_3)_4$. The oxidation of papaverine by mercuric acetate yields papaveraldine, dimethoxycinchonic acid, and about 10 % of papaverinol, which thus becomes a comparatively easily obtainable substance. When papaverine and mercuric acetate are mixed in equivalent quantities a clear solution is obtained, from which a white precipitate containing non-ionisable mercury is thrown down by sodium chloride. The clear solution therefore probably contains a mercuriacetate, this group having entered at the methylene bridge. The substance is not very stable, however, and reacts with a further quantity of mercuric acetate to form mercurous acetate, acetic acid, and papaverinol.

Apomorphine ; Sensitive reaction for ——. L. P. J Palet. Ann. Soc. Quim. Argentina, 1916, **4**, 83—86. J. Chem. Soc., 1916, **110**, ii., 587.

With Guglialmelli's arseno-tungstic or arseno-tungsto-molybdic reagent, apomorphine gives an indigo-blue coloration ; the coloured substance dissolves in amyl alcohol to a solution of the same colour, and in benzene to an intense violet solution. (See also following abstract.)

Dimethylaminophenyldimethylisopyrazolone (pyramidone) : Delicate test for ——. L. Guglialmelli. Annal. Soc. Quim. Argentina, 1916, **4**, 180—182. J. Chem. Soc., 1916, **110**, ii., 587—588.

Arsenotungstic acid gives with dimethylaminophenyldimethylisopyrazolone a white precipitate soluble in alkali with production of an intense blue coloration. Arsenotungstomolybdic acid gives a white precipitate, soluble in alkali to an indigo-blue solution. Both nitric acid and ferric chloride give an indigo-blue coloration.

Medicines ; Preservation of —— *in dry capsules, especially for use in the field.* T. Paul. Münch. Med. Wochenschr., 1916, 1317—1321. Chem.-Zeit., 1916, **40**, Rep., 364—365.

Comparative tests at 37°, 70°, and 100° C., with containers of ordinary medicine glass, Jena glass, and quartz showed that decomposition of morphine hydrochloride in aqueous solution takes place slowly even in quartz and hence cannot be due to impurities dissolved from glass, though such impurities markedly accelerate the decomposition. Salts of physostigmine, atropine, scopolamine, homatropine, and hydrastine, and suprarenin (adrenaline) and organotherapeutic preparations decompose still more readily and it is very difficult to sterilise their aqueous solutions. Addition of very small quantities of hydrochloric acid or of glycerin, alcohol, dextrose, etc., has been proposed as a remedy, but is ineffective, and, in some cases, may even accelerate the decomposition, without this becoming apparent to the eye. The author recommends that measured quantities of the solid medicine and of the solvent should be put up in separate containers and mixed immediately before use. The dry medicine is dissolved in a volatile solvent and introduced into a dry, sterilised, boat-shaped capsule, drawn out at the ends ; the solvent is then expelled by a current of germ-free air at 20°—30° C., and the ends of the capsule sealed. The solvent (dilute sodium chloride solution or distilled water) is introduced into a pipette-shaped container, which is then sealed and sterilised.—A.S.

Fatty acids ; Oxidation of branched chain ——. *Action of hydrogen peroxide on the homologues of isobutyric acid.* P. A. Levene and C. H. Allen. J. Biol. Chem., 1916, **27**, 433—462.

The action of hydrogen peroxide on the higher homologues of dimethylacetic (isobutyric) acid was investigated with the object of establishing the conditions under which the tertiary carbon atom was oxidised readily. In the course of the work the acids, esters, alcohols, iodides, and substituted malonic acids of eight homologues of isopropane were prepared, whilst the oxidation experiments were made on acids ranging from 2-methylpropylic acid to 9-methyldecylic acid. The following products of oxidation were to be expected :— $(CH_3)_2CH(CH_2)_nCH_2CH_2COOH \rightarrow (CH_3)_2CH(CH_2)_nCH_2CHO$, or $(CH_3)_2CH(CH_2)_nCOCH_3$, or $(CH_3)_2CO$. The latter reaction proceeded most favourably when the organic acid in slightly acid solution was treated with an amount of hydrogen peroxide equivalent to 3·5 atoms of oxygen. Under these conditions, all three reactions took place, but acetone was the predominating product of the oxidation. The presence of the higher ketones was demonstrated by an indirect method ; the value of the mixed ketones was determined and from this was deducted the value of the acetone, identified previously by means of its *p*-nitrophenylhydrazone. The aldehydes resulting from the oxidation in the α-position were identified as the corresponding acids. There was a progressive decrease in the yield of acetone as the distance between the tertiary carbon atom and the carboxyl group increased, but a marked exception to this rule was observed with isobutyric and isovaleric acids.—W. P. S.

Silver in protein preparations ; Determination of ——. H. Wastenson. Pharm. Post, 1916, **49**, 187—188. J. Chem. Soc., 1916, **110**, ii., 577.

A method is described for the estimation of silver in protein preparations (for example, *Argentum proteinicum*) which also contain chlorides. From 0·2 to 0·5 grm. of the substance is heated with 10 c.c. of concentrated sulphuric acid and 2 c.c. of concentrated nitric acid until nitrous fumes cease to appear ; after cooling, the mixture is diluted with 25 c.c. of water, heated until the water has evaporated, and the heating then continued for a further thirty minutes. The clear solution is now diluted with water to about 100 c.c. and titrated with N/10-ammonium thiocyanate solution in the presence of ferric alum.

Physiological and pharmacological studies on coal-tar colours. Fat-soluble dyes. Salant and Bengis. *See* IV.

Volumetric determination of mercury salts. Evaluation of mercuric chloride compresses. Adanti. *See* VII.

General conceptions of intoxication [of enzymes]. Jacoby. *See* XVIII.

Patents.

(A) *Cephaeline isobutyl ether, and* (B) *cephaeline propyl ether, and salts thereof.* J. W. Meader, Indianapolis, U.S.A. Eng. Pats. (A) 11,717, (B) 11,719, Aug. 13, 1915.

(A) Cephaeline isobutyl ether is produced by treating cephaeline with an alkali metal and an isobutyl halide. *Example* :—17 grms. of isobutyl bromide is added to 46·6 grms. of cephaeline and 4·6 grms. of sodium dissolved in about 400 c.c. of absolute alcohol, and the mixture is boiled for about 2 hours. The alcohol is then distilled off, the residue dissolved in dilute hydrochloric acid, made alkaline with ammonia, and extracted with ether. The ethereal solution is extracted with excess of dilute caustic soda, to remove unchanged cephaeline, and is evaporated to dryness. The product may be purified by dissolving it in an acid, crystallising the salt, dissolving it in water, adding ammonia, extracting with ether, evaporating off the ether, and drying *in vacuo*. Cephaeline isobutyl ether is a varnish-like substance, easily soluble in alcohol, ether, and chloroform. It forms a crystalline hydrobromide (white needles) and hydrochloride. (B) Cephaeline propyl ether, having similar properties to the isobutyl ether, is prepared by a similar reaction, using 16 grms. of propyl bromide instead of 17 grms. of isobutyl bromide. —F. Sp.

Carbon tetrachloride ; Process of making ——. C. J. Strosacker, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,204,608, Nov. 14, 1916. Date of appl., Feb. 13, 1915.

Carbon tetrachloride is prepared by treating sulphur dichloride with carbon bisulphide until the sulphur dichloride is reduced practically to sulphur monochloride, and then raising the temperature and adding more carbon bisulphide until the sulphur monochloride is reduced to sulphur. The process may be modified by carrying on the first stage until the residue consists of a hot solution of sulphur in sulphur monochloride, adding more sulphur dichloride, and continuing the addition of carbon bisulphide until the same point is reached again, and finally raising the temperature and adding carbon bisulphide until the residue, which is kept liquid, consists mainly of sulphur. The carbon tetrachloride evolved in the reactions is condensed.—F. Sp.

2-*Naphthylquinoline-4-carboxylic acids.* M. Dohrn, Assignor to Chem. Fabr. auf Actien (vorm. E. Schering), Berlin. U.S. Pat. 1,197,462, Sept. 5, 1916. Date of appl., June 10, 1915.

2-NAPHTHYLQUINOLINE-4-CARBOXYLIC acids are prepared by condensing isatin with acetonaphthone (methyl naphthyl ketone) in alkaline solution or by condensing aniline with pyroracemic acid (pyruvic acid) and naphthaldehyde. *Example:* 180 parts of isatin dissolved in 500 parts of alcohol, 300 parts of 33% caustic potash solution, and 90 parts of methyl α-naphthyl ketone, are heated together on the water-bath for some hours. The alcohol is then distilled off, and the product precipitated by hydrochloric acid, dissolved in sodium carbonate solution, re-precipitated, and crystallised from dilute alcohol. 2.1′-Naphthylquinoline-4-carboxylic acid forms yellowish-red needles, melting at 198° C.; 2.2′-naphthylquinoline-4-carboxylic acid forms yellow crystals, melting at 234° C. Both compounds are soluble in alcohol and alkalis and insoluble in benzene, and are remedies for gout and rheumatism.—F. Sp.

Surgical suture and ligature and method of preparing same. C. H. Watson, Assignor to Davis & Geck, Inc., Brooklyn, N.Y. U.S. Pat. 1,202,931, Oct. 31, 1916. Date of appl. Oct. 29, 1915.

CATGUT sutures for surgical purposes are impregnated with a solution of potassium mercuric iodide.—F. Sp.

Chloroform: Process for purifying ——. G. Michaelis, Albany, N.Y. U.S. Pat. 1,203,032, Oct. 31, 1916. Date of appl., July 12, 1916.

100 PARTS of chloroform is shaken with 33 parts of sulphuric acid of 66° B. (sp.gr. 1·33) until a sample of the chloroform, after separation of the discoloured acid, no longer colours pure sulphuric acid when shaken with it for at least five minutes. The acid is then separated and a fresh quantity of 33 parts of sulphuric acid of the same strength is added, and the mixture is shaken and heated nearly to the boiling point of chloroform. Any chloroform which distils off is condensed and returned to the mixture, which is cooled and allowed to settle. The chloroform layer is drawn off, freed from acid by treatment with a suitable alkali, dried, and distilled. The first portion (10 parts) of the distillate is slightly impure. The next portion (60 or 70 parts) is pure chloroform, which is preserved by the addition of 0·6% to 1% of alcohol.—F. Sp.

Combination of organic acids [viz., salicylic acid and 2-phenylquinoline-4-carboxylic acid]. A. B. Davis, Assignor to Eli Lilly and Co., Indianapolis, Ind. U.S. Pat. 1,203,499, Oct. 31, 1916. Date of appl., July 26, 1915.

A COMPOUND of salicylic acid and 2-phenylquinoline-4-carboxylic acid is produced by precipitating an equimolecular mixture of their alkali salts with a mineral acid.—F. Sp.

Combination of organic acids. [Ester of 2-phenylquinoline-4-carboxylic acid and salicylic acid.] A. B. Davis, Assignor to Eli Lilly and Co., Indianapolis, Ind. U.S. Pat. 1,203,500, Oct. 31, 1916. Date of appl., July 26, 1915.

AN ester of salicylic acid and 2-phenylquinoline-4-carboxylic acid is produced by treating 2-phenylquinoline-4-carboxylic acid with thionyl chloride, and combining the resulting chloride with salicylic acid. It has the formula, $C_9H_5N(C_6H_5)(CO·O·C_6H_4·COOH)(2.4)$.—F. Sp.

Combination of organic acids [2-phenylquinoline-4-carboxylic acid and salicylic acid]. A. B. Davis, Indianapolis, Ind., U.S.A. Eng. Pat. 102,136, Aug. 29, 1916. (Appl. No. 12,220 of 1916.)

SEE U.S. Pat. 1,203,499 of 1916; preceding.

Therapeutically-active substance [from bile]. R. C. W. Nöhring, Koswig, Germany. U.S. Pat. 1,204,479, Nov. 14, 1916. Date of appl., May 22, 1914.

SEE Ger. Pat. 280,108 of 1913; this J., 1915, 452.

Phosphorus and oxygen containing organic compounds. R. Willstätter, Berlin. U.S. Pat. 1,205,138, Nov. 14, 1916. Date of appl., Apr. 16, 1915.

SEE Ger. Pat. 288,393 of 1914; this J., 1916, 385.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Tone reproduction and its limitations. F. F Renwick. Traill-Taylor Memorial Lecture. Phot. J., 1916, 56, 222—238.

THE possibility of obtaining a correct continuous tone reproduction, *i.e.*, one in which the tone values bear the same relationship as in the original, is dependent upon the luminosity range of the object, the qualities of the plate used for taking the negative, and the quality of the printing medium. The total range of most subjects is less than 30 to 1 and this range is easily obtained on the "correct exposure" portion of a good negative plate. The total range of photographic papers, including the "under-" and "over-exposure" periods, varies from about 16 to 1 with matt surface development papers, up to 50 to 1 with glossy development papers, and reaches as high as 200 to 1 with glossy P.O.P. The curves of a number of papers, obtained by plotting logarithms of exposures against reflection-densities, are given. A special instrument was designed for measuring reflection densities, the paper surface being illuminated at 45° and viewed at 90° to avoid the interference of specular reflection. Curves are given illustrating the results obtained by reproducing through a given plate on to a given paper. It is easily seen that scientifically correct reproduction is not obtainable except for a very limited range and using only the middle tones of both plate and paper. The problem as to whether scientifically correct reproduction is also artistically correct is then considered. Numerous facts are collated dealing with the sensitiveness of the eye under different conditions to lights of varying luminosity. The normal eye sees correctly over a range of about 20 to 1 in bright diffused daylight and approximately correctly over a range of about 100 to 1. Outside these limits—from 10.000 to 1,000,000 foot-candles luminosity—departures from correct seeing are increasingly greater, a given range of luminosities appearing less than it is. The exact relationship which should exist therefore between the range of luminosities in the original and the range of tones in the reproduction is dependent upon the actual values of the former and also to some extent on the conditions under which the reproduction is to be viewed. The varying qualities of plates and papers give the photographer a certain control over this relationship which would be absent if the "correct-exposure" portion were the whole of the characteristic curve.—B. V. S.

Patent.

Photographic films ; Manufacture of ——. E. A. Pin, Clichy, France. Eng. Pat. 102,066, Jan. 3, 1916. (Appl. No. 81 of 1916.)

See U.S. Pat. 1,184,772 of 1916 ; this J., 1916, 755.

XXIII.—ANALYSIS.

Vacuum desiccator ; An electrically heated ——. T. B. Robertson and C. L. A. Schmidt. J. Biol. Chem., 1916, **27**, 429—431.

The desiccator consists of a double-walled cylindrical copper chamber, insulated by asbestos packing and enclosed by a metal casing. This chamber is provided with an aluminium cover which fits on a rubber ring and is screwed down by three thumb-screws. The temperature of the chamber is maintained by the vapour of dichloromethane (b.pt. 40° C.), this liquid being placed in an annular well at the bottom of the chamber ; the heat is furnished by eight 25-watt nichrome heating elements, connected in parallel and placed round the well. A sprung copper disc is fitted inside the vapour jacket and just over the central opening of the annular well ; as the temperature rises, the pressure of the vapour presses this disc downwards, a pin attached to the lower side of the disc moves correspondingly and, by depressing a brass spring attached to each heating element, causes the current to be interrupted. In this way any or all of the elements may be switched on or off as required to produce a constant vapour pressure and temperature in the double-wall space surrounding the chamber. The temperature may be varied within a certain range by means of a weight on a lever acting on the lower end of the pin. The air is exhausted through a tapped tube at the upper part of the chamber, and a draw-off tap is provided for removing the liquid from the well when necessary.—W. P. S.

Nitric nitrogen ; Determination of ——. F. M. Scales. J. Biol. Chem., 1916, **27**, 327—337.

Nitrates in culture media and in soil extracts can be accurately estimated in presence of unstable amino-compounds by reducing with a zinc-copper couple at the boiling point of the solution, in presence of a small quantity of magnesia, and simultaneously distilling off the ammonia into excess of standard acid, the excess of acid being titrated at 37°—70° C. using *p*-nitrophenol as indicator. In the case of solutions containing a large amount of organic matter, previous shaking with alumina cream and filtering removes sufficient organic matter to prevent interference with the method. Details are given of a modified Kjeldahl distillation apparatus suitable for this method.—T. C.

Lithium ; Separation of —— from the other alkali metals. S. Palkin. J. Amer. Chem. Soc., 1916, **38**, 2326—2332.

The author makes use of alcohol and ether to precipitate sodium and potassium chlorides from an aqueous solution containing them together with lithium chloride. The mixed alkali chlorides are dissolved in a minimum amount of cold water, treated with one drop of concentrated hydrochloric acid, and 20 c.c. of absolute alcohol added gradually. The sodium and potassium chlorides should come down in a uniform granular condition. 60 c.c. of ether is added, and the mixture allowed to stand for about 5 minutes, filtered through a weighed Gooch crucible, and the containing vessel thoroughly washed with a mixture of alcohol 1 part and ether 4 to 5 parts. The precipitate is well washed, and the filtrate evaporated to dryness, and the residue treated with 10 c.c. of absolute alcohol, if necessary warming to complete solution. 50 c.c. of ether and one drop of concentrated hydrochloric acid are then added, the mixture allowed to stand for ½ hour, the precipitate collected in the same crucible as used for the first precipitate, washed with ether-alcohol mixture as before, dried, gently ignited, cooled, and weighed. The ether-alcohol solution of lithium chloride is evaporated on a steam bath, the residue dissolved in water, treated with a slight excess of sulphuric acid, transferred to a weighed porcelain or platinum dish, evaporated on a steam bath, and ignited. If charring occurs, the treatment with sulphuric acid and ignition are repeated. In an optional method for the lithium, the ether-alcohol solution is evaporated on a steam bath and the residue dried at 110° C. for 15—20 minutes, treated with 5—10 c.c. of alcohol, warming if necessary, the solution diluted with about 50 c.c. of water, and filtered if necessary through a Gooch crucible. The acid solution is titrated with *N*/10 alkali, the chlorides precipitated as silver salt, and from the weight of the latter is deducted the amount corresponding to the hydrochloric acid determined by titration. If the total quantity of mixed chlorides is greater than 0·5 grm., proportionately larger quantities of solvents are necessary in the first precipitation, but more accurate results are obtained when the total chlorides do not exceed 0·5 grm.—T. H. B.

Volumetric determination of mercury salts. Evaluation of mercuric chloride compresses. Adanti. *See* VII.

Reduction of vanadic acid by hydriodic acid. Edgar. *See* VII.

Analysis of certain tungsten derivatives. Sweeney. *See* VII.

Determination of boron in boron-steel Aschman. *See* X.

Detection of excess of cocoa shell in cocoa powder. *See* XIXa.

Sensitive reaction for apomorphine. Palet. *See* XX.

Delicate test for dimethylaminophenyldimethylisopyrazolone (pyramidone). Guglialmelli. *See* XX.

Determination of silver in protein preparations. Wastenson. *See* XX.

Patents.

Miners' electric safety lamps for detecting firedamp and other combustible gases : Attachment for ——. T. J. Thomas, Rhondda, Glam. Eng. Pat. 15,094, Oct. 26, 1915.

In an apparatus of the type in which the presence of firedamp is indicated by the fluctuation in intensity of the light of an electric lamp, the fluctuation being caused by the action of a catalytic body (*e.g.*, platinum wire) inserted in series with the lamp, the catalytic body employed has such resistance that it becomes fused, and the lamp extinguished, in the presence of a dangerous proportion of firedamp.—W. E. F. P.

Photometers, especially sector spectrophotometers. S. J. Lewis, London. Eng. Pat. 15,663, Nov. 5, 1915.

In an apparatus for measuring or comparing the intensity of the light of the regions or lines in two spectra, the light in the two paths is similarly treated in all respects by systems of reflecting prisms, with or without lenses, and the pencils of light are rendered parallel before or soon after passing through the first reflecting prisms. The transmission of light is continuous and the proportions are measured by means of a sector system comprising two pieces of metal mounted co-axially and cut so as to produce alternate sectors of metal and sector-shaped openings. The apparatus is also applicable to ordinary photometry.—W. E. F. P.

Filtration and/or percolation of liquids. Eng. Pat. 14,287. *See* I.

Trade Report.

Industrial developments in Russia. Board of Trade J., Nov. 30, 1916.

A SUPERPHOSPHATE factory has been erected on the railway between the stations Molovilich-Levshino, by the Zemstvo of Perm and Viatka. The capital invested in this undertaking is £100,000. A celluloid factory has been erected at Kalino on the Perm Railway. The Nijegorodski Zemstvo has built a formalin factory at Vetluga. A technical laboratory for the production of lanoline, naphthalene, etc., has been built in Rostov.

A large company has been formed in Moscow, with a capital of £400,000, for the erection of a coke-benzol factory. In Tomsk a large chemical factory is projected for the production of medicaments. A factory producing tanning materials in Kiev, having been sequestered, is now being administered by the Zemski Soyuz (Union of Zemstvos), and the output of tanning materials has been largely increased. Another tanning material factory is projected at Maikop in the Caucasus.

Prior to the war, the production of fertilisers in Russia was largely dependent on raw materials supplied by Germany. A great shortage of machinery for the use of artificial manure factories is badly felt, and this hinders the more rapid development of the industry. The manufacture of sulphuric acid appears to be progressing fairly well, several new works having been erected in the Volga region, in the Donetz basin, in the Caucasus, and in the Urals.

The supply of Russian pyrites is increasing, but other raw materials used by sulphuric acid works are in short supply. New saltpetre deposits have been discovered in the Altai districts (Siberia) and are being studied with a view to their exploitation. New deposits of pyrites have been discovered near the railway station Kinel in the Boguruslan district, and near Samara there are said to be deposits of sulphur.

Glass industry.—The mobilisation of Russian industries in 1915 also affected the glass industry, which was called upon to produce for the military authorities goods that were formerly imported from abroad, *e.g.*, mirrors, lenses, and other supplies for optical instruments, thermometer tubing, etc. The production of thermometers in Russia is a new industry, these being formerly imported from Germany. Fair progress was also made in the manufacture of insulating glasses for electrical purposes. Some difficulties were experienced in making optical glasses, but it is hoped that these will gradually be overcome.

The prices of optical and other instruments in Russia have risen by some 100%. There is a great demand for microscopes, scientific apparatus, field glasses, etc. Russian industry in these products is undeveloped, as there are no specialists or experienced hands available.

Peat industry.—The peat industry in the central industrial districts of Russia (the Governments of Moscow, Vladimir, Nijni-Novgorod, Riazan, Kostroma, and Tambov) began to develop in 1906, when a crisis arose in the oil industry, and not only manufacturers, but also the Government have been greatly interested in its development during recent years. The output of peat in the above-mentioned districts increased from 998,400 tons in 1909 to 1,307,200 tons in 1913. The output of peat is greatly dependent on the price of oil. During 1913 for example, when the consumption of oil decreased somewhat, larger amounts of peat and coal were used in its stead. There should be a good opening for peat pressing machinery in the future. The Council of Ministers has assigned about £170,000 for the purchase of peat presses, and a trial order of 70 presses has been placed with works in Moscow. The Ministry of Agriculture has applied for a credit of £300,000 for the development of the peat industry.

Books Received.

ANALYTICAL CHEMISTRY. VOLUME I. QUALITATIVE. Based on the German text of F. P. TREADWELL. Translated and revised by W. T. HALL. Fourth Edition. Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C. xii + 538 pages, 9×6 in. Price 12s. 6d.

THE eighth German edition of Treadwell's well-known treatise forms the basis on which this volume has been prepared. It is not a literal translation of the German work, having been largely re-written and throughly revised. The translator expresses his obligations to the text of other writers, particularly Noyes, Stieglitz, Böttger, and Ostwald. The general plan of the book remains unaltered, but greater stress has been laid on the theoretical side of the subject, particularly with regard to the applications of the mass action principle, the ionisation theory, etc. The present volume consists of five parts, the first being introductory, the second dealing with the reactions of metals, and the third with reactions of the metalloids. Part IV. is entitled "Systematic analysis," and Part V. describes reactions of some of the rarer metals.

A METHOD FOR THE IDENTIFICATION OF PURE CARBON COMPOUNDS. Volume II. By S. P. MULLIKEN. Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C. ix. + 327 pages, $10 \times 6\frac{3}{4}$ in. Price 21s.

SOME four thousand of the more important compounds of carbon with nitrogen, hydrogen, and oxygen are classified in this volume, with an account of the physical properties and chemical tests for each. The opening chapters contain descriptions of the various tests referred to in the tables which occupy the main portion of the book. In these tables the compounds are classified as genus I., colourless acidic compounds; genus II., colourless basic compounds; genus III., colourless neutral compounds, each genus being subdivided into solid and liquid species; coloured compounds are treated in a separate table. The substances are arranged in order of increasing melting point or boiling point. The abbreviations and symbols which have been included, in order to economise space, appear to be rather puzzling at first (*e.g.*, "Lft. fr. alc. or bz. D.s.c. alc.; e.s. bz.," for "Leaflets from alcohol or benzene. Soluble with difficulty in cold alcohol, easily in benzene"), but apart from this the tables should be of value to those who desire to see at a glance the characteristic properties of organic compounds. It is questionable, however, whether the use of the melting- or boiling-point as a basis for the identification of a compound can be of much practical value.

The Society of Chemical Industry.

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1909. Allan, Maurice, 103, Burford Road, Nottingham, Soapmaker.
1907. Allard, M. L., c/o Dunlop Tire and Rubber Goods Co., Toronto, Canada, Chemist.
1902. Allbright, Wm. B., 4937, Madison Avenue, Chicago, Ill., U.S.A., Chemical Engineer.
1915. Allchin, L. J., 92, Monton Road, Eccles, nr. Manchester, Managing Chemist.
O.M. Alldred, C. H., 8, St. Margaret's Road, Plumstead Common, Woolwich, S.E., Technical Chemist.
1898. Alleman, Dr. Gellert, Swarthmore College, Swarthmore, Pa., U.S.A., Professor of Chemistry.
1903. Allen, Chas. A., Overdale, Sunnyhurst, Darwen, Lancashire, Chemist.
1911. Allen, Harry L., 470, Morris Avenue, Elizabeth, N.J., U.S.A., Chemist.
O.M. Allen, J., 164, Upper North Street, Poplar, E., Manufacturing Chemist.
1893. Allerton, Rt. Hon. Lord, F.R.S., (Journals) Allerton Hall, near Leeds; and c/o W. L. Jackson and Sons, Ltd., Buslingthorpe, Leeds, Tanner.
O.M. Allhusen, A., Beadnell Tower, Chathill, Northumberland, Chemical Manufacturer.
1886. Allibon, G. H., The Gables, Deramore Park, Belfast, Ireland, Chemical Works Manager.
1916. Alliott, E. A., c/o Manlove, Alliott & Co., Ltd., 23, King Street, Manchester, Chemical Engineer.
1905. Allpass, Jas., 9, Albert Square, Manchester, Secretary.
1912. Almy, Charles, c/o Virginia Products Corporation, Baltimore, Md., U.S.A, Chemical Engineer.
1899. Alsop, Wm. K., Ridgway, Pa., U.S.A., Chemist.
1910. Amin, Bhailal D., The Alembic Chemical Works Co., Ltd., Gorwo Road Camp, Baroda, India, Chemical Agent.
1905. Amory, L. H., c/o Messrs. J. Heathcoat and Co., Tiverton, Devon, Lace Manufacturer.
1914. Anders, H. R., Dept. F. of Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.
1916. Andersen, Aage, c/o Planters Margarine Co., and Brooklyn House, Chapel Street, Hyde, Cheshire, Works Manager.
1914. Anderson, Albert E., c/o Procter and Gamble Co., Ivorydale, Ohio, U.S.A., General Superintendent.
1915. Anderson, E., P.O. Box 1044, Durban, Natal, S. Africa, Soap Manufacturer.
1910. Anderson, Jas. R. V., School of Mines, Bendigo, Victoria, Australia, Lecturer in Chemistry and Metallurgy.
1900. Anderson, Jas. W., Cliffe Lodge, Cliffe, nr. Rochester, Kent, Analytical Chemist.

1914. Anderson, P. J., Marischal College, Aberdeen, Librarian.
1889. Anderson, Robt. T. R., 42, Roslea Drive, Dennistoun, Glasgow, Technical Chemist.
1894. Anderson, Dr. W. Carrick, 7, Scott Street, Garnet Hill, Glasgow, Consulting Chemist.
1905. Andreae, Dr. E. P., c/o British Glanzstoff Manufacturing Co., Ltd., Flint, North Wales, Chemist.
1907. Andrews, Chas. T., c/o W. S. Andrews, The British Metals Extraction Co., Ltd., Chemical Works, Llansamlet, R.S.O., Glam., Chemist.
1889. Andrews, Dr. Clement W., c/o The John Crerar Library, Wabash Avenue and Washington Street, Chicago, Ill., U.S.A., Librarian.
1912. Andrews, Ernest R., "Nutfield," Drueo Road, Dulwich, S.E., Analytical and Consulting Chemist.
1914. Andrews, Joseph C., 123, Vine Street, New Britain, Conn., U.S.A., Chemical Engineer.
1916. Andrews, William, 45, Snowdon Road, Eccles, Lancashire, Works Manager.
1903. Andrews, Wm. H., 79, Tonawanda Street, Buffalo, N.Y., U.S.A., Manager (Varnish Works).
1913. Andrews, W. O., P.O. Box 2671, Johannesburg, South Africa, Analytical Chemist.
1903. Anfilogoff, N. A., Thames Haven, Essex, Chemist and Petroleum Refiner.
1913. Annan, J. G., Elm Cottage, Addiewell, Midlothian, Chief Chemist (Mineral Oil Works).
1892. Annandale, C. J. R., The Briary, Shotley Bridge, Co. Durham, Paper Maker.
1894. Ansbacher, L. A., 527, Fifth Avenue, New York City, U.S.A., Colour Manufacturer.
1913. Anspach, Dr. Richard, Lyckorna, Raynham Avenue, Didsbury, Manchester, Dyeworks Manager.
1902. Anthony, John, 217, King Street East, Toronto, Canada.
1915. Appleby, E. G., 12, The Broadway, Westminster, S.W., Civil Engineer.
1895. Appleby, Prof. W. R., 911, 5th Street S.E., Minneapolis, Minn., U.S.A., Prof. of Mining and Metallurgy.
1900. Appleyard, Geo. H., 1, Carlton Terrace, Hornsea, East Yorks, Chemist.
1905. Appleyard, Jas. R., Royal Technical Institute, Salford, Lecturer.
O.M. Archbutt, Leonard, The Yews, Madeley Street, Derby, Analytical Chemist.
1899. Archdale, T. Henry, 38, Whitebirk, Blackburn, Manager of Tar and Ammonia Works.
1904. Archdale, Wm., Sandhutton, Hill Lane, Blackley, Manchester, Manager of Chemical Works.
1901. Ardagh, Prof. Edw. G. R., Faculty of Applied Science, University of Toronto, Canada, Chemist.
1900. Ardern, Edw., Holmleigh, Marlborough Road, Flixton, Manchester, Chemist.
1907. Armstrong, Chas. F., c/o Cawnpore Sugar Works, Ltd., Marhourah Factory P.O., Chupra, Sarun, India, Technical Chemist.
1902. Armstrong, Edward E., Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A., Manufacturing Chemist.
1905. Armstrong, Dr. E. Frankland, c/o J. Crosfield and Sons, Ltd., Warrington, Technical Chemist.
1912. Armstrong, Prof. H. E., F.R.S., 55, Granville Park, Lewisham, S.E., Consulting Chemist.
1899. Armstrong, Richard, Saul Street Soap Works, Preston, Lancashire, Soap Manufacturer.
1905. Arnold, Frank L., 32, School Street, North Woburn, Mass., U.S.A., Chemist.
1899. Arnott, Dr. G. W. Campbell, c/o Fertiliser Manufacturers' Association, 68–70, Fenchurch Street, London, E.C., Agricultural Chemist.
1912. Arny, H. V., 115, West 68th Street, New York City, U.S.A., Teacher and Chemist.
1915. Arundel, Edgar, 99, Poppleton Road, Leytonstone, N.E., Chemist.
1911. Asahina, Koju, Uyeda Sericulture College, Uyeda, Shinano, Japan, Chemist.
1901. Asano, K., Ashio Copper Mine, Shimozuke, Japan, Consulting Mining Chemist.
1908. Ashbury, J. W., c/o John Brown and Co., Ltd., Laboratory, Atlas Works, Sheffield, Chief Chemist.
1914. Ashcroft, Edgar A., 30, Union Road, Stratford, E., Technical Chemist.
1903. Ashley, Frank R., c/o Western Chemical Manufacturing Co., Denver, Colo., U.S.A., Manufacturing Chemist.
1915. Ashton, Jack, 110, Hubert Street, Leichhardt, New South Wales, Australia, Oil Chemist.
1890. Ashton-Bost, W. D. *See* Bost, W. D. Ashton.
1894. Ashworth, Arthur, Fernhill Chemical Works, Bury, Lancs., Chemical Manufacturer.
1908. Ashworth, D. Irving, P.O. Box 503, Wappingers Falls, N.Y., U.S.A., Chemist.
1915. Ashworth, Fred., 15, Woodlea, Waterfoot, nr. Manchester, Analytical and Consulting Chemist.
1907. Aspey, Urban, jun., New Station Soap Works, School Close, and (Journals) Tonbridge Villa, Tonbridge Place, Leeds, Works Manager and Chemist.
1898. Aspinall, Thos., 34, Chorley New Road, Bolton, Analytical and Manufacturing Chemist.
1900. Aston, Bernard C., Box 40, P.O., Wellington, New Zealand, Chemist.
1915. Atack, F. W., 88, Claudo Road, Chorltonville, Manchester, Demonstrator in Chemistry.
1891. Atkins, C. E., The Heath, Redbourn, Herts., Chronometer Maker.
1885. Atkinson, A. J., 10, North Church Street, Cardiff, Analytical Chemist.
1912. Atkinson, F. C., c/o American Homing Co., Gent Avenue, Indianapolis, Ind., U.S.A., Chemist.
1911. Atkinson, James E., The Sheffield Testing Works, Ltd., Blonk Street, Sheffield, Analytical Chemist.
1915. Atlas, Henry, Yalding Manufacturing Co., Ltd., Yalding, Kent, Technical Chemist.
1905. Atteaux, F. E., 176, Purchase Street, Boston, Mass., U.S.A., Dyestuff Importer.
1900. Atwood, Frank W., 216, Milk Street, Boston, Mass., U.S.A., Chemist.
1895. Auchterlonie, Wm., c/o Clark Thread Co., Newark, N.J., U.S.A., Dyeworks Manager.
1897. Auger, Chas. L., Room 24, First National Bank Building, Paterson, N.J., U.S.A., Silk Dyer.
1911. Austin, Fred. J., 343, Sixth Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1913. Austin, Wm. L., 113, Church Lane, Charlton, S.E., Analytical Chemist.
1901. Auty, Albert M., c/o John Smith and Sons, Ltd., Field Head Mills, Bradford, Works Chemist.
1902. Avery, D., 387, Barker's Road, Kew, Melbourne, Vic., Australia, Teacher of Chemistry.
1910. Ayers, Gilbert F., Dynamite Factory, Modderfontein, Transvaal, Chemist.
1899. Aylsworth, Jonas W., 223, Midland Avenue, East Orange, N.J., U.S.A., Chemist.

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1908. Babington, Fred. W., Customs Laby., Customs Dept., Ottawa, Canada, Analyst.
1913. Backus, Cecil F., c/o Atlas Powder Co., Wilmington, Del., U.S.A., Chemist.
1913. Bacon, Raymond F., Mellon Institute of Industrial Research, The University, Pittsburgh, Pa., U.S.A., Associate Director.
1911. Baddiley, James, c/o Levinstein, Ltd., Crumpsall Vale Chemical Works, Blackley, Manchester, Research Chemist.
1897. Badock, Stanley H., Holmwood, Westbury on Trym, near Bristol, Smelter.
1898. Baekeland, Dr. Leo, Snug Rock, Harmony Park, Yonkers, N.Y., U.S.A., Research Chemist.
1912. Bagley, Fred. P., c/o George H. Morrill Co., Norwood, Mass., U.S.A., Ink Manufacturer.
1913. Bailey, Alan M., c/o The National Explosives Co., Ltd., Hayle, Cornwall, Analytical Chemist.

1903. Bailey, Prof. E. H. S., The Library, Kansas State University, Lawrence, Kas., U.S.A., Professor of Chemistry.
1885. Bailey, Edwin M., Almond Hill, Pumpherston, Mid Calder, Scotland, Technical Chemist.
1908. Bailey, Frank W., 25, Lord Street, Glossop, Derbyshire.
1883. Bailey, Dr. G. H., Kinlochleven, Argyll, Scotland, Chemist.
1903. Bailey, Harold J., 10, Park Road, Pendleton, Manchester, Alkali Inspector.
1906. Bailey, Ralph W., 66, Cherry Street, Elizabeth, N.J., U.S.A., Chemist.
1888. Bailey, Dr. T. Lewis, 21, Shavington Avenue, Chester, H.M. Inspector of Alkali Works.
1910. Baillie, Dr. Thomas B., 5, Mossgiel Avenue, Ainsdale, Lancashire, Analytical Chemist (Love Lane Sugar Refinery).
1902. Bain, Prof. Jas. Watson, Faculty of Applied Science, The University, Toronto, Ont., Canada, Chemist.
1915. Bainbridge, J. R., Inglenook, Arklow, Co. Wicklow, Ireland, Chemist.
1911. Baird, Douglas H., 14, Cross Street, Hatton Garden, London, E.C., Scientific Instrument Maker.
1908. Baird, M. M., 18, Jedburgh Avenue, Rutherglen, Glasgow, Analytical Chemist.
1891. Baird, Wm., c/o Lewis Berger and Sons, Ltd., Homerton, N.E., Technical Chemist.
1895. Baird, W. Raymond, 271, Broadway, New York City, U.S.A., Patent Lawyer.
1890. Bairstow, John, Burley, Queen's Park, Chester, Chemical Works Manager.
1903. Baker, Arthur, "Denhurst," Earnsdale, Darwen, Chemist.
1916. Baker, Bertram, 44, Melton Road, West Bridgford, Nottingham, Analytical Chemist.
1913. Baker, Bertram F., Oak Villa, New Chester Road, Cheshire, Technical Chemist.
1902. Baker, Chas. F., Technical College, Sunderland, Lecturer in Chemistry.
1910. Baker, C. Kerslake, 16, Change Alley, Sheffield, Analytical Chemist.
1901. Baker, F. Guy Stirling, The Brewery, Chiswell Street, London, E.C., Brewer's Chemist.
1883. Baker, Harry, Epworth House, Moughland Lane, Runcorn, Analytical Chemist.
1904. Baker, John T., c/o J. T. Baker Chemical Co., Phillipsburg, N.J., U.S.A., Manufacturing Chemist.
1892. Baker, Julian L., Ardingley, Linden Avenue, Maidenhead, Brewing and Sugar Chemist.
1909. Baker, Robert P.: on active service, Technical Chemist.
1886. Baker, Theodore, 781, Du Pont Building, Wilmington, Del., U.S.A., Analytical Chemist.
1910. Baker, Dr. Thos., Westville, Doncaster Road, Rotherham, Chemist and Metallurgist.
1912. Balch, Prof. Alfred W., 416, Huntington Avenue, Boston, Mass., U.S.A., Professor of Biological Chemistry.
1914. Balcon, Lt. P. C., 234th Field Co., R.E., Milford Camp, Milford, Surrey, Chemist.
1912. Baldracco, Cav. Prof. Dr. Giacinto, R. Conceria Scuola Italiana, Corso Cirie, ang. Via Biella, Turin, Italy, Leather Trades Chemist.
1903. Baldwin, F. H., Bergenport Chemical Works, Bayonne, N.J., U.S.A., Superintendent.
1903. Baldwin, Dr. H. B., 927, Broad Street, Newark, N.J., U.S.A., Chemist (Dept. of Public Health).
1903. Ball, S. F., 289, East 201st Street, New York City, U.S.A., Analytical Chemist.
1889. Ballantyne, Horatio, 75, Chancery Lane, London, W.C., Analytical and Consulting Chemist.
1903. Ballantyne, W. H., 111, Hatton Garden, London, E.C. Patent Agent's Assistant.
O.M. Ballard, Edw. G., 8, Lansdowne House, Lansdowne Road, Holland Park, London, W., Alkali Works Inspector.
1915. Balmforth, Charles, The Avenue, Birstall, nr. Leeds, Analytical Chemist.
1910. Baly, Prof. E. C. C., F.R.S., 14, Sunnyside, Prince's Park, Liverpool, Professor of Inorganic Chemistry,
O.M. Bamber, H. Kelway, Outram House, Addiscombe, Surrey, Consulting Chemist.
1894. Bamber, H. K. G., Ingress House, Greenhithe, Kent, Cement Works Manager.
1898. Bamford, Harry, 70, Duckworth Terrace, Bradford, Yorks, Dyer.
1906. Bancroft, John, Wilmington, Del., U.S.A., Bleacher and Dyer.
1916. Banker, S. G., Belle Vue, 36, Chowpaty, Bombay, India, Leather Chemist.
1913. Banks, A. J., c/o The Ogilvie Flour Mills Co., Ltd., Montreal, Canada, Analyst.
1890. Banks, Jno. H., 61, Broadway, New York City, U.S.A., Mining Engineer.
O.M. Bannister, W., Dunloe, Bramley Hill, South Croydon, Manufacturing Chemist.
1909. Barber, C. Douglas, Great Nelmes, Hornchurch, Essex, Chemist.
1914. Barber, Charles F. L., 13, Cambridge Terrace, Otley, Yorks., Leather Chemist.
1915. Barber, Christopher, 60, Harcourt Road, Sheffield, Chemical Engineer.
1908. Barber, Percy S., The Reform Food Stores, 84, Whitechapel, Liverpool, Chemist.
1911. Barclay, Andrew, c/o Buchanan, Jones & Co., Antofagasta, Chile, Chemist.
1912. Barclay, William R., 31, Glenalmond Road, Eccleshall, Sheffield, Manager of Electroplate Factory and Lecturer in Electro-Metallurgy.
1892. Barden, Alf., Far Bank, Shelley, near Huddersfield, Glue and Size Maker.
1907. Bardorf, C. F., c/o St. Lawrence Sugar Refining Co., Maisonneuve, P.Q., Canada, Chief Chemist.
1915. Bardsley, J.R., "Belair," Walton Crescent, Abbotsford, Sydney, N.S.W., Australia, Hat Manufacturer.
1902. Barker, Hugh S., 32, Cumberland Avenue, Sefton Park, Liverpool, Laboratory Furnisher.
1912. Barker, Dr. Jonathan T., Victoria Villa, Halkyn Street, Flint, North Wales, Chemist.
1895. Barlow, Clinton W., 104—112, East 25th Street, New York City, U.S.A., Merchant.
1901. Barlow, John J., Broadway, Accrington, Calico Printer's Chemist.
1899. Barlow, Wm., 23, Alton Terrace, Fairfield, Manchester, Analytical Chemist.
1908. Barnes, Alfred, Box 556, Pretoria, Transvaal, Dealer in Minerals.
1906. Barnes, A. G., c/o Hasland Coking Co., Grassmoor Collieries, Chesterfield, Colliery Proprietor.
1914. Barnes, Edward A., c/o Aetna Chemical Co., Drummondville, P.Q., Canada, Chemical Engineer.
1905. Barnes, F. V., Gas Works, Todmorden, Engineer and Manager.
1884. Barnes, H. J., Phœnix Chemical Works, Hackney Wick, N.E., Manufacturing Chemist.
1884. Barnes, Jonathan, 301, Great Clowes Street, Manchester, Analytical Chemist.
O.M. Barnes, Jos., Highbrake, Arnside, Westmorland, Analytical Chemist.
1916. Barnes, Wm. H., c/o Follows and Bate, Ltd., Engineers, Gorton, Manchester, Manager and Representative.
1912. Barnett, E. de Barry, 9, Collingham Road, South Kensington, S.W., Chemist.
1904. Baron, Wm. Briscoe, "Ingleside," Woodfield Road, Cheadle Hulme, Stockport, Chemist.
O.M. Barr, J., Dinting Vale, Dinting, near Manchester, Chemical Manager.
1915. Barraclough, C. E., c/o J. Crossey & Sons, Ltd., Dean Clough Mills, Halifax, Chemist.
1914. Barraclough, Dennis H., North Brierley Sewage Works, Oakenshaw, Bradford, Chemist.
1890. Barraclough, Wm. H., Chapeltown House, Chapeltown, near Sheffield, Analytical Chemist.
1890 Barrett, Arthur A., 139, Viale San Martino, Messina, Sicily, Manufacturer of Essential Oils.

1907. Barrett, Maurice, 9, Roundhay Mount, Leeds, Technical Chemist (Leeds Fireclay Co.).

1912. Barrow, Jas. V., c/o Messrs. W. H. Holmes and Sons, Portland Road, Newcastle-on-Tyne, Works Chemist.

1900. Barrow, Jos., "Woodhey," Malford Grove, South Woodford, N.E., Chemist.

1915. Barrowcliff, M., 2, Rushworth Avenue, West Bridgford, Nottingham, Research Chemist.

1906. Barrs, Chas. E., 12B, Belsize Parade, Hampstead, N.W., Analyst.

1905. Barry, Eugene, Ayer, Mass., U.S.A., Leather Manufacturer.

1915. Barton, B. Cyril, Sun Chambers, Lowgate, Hull, Seed Crusher.

1893. Barton, G. E., 227, Pine Street, Millville, N.J., U.S.A., Technical Chemist.

1903. Bartrip, Geo. F., c/o B. Laporte, Ltd., Luton, Beds, Managing Chemist.

1905. Baruch, Edgar, 805-806, Wright and Callender Building, Los Angeles, Cal., U.S.A., Chemical Engineer.

1910. Barwick, F. W., Chamber of Commerce Testing House, Royal Exchange, Manchester.

1915. Bashore, E. G., La Tourette Hotel, Bayonne, N.J., U.S.A., Chemist.

1895. Baskerville, Dr. Chas., College of the City of New York, New York City, U.S.A., Professor of Chemistry.

1884. Bassett, H., 26, Belitha Villas, Barnsbury, N.

1908. Bassett, Professor Henry, University College, Reading, Prof. of Chemistry.

1899. Bassett, Wm. H., Main Street, Cheshire, Conn., U.S.A., Chemist.

1890. Bate, William, Upton Villa, Hayle, Cornwall, Technical Chemist (National Explosives Co., Ltd.).

1903. Bateman, A. H., Eridge, Shooter's Hill, Woolwich, S.E., Chemist.

1913. Bateman, James T., 34, Bridge Avenue, Hammersmith, W., Engineer and Works Manager.

1912. Bates, D. M., Lewiston Bleachery and Dye Works, Lewiston, Maine, U.S.A., General Manager.

1914. Bates, John S., 700, University Street, Montreal, Canada, Superintendent.

1914. Battersby, W. H., Bury Corporation Gas Works, Elton, Bury, Lancs., Chief Chemist.

1885. Batty, R. B., Wharncliffe, Erdington, near Birmingham, Nickel Works Manager.

1910. Battye, Horace G., 28, Roman Place, Street Lane, Roundhay, Leeds, Chemist and Works Manager.

1903. Baty, E. J., c/o Thermoelectric, York Street, Luton, Beds, Chemist.

1903. Bauer, Geo. W., 660, Sacramento Street, San Francisco, Cal., U.S.A., Vice-President and Chemist (Hop and Malt Co.).

1915. Baumann, Dr. L., Manufacture Emile Zündel, Moscow, Russia, Managing Director of Printworks.

1910. Baxter, F. Stanley, 5, York House, College Place, St. Pancras, London, N.W., Chemist.

1913. Baxter, Harold R., c/o Aktiebolaget J. and G. Cox, Kungsgatan 13, Gothenburg, Sweden, Manager (Glue Works).

1898. Baxter, John G., Glenarm, Lennox Avenue, Gravesend, Kent, Chemist.

1915. Bay, Dr. B., Technical Chemist.

1915. Bayley, Frank, 14, Slade Grove, Slade Lane, Longsight, Manchester, Technical Chemist.

1908. Bayly, Percival G. W., Mines Dept. Laby., Spring Street, Melbourne, Victoria, Government Metallurgical Chemist.

1886. Beadle, Clayton, Oakbank, Lansdown Road, Sidcup, Kent, Consulting Chemist.

1911. Beard, Stanley D., Lederle Antitoxin Laboratories, Pearl River, N.Y., U.S.A., Biological Chemist.

1907. Beardsley, Dr. Alling P., East Main Street, Somerville, N.J., U.S.A., Chemist (New Haven Gas Co.).

1909. Bearpark, Arthur F., P.O. Box 497, Durban, South Africa, Consulting Chemist and Chemical Engineer.

1908. Beasley, Fred. G., Central Hotel, Widnes, Lancashire, Metallurgical Chemist.

1905. Beasley, Jno. K., c/o The Borneo Co., Kuching, Sarawak, Metallurgical Chemist.

1897. Beaver, Chas. J., Rangemoor, Crescent Road, Hale, Cheshire, Chemist.

1905. Beckers, Dr. Wm., East 83 Street and Ditmar Av., Brooklyn, N.Y., U.S.A., Manufacturing Chemist.

1909. Becket, Fredk. M., 31, Sugar Street, Niagara Falls, N.Y., U.S.A., Chief Metallurgist, Electro Metallurgical Co.

1912. Beckett, Dr. E. G., No. 1, Sandhills, Ardeer, Stevenston, Ayrshire, Analytical Chemist.

1899. Bedford Alf. C., 26, Broadway, New York City, U.S.A., Chemical Merchant.

1891. Bedford, Chas. S., Rocella, Weetwood, Headingley, Leeds, Manufacturing Chemist.

1891. Bedford, James E., Shire Oak Road, Headingley, Leeds, Chemical Manufacturer.

1911. Bedforth, G. E., Aspley Dyeware Mills, Huddersfield, Works Chemist.

O.M. Bedson, Prof. P. Phillips, Armstrong College Newcastle-on-Tyne, Professor of Chemistry.

1901. Beevers, Clifford J., c/o The Shipley Grease and Fertiliser Co., Westfield Works, Wrose Hill, Shipley, Yorks, Analyst.

1903. Behrend, F., 54, Front Street, New York City U.S.A., Importer of Chemical Stoneware.

O.M. Beilby, Dr. George T., F.R.S., 11, University Gardens, Glasgow, Chemical Engineer.

1912. Belaïew, Col. Nicolai, c/o Russian Government Supply Committee, India House, Kingsway, London, W.C., Lecturer in Metallurgy and Chemistry.

1884. Bell, Sir Hugh, Bart., Middlesbrough-on-Tees, Soda and Iron Manufacturer.

1886. Bell, J. Ferguson, Derby Gas Light and Coke Co., Derby, Gas Engineer.

1907. Bell, Marcus, Defence Dept., Melbourne, Victoria, Chemist.

1905. Bell, Miss M. M., Tulane University Library, New Orleans, La., U.S.A., Librarian.

1903. Bell, P. Carter, Millburn, N.J., U.S.A., Chemical Manufacturer.

1915. Bell, Wm., c/o Parry and Co., Ranipettai, S. India, Works Chemist.

O.M. Bendix, D., 371, Romford Road, Forest Gate, E., Managing Chemist, British Alizarin Co., Ltd.

1903. Benham, Keith, The Woodlands, Rowley Park, Stafford, Analytical and Consulting Chemist.

O.M. Benjamin, Dr. M., Smithsonian Institution, Washington, D.C., U.S.A., Consulting Chemist.

1899. Bennett, Alex. H., Via Giuseppe La Farina, Messina, Sicily, Chemist.

1907. Bennett, H. Garner, 115, Grovehill Road, Beverley, Yorks, Leather Chemist.

1915. Bennett, Walter, 37, Town Street, Bramley, Leeds, Analytical Chemist.

1909. Benson, George F., Edwardsburg Starch Co., Cardinal, Ontario, Canada, President and Managing Director.

1901. Bentley, Wm. H., 12, Cromwell Terrace, Irlam, near Manchester, Technical Chemist.

1890. Bentz, Ernest, 30, Manley Road, Whalley Range, Manchester, Technical Chemist.

1893. Berk, Fred. W., 1, Fenchurch Avenue, London, E.C., Chemical Manufacturer.

1907. Berk, Paul F., 1, Fenchurch Avenue, London, E.C., Chemical Manufacturer.

1900. Bermingham, John, jun., c/o Union Powder Corporation, 50, Church Street, New York City, U.S.A., Superintendent.

1889. Bernard, Jas., jun., c/o The United Alkali Co., Ltd., Muspratt Works, Widnes, Chemical Works Manager.

1897. Berry, Albert E., Abbotsleigh, Wanstead, Essex, Works Manager.

1911. Berry, Arthur G. V., c/o Sir Boverton Redwood, Bart., 4, Bishopsgate, London, E.C., Analyst.

1906. Berry, Arthur J., 14, Regent Street, Cambridge, Chemist.

1883. Berry, E. E., Bordighera, Italy, and (Journals) c/o C. H. Grinling, 17, Rectory Place, Woolwich, S.E., Technical Chemist.
1913. Berry, Prof. R. A., The Agricultural College, Blythswood Square, Glasgow, Prof. of Agric. Chemistry.
1903. Berry, W. G., 200, Claremont Avenue, Manhattan, New York City, U.S.A., Chemist.
1909. Beskow, K. J., Södra Storgatan 19, Helsingborg, Sweden, Head Engineer.
1914. Best, Ronald L., 55, Derwent Road, Palmer's Green, N., Analytical Chemist.
1886. Best, Dr. T. T., Hardshaw Brook Chemical Works, St. Helens, Lancashire, Technical Chemist.
1914. Bettesworth, A. E. A., 490, St. Paul Street, Montreal, Canada, Managing Director.
1901. Betts, Anson G., Box 792, Ashville, N.C., U.S.A., Chemist.
O.M. Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C., Public Analyst and Consulting Chemist.
1900. Bevan, Jno. W., Morriston Spelter Works, Morriston, R.S.O., Glamorgan, Manager of Metallurgical Works.
O.M. Beveridge, Jas., Springfield House, Chatham, N.B., Canada, Pulp and Paper Manufacturer.
1909. Bewick, R. M., "Lynton," Park West, Heswall, Cheshire, Traveller.
1916. Beynon, D. E., 80, Hogarth Avenue, Toronto, Canada, Rubber Chemist.
1898. Bhattacharyya, Haripada, Gun and Shell Factory, Ishapore, Bengal, India, Chemist.
1896. Bibby, John, c/o J. Bibby and Sons, Formby Street, Liverpool, Chemist.
O.M. Bickerdike, W. E., Bryer's Croft, Wilpshire, near Blackburn, Manufacturing Chemist.
1907. Bickerstaffe, Robert, "Wynstay," St. Anne's Road, Blackpool, Chemist.
1903. Bierwith, L. W., c/o Du Pont Powder Co., Haskell, N.J., U.S.A., Civil Engineer.
1910. Bigelow, Chas. A., c/o Pluto Powder Co., Ishpeming, Mich., U.S.A., Superintendent.
1912. Bigelow, Edward P., Mellin's Food Library, 291, Atlantic Avenue, Boston, Mass., U.S.A., Chemist.
1884. Biggart, J. Wm., 29, Cathcart Street, Greenock, Scotland, Analytical Chemist.
1891. Biggart, Wm. L., Rossarden, Kilmacolm, Scotland, Public Analyst.
1911. Biggins, J. E., c/o Gulf Refining Co., Port Arthur, Texas, U.S.A., Chemist.
1910. Biggs, J. W. H., 318, High Street, Plumstead, S.E., Chemist.
O.M. Billing, H. S., 42, Kingsley Road, Mutley, Plymouth, Chemist.
1896. Billington, Chas., Heimath, Porthill, Longport, Staffordshire, Metallurgist.
1911. Bingham, H. C., 7, Gracechurch Street, London, E.C., Consulting Engineer.
1907. Bird, Charles S., jun., Messrs. F. W. Bird and Son, Library Dept., East Walpole, Mass., U.S.A., Paper Maker.
1895. Bird, Wm. R., (communications) 125, Goddard Avenue; (Journals) Laboratory, G.W.R. Works, Swindon, Wilts., Analytical Chemist.
1902. Bird, W. Robt., 217, Newport Road, Cardiff, Oil Merchant.
1915. Birley, J. Harold, c/o Chas. Macintosh and Co., Ltd., Cambridge Street, Manchester, Indiarubber Manufacturer.
1883. Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, E., Manufacturing Chemist.
1884. Bishop, Fred., c/o Burmah Oil Co., P.O. Box 67, Rangoon, Burmah, Technical Chemist.
1903. Bishop, Howard B., 119, Pierce Street, Easton, Pa., U.S.A., Chemist.
1903. Bishop, J. T. F., Manchester Chemical Club, Victoria Hotel, Manchester, Secretary.
1905. Bixby, Willard G., 46th Street and 2nd Avenue, Brooklyn, N.Y., U.S.A., Blacking Manufacturer.
1905. Bjerregaard, A. P., 10724, Kimberley Avenue, Cleveland, Ohio, U.S.A., Varnish Chemist.
1912. Björnström Steffanson, G., Hovedpostkontorel, Kristiania, Norway, Pulp and Paper Works Manager.
1909. Blacher, Prof. Charles, Chemical Engineer.
1904. Black, J. Wyclif, 62, Falcon Avenue, Edinburgh, Analytical Chemist.
1902. Black, W. Geoffrey, St. John's House, Christchurch Road, Norwich, Chemist
1910. Blackie, Archibald, 223, James Street, Winnipeg, Canada, Chemist.
1894. Blackmore, H. S., P.O. Box 145, Mount Vernon, N.Y., U.S.A., Industrial Chemist.
1896. Blagden, Victor, 4, Lloyd's Avenue, London, E.C., Chemical Merchant.
1883. Blagden, W. G., 245, Preston Road, Brighton, Chemical Merchant.
1897. Blair, Andrew A., 406, Locust Street, Philadelphia, Pa., U.S.A., Analytical Chemist.
1915. Blake, Azel F., Atlantic Sugar Refineries, Ltd., St. John, New Brunswick, Canada, Chief Chemist.
1884. Blake, Jas., Thames Sugar Refinery, Silvertown, E., Manager.
1910. Blakeley, A. G., P. and R. Coal and Iron Co., Pottsville, Pa., U.S.A., Chemist.
1913. Blanc, E. R., c/o I. Levinstein and Co., Inc., 115, 5th Street, Chelsea, Mass., U.S.A., Chemist.
1893. Blears, John, c/o Langworthy Bros. and Co., Ltd., Greengate Mills, Salford, Dyer and Calico Printer.
1908. Blichfeldt, S. H., Vine Cottage, Southall, Middlesex, Bacteriologist and Fermentation Chemist.
1905. Bliss, H. J. W., United University Club, Pall Mall East, London, S.W., Chemist.
1916. Bloch, J. J., 85, Deansgate Arcade, Manchester, Chemist.
1889. Bloede, Victor G., Station D., Baltimore, Md., U.S.A., Manufacturing Chemist.
1908. Blomeley, Adam Y., c/o Arbuckle Bros. Sugar Refinery, Brooklyn, N.Y., U.S.A., Chemist.
1916. Blondel, Paul, La Revue des Produits Chimiques, 196, rue La Fayette, Paris, France, Director and Proprietor.
1891. Bloomer, Fred J., Penpont, Clydach, R.S.O., Glamorgan, Nickel Works Manager.
1886. Blount, Bertram, Laboratory, 76 and 78, York Street, Westminster, S.W., Analytical Chemist.
1888. Bloxam, A. G., 29, Southampton Buildings, Chancery Lane, London, W.C., Chemist and Patent Agent.
1903. Blumenthal, Lionel. *See* Blundell, Lionel.
1903. Blundell, Lionel, Ravensholme, Merry Bower Road, Broughton Park, Manchester, Chemist.
1886. Blundstone, E. R., 79, York Street, Westminster, S.W., Consulting Chemist.
1906. Blyth, M. Wynter, Lacton House, Tankersley, near Barnsley, Yorks, Analytical and Consulting Chemist.
1908. Blythe, Jas. R., Craiglea, Audenshaw, near Manchester, Leather Trades Chemist.
O.M. Boake, A., Warton Road, Stratford, E., Manufacturing Chemist.
1888. Boake, Edmund J., Widford Lodge, Chelmsford, Essex, Manufacturing Chemist.
1912. Boan, Robt., Laboratory, Government Railway Offices, Spencer Street, Melbourne, Vic., Australia, Engineer-in-charge.
1915. Boardman, Fred., 17A, Wemyss Road, Blackheath, S.E., Metallurgical Chemist.
1899. Boehm, Fred., 16, Jewry Street, London, E.C., Chemical Agent and Merchant.
1910. Boehringer, Dr. R., 112, Second Avenue, Newark, N.J., U.S.A., Chemist.
1898. Bogert, Prof. Marston T., Department of Organic Chemistry, Columbia University, New York City, U.S.A., Professor of Organic Chemistry.
1915. Boiling, E. H., 6, Leylang Road, New Cross, S.E., Analytical and Research Chemist.
1903. Bolam, Dr. H. W., Queen Margaret College, Glasgow, Lecturer on Chemistry.
1909. Bolden, Wm., Dalmellington Iron Works, Dunaskin, Ayrshire, Chemist.

1901. Bolton, E. Richards, 46, Stamford Brook Road, Hammersmith, W., Manufacturing Chemist.
1905. Bond, John, Crowlands, Southport, Engineer.
1905. Bond, Josiah, Alto, Arizona, U.S.A., Mining Engineer.
1912. Bone, S. C., 30, Long Lane, Garston, Liverpool, Chemical Works Manager.
1905. Bone, Prof. W. A., F.R.S., "Montrose," Harpenden Road, St. Albans, Herts. Professor of Chemical Technology.
1892. Bookman, Dr. S., 46, East 82nd Street, New York City, U.S.A., Chemist.
1914. Boon, A. Archibald, Chemistry Dept., Heriot Watt College, and (Jnls.) 87, Warrender Park Road, Edinburgh. Assistant Professor of Chemistry.
1888. Boor, Leonard G., 21, Mincing Lane, London, E.C., Chemical Merchant.
1912. Boorne, Wm. H., Bush Lane House, Cannon Street, London, E.C., Metallurgist.
1916. Booth, Jas., jun., 50, Barrow Hill, near Chesterfield, Chemist.
1908. Booth, Jos. W., George E. Kunhardt Mills, Lawrence, Mass., U.S.A., Superintendent.
1904. Booth, N. Parr, Laboratory, Cadbury Bros., Ltd., Bournville, near Birmingham, Chemist.
1903. Boral, Robin, Rhodes Mount, Rhodes, near Manchester, Works Manager.
1897. Borland, C. R., Concord, Mass., U.S.A., Smokeless Powder Manufacturer.
O.M. Borland, W. D., Beacon Lodge, Bean, *viâ* Dartford, Kent, Manufacturer of Explosives.
1908. Bose, R., 92–95, Upper Circular Road, Calcutta, India, Chemical Works Manager.
1890. Bost, W. D. Ashton, Cartvale Chemical Works, Paisley, Chemical Manufacturer.
1912. Boswell, Maitland C., Chemistry and Mining Building, University of Toronto, Canada, Lecturer on Organic Chemistry.
O.M. Bothamley, C. H., Weston-super-Mare, Somerset, County Director of Technical Instruction.
1890. Bott, Dr. W. Norman. *See* Norman-Bott, Dr. W.
1901. Bottomley, Dr. J. Frank, c/o The Thermal Syndicate, Ltd., Neptune Road, Wallsend-on-Tyne, Consulting Chemist.
1906. Bottomley, W., c/o The United Alkali Co., Ltd., Chief Engineer's Office, Widnes, Chief Engineer.
1915. Boulter, E. C., 113, Lawrence Road, Wavertree, Liverpool, Chemist.
O.M. Boulton, H. E., 64, Cannon Street, London, E.C., Chemical Manufacturer.
O.M. Boulton, Sir Samuel B., Bart., 64, Cannon Street, London, E.C., Chemical Manufacturer.
1883. Boulton, T. S., 14, Freegrove Road, Caledonian Road, London, N., Manager.
1905. Bourne, Lyman M., 506, Ohio Building, Akron, Ohio, U.S.A., Chemist.
1910. Bowater, J. W., Woodville, Beeches Road, West Bromwich, Works Manager.
1905. Bowen, Henry, South Street, East Aurora, N.Y., U.S.A., Secretary.
1888. Bower, Frank, Brewery House, Spitalfields, E., Analytical Chemist.
1909. Bower, Joshua, c/o Kynoch, Ltd., Arklow, Co. Wicklow, Ireland, Chemist.
1897. Bower, Wm. H., 29th Street and Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemical Manufacturer.
1892. Bowes, Harry, 9, Park Road, Heaton Moor, Stockport, Analytical Chemist.
1915. Bowis, Dr. H. J., 9, Rectory Road, West Bridgford, Nottingham, Technical Chemist.
1883. Bowley, Jos. John, Wellington Works, Battersea Bridge, London, S.W., Chemical Manufacturer.
1899. Bowley, J. Plunkett, 36, Argyll Mansions, Chelsea, London, S.W., Varnish Manufacturer.
1908. Bowman, Fred. C., 179, Marcy Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1884. Bowman, R., c/o Bowman's Ltd., Lythgoe's Lane, Warrington, Chemical Manufacturer.
1907. Bowman, Richard S., Quarn Cottage, Great Sankey, near Warrington, Chemist.
1896. Bowman, Walker, 39, Cortlandt Street, New York City, U.S.A., Chemist.
1904. Boyce, Framroze H., 86, Hugh's Road, Chaupaty Bombay, India, Technical Chemist.
1893. Boyce, Frank, 48, Duchy Road, Harrogate, Technical Chemist.
1910. Boyce, James, Route 8, Holland, Mich., U.S.A., Chemist.
1909. Boyd, Dr. Harold de H., c/o The Southern Cotton Oil Co., Ltd., Trafford Park, Manchester, Chemist.
1915. Boyd, Jas. H., 57, Hampstead Road, Fairfield, Liverpool, Manufacturing Pharmacist.
1913. Boyd, Robert, c/o British Columbia Sugar Refining Co., Ltd., Vancouver, B.C., Canada, Chemist.
1909. Boyd, T. D., jr., P.O. Box 381, Nogales, Arizona, U.S.A., Sugar Refiner.
1885. Bradburn, J. A., 311, Montgomery Street, Syracuse, N.Y., U.S.A., Manufacturing Chemist.
1912. Bradford, Francis L. W., 100, Rotton Park Road, Edgbaston, Birmingham, Chemist and Works Manager.
1895. Bradford, Henry, Strettington, Goodwood, near Chichester, Analytical Chemist.
1915. Bradley, G. W. J., Earl Fitzwillim's Coke Oven and By-Product Plant, Parkgate, near Rotherham, Chemist.
1896. Bragg, Everett B., 1838, Chicago Avenue, Evanston, Ill., U.S.A., Manufacturing Chemist.
1891. Braithwaite, Isaac, Ghyll Close, Kendal, Westmoreland, Drysalter.
1897. Braithwaite, Jno. O., Holme Lacey, Warren Road, Chingford, Essex, Pharmaceutical Research Chemist.
1903. Brame, Prof. J. S. S., Royal Naval College, Greenwich, S.E., and (Journals) 67, Coleraine Road, Blackheath, S.E., Professor of Chemistry.
O.M. Bramham, W., Bank Chambers, 300, Mare Street, Hackney, N.E., Chemical Engineer.
1902. Branegan, Jas. Aug., 12, Park Avenue, Millbourne, Delaware Co., Pa., U.S.A., Chemical Salesman.
1915. Branson, F. H., 14, Commercial Street, Leeds, Manufacturing Chemist.
O.M. Branson, F. W., Wynneholme, Far Headingley, Leeds, Pharmaceutical Chemist.
1903. Brassard, Fred à, 46, Vicar Lane, Bradford, Yorks, Aniline Dyestuff Importer.
1901. Brearley, Harry, c/o The Amalgams Co., Ltd., Attercliffe Road, Sheffield, Analytical Chemist.
1906. Breckenridge, John E., American Agricultural Chemical Co., Carteret, N.J., U.S.A., Chemist.
1900. Brewis, E. T., 31, Belgrave Road, Leyton, E., Chemist.
1894. Breyer, Theodor, 725, Washington Avenue, Wilmette, Ill., U.S.A., Chemist.
1885. Briant, L., 24, Holborn Viaduct, London, E.C., Analytical Chemist.
1916. Briefer, Michael, c/o Ansco Co., Research Laboratory, Binghamton, N.Y., U.S.A., Chemist.
1890. Brierley, J. T., Highfield, Golden Hill, Leyland, near Preston, Lancs., Analytical Chemist.
1893. Briggs, J. F., Auchmuty Paper Mills, Markinch, Fifeshire, Technical Chemist.
1912. Briggs, Capt. O. W. H., c/o Harborough Rubber Co., Market Harborough, Chemist.
1885. Briggs, T. Lynton, 188, Central Avenue, Flushing, Long Island, N.Y., U.S.A., Technical Chemist.
1914. Brinsley, Frank, Huguenot College, Wellington, C.P., South Africa, Demonstrator in Physical Chemistry.
1910. Brisbane, James W., H.M. Works, Queensferry, Chester, Analytical Chemist.
1905. Bristol, Dr. H. Stanley, c/o Fibre Finishing Co., Greendale, Worcester, Mass., U.S.A., Chemist.
1886. Bristow, G. W., c/o Walter J. Crook, 10, Eastcheap, London, E.C., Chemical Manager.
1912. Britland, Wm. J., Pear Tree Cottage, Alvanley, near Helsby, Cheshire, Chemist.

1887. Broadbent, H., c/o Goodall, Backhouse and Co., Sovereign Street, Leeds, Chemist.
1889. Brock, Arthur, Firework Factory, Sutton, Surrey, Firework Manufacturer.
1910. Brodribb, Noel K., Cordite Factory, Ascot, Vale, Melbourne, Victoria, Australia, Chemist.
1912. Bromley, Henry S., 1000, Wissahickon Avenue, Germantown, Philadelphia, Pa., U.S.A., Lace Manufacturer.
1896. Brooke, C. B., jun., Colne House, Brantham, near Manningtree, Xylonite Manufacturer.
1900. Brooke, Jno. R., Government Opium Factory, Singapore, S.S., Superintendent.
1884. Brookes, E. A., c/o Braden Copper Co., Molino, Rancagua, Chile, Chemist.
1916. Brooks, Prof. B. T., Mellon Institute of Industrial Research, Pittsburgh, Pa., U.S.A., Prof. of Chemical Engineering.
1906. Brooks, Cecil J., c/o M. M. Simau, Benkoelen, Sumatra, Ned. India, Metallurgist.
1909. Brooks, Theodore, Guantanamo, Cuba, Cane Sugar Manufacturer
1911. Brothers, Horace E., Higher Knutsford Road, Latchford, Warrington, H.M. Inspector of Factories.
1909. Brothers, Wm., Meadow House, Tunstead Milton, near Whaley Bridge, Derbyshire, Chemical Manufacturer.
O.M. Brotherton, Colonel E. A., City Chambers, Leeds, Ammonia Distiller.
1884. Brown, Prof. A. Crum, F.R.S., 8, Belgrave Crescent, Edinburgh, Professor of Chemistry.
1905. Brown, Prof. Adrian J., West Heath House, Northfield, near Birmingham, Professor of Brewing.
1902. Brown, A. H. M., Hudson Bay Mine, Cobalt, Ont., Canada, Metallurgist.
1891. Brown, Cæsar R., 141, Victoria Avenue, Prittlewell, near Southend, Works Foreman.
O.M. Brown, D., 93, Abbey Hill, Edinburgh, Chemical Manufacturer.
O.M. Brown, D., Donaghmore, Tyrone, Ireland, Soap Manufacturer.
1890. Brown, Edw. Hilton, c/o W. Ropes and Co., Petrograd, Russia, Analytical Chemist.
1894. Brown, Geo. E., c/o "The British Journal of Photography," 24, Wellington Street, Strand, London, W.C., Chemist.
1910. Brown, Geo. Winslow, Assabet Mills, Maynard, Mass., U.S.A., Chemist.
O.M. Brown, Henry, Benskin's Brewery, Watford, Herts., Brewing Chemist.
1899. Brown, Dr. Henry C., The Chemical Works, King's Lynn, Chemical Manufacturer.
O.M. Brown, Dr. Horace T., F.R.S., 52, Nevern Square, Kensington, S.W., Brewing Chemist.
1905. Brown, Hugh B., c/o Jas. Robertson and Sons, Ltd., Thrushgrove Works, Paisley, Chemist.
1892. Brown, Reginald B., 45, Finsbury Square, London, E.C., Technical Chemist.
1901. Brown, Samuel B., Marringhurst, Marple, Cheshire, Calico Printer.
O.M. Brown, Walter, c/o Jas. H. Dennis and Co., Ltd., Widnes, Technical Chemist.
1900. Brown, Walter B., Victor Chemical Works, 1805, Fisher Building, Chicago, Ill., U.S.A., Chemist and General Superintendent.
1901. Browne, Dr. Arthur L., 215, East Fayette Street, Baltimore, Md., U.S.A., Analytical Chemist.
1906. Browne-Cave, E. J. C. *See* Cave-Browne-Cave, E. J.
1905. Browning, Prof. K. C., Medical College, Colombo, Ceylon, Professor of Chemistry.
O.M. Browning, W., Broad Oak, Accrington, Calico Printer.
1902. Brownsdon, Dr. H. W., King's Norton Metal Co., Ltd., King's Norton, Birmingham, and (Jnls.) 109, Oxford Road, Moseley, near Birmingham, Works Chemist.
1902. Bruce, Alex., Laboratory, Hyde Park Corner, Colombo, Ceylon, Chemist.
1911. Bruce, Joseph, Jnls. to General Manager, Dynamite Factory, West Somerset, Cape Colony, Secretary.
1908. Bruce, Robert, 44, High Street, Leven, Fifeshire, Works Chemist.
1900. Bruce, Wm. T., 3, Lombard Court, London, E.C., and (Jnl.) c/o T. C. Allchin, Longfield, Kent, Director.
1911. Brunet, Louis, "Revue Générale des Sciences," 97, Boul. Montmorency, Paris XVI, France, Chemist and Secretary.
O.M. Brunner, H., Holly Mount, Tarbock Road, Huyton, near Liverpool, Chemical Manufacturer.
1894. Brunner, H. Bertram, The Hollies, Hartford, Cheshire, Chemist and Electrician.
1887. Brunner, J. F. L., M.P., c/o Brunner, Mond, and Co., Ltd., Caxton House, Westminster, S.W., Chemical Manufacturer.
O.M. Brunner, Rt. Hon. Sir J. T., Bart., Silverlands, Chertsey; and (Journals) c/o Brunner, Mond, and Co., Ltd., Northwich, Cheshire, Chemical Manufacturer.
1902. Brunner, Roscoe, The Winnington Hall Club, Winnington, Northwich, Alkali Manufacturer.
1894. Brunton, J. Dixon, Wire Mill, Musselburgh, Scotland, Wire Manufacturer.
1904. Bryant, Arthur P., c/o Clinton Sugar Refining Co., Clinton, Iowa, U.S.A., Chemist.
1908. Bryce, Chas. C., 43-45, Great Tower Street, London, E.C., Merchant.
1894 Bryce, Thos., Tharsis Mines, Huelva, Spain, Chemist.
1897. Bryson, Jas., Pumpherston Oil Works, Midcalder, Scotland, Oil Works Manager.
1892. Buchanan, D. G., 39, Inverness Terrace, Hyde Park, London, W., Analyst.
1908. Buchanan, Duncan G., 27, Woodlawn Avenue East, Toronto, Canada, Chemist (Rubber Works).
1904. Buchanan, E. F., 128, East Crescent Street, Marquette, Mich., U.S.A., Chemist.
1888. Buchanan, Jas., Caledonia Foundry, Brasenose Road, Liverpool, Engineer.
1904. Buchanan, John L., Braehead, Mill Road, Bromborough, Cheshire, Analytical Chemist.
1904. Buchanan, Joshua D., c/o Nobel's Explosives Co., Ltd., Polmont Station, Scotland, Chemist.
1910. Buchanan, Walter G., c/o Lautaro Nitrate Co., Taltal, Chile, Chemist.
1897. Buck, Chas. A., Prospects and Park Avenues, Bethlehem, Pa., U.S.A., Chief Chemist (Bethlehem Iron Co.).
1911. Budde, Dr. Carl, 1, Belford Road, Sunderland, Chemical Engineer.
1909. Buell, W. H., c/o Winchester Repeating Arms Co., New Haven, Conn., U.S.A., Chemist.
1915. Buggé, E. R., Instow, Mycenæ Road, Blackheath, S.E., Manufacturing Chemist.
1909. Buggy, Thos., Butte, Montana, U.S.A., Assayer and Chemist.
1902. Bull, Irving C., 100, Maiden Lane, New York City, U.S.A., Chemist.
1899. Bult, Herbert J., 140, Fenchurch Street, London, E.C., Chemist.
O.M. Bumby, H., Bellevue, Sandbach, Cheshire, Iron and Chemical Works Director.
1915. Bunce, A., c/o The Morgan Crucible Co., Ltd., Church Road, Battersea, S.W., Works Chemist.
O.M. Bunker, H. E., 310, Kingston Road, Toronto, Ont., Canada, Technical Chemist.
1901. Bunting, Henry H., Oficina de Ensayes F. C. C. del P., Callao, Peru, Analyst.
1893. Burbridge, Jas., India-rubber Mills, Tottenham, N., India-rubber Manufacturer.
1896. Burford, Samuel F., The Ridgeway, Rothley, near Leicester, Analytical Chemist.
1889. Bürger, Dr. J., 9, Vincent Avenue, Chorlton-cum-Hardy, Manchester, Technical Chemist.
1889. Burgess, Geo., Sydney Cottage, Halebank, Widnes, Chemist.
1889. Burgess, Wm. T., 20, Priory Road, Bedford Park, London, W., Analytical Chemist.

1902. Burkard. Dr. Ernst, Solothurn, Switzerland, Chemist.

1898. Burls, Herbert T., 2, Verulam Buildings, Gray's Inn, London, W.C., Mechanical Engineer.

1891. Burnet, Henry K., North Brook Vitriol Works, Bradford, Yorks, Sulphuric Acid Maker.

1897. Burnet, Jno. Jas., 18, University Avenue, Glasgow, and (Journals) 1, Montague Place, Bedford Square, London, W.C., Architect.

1909. Burnett, Arthur, Clairville, Weaste Lane, Pendleton, Manchester.

1893. Burnham, J. C., Analytical Chemist.

1909. Burr, Edmund C., 1722, Vallejo Street, San Francisco, Cal., U.S.A., Manufacturer.

O.M. Burrell, B. A., 8, Springfield Mount, Leeds, Analytical Chemist.

1910. Burrell, Keith, Burrell's Wharf, Millwall, London, E., Manufacturer.

1906. Burrough, Ernest J., Cale Distillery, Hutton Road, Lambeth, S.E., Rectifier.

1912. Burt-Gerrans, J. T., 46, Dewson Street, Toronto, Canada, Electro-Chemist.

1901. Burton, Alf., Canadian Dyers' Association, 2-16, Liberty Street, Toronto, Canada, Dyer and Finisher.

1914. Burton, Donald, Westbourne, St. Andrew's Avenue, Morley, near Leeds, Research Assistant.

1903. Burton, Jno., 2, Green Street, Bethnal Green, E., Dye and Chemical Manufacturer.

1914. Burton, Tom F., 63, Melbury Gardens, West Wimbledon, S.W., Editor.

1904. Burton, T. R., c/o Scott, Greenwood, and Son, 8, Broadway, Ludgate Hill, London, E.C., Technical Journalist.

1889. Burton, Wm., Carisbrook, Park Crescent, Victoria Park, Manchester, Potter's Chemist.

1915. Bury, Ernest, Skinningrove Iron Co., Carlin How S.O., Yorks, Works Manager.

1906. Busby, Fred. E., Arnold Print Works, North Adams, Mass., U.S.A., Chemist.

1913. Bush, Dr. Harry T., 7, Gracechurch Street, London, E.C., Chemical Engineer.

1897. Bush, J. M., c/o W. J. Bush and Co., Ltd., Ash Grove, Hackney, E., Manufacturing Chemist.

1897. Butler, David B., 41, Old Queen Street, Westminster, S.W., Cement Expert.

1913. Butler, Geo. B., Adelaide Villa, Belle Vue Grove, Grove Hill, Middlesbrough, Assistant Blast Furnace Manager.

1890. Butler, Paul, Lowell, Mass., U.S.A., Ammunition Manufacturer.

1885. Butler, Samuel, The Cedars, Compton, Wolverhampton, Brewer.

1905. Butler, Dr. T. H., c/o Wm. Butler and Co., Ltd., Crews Hole, Bristol, Chemist (Tar and Rosin Distillery).

1886. Butler, W. W., c/o Mitchells & Butlers, Ltd., The Brewery Library, Cape Hill, Birmingham, Brewer.

O.M. Butterfield, J. C., 79, Endlesham Road, Balham, S.W., Analytical Chemist.

1892. Butterfield, W. J. A., 66, Victoria Street, Westminster, S.W., Analytical Chemist.

1897. Butters, Charles, 54, New Broad Street, London, E.C., and (Journals) 6272, Chabot Road, Oakland, Cal., U.S.A., Metallurgist.

1900. Butterworth, Elwell R., c/o Reversible Collar Co., 111, Putnam Avenue, Cambridge, Mass., U.S.A., Chemist.

O.M. Byard, A. G., c/o Burt, Boulton, and Haywood, Apartado 8, Bilbao, Spain, Technical Chemist.

1905 Byrne, F. A., 2, Ludgate Hill, Birmingham, Director of Chemical Co.

1893. Byrom, T. H., Virol Research Laboratories, 10, Bedford Square, London. W.C., Analytical Chemist.

1915. Bywaters, H. W., 9, Henleaze Avenue, Bristol, Chemist.

C

1884. Cabot, Godfrey L., 940, Old South Building, Boston, Mass., U.S.A., Manufacturing Chemist.

1907. Cabot, Samuel, 141, Milk Street, Boston, Mass., U.S.A., Chemical Manufacturer.

1906. Caddick, Arthur, Bella Vista 6, Minas de Rio Tinto, Huelva, Spain, Works Chemist.

1889. Cadett, Jas., Ashtead, Surrey, Chemical Engineer.

1905. Cain, Dr. J. C., 24, Aylestone Avenue, Brondesbury Park, N.W., Colour Chemist.

1891. Caines, G. S. A., 68, Hilldrop Crescent, Camden Road, London, N.W., Analytical Chemist.

1897. Cairns, Wm., 5, Carlton Place, Glasgow, Plumber.

1907. Caistor, J. W. Y., Homestead, Deganwy, North Wales, Chemist.

1905. Calder, Prof. Edwin E., Long Meadow, R.I., U.S.A., Professor of Chemistry.

1897. Calder, W. A. S., 449, Hagley Road, Birmingham, Chemical Manufacturer.

1912. Caldwell, Wallace L., 1025½, North 24th Street, Birmingham, Ala., U.S.A., Engineering Chemist.

1888. Caldwell, Wm., Murray Street, Paisley, Scotland, Drysalter.

1912. Callan, Dr. Thomas, 26, Perrymead, Polefield, Prestwich, Manchester, Technical Chemist.

1915. Callimachi, Count M., 32, Kingsmead Road, Tulse Hill. S.W., Metallurgist.

1902. Calm, Dr. Chas. E., California Club, Los Angeles, Cal., U.S.A., Manufacturing Chemist.

1904. Calvert, Dr. Harry T., Ministry of Munitions, Dept. of Explosives Supplies, Storey's Gate, Westminster, S.W., Chemist.

1895. Cambier, Jacob, 1401, Carteret Avenue, Pueblo, Colo., U.S.A., Chemist.

1904. Cameron, Walter S., 239, West 136th Street, New York City, U.S.A., Manufacturing Perfumer.

1908. Cameron, Wm., c/o The Asiatic Petroleum Co., Barrow-in-Furness, Technical Chemist.

O.M. Cammack, J., "Fernsholme," Prescot Road, St. Helens, Lancashire. Technical Chemist.

1886. Campbell, Andrew, 1, Park Road, Beckenham, Kent, Chemist (Mineral Oil).

1912. Campbell, Arthur F., 9, Fort Road, Sedgley Park, Manchester, Research Chemist.

1908. Campbell, Fred. A., The Working Men's College, Latrobe Street, Melbourne, Victoria, Australia, Principal.

1907. Campbell, John A., c/o British South African Explosives Co., Modderfontein, Transvaal, Chemist.

1912. Campbell, Kennedy, c/o British Dyewood Co., Ltd., Parkhead, Glasgow, Chemist.

1901. Campbell, Kenneth F., M.Inst.C.E., 1, Peel Street, Huddersfield, Civil Engineer.

1911. Campbell, L. E., Dept. of Agriculture, Peradeniya, Ceylon, Chemist.

1909. Campbell, Peter, Kearny, N.J., U.S.A., Linoleum Manufacturer.

1915. Campbell, W. B., on active service, Chemist.

1911. Campbell, Wm. E., c/o Gutta Percha and Rubber Ltd., O'Hara Avenue, Toronto, Canada, Industrial Chemist.

1914. Camus, Edward C. A., 8, Rue de Mondovi, Paris I., France, Chemical Merchant.

1909. Candee, Chas. N., 39, South Drive, Toronto, Canada, Rubber Manufacturer.

1908. Canning, Ernest R., 137, Great Hampton Street, Birmingham, Manufacturer.

O.M. Cannon, M., 25, Stormont Road, Clapham Common, S.W., Vinegar Works Manager.

1913. Cantelo, Robt. C., Imperial College of Science and Technology, South Kensington. S.W., Chemist.

1891. Carden, Albert J., 20—21, Harp Lane, Gt. Tower Street, London, E.C., Distiller.

1915. Cardwell, David, 50, Alexandra Road South, Manchester, S.W., Chemist.

1893. Carey, Arthur, The Groves, Grassendale Park, near Liverpool, Chemist.

1906. Carey, W. Gordon, "Eastbury," Uplands Avenue, Loughton, Essex, Chemist.

1904. Cargill, J. T., c/o Finlay, Fleming, and Co., Rangoon, Burmah, East India Merchant.

1915. Carlos, Arthur S., 42, Foxley Road, North Brixton, S.W., Analytical Chemist.

1896. Carmichael, Herbert, Bureau of Mines, Victoria, British Columbia, Public Analyst and Assayer.

1884. Carmody, Prof. Patrick, Department of Agriculture, Trinidad, B.W.I., Analytical Chemist.

1897. Carrell, Wm. C., 1108, South 46th Street, Philadelphia, Pa., U.S.A., Chemist.

1893. Carpenter, Dr. C. C., South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E., Civil Engineer.

1908. Carpenter, Edwin P., Culvert Works, Sheepcote Lane, Battersea, S.W., Manager of Casein, Ltd.

1900. Carpenter, Frank B., 11, South 12th Street, Richmond, Va., U.S.A., Chemist.

1909. Carpenter, Harry B., c/o Lister's Agricultural Chemical Works, Newark, N.J., U.S.A.

1915. Carpenter, Henry A., Leetsdale, Pa., U.S.A., Vice-President, Riter-Conley Co.

1904. Carr, Francis H., Westhorpe, Ruddington, Notts., Manufacturing Chemist.

1907. Carrier, C. F., jun., 1567, Lee Street, Charlestown, W. Va., U.S.A., Manufacturing Chemist.

1904. Carter, A., Cuba Street, Petone, Wellington, New Zealand, Works Manager.

1905. Carter, Robert A., 4923, Osage Avenue, Philadelphia, Pa., U.S.A., Chemist.

1895. Carter, Stewart F., 43, Montana Street, North Adams, Mass., U.S.A., Technical Chemist.

1903. Carter, Thomas, West End View, Ravensthorpe, Dewsbury, Yorks, Works Chemist.

1886. Carter, W. Chas., c/o Dominion Iron and Steel Co., Sydney, C.B., Canada, Analytical Chemist.

1916. Cartwright, T. F., c/o New Explosives Co., Stowmarket, Suffolk, Chemist.

1911. Carty, Ronald D., The Laboratories, Public Works Ministry Gardens, Cairo, Egypt, Analytical Chemist.

1889. Carulla, F. J. R., 84, Rose Hill Street, Derby, Chemical Manufacturer.

1906. Carveth, Dr. H. R., Niagara Electrochemical Co., Niagara Falls, N.Y., U.S.A., Works Manager.

1914. Casey, John A., Charlemont, Moy, Co. Tyrone, Ireland, Waterproof Manufacturer.

1903. Caspari, Dr. W. A., c/o Messrs. Evans, Sons, Lescher, and Webb, Ltd., 60, Bartholomew Close, London, E.C., Chemist and Physicist.

1899. Castro, J. Paul de, 1, Essex Court, Temple, London, E.C., Barrister-at-Law.

1895. Catlin, Chas. A., 133, Hope Street, Providence, R.I., U.S.A., Chemist (Rumford Chemical Works).

1909. Caulkin, Howard A., "The Glen," Cumberhill Road, Duffield, Derbyshire, Analyst.

1906. Cave-Browne-Cave, E. J., c/o Thos. Ness, Ltd., Newcastle Tar Works, Blaydon-on-Tyne, Works Chemist.

1896. Caven, Robt. M., University College, Nottingham, Lecturer in Chemistry.

1914. Caw, Wm. on active service, Chemist.

O.M. Cawley, G., 82, Victoria Street, Westminster, S.W., Chemical Engineer.

O.M. Cawley, J., 278, Passaic Street, Newark, N.J., U.S.A., Analytical Chemist.

1897. Cawley, Thos. A., British Gelatin Works, Ltd., New Bedford Road, Luton, Gelatin Manufacturer.

1906. Chadsey, Stanley B., 476, Brunswick Avenue, Toronto, Canada, Chemist.

1916. Chadwick, George B., c/o The Paterson Manufacturing Co., Ltd., 172, King Street East, Toronto, Canada, District Manager.

1910. Challinor, Richard W., Chemical Laboratory, The Technical College, Sydney, N.S.W., Australia, Teacher of Chemistry.

1894. Chaloner, G. W., 26, Eagle Wharf Road, Hoxton, N., Chemical Manager.

1901. Chamberlain, G. E., 641, West Prairie Avenue, Decatur, Ill., U.S.A., Chemist.

1910. Chambliss, Prof. Hardee, Journals to Librarian, Agricultural and Mechanics College, Stillwater, Oklahoma, U.S.A., Assistant Commissioner of Public Health.

O.M. Chance, A. M., Lawnside, Edgbaston, Birmingham, Chemical Manufacturer.

1912. Chance, Clinton F., Messrs. Chance and Hunt, Ltd., Oldbury, near Birmingham, Managing Director.

1909. Chance, Edwin M., 399, South Main Street, Wilkes-Barre, Pa., U.S.A., Chemist.

O.M. Chandler, Dr. C. F., 51, East 54th Street, New York City, U.S.A., Professor of Chemistry.

1912. Chandler, Lee L., Research Laboratory, Pittsburgh Plate Glass Co., Creighton, Pa., U.S.A., Assistant.

1893. Chaplin, Dr. Edw. M., Public Analyst's Laboratory, Wakefield, Yorks, Analytical Chemist.

1890. Chapman, A. Chaston, 8, Duke Street, Aldgate, E.C., Public Analyst and Consulting Chemist.

1906. Chapman, Arthur J., Baronsmere, Stanhope Avenue, Church End, Finchley, N., and (Journals) c/o F. Claudet, Ltd., 6 and 7, Coleman Street, London, E.C., Analytical Chemist.

1906. Chapman, E. A., c/o Robert Heath and Sons, Ltd., Norton Works, Stoke-on-Trent, Works Chemist.

O.M. Chapman, Spencer, 36, Mark Lane, E.C., Chemical Manufacturer.

1915. Chardonnet, Comte de, 22, Place Malesherbes, Paris, France, and (Jnls.) Grand Hotel, Manchester, Inventor of Artificial Silk.

1894. Charlier, A. C. J., 3, Bedford Road, South Tottenham, N., Consulting Chemist.

1915. Charlton, W. S. S., c/o The Cotton Powder Co., Uplees, Faversham, Kent, Manufacturing Chemist.

1900. Chase, March F., c/o Commercial Acid Co., 1916, Boatmen's Bank Building, St. Louis, Mo., U.S.A., Chemist.

1889. Chase, R. L., Arnold Printworks, North Adams, Mass., U.S.A., Manager.

1898. Chattock, Herbert E., 23, Apsley Road, Clifton, Bristol, Oilcake Manufacturer.

1910. Chattopadhaya, P. C., 27, Narikeldanga Main Road, Harrison Road P.O., Calcutta, India, Chemist.

1915. Chazan, Simon, 188, Elizabeth Street, Hightown, Manchester, Works Chemist.

1905. Cheeseman, Frank P., 100, William Street, New York City, U.S.A., Paint Manufacturer.

1901. Cheetham, Howard, 18, St. Ann Street, Manchester, Chartered Patent Agent.

1894. Cheney, John P., Messrs. Cheney Bros., South Manchester, Conn., U.S.A., Chemist and Silk Manufacturer.

1915. Cheng, Pinzen, Kia-ting-Lsien, nr Shanghai, China, Analytical Chemist.

1913. Chiaraviglio, Dr. Dino, Piazza Esquilino 23, Rome, Italy, Director, Explosives Laboratory.

1905. Chick, Oliver, 31, Auckland Road, Cranbrook Park, Ilford, Essex, Analytical Chemist.

1890. Chorley, Jno. C., Bewsey, Oxford Road, Birkdale, Lancs., Analytical Chemist.

O.M. Christie, J., Levenfield, Alexandria, Scotland, Dyer and Printer.

1903. Christie, John, c/o Nobel's Explosives Co., Ltd. Pembrey, South Wales, Analytical Chemist.

1914. Christie, John T., c/o Messrs. John Miller and Co., Sandilands Chemical Works, Aberdeen, Analytical Chemist.

1908. Christie, Malcolm, Hornock Cottages, Coatbridge, Scotland, Analytical Chemist.

1910. Christie, Dr. M. G., c/o The Otto-Hilgenstock Coke Oven Co., Post Office House, Leeds, Assistant General Manager.

1898. Christison, Geo., 2, Kelvinside Gardens, Glasgow, Engineer.

1907. Christopher, George, Walkden Works, Verney Road, South Bermondsey, S.E., Consulting Chemist.

1907. Christopher, J. E., Solvay Coke Works, Kirkless Wigan, Assistant in Charge.

O.M. Chrystal, W. J., 7, West George Street, Glasgow Chemical Manufacturer.

1908. Chrystall, E. R., c/o Curtis's and Harvey, Ltd., Cliffe at Hoo, Kent, Research Chemist.
1906. Church, Sumner R., c/o Barrett Manufacturing Co., 17, Battery Place, New York City, U.S.A. Chemical Engineer.
1907. Churchill, Wm., Corning Glass Works, Corning, N.Y., U.S.A., Chemist.
1915. Chute, Robt. J., 347, Pape Avenue, Toronto, Canada, Manufacturer.
1896. Claflin, Alan A., c/o Avery Chemical Co., Lowell, Mass., U.S.A., Manufacturing Chemist.
1909. Claflin, Albert W., 190, Waterman Street, Providence, R.I., U.S.A., Manufacturing Druggist.
1900. Clamer, Guilliam H., 46, Richmond Street, Philadelphia, Pa., U.S.A., Chemist.
1885. Clanahan, H. C., 79, Mosley Street, Manchester, Chemical Merchant.
1905. Clapp, Geo. A., 49, Federal Street, Boston, Mass., U.S.A., Chemist.
1891. Clapp, Ralph R., c/o B. P. Clapp Ammonia Co., Providence, R.I., U.S.A., Manager.
1889. Clapperton, J., jun., Analytical Chemist.
1913. Clark, A. Stanley, 16, Richmond Hill, Langley Green, near Birmingham, Technical Chemist.
1910. Clark, A. W., c/o Heath and Milligan Manufacturing Co., 1832, South Canal Street, Chicago, Ill., U.S.A., Superintendent.
1904. Clark, Arthur W., c/o Johnson and Johnson, New Brunswick, N.J., U.S.A., Chemist and Bacteriologist.
1908. Clark, Chas. T., 1303, Sixth Street, Bay City, Mich., U.S.A., Manufacturing Chemist.
1913 Clark, Francis W., 35, Wilmington Square, London, W.C., Chemist.
1910. Clark, Henry, 49, Eastcheap, London, E.C., Oil Refiner.
1909. Clark, Hubert A., 83, Amherst Street, Montreal, Canada, Canner.
1900. Clark, Jno., Broadway Works, Millwall Dock, London, E., Manufacturing Chemist.
1916. Clark, John A., Scottish Co-operative Flour Mills, and 11, Walmer Terrace, Ibrox, Glasgow, Analyst.
1906. Clark, M. H., c/o Goodyear's Metallic Rubber Shoe Co., Naugatuck, Conn., U.S.A., Chemist.
1902. Clark, Robt. M., 138, Bath Street, Glasgow, Chemist.
1915. Clark, T. W. Firth, "Tilehurst," Pollard Road, Mitcham, Technical Chemist.
1906. Clark, Wm. B., Larkfield, Earlestown, Lancashire, Chemist.
1907. Clark, Wm. H., 26, Barry Street, Dunston-on-Tyne, Analytical Chemist.
1912. Clark, William M., Niles Glass Works, Niles, Ohio, U.S.A., Chemist.
1908. Clarke, Arthur F., c/o White's South Africa Cement Co., Ventersburg Road, Orange Colony, South Africa.
1897. Clarke, Wm. B., c/o Edison-Swan U.E.L. Co., Ltd., Electric Works, Ponders End, N., Electro-Chemist.
1889. Claus, Wm. H., c/o Claus and Co., Ltd., Clayton, Manchester, Manufacturing Chemist.
1909. Clayton, Ellis, 7, Deerpark Road, Belfast, Ireland, Lecturer on Bleaching, Dyeing, and Printing.
1895. Clayton, Dr. G. C., c/o The United Alkali Co., Ltd., 30, James Street, Liverpool.
1894. Clayton, Robt. H., 1, Parkfield Road, Didsburys Manchester, Chemist.
1910. Clayton, Will, Cliffe House, Accrington, Works Chemist.
1905. Clayton, W. E., Victualling Dept., Admiralty, Whitehall, London, S.W., Superintendent.
1907. Clement, Leonard, 11, Agnew Street, Lytham, Lancs., Chemist.
1893. Clemes, J. H., 111, Mount Wise, Newquay, Cornwall.
1905. Clexton, Thos. J., 285, Congress Street, Boston, Mass, U.S.A., Manager (A. Klipstein and Co.).
1915. Clibborn, Jno. W., 4, Kennyhill Gardens, Dennistoun, Glasgow, Assistant Works Manager.
1906. Clifford, Jos., Laboratories, Public Works Ministry Gardens, Cairo, Egypt, Chemist.
1913. Clifford, Sydney G., 51, Peak Hill, Sydenham, S.E., Analytical Chemist.
1900. Clifford, Wm., Sewage Outfall Works, Wolverhampton, Sewage Works Manager.
O.M. Cloud, T. C., 20, Bucklersbury, London, E.C., Metallurgist.
O.M. Clowes, Dr. F., The Grange, College Road, Dulwich, S.E.; retain Journals; Chemist.
1891. Clutton, J. H., Fonderie Mines de l'Aude, Villanière par Lastours (Aude), France, Assayer.
1911. Clymer, Wm. R., Publicity Department, National Carbon Co., Cleveland, Ohio, U.S.A., Manager.
1899. Coates, Chas. E., jun., Louisiana State University, Baton Rouge, La., U.S.A., Professor of Chemistry.
1911. Cotes, Jos. E., c/o Thos. Tyrer Co., Stirling Chemical Works, Stratford, E., Lecturer.
1888. Coats, Jno. T., 105, Broughton Street, Edinburgh, Manufacturing Chemist.
1915. Cobb, Ernest B., c/o Standard Oil Co. (N.J.), Bayonne, New Jersey, U.S.A.
1893. Cobb, Prof. Jno. W., The University, Leeds, Prof. of Coal Gas and Fuel Industries.
1894. Coblentz, Dr. Virgil, 23, Vine Street, Brooklyn, N.Y., U.S.A., Research Chemist (R. R. Squibb and Co.).
1899. Cochran, Alfred, 559, Madison Street, Brooklyn, N.Y., U.S.A., Chemist.
1901. Cockburn, John A., Mayville, Stevenston, Ayrshire, Analytical Chemist.
1902. Cocking, Allan T., c/o Kynoch, Ltd., Lion Works, Witton, Birmingham, Ammunition Manufacturer.
1905. Cocs, Chas. S., 1024, East River Street, Hyde Park, Mass., U.S.A., Oil Chemist.
1903. Coggeshall, Dr. G. W., 1850, Mintwood Place, Washington, D.C., U.S.A., Chemical Engineer.
1887. Coghill, P. de G., Borax Works, Old Swan, Liverpool, Technical Chemist.
1884. Cogswell, W. B., Syracuse, N.Y., U.S.A., Chemical Engineer.
1915. Cohen, A. M., 19, Wyndcote Road, Mossley Hill, Liverpool, Chemist.
O.M. Cohen, Dr. J. B., 1, North Grange Mount, Headingley, Leeds, Professor of Organic Chemistry.
1897. Cohn, Alfred I. *See* Cone, Alfred I.
1901. Cohn, Sigmund, 13, Dutch Street, New York City, U.S.A., Metallurgical Chemist.
1904. Cohoe, Prof. W. P., 50, East 41st Street, New York City, U.S.A., Professor of Chemistry.
1891. Colby, Albert L., 447, Lehigh Street, South Bethlehem, Pa., U.S.A., Metallurgical Engineer.
1899. Colby, E. A., Baker Platinum Works, Newark, N.J., U.S.A., Metallurgical Chemist.
O.M. Colby, W. H., 80, Coldharbour Road, Redland, Bristol.
1893. Coleman, W. H., 1, Athole Gardens, Newlands, Glasgow, Chemical Engineer.
1915. Coley, H. Edwin, 6, Bury Court, St. Mary Axe, E.C., Chemical Manufacturer.
1913. Colgate, R. T., 25, Denmark Road, Reading, Works Chemist.
1905. Collett, John H., Sunnycroft, Tuffley, and (Jnls.) The Librarian, Free Library, Gloucester, Chemical Manufacturer.
1887. Collett, J. M., Wynstone Place, Brookthorpe, Gloucester, Chemical Manufacturer.
1901. Colley, Bernard T., c/o Braden Copper Co., Rancagua, Chile, South America, Superintendent.
1908. Collier, F. C., Inland Revenue Laboratory, 317, Queen Street, Ottawa, Canada, Analytical Chemist.
1903. Collier, Pierre, Companhia Industrial Pernambucana, Pernambuco, Brazil, Civil Engineer.
1893. Collin, Dr. C. A., Ferguslie Threadworks, Paisley, Textile Chemist.
1913. Collinge, H. G., Rua Tenente Costa 183, Todos os Santos, Rio de Janeiro, Brazil, Technical Chemist.
1898. Collingridge, Frank, Highstone, New Road, Llanelly, South Wales, Chemist.
1899. Collins, S. Hoare, 9, Cavendish Place, Newcastle-on-Tyne, Agricultural Chemist.

1888. Collins, W. Hepworth. *See* Hepworth Collins, W.
1913. Collinson, R. W., c/o Messrs. J. and J. Colman, Ltd., Starch Dept., Carrow Works, Norwich, Starch Manufacturer.
1899. Collis, Walter T., Parkhurst, St. Peter's Road, Harborne, Birmingham, Chemist.
1910. Collitt, Bernard, Chem. Laboratory, Messrs. Ruston, Proctor, and Co., Ltd., Lincoln, Chemist.
1910. Colman, Fred. J., c/o Brotherton and Co., Ltd., Wear Tar Works, Sunderland, Tar Works Chemist.
1891. Colman, Dr. H. G., Woodthorpe, New Malden, Surrey, Analytical Chemist.
1892. Colquhoun, Ludovic, Dynamite Factory, Modderfontein, Transvaal, Analytical Chemist.
1894. Colquhoun, W., Endcliffe, Endcliffe Crescent, Sheffield, Engineer.
1901. Colwell, J. Kear, Finsbury Town Hall, Rosebery Avenue, E.C., Analytical and Consulting Chemist.
1906. Comber, A. W., 23, Courtenay Gardens, Upminster, Essex, Metallurgical Chemist.
1900. Comey, Dr. Arthur M., Upland Avenue, opposite Summit Street, Chester, Pa., U.S.A., Technical Chemist.
1911. Comey, Robert H., Wenonah, N.J., U.S.A., Bleacher.
1906. Compton, Miss N. J., Library, University of Nebraska, Lincoln, Neb., U.S.A., Librarian.
1897. Cone, Alfred L., 122, East 74th Street, New York City, U.S.A., Chemist.
1901. Connah, Jas., Laboratory, Custom House, London, E.C., Government Analyst.
1891. Conradson, Pontus H., Galena Oil Works, Franklin, Pa., U.S.A., Analytical Chemist.
1889. Conroy, Dr. Jas. T., 9, The Serpentine, Grassendale, Liverpool, Chemist.
1887. Constable, W. H., Australian Alum Works, Runcorn, Analytical Chemist.
1909. Cook, E. Bernard, 23, Cross Street, Finsbury, London, E.C., Manufacturing Chemist.
O.M. Cook, H. J., The Firs, Woodford Green, Essex, Soap Manufacturer.
1903. Cook, Jas. W., London and Provincial Dye Works, Hackney Wick, N.E., Dyer.
1898. Cook, Thos. Alex., East London Soap Works, Bow, E., Soapmaker.
1916. Cooke, Frank, Trafford House, Marley Hill, Swalwell S.O., Co. Durham, Chemist.
1904. Cooke, W. Ternent, The University, Adelaide, South Australia, Lecturer in Chemistry.
1910. Coombs, Frank A., Technical College, Sydney, N.S.W., Australia, Lecturer on Tanning.
1913. Cooper, G. Stanley, "Colwyn," Park Avenue, Castleford, Yorks., Chemist.
1910. Cooper, Leonard H., Royal Crown Soap Co., Calgary, Alberta, Canada, Chemist.
1901. Cooper, T. S., Beckfoot, Birch Hall Lane, Manchester, Calico Printing Chemist.
1891. Cooper, Walter J., The Elms, Lavernock, nr. Penarth, South Wales, Cement Works Manager.
1916. Cooper, W. F., Cooper Laboratory for Economic Research, Rickmanworth Road, Watford, Herts, Synthetic Chemist.
1914. Corder, Walter S., Messrs. Williamson and Corder, Ltd., Low Walker, Newcastle-on-Tyne, Chemical Manufacturer.
1899. Cornelison, Dr. Robt. W., 275, West Summit Street, Somerville, N.J., U.S.A., Consulting Chemist.
1909. Cornell, Fred, 16, Place Royal, Montreal, Canada, Chemical Merchant.
1894. Coste, J. H., 2, Savoy Hill, Victoria Embankment, W.C., and (Jnls.) Utopia, Gloucester Road, Teddington, Chemist (Public Health Dept., L.C.C.).
1913. Cotterill, John W., 5, King Alfred's Place, Birmingham, Analyst.
1915. Coulton, C. P., "The Nook," Raby Drive, Bromborough, Cheshire, Chemist.
1912. Coupe, Geoffrey, 6, Marlborough Square, Apsley Road, Great Yarmouth, Chemist.
1914. Cousins, F. G., on active service, Science Master.
1894. Cousins, W. J., Cromwell House, High Holborn, W.C., Consulting Chemist and Director.
1909. Coventry, Bernard O., Lahore, Punjab, India, Deputy Commissioner of Forests.
1903. Cowan, A. Wallace, Bayfield, Bowdon, Cheshire, Analytical Chemist.
1906. Cowan, George D., Bridge House, Bridge Road, Millwall, E., Manager, Desilverising Works.
1912. Cowan, H. W., 22, Cornish Road, Moore Park, Toronto, Canada, Water and Sewage Specialist.
1893. Cowan, W. J., 12, Park Avenue, Wood Green, N., Fine Colour Manufacturer.
1910. Coward, Hubert F., Board of Education Offices, Whitehall, London, S.W., Lecturer in Chemistry.
1897. Cowburn, Arthur W., 20, Mount Street, Manchester, Chemical Merchant and Analytical Chemist.
1907. Cowburn, J. Robert, 10, Eastwood Road, South Woodford, Essex, Technical Chemist.
1891. Cowper-Coles, Sherard Osborn, 1 and 2, Old Pye Street, Westminster, S.W., and (Jnls.) The Cottage, French Street, Sunbury-on-Thames, Metallurgical Engineer.
1905. Cox, Harold N., c/o Lalance and Grosjean Mfg. Co. Woodhaven, N.Y., U.S.A., Chemist.
1915. Coye, Chas. H., c/o C. H. Dexter and Sons (Inc.), Windsor Locks, Conn., U.S.A., Paper-Maker.
1915. Craggs, J. W., 38, Ventnor Gardens, Whitley Bay, Northumberland, Analytical Chemist.
1884. Craig, Geo., Chemical Laboratory, 95, Bath Street, Glasgow, Technical Chemist.
1895. Craig, Dr. Thos. J. I., c/o Peter Spence and Sons, Ltd., Alum Works, Manchester, Chemist.
1908. Craig, Wm. J., c/o Rio Tinto Co., Casa Colon, Huelva, Spain, Analytical Chemist.
1901. Crane, Fred. D., 28, Hillside Avenue, Montclair, N.J., U.S.A., Consulting Chemist.
1902. Crane, Jasper E., c/o The Arlington Co., Arlington, N.J., U.S.A., Chemist.
1903. Cranmer, Ridgeway, 170, 88th Street, Bay Ridge, Brooklyn, N.Y., U.S.A., Chemist.
1902. Craven, Alfred B., Northcote, Thorpe Road, Selby, Yorks, Analytical Chemist.
1906. Craven, J. A., 119, Moorside, Armley, Leeds, Chemist.
1891. Craven, Jno., The Ark, South Bersted, Bognor, Sussex, Chemist.
1906. Craven, John I., Niederwald, Hebers Ghyll, Ilkley, Yorks, Chemist and Salesman.
O.M. Crawford, D., 60, Holly Avenue, Jesmond, Newcastle-on-Tyne, Manager.
1913. Crawford, John, 76, Forsyth Street, Greenock, Scotland, Works Chemist.
1908. Crawford, Lawrence, c/o Thos. Ness, Ltd., Blackbank Chemical Works, Darlington, Analytical Chemist.
1890. Crawshaw, E., 25, Tollington Park, London, N. Dye Merchant.
1914. Creese, Guy T., 2, Poplar Street, Danvers, Mass., U.S.A., Leather Manufacturer.
O.M. Cresswell, C. G., Ermyngarth, Ashtead, Surrey; and Broadway Chambers, Westminster, S.W., Chemist.
1901. Cribb, Cecil H., 60, Greek Street, Soho Square, London, W., Analytical and Consulting Chemist.
1908. Crighton, Adam M., "London Place," Agecroft Print Works, Pendleton, Manchester, Calico Printer's Chemist.
1910. Crighton, David T., B15, Queen Insurance Buildings, 10, Dale Street, Liverpool, Buying Manager.
1905. Crighton, W. H., 116, Southbury Road, Enfield, Chemist.
1890. Criper, Wm. R., c/o Messrs. D. Waldie and Co., Konnagar, near Calcutta, India, Manufacturing Chemist.
1911. Croasdell, Jas. F., 108, Burnt Ash Road, Lee, S.E., Engineer.
1901. Cronquist, G. W., S. Trädgardsgatan 2, Helsingborg, Sweden, Consulting Ceramic Engineer.
1915. Cronshaw, Cecil J. T., c/o Levinstein, Ltd., Blackley, Manchester, Research Chemist.
O.M. Crookes, Sir Wm., O.M., F.R.S., 7, Kensington Park Gardens, Notting Hill, W., Analytical Chemist.

1896. Crosby, Thos., Llanelly Steelworks, Llanelly, South Wales, Metallurgist.

O.M. Crosfield, A. L., 46, Bidston Road, Oxton, Birkenhead ; (Journals) c/o Prof. B. Moore, Biochemical Dept., The University, Liverpool, Analytical Chemist and Assayer.

1896. Crosfield, Capt. G. R., Lodge Lane, Warrington, Soap Manufacturer.

1908. Crosland, Percy F., Century Dye Works, Elland, Yorks, Technical Chemist.

1884. Cross, C. F., 4, New Court, Lincoln's Inn, London, W.C., Analytical Chemist.

1894. Crossley, Prof. Arthur W., F.R.S., King's College, Strand, and (Jnls.) 46, Lindfield Gardens, Hampstead, N.W., Professor of Chemistry.

1915. Crossley, Henry, 70, Cut Lane, Norden, near Rochdale, Engine Packing Maker.

1904. Crossley, T. Linsey, 318, Lagauchetière Street West, Montreal, Canada, Technical Chemist.

1908. Croston, Henry, 583, Leonard Street, Brooklyn, N.Y., U.S.A., Foreman.

1894. Crow, Henry W., Hart's Lane, North Street, Barking, E., Tar Distiller.

1884. Crow, Dr. J. K., Ivydene, Westcombe Park Road, Blackheath, S.E., Technical Chemist.

1915 Crowdy, Thomas, 13, Clifton Road, Devizes Road, Salisbury, Gas Engineer and Chemist.

1883. Crowther, Horace W., The Beeches, West Bromwich, Technical Chemist.

1906. Crowther, R. E., c/o Ferguson Bros., Ltd., Holme Head, Carlisle, Chemist.

1912. Cruikshanks, Dr. Geo. S., Royal Technical College, Glasgow, Chemist.

1906. Cruser, Dr. Fred. Van D., c/o The Diamond Match Co., Oswego, N.Y., U.S.A., Chemical Engineer.

1892. Cullen, Wm., c/o British South African Explosives Co., Ltd., 612, Salisbury House, Finsbury Circus, London, E.C., Chemist.

1903. Cullen, W. H., The Castner-Kellner Alkali Co., Ltd., Wallsend-on-Tyne, Engineer.

1897. Culmann, Dr. J., c/o G. Siegle Co., Rosebank, Staten Is., N.Y., U.S.A., Chemist and Colourist.

1883. Cuming, James, jun., Chemical Works, Yarraville, Melbourne, Australia, Chemical and Fertiliser Manufacturer.

1912. Cuming, Wm. F., c/o Cuming, Smith, and Co. Proprietary, Ltd., Yarraville, Victoria, Australia, Manufacturing Chemist.

1916. Cumming, Dr. A., Chemistry Dept., University of Edinburgh, Chemist.

1907. Cunningham, James E., Minas Peña del Hierro, Provincia de Huelva, Spain, Analytical Chemist.

1915. Cunningham, Thos. R., 6A, Lochiel Apartment, Niagara Falls, N.Y., U.S.A., Chemist.

O.M. Curphey, W. S., 87, Canfield Gardens, South Hampstead, N.W., Chief Alkali Works Inspector.

1916. Curran, E. A., 27, St. Jean Baptiste Street, Montreal, Canada, Manufacturing Chemist.

1898. Curtis, Marvin, 108, Front Street, San Francisco, Cal., U.S.A., Wine Chemist.

1903. Cushing, Robt. P., c/o Cattaraugus Tanning Co., Olean, N.Y., U.S.A., Chemist.

1902. Cutbush, Chas. G., 59, Byne Road, Sydenham, Kent, Electrical Engineer.

1899. Cutler, Fred. F., 166, Essex Street, Boston, Mass., U.S.A., Publisher.

1914. Cutler, J. Vernell, c/o E. W. Hawksworth and Sons, Beneva Sugar Estate, Esperanza, Natal, S. Africa Technical Chemist.

1913. Cutts, H. Cyril, Brooklyn, Private Road, Sherwood, Nottingham, Embroidery Manufacturer.

1904. Cutts, Henry E., c/o Stillwell and Gladding, 181, Front Street, New York City, U.S.A., Technical Chemist.

D

1911. Dager, Herman J., 278, Jarvis Street, Toronto, Canada, Dominion Food Inspector.

1897. Dains, Herbert H., c/o J. E. Ferguson, 2, Union Court, London, E.C., Analytical Chemist.

1915. Daley, Samuel F., 11, Fitzwarren Street, Seedley, Manchester, Works Chemist.

1884. Daniell, Louis C., Royal Standard Brewery, Tamworth, New South Wales, Brewer.

1904. Danker, Dan. J., 73, Dean Road, Brookline, Mass., U.S.A., Dyestuff and Chemical Merchant.

1903. Dannenbaum, Dr. H., c/o National Ammonia Co Frankford, Philadelphia, Pa., U.S.A., Secretary and Treasurer.

1885. Darby, Jno. H., Howard Chambers, 155, Norfolk Street, Sheffield, Ironmaster.

1916. Daver, B. F., 32, Churchgate Street, Fort, Bombay, India, Chemical Engineer.

1911. David, Edward J., 249, Wood Avenue, Tottenville, Staten Is., N.Y., U.S.A., Chemist and Assayer.

1900. Davidson, Alex., Whitecastle, Biggar, Lanarkshire, Analytical Chemist.

1899. Davidson, Charles, 65, Cadder Street, Pollokshields, Glasgow, Analytical Chemist.

1901. Davidson, G. M., Chicago and N.W. Railroad Shops, P.O. Station E., Chicago, Ill., U.S.A., Chemist.

1883. Davidson, J. E., 40, Percy Gardens, Tynemouth, Chemical Manufacturer.

1891. Davidson, Richard, 133, Victoria Road, Dundee, Oil Merchant's Clerk.

O.M. Davidson, R. Holden, c/o United Alkali Co., Ltd., Ammonia Soda Works, Fleetwood, Manager.

1911. Davidson, Thos. A., 57, Strathyre Avenue, Norbury, S.W., Chemist and Varnish Expert.

1905. Davidson, Dr. Wm. B., c/o British Dyes Ltd., Huddersfield, Chemical Engineer.

1906. Davies, Harry R., 80, Prince Street, Jamaica Plain, Mass., U.S.A., Chemist.

1898. Davies, Herbert E., The Laboratory, 28, Chapel Street, Liverpool, Analytical Chemist.

1907. Davies, James, 12, Harefield Road, Brockley, London, S.E., Scientific Apparatus Maker.

1911. Davies, Jas. H., c/o Lever Bros., Ltd., Royal Liver Building, Liverpool, Chemist.

1896. Davies, Llewellyn J., 103, Bute Road, Cardiff, Analytical and Consulting Chemist.

1886. Davies, M. L., Standard Chemical Iron and Lumber Co., Toronto, Canada, General Manager.

1897. Davies, Saml. H., c/o Rowntree and Co., Ltd., The Cocoa Works, York, Research Chemist.

1908. Davies, T. H., c/o John Cox and Co.'s Successors, Stillhouse Lane, Bedminster, Bristol, Tanner.

O.M. Davis, A. R., 27, Wellington Road, Heaton Chapel, Stockport, Analytical Chemist.

1901. Davis, Bernard F., 19, Holligrave Road, Bromley, Kent, Metallurgical Engineer.

1902. Davis, Charles B., c/o National Brewers' Academy, 402, West 23rd Street, New York City, U.S.A., Technical Chemist.

1912. Davis, E. Gordon, Stockton-on-Tees Chemical Co., Stockton-on-Tees, Research Chemist.

1914. Davis, Eric, N., 68, Bowrons Avenue, Wembley, N.W., Technical Journalist.

1908. Davis, G. Keville, 265, Strand, London, W.C, Chemical Engineer.

O.M. Davis, H. W., 18, Crescent Road, Kingston-on-Thames, Analytical Chemist.

1897. Davis, Wm. A., 7, Carlton Bank, Harpenden, Herts, Chemist.

1911. Davis, Wm. C., 6, Park Road, West Smethwick, near Birmingham, Chemist.

1900. Daw, Fred W., Duffryn House, Ebbw Vale, Mon., Metallurgical Chemist.

O.M. Dawson, C. A., 32, Elm Hall Drive, Mossley Hill, Liverpool, Technical Chemist.

1916. Dawson, J. A. M., Inland Revenue Laboratory, 249, Hastings Street East, Vancouver, B.C., Canada, Analyst-in-Charge.

1915. Dawson, Reginald D., Chemical Dept., Southern Outfall Works, Crossness, Abbey Wood, Kent, Chemist.

1886. Dawson, W. Haywood, British Alizarin Co., Ltd., Silvertown, E., and (Journals) 15, Wrottesley Road, Woolwich, S.E., Technical Chemist.

1901. Day, Dr. David T., Adams Building, 1333, F. Street, N.W, Washington, D.C., U.S.A., Geologist.
1913. Day, Frank E., c/o Condensed Milk Co. of Ireland, Lansdowne, Limerick, Ireland, Analytical Chemist.
1912. Day, G. A. C., Casilla No. 417, Lima, Peru (*viâ* New York), Oil Mill Manager.
O.M. Deacon, H. Wade, 8, Ullet Road, Liverpool; and (Jnls.) c/o C. E. Tyers, 186, Derby Road, Farnworth, Widnes, Alkali Manufacturer.
O.M. Deakin, H. T., Dewhurst, Egerton, near Bolton, Dyer.
1911. Dean, Arthur L., College of Hawaii, Honolulu, H.I., U.S.A., Assistant Prof. of Industrial Chemistry.
1906. Dean, Harry, Armstrong College, Newcastle-on-Tyne, Demonstrator.
1892. Deaville, B., Beech Avenue, Nottingham Manufacturing Chemist.
1899. De Castro, J. Paul. *See* Castro, J. Paul de.
1902. De Cew, J. A., 903. McGill Building, Montreal, Canada, Chemical Engineer.
1900. Deerr, Noel F., Jobabo, Oriente, Cuba, Analytical Chemist.
1902. Deghuée, Dr. Jos. A., 39, West 38th Street, New York City, U.S.A., Chemist.
1911. Dehn, Dr. Frank B., Broad Sanctuary Chambers, Westminster, S.W., Chemist and Patent Agent.
1901. De Jonge, Cornelius, 584, East 7th Street, Brooklyn, N.Y., U.S.A., Pharmaceutical Chemist.
1908. Delafield, Dr. F. H., Winnington, Northwich, Cheshire, Chemical Manufacturer.
1916. Delage, Edmond, Usines de Prod. Chim. de la Cie de St. Gobian, 1, Place des Saussaies, Paris (8), France, Director-General.
1909. De Laire, Edgar, 129, Quai de Moulineaux, Issy, Seine, France, Industriel.
1901. Delany, Chas., c/o Elliott Bros., Ltd., O'Connell Street, Sydney, N.S.W., Australia, Chemist.
1915. De Laporte, A. V., 90, Gloucester Street, Toronto, Canada, Chemist, Provincial Board of Health.
1908. Dellschaft, Dr. F. H. *See* Delafield.
1910. De Meeus, Etienne, Beacon Falls, Conn, U.S.A., Chemist.
1888. Dempsey, Geo. C., 165, Market Street, Lowell, Mass., U.S.A., Chemist.
1909. Demuth, Rudolph, 68, Salusbury Road, London, N.W., Manufacturer.
1899. Denham, Wm. S., The United College, St. Andrews, Scotland.
1913. Denington, R. C., 69, Dover Road, South Wanstead, Essex, Research Chemist.
1891. Denison, Joseph R., Valley Dyeworks, Bradford, Yorks, Analytical Chemist.
1911. Dennis, Louis, 2, Norman Avenue, Birkby, Huddersfield, Works Chemist.
1908. Dennis, Martin, 859, Summer Avenue, Newark, N.J., U.S.A., Manufacturing Chemist.
1907. Dennison, Henry S., c/o Dennison Manufacturing Co., Framingham, Mass., U.S.A., Manufacturer.
1898. Dent, Dr. Frankland, Government Analyst's Dept., Singapore, S.S., Government Analyst.
1912. Depierres, Gaston, The Indestructible Paint Co., King's House, King Street, Cheapside, London, E.C., Managing Director.
1911. Derry, Albert Victor, 301, Glossop Road, Sheffield, Gas Engineer.
1913. Desch, Dr. Cecil H., Metallurgical Dept., The University, Glasgow, Lecturer.
1912. Dettmann, A. H., Stuart Street, Longueville, Sydney, N.S.W., Leather Manufacturer.
1914. Detwiler, Jas. G., La Tourette Hotel, Bergen Point, Bayonne, N.J., U.S.A., Chemist.
1906. Deverell, Louis C., 1, Shortlands Grove, Shortlands, Kent, Chief Chemist.
1898. Dewar, Alex. H., c/o The Linoleum Manufacturing Co., Staines, Middlesex, Chemist.
O.M. Dewar, Sir J., F.R.S., 21, Albemarle Street, London, W., Professor of Chemistry and Physics.
1889. Dewey, Fred. P., 1232, Massachusetts Avenue, N.W., Washington, D.C., U.S.A., Metallurgist.
1904. Dewhirst, J. A., Imperial Chambers, Halifax, Yorks, Analyst.
1909. Dewhirst, Wm. B., Gen. Delivery, Carnigie, Pa., U.S.A., Technical and Engineering Chemist.
1915. Dey, Alex. J., Blandfield Chemical Works, Wheatfield Road, Edinburgh, Manufacturing Chemist.
1903. Diamond, Wm., La Norie, Marley Hill, Co. Durham, Works Manager.
1913. Diaz-Ossa, Prof. Belisario, Casilla 962, Santiago, Chile, Prof. of Chemistry.
1913. Dick, James, c/o Canadian Explosives, Ltd., Beloeil Station, P.Q., Canada, Superintendent.
1902. Dick, John, Wharf Road, Cubitt Town, London, E., Manager and Chemist.
1904. Dick, W. D., c/o Hugh Baird and Sons, 29, St. Vincent Place, Glasgow, Analytical Chemist.
1898. Dickenson, F. M., c/o Broken Hill Proprietary Co., 3, Great Winchester Street, London, E.C., Secretary.
1904. Dickenson-Gair, C. J. *See under* Gair.
1893. Dickerson, E. N., 141, Broadway, New York City U.S.A., Lawyer.
O.M. Dickinson, A. J., 178, Lewisham High Road, Brockley, S.E., Tar Distiller.
1905. Dickinson, Cyril, Southwark Town Hall, Walworth Road, London, S.E., Analytical Chemist.
1915. Dickinson, Frank E., on active service, Research Chemist.
1914. Dickson, J. M., 36, Leopold Street, Toronto, Canada, Manager.
1898. Dickson, Samuel, 26, Tothill Street, Westminster, S.W., Analytical Chemist.
1899. Dieckmann, Dr. Otto, 1180, Harrison Avenue, Cincinnati, Ohio, U.S.A., Chemist.
1914. Diehl, Dr. L. H. Metallurgical Chemist.
1908. Diekman, Dr. George C., 115, West 68th Street New York City, U.S.A., Professor of Pharmacy.
1894. Diestel, Wm., 117, Hudson Street, New York City, U.S.A., Dyestuff Importer.
1908. Dill, Colby, Rabway Avenue, Woodbridge, N.J., U.S.A., Chemist.
1898. Dillon, Wm., 148, Peverell Park Road, Plymouth, Oil, Colour, and Varnish Manufacturer.
1911. Dissosway, Thurston N., 23, Vine Street, Brooklyn, N.Y., U.S.A., Chemist.
1916. Dixon, Alfred, 17, Lonsdale Place, Whitehaven, Cumberland, Tanner.
1899. Dixon, Fred. W., P.O. Box 43, Jamestown, N.Y., U.S.A., Dyer.
1888. Dixon, Prof. Harold B., F.R.S., Owens College, Manchester, Professor of Chemistry.
1902. Dixon, Wm. A., Reiby Chambers, Reiby Lane, Circular Quay, Sydney, N.S.W., Australia, Public Analyst and Assayer.
1909. Dixon, W. H., c/o Bryant and May, Ltd., Fairfield Works, Bow, London, E., Match Manufacturer.
1892. Dobb, Thos., c/o J. T. Dobb and Son, West Bar, Sheffield, Pharmaceutical Chemist.
O.M. Dobbie, Sir J. J., F.R.S., Government Laboratory, Clement's Inn Passage, London, W.C., and (Jnls.) 4, Vicarage Gate, Kensington, W., Director.
O.M. Dobbin, Dr. L., Chemical Laboratory, University, Edinburgh, Professor of Chemistry.
1908. Dobbs, Ernest J., "The Cedars," 88a, East India Road, Poplar, E., Analytical Chemist.
1907. Dodd, Arthur J., 2, Criffel Avenue, Streatham Hill, S.W., Oil Manufacturer.
1915. Dodd, A. Scott, Laboratory, 20, Stafford Street, Edinburgh, Public Analyst.
1889. Dodd, W. Ralph, Burton Grange, Goff's Oak, near Cheshunt, Chemical Works Manager.
1913. Dodds, Herbert H., c/o Kynoch, Ltd., Umbogintwini, Natal, Explosives Chemist.
1906. Dodds, Thos., c/o Reckitt and Sons, Ltd., and (Journals) 7, The Oval, Garden Village, Hull, Works Manager and Chemist.
1900. Dodge, Dr. Francis D., 69, Avenue A., Bayonne, N.J., U.S.A., Chemist.
1897. Doerflinger, Wm. F., Rosebank, Staten Island, N.Y., U.S.A., Research Chemist.

1897. Dohme, Dr. Alf. R. L., Messrs. Sharp and Dohme, Baltimore, Md., U.S.A., Manufacturing Chemist.
1905. Dolan, H., Westbourne, Belvoir Road, Lower Walton, Warrington, Chemist.
1914. Donald, James R., 318, Lagauchetière Street West, Montreal, Canada, Chemical Engineer.
1903. Donald, Dr. Jas. T., 318, Lagauchetière Street West, Montreal, Canada, Consulting Chemist.
1900. Donald, Wm. Ridgefield Park, Bergen Co., N.J., U.S.A., Assayer and Chemist.
1913. Donaldson, Richard, 63, Waverley Gardens, Crossmyloof, Glasgow, Assistant Manager.
1902. Donaldson, Thos., Beechcroft, Ardrossan Road, Saltcoats, Scotland, Chemist.
1905. Donnan, Prof. F. G., F.R.S., Chemical Laboratories, University College, Gower Street, London, W.C., Professor of Physical Chemistry.
1886. Doolittle, Oirin S., 388, Palisade Avenue, Yonkers, N.Y., U.S.A., Chemist.
1905. Doolittle, Roscoe E., 109, Hillside Avenue, Glen Ridge, N.J., U.S.A., Chemist.
1890. Dore, Jas., Copper Works, High Street, Bromley-by-Bow, E., Distiller's Engineer.
1911. Dorée, Dr. Charles, 58, Gore Road, South Hackney, London, N.E., Head of Chemistry Department, Borough Polytechnic.
1896. Doremus, Dr. Chas. A., 55, West 53rd Street, New York City, U.S.A., Professor of Chemistry.
O.M. Dott, D. B., Ravenslea, Musselburgh, Scotland, Analytical Chemist.
1911. Dougall, Jas. S. N., 305, Manufacturers Street, Montreal, Canada, Varnish Manufacturer.
1915. Dougill, George, 35, Caledonian Road, Leeds, Gas Engineer.
1897. Douglas, Geo., Farfield Hall, Addingham, Yorks, Dyer.
1915. Douglas, John, Reed Street, Cliff-at-Hoo, Kent, Explosives Chemist.
1894. Douglas, Loudon M., Douglas Wharf, Putney, S.W., Chemical Manufacturer.
1909. Douglas, Robt. P., Prudential Buildings, Nelson Square, Bolton, Consulting Chemist.
1884. Douglas, William, Grafton House, Berkhamsted, Herts., Chemical Engineer.
1900. Doulton, H. Lewis, Royal Doulton Potteries, Lambeth, S.E., Potter.
1900. Dow, Allan W., 126, Joralemon Street, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1893. Dow, Herbert H., Midland, Mich., U.S.A., Manufacturing Chemist.
1908. Dow, John W., 564, Park Avenue West, Mansfield, Ohio, U.S.A., Manufacturing Chemist.
1905. Dowbiggin, James, Craiglands, Albert Park, Lancaster, Chemist.
1915. Downing, James, 1, Perth Road, Finchley Park, N., Analytical Chemist.
1912. Doxey, Carl W., c/o Whalley Abbey Printing Co., Whalley, near Blackburn, Printworks Chemist.
1901. Doxrûd, Christian, Technical School, Christiania, Norway, Professor of Chemical Technology.
1907. Doyle, B. W., 245, Lindell Avenue, Leominster, Mass., U.S.A., Manufacturer.
1902. Drake, Bryant S., 5839, Colby Street, Oakland, Cal., U.S.A., Chemist.
1911. Drake, Joseph W. D., Three Mills Distillery, Bromley-by-Bow, London, E., Distillery Brewer.
1914. Drew, John M., Lower House, Burnley, Lancashire, Calico Printer.
1906. Drew, W. Newton, Raincliffe, Ecclesfield, near Sheffield, Chemical Manufacturer.
1896. Drewsen, Dr. Viggo B., 5, Beekman Street, New York City, U.S.A., Wood Pulp and Paper Expert,
O.M. Dreyfus, Dr. C., Claremont, Fallowfield, Manchester. Dye Manufacturer.
1904. Dreyfus, Dr. L. A., Maple Avenue, Rosebank, S.I., N.Y., U.S.A., Chemist.
1893. Dreyfus, S., Thornciffe Villa, Windmill Lane, Denton, near Manchester, Chemist.
1899. Dreyfus, Dr. Wm., 57, East 96th Street, New York City, U.S.A., Chemist.
1898. Drummond, Dr. Isaac W., 436, West 22nd Street, New York City, U.S.A., Chemist.
1910. Drury, Chas. Dru, Hendon Gas Works, Sunderland, Engineer.
1899. Ducas, B. P., 25-27, South William Street, New York City, U.S.A., Chemical and Dyestuff Importer.
1905. Duché, E., 6, Eastcheap, London, E.C., Merchant.
1909. Duchemin, Réné P., 6, Rue Chanoinesse, Paris IV., France, Chemical Engineer.
1897. Duckham, Alex., Phœnix Wharf, West Ferry Road, Millwall, E., and (Jnls.) Vanbrugh Castle, Blackheath, S.E., Chemical Manufacturer.
1915. Duckham, Arthur M., Palace Chambers, Westminster, S.W., Engineer.
1905. Duckworth, Harry S., Garner Printworks and Bleachery, Garnerville, Rockland Co., N.Y., U.S.A., Printworks Chemist.
1913. Duff, Alex. R., 211, Fern Avenue, Toronto, Canada, Rubber Chemist.
1899. Duff, Wm. S., Merrie Lands, Westbury Road, Buckhurst Hill, Essex, Manufacturing Chemist.
1901. Dufty, Lawrence, 92, Tom Lane, Nether Green, Sheffield, Analytical Chemist.
1905. Duggan, Edw. J., c/o Brewer and Co., 95, William Street, New York City, U.S.A., Vice-President.
O.M. Duggan, T. R., 52, East 41st Street, New York City, U.S.A., Analytical Chemist.
1916. Duke, J. A. H., The Dell, Sutton, Surrey, Edible Oil Manufacturer.
1888. Dukes, T. William, Box 10, Vrijheid, South Africa, Merchant.
1906. Duncalfe, Roger, Forge Mills, Bestwood Colliery, Nottingham, Glue Manufacturer.
1889. Duncan, Arthur W., c/o J. Woolley, Sons and Co., Ltd., Victoria Bridge, Manchester, Analytical Chemist.
1909. Duncan, Jas., c/o Steel Bros. and Co., Ltd., 6, Fenchurch Avenue, London, E.C., Merchant.
1915. Duncan, J. Gibson, 67, Waverley Gardens, Crossmyloof, Glasgow, Works Chemist.
1906. Dunford, Jno. H., Trent Side Bone Works, Nottingham, Assistant Manager.
1915. Dunglinson, B., c/o A. Campbell, 324, Cron Road, Broomhill, Glasgow, Analytical Chemist.
1912. Dunkelsbühler, F. S., 63, Brock Street, Grosvenor Square, London, W., Technical Chemist.
1905. Dunlop, Harry, 231, St. Vincent Street, Glasgow, Chemist.
1892. Dunn, Fred, 193, Collins Street, Melbourne, Victoria, Australia, Analytical Chemist.
O.M. Dunn, Dr. J. T., 10, Dean Street, Newcastle-on-Tyne, Consulting Chemist.
O.M. Dunn, P., Northern Assurance Buildings, Albert Square, Manchester, Chemical Merchant.
1915. Dunningham, Dr. Alfred C., c/o Electro-Bleach and By-Products Ltd., Middlewich, Cheshire, Technical Chemist.
1908. Dünschmann, Dr. Max, c/o Meister, Lucius, und Brüning, Ltd., Ellesmere Port, Cheshire, Manager.
1901. Dunsford, Geo., Laboratory, Wigan Coal and Iron Co., Ltd., Wigan, Analytical Chemist.
1907. Dunstan, Dr. A. E., 7, Woodhouse Grove, East Ham, E., Head of Chemical Department (Technical College, East Ham).
1907. Dupré, F. H., 2, Edinburgh Mansions, Howick Place, S.W., Analytical Chemist.
1907. Dupré, P. V., 2, Edinburgh Mansions, Howick Place, S.W., Analytical Chemist.
1905. Durfee, Winthrop C., 516, Atlantic Avenue, Boston, Mass., U.S.A., Manufacturing Chemist.
1897. Durkee, Frank W., Tuft's College, Medford, Mass., U.S.A., Professor of Chemistry.
1911. Durkin, Jos. A., c/o Butterworth Judson Co., Newark, N.J., U.S.A., Chemical Superintendent.
1907. Durrans, Thos. H., 10, Titchfield Terrace, Regent's Park, London, N.W., Chemist.
1915. Dutt, P. K., 53, Lelthouse Place, Leeds, Research Chemist.

1891. Dvorkovitz, Dr. P., 4. Broad Street Place, London, E.C., Technical Chemist.
1912. Dyche-Teague, F. C., 258, Gloucester Terrace, Hyde Park, London, W., Analytical Chemist and Bacteriologist.
O.M. Dyer, Dr. B., 17, Great Tower Street, London, E.C., Analytical and Consulting Chemist.
1911. Dyke, F. Montague, Nelson Croft, Church Road, Bebington, Cheshire, Analytical Chemist.
O.M. Dyson, C. E., Flint, North Wales.
1902. Dyson, George W., 24, Clarkehouse Road, Sheffield, Analyst.
1892. Dyson, Septimus, Nyddcombe, Warlingham, Surrey, Manufacturing Chemist.

E

1905. Eager, Chas. E., 77, Pearl Street, Boston, Mass., U.S.A., Merchant.
1910. Eardley, J. F., 265, Glossop Road, Sheffield, Pharmaceutical Chemist.
1913. Earl, J. C., c/o Government Analyst, Victoria Square West, Adelaide, S. Australia, Chemist.
O.M. Earp, W. R., Preston Brook, near Warrington, Chemical Manufacturer.
1910. Easterfield, Prof. Thomas H., Victoria College, Wellington, New Zealand, Prof. of Chemistry.
1884. Eastick, C. E., 13, King Edward Street, Whitechapel, E., Sugar Refinery Director.
1909. Eastick, J. C. N., 49a, Clapton Common, London, N.E., Electrochemist.
O.M. Eastick, J. J., 2, St. Dunstan's Hill, London, E.C., Consulting Sugar Expert.
1890. Eastlake, A. W., Grosmont, Palace Road, Streatham Hill, S.W., Consulting Petroleum Engineer.
1909. Eastlake, William H., The Cable Shop, Northern Electric Co., Ltd., Montreal, Canada, Chemist.
1914. Easton, Reginald F., 111, Cromwell Road, St. Andrews, Bristol, Technical Chemist.
1914. Eastwood, John A., "Horbury," Gordon Square, Marrickville, Sydney, N.S.W., Dyer.
1906. Eaton, B. J., Agricultural Dept., Kuala Lumpur, Selangor, Fed. Malay States, Govt. Chemist.
1909. Eberlin, Leon W., 360, Lake View Park, Rochester, N.Y., U.S.A., Chemist.
1892. Eddy, Harrison P., 14, Beacon Street, Boston, Mass., U.S.A., Superintendent.
1913. Edge, Alfred, Ravenhurst, Clayton Bridge, Manchester, Technical Chemist.
1909. Edge, J. Harold, c/o Wm. Edge and Sons, "Dolly" Blue Works, Bolton, Lancashire, Technical Chemist.
1902. Edison, Thos. Alva, Edison Laboratory, Orange, N.J., U.S.A., Inventor and Manufacturer.
1911. Edwards, Alfred, The Laboratory, Meadow Lane Gas Works, Leeds, Analytical Chemist.
1909. Edwards, George M., 241, Pine Avenue West, Montreal, Canada, Paintworks Manager.
1915. Edwards, H. C., "Neotsbury," Laton Road, Hastings, Chemist.
1902. Edwards, H. Leaton, The Shanty, Banks Avenue, Meols, Hoylake, Cheshire, Analyst.
1915. Edwards Owen C., 46, Saxon Road, Faversham, Kent, Works Chemist.
1895. Ehrenfeld, Prof. Chas. H., York Collegiate Institute, York, Pa., U.S.A., Professor of Chemistry.
1896. Ehrhardt, Ernest F., The Mersey Chemical Co., Bromborough Port, New Ferry, Cheshire, Research Chemist.
1913. Eipper, William R., Meadow Brook, Dallas, Pa., U.S.A., Chemist.
1909. Eisenhart, M. H., c/o Eastman Kodak Co., Kodak Park, Rochester, N.Y., U.S.A., Chemist.
1916. Eldridge, A. A., 63, Ellerton Road, Surbiton, Chemist.
1901. Elkan, Leo H., Tannery, 1511, Webster Avenue, Chicago, Ill., U.S.A., Tanner.
1901. Elkins, Arthur W., 116, Prospect Street, East Orange, N.J., U.S.A., Civil Engineer.
1884. Elliott, Dr. A. H., College of Pharmacy, 115, West 68th Street, New York City, U.S.A., Consulting Engineer and Chemist.
1912. Elliott, Edward, c/o Reckitts (Over-Sea), Ltd., Burke Street, Redfern, N.S.W., Australia, Chemical Engineer.
1907. Elliott, George K., c/o Lunkenheimer Co., Cincinnati, Ohio, U.S.A., Chief Chemist.
1896. Elliott, Dr. J. F., O'Connell Street, Sydney, N.S.W., Manufacturing Chemist.
1902. Elliott, Victor G., Chemical Works, Rozelle, Sydney, N.S.W., Australia, Manufacturing Chemist.
1905. Ellis, Carleton, 143, Gates Avenue, Montclair, N.J., U.S.A., Chemical Engineer.
1893. Ellis, E. Victor, c/o J. McLellan, 25, York Place, Edinburgh, Analytical Chemist.
1894. Ellis, G. Beloe, 70, Chancery Lane, London, W.C., Patent Agent.
1913. Ellis, Henry D., 30, Blackheath Park, S.E., Metallurgical Engineer.
1912. Ellis, Percival W., 90, Tooley Street, London Bridge, S.E., Tanning Material Merchant.
1910. Ellis, Ridsdale, 1626, Lytton Building, Chicago, Ill., U.S.A., Patent Agent.
1910. Ellis, Rowland H., c/o Olympia Oil and Cake Co., Barlby Road, Selby, Yorks, Analytical Chemist.
1891. Ellis, Prof. W. Hodgson, 74, St. Alban Street, Toronto, Canada, Prof. of Applied Chemistry.
1891. Ellison, Henry, Moor Lane House, Gomersal, near Leeds, Manufacturing Chemist.
O.M. Elmore, A. S., 72, Gloucester Terrace, Hyde Park, London, W., Electro-Metallurgist.
1915. Elphick, Fred. C., c/o Burt, Boulton and Haywood, Ltd, Prince Regent's Wharf, Silvertown, E., Technical Chemist.
1907. Elsden, A. Vincent, 10, Gourock Road, Eltham, Kent, Analytical Chemist.
1911. Elsdon, Geo. D., Municipal Chemical Laboratory, 141, Regent Road, Salford, Manchester, Public Analyst.
1904. Elson, J. Hugh, Monroe Drug Co., Quincy, Ill., U.S.A., General Manager.
1909. Ely, Benjamin, The Limes, Pye Bridge, near Alfreton, Tar Distiller.
1910. Emanuel, Louis V., c/o River Smelting and Refining Co., Florence, Colorado, U.S.A., Metallurgical Engineer.
1910. Embley, Dr. E. H., 245, Latrobe Street, Melbourne, Victoria, Australia.
1902. Emery, Arthur L., c/o Smith, Emery, and Co., 651, Howard Street, San Francisco, Cal., U.S.A., Chemical Engineer.
1907. Emmons, Frank W., c/o Washburn Crosby Co., Minneapolis, Minn., U.S.A., Chemist.
1894. Enequist, John, 3710, Avenue J., Brooklyn, N.Y., U.S.A., Chemical Engineer.
1904. Englehard, Charles, 30, Church Street, New York City, U.S.A., Platinum Importer.
1895. English, Frank H., 89, Belgrave Road, Wanstead, N.E., Analytical Chemist.
1911. Epps, James W., Holland Street, London, S.E., Chemist.
1907. Erdoes, Julius, 1100, Brook Avenue, New York City, U.S.A., Chemical Engineer.
1902. Erhart, Wm. H., 81, Maiden Lane, New York City, U.S.A., Manufacturing Chemist.
1904. Ermen, Walter F. A., The Firs, Alderley Edge, Cheshire, Analytical Chemist.
1897. Escher, Paul, c/o Swift and Co., Chemical Laboratory, Union Stock Yards, Chicago, Ill., U.S.A., Chemist.
1884. Esilman, A., 38, Norwood Avenue, Southport, Lancashire, Analytical Chemist.
1913. Esling, Fred., 36, Kenilworth Court, Putney, S.W., Chemical Engineer.
1912. Espenhahn, E. V., c/o Metropolitan Gas Co., 186, Flinders Street, Melbourne, Victoria, Australia, Works Chemist.
O.M. Estcourt, C., 5, Seymour Grove, Old Trafford, Manchester, Consulting Chemist.

1903. Euler, C. G., 18–20, Platt Street, New York City, U.S.A., Chemical Agent.

1912. Evans, Edward V., South Metropolitan Gas Co., Old Kent Road, London, S.E., Chief Chemist.

1903. Evans, F. Sparke, Avonside Tannery, Bristol, Tanner.

1905. Evans, Geo. A., 832, Yonge Street, Toronto, Canada, Pharmacist.

1913. Evans, George A., c/o Australian Explosives and Chemical Co., Ltd., 135, William Street, Melbourne, Victoria, Australia, General Manager.

1905. Evans, John, 67, Surrey Street, Sheffield, Analytical Chemist.

1908. Evans, Prof. Nevil Norton, Redpath Library, McGill University, Montreal, Canada, Associate Professor of Chemistry.

1912. Evans, Sam, 4, Whickham Avenue, Dunston-on-Tyne, Chemist.

1912. Evans, Ulick R., 28, Victoria Street, Westminster, S.W., Consulting Electrochemist.

1898. Evans, Wm. Perceval, Canterbury College, Christchurch, New Zealand, Professor of Chemistry.

1909. Everette, Dr. W. E., 3512, South 11th Street, Tacoma, Wash., U.S.A., Consulting Chemical Engineer.

1904. Everitt, Walter, Norwood Wharf, Southall, Middlesex, Analyst.

1912. Evers, Norman, c/o Allen and Hanbury's, Ltd., Bethnal Green, London, E., Analytical Chemist.

1907. Eves, Archie, P., 762, East Buchtel Avenue, Akron, Ohio, U.S.A., Chemist.

1894. Ewan, Dr. Thos., c/o Cassel Cyanide Co., Shuna Street, Maryhill, Glasgow, Chemist.

1905. Eynon, Lewis, 4, Stag Lane, Buckhurst Hill, Essex, Chief Chemist (London Beetroot Sugar Association).

F

1902. Faill, Jas., 52, Robertson Street, Glasgow, Technical Chemist.

1902. Fairchild, Benj. T., P.O. Box 1120, New York City, U.S.A., Manufacturing Chemist.

1911. Fairchild, B. Tappen, 74, Laight Street, New York City, U.S.A., Analytical Chemist.

1910. Fairclough, Lt.-Col. Brereton, Quarry House, Hill Cliffe, Warrington, Cheshire, Miller.

1911. Fairfield, Thos. J., c/o W. T. Glover and Co., Trafford Park, Manchester, Analytical Chemist.

1903. Fairhall, E. J., Lindfield, Windmill Lane, Southall, Middlesex, Chemist.

O.M. Fairley, T., 17, East Parade, Leeds, Analytical Chemist.

1901. Fairlie, Jas., Camelon Chemical Works, Falkirk, Manufacturing Chemist.

1911. Farey, F. O., 905, McGill Building, Montreal, P.Q., Canada, Chemist.

1910. Farr, Harry, Free Library, Cardiff, Librarian.

O.M. Farrant, N., c/o J. Nicholson and Sons, Ltd., Chemical Works, Hunslet, Leeds, Chemist.

1913. Farrar, Stanley C., c/o John Wright and Co., Essex Works, Aston, Birmingham, Chemical Technologist.

1897. Farrell, Frank James, Shanrahan, Beccles, Suffolk, Artificial Silk Manufacturer.

O.M. Farrington, T., 4, Waterloo Place, Cork, Ireland, Chemical Engineer.

1913. Farrow, Lieut. F. D., on active service, Lecturer in Chemistry.

1909. Fath, Dr. Arthur, Chemical Engineer.

1903. Fawsitt, Prof. Chas. E., The University, Sydney, N.S.W., Australia, Prof. of Chemistry.

1914. Fearnley, C. A., 2, Alcester Terrace, Shepherd's Lane, Leeds, Technical Chemist.

1903. Feilmann, Dr. M. E., *See* Fyleman, Dr. M. E.

1913. Feldenheimer, Wm., 20, Holborn Viaduct, London, E.C., Clay Merchant.

1909 Fell, Wm. M. W., 27, Clarendon Road, Garston, Liverpool, Chemist.

1905. Felton, Herbert L., 516, East Second Street, South Boston, Mass., U.S.A., Distiller.

1900. Ferguson, Prof. Geo. A., 121, West 42nd Street, New York City, U.S.A., Professor of Analytical Chemistry.

1911. Ferguson, Jas., c/o Brotherton and Co., Ltd., Stourton, near Leeds, Technical Chemist.

O.M. Ferguson, Prof. J., The University, Glasgow, Professor of Chemistry.

1902. Fergusson, Donald M., c/o Acadia Sugar Refining Co., Halifax, N.S., Canada, Analytical Chemist.

1883. Fergusson, H., Prince Regent's Wharf, Victoria Docks, E., Technical Chemist.

1916. Ferns, John F., 61, Withington Road, Whalley Range, Manchester, Technical Chemist.

1893. Fiebing, John H., 238, Reed Street, Milwaukee, Wis., U.S.A., Leather Trade Chemist.

1911. Field, Allan J., c/o G. Siegle Co., Rosebank, Staten Island, N.Y., U.S.A., Chemist.

1885. Field, E. W., Brewer.

1915. Field, G. H., c/o The Aluminium Corporation, Ltd., Dolgarrog Works, Tal-y-Cafn, North Wales, Chief Chemist.

1887. Field, S. S., 5, The Paragon, Blackheath, S.E. Manufacturing Chemist.

1891. Field, Wm. Eddington, Martin Street, Elsternwick, Melbourne, Victoria, Chemist.

1900. Fillis, Frank, 106, London Road, Neath, South Wales, Cement Works Manager.

1907. Finch, Archibald M., Vitriol and Chemical Works, Cattedown, Plymouth, Chemical Manufacturer.

1910. Findlater, James, c/o Price's Patent Candle Co., Ltd., Bromborough Pool, near Birkenhead, Chief Chemist.

1910. Findley, Albert E., Dept. of Applied Science, The University, St. George's Square, Sheffield, Lecturer.

1899. Fingland, Jno. J., Kaslo, B.C., Canada, Analytical Chemist.

1911. Fink, F. W., 420, Riverside Drive, New York City, U.S.A., Manufacturing Chemist.

1904. Finn, Cornelius P., Hemsworth Colliery, near Wakefield, Yorks, Coke Ovens Manager.

1903. Fish, Chas. C. R., 439, Boylston Street, Boston, Mass., U.S.A., Chemist.

1911. Fish, Charles W., c/o The Turner Paper Mill Co., Rawcliffe Bridge, S.O., Yorks, Chemist and Paper Technologist.

1900. Fisher, Henry, 16, East 96th Street, New York City U.S.A., Teacher of Chemistry.

1915. Fisher, L. E., The Laboratory, Messrs. Ardol, Ltd., Barlby Road, Selby, Yorks, Works Chemist.

1895. Fison, Jno., Messrs. Jas. Fison and Sons, Thetford, Norfolk, Chemical Manufacturer.

1904. Fitch, A. J., 67, Branstone Road, Burton-on-Trent, Brewer's Chemist.

1913. Fleming, M. D., 26, Aytoun Road, Pollokshields, Glasgow, Analyst.

1893. Fletcher, E. Morley, 30, Grosvenor Place, Newcastle on-Tyne, Alkali Works Inspector.

O.M. Fletcher, F. W., c/o Fletcher, Fletcher, and Co., Ltd., Holloway, N., Manufacturing Chemist.

1891. Fletcher, R. Jaques, North Geelong, Victoria, Australia, Manufacturing Chemist.

1904. Fletcher, Wm. E., 411, West Broad Street, Tamaqua, Pa., U.S.A., Chemist.

1912. Flürscheim, Dr. Bernhard J., Rushmoor, Fleet, Hampshire, Research Chemist.

1899. Focht, Louis, 12, Atterbury Avenue, Trenton, N.J., U.S.A., Civil Engineer.

1890. Foden, Alfred, 19, Lancaster Avenue, Sefton Park, Liverpool, Metallurgical Chemist.

1900. Foersterling, Dr. H., c/o Roessler Hasslacher Chem. Co., Perth Amboy, N.J., U.S.A., Chemist.

1916. Foley, Nelson T., c/o Loders and Nucoline, Ltd., Hammersmith, W.: and (J.) The Nook, Claygate, Surrey, Assistant Manager and Chemist.

1895. Forbes, Paul R., Chemist and Assayer.

1893. Ford, J. B., jun., Michigan Alkali Co., Wyandotte, Mich., U.S.A., Secretary and Treasurer.

1915. Ford, J. J., 84, Normandy Avenue, High Barnet, Herts, Agent, Classes I. and V.

1889. Ford, Jno. S., Abbey Brewery, Edinburgh, Analyst.

1914. Ford, Joseph James, c/o Skinner and Holdford, Ltd., Waleswood Collieries, Waleswood, near Sheffield, Analytical Chemist.

1885. Formoy, J. Arthur, Oil Expert.

1904 Forrest, Chas. N., Maurer, N.J., U.S.A., Chemist.

1898. Forrest, J. Kerr, Wonham House, Brampton, Devon, Manufacturing Chemist.

1890. Forrester, A. M., c/o Richmond Guano Co., Richmond, Va., U.S.A., Analytical Chemist.

1905. Forrester, H. A., Fabrica do Gaz, Recife, Pernambuco, Brazil, Chemical Works Manager.

1909. Forshaw, Arthur, c/o John Wright and Co., Ltd., Essex Works, Aston, Birmingham, Works Chemist.

1902. Forstall, Alf. E., 84, William Street, New York City, U.S.A., Consulting Gas Engineer.

1916. Forster, E. L. C., Inland Revenue Laboratory, Postal Station "B," Winnipeg, Canada, Analyst.

1902. Forster, Ferdinand E. P., c/o Messrs. Bass and Co., 19, Guild Street, and (Jnls.) The River House, Burton-on-Trent, Brewer's Chemist.

1907. Forster, Francis, c/o Champion, Druce, and Co., Ltd., 6, Laurence Pountney Hill, London, E.C., Lead Manufacturer.

1889. Forster, Joseph F., 17, Philpot Lane, London, E.C., Chemical Merchant.

1899. Forster, Dr. M. O., F.R.S., 84, Cornwall Gardens, South Kensington, S.W., Chemist.

1884. Forster, Sir Ralph C., Bart., c/o Messrs. Bessler, Waechter, and Co., Salisbury House, Finsbury Circus, London, E.C., Chemical Merchant.

1915. Forster, Dr. R. B., c/o Levinstein, Ltd., Blackley, Manchester, Chemist.

1884. Forth, Henry, Stoke Lacy, Marple, Cheshire, Drysalter

1907. Forward, Charles C., Dept. of Inland Revenue Laby., 50, Bedford Road, Halifax, N.S., Canada, Chemist.

1906. Foster, Robt. K., Church Street, Middle Brighton, Melbourne, Victoria, Pharmaceutical Chemist.

O.M. Foster, R. Le Neve, Fulshaw Cottage, Wilmslow, Cheshire, Manufacturing Chemist.

1888. Foster, Wm., St. Martin's Terrace, Newton Park, Leeds, Manufacturing Chemist.

1891. Fowler, Dr. Gilbert J., Indian Institute of Science, Bangalore, India, and (Journals) Frankland Laboratory, Chem. Dept., Victoria University, Manchester, Prof. of Applied Chemistry.

1896. Fox, A. Stanley, Courtenay Lodge, Sutton Courtenay, Abingdon, Berks, Explosives Works Manager.

1912. Fox, Charles P., 395, Doyle Street, Akron, Ohio, U.S.A., Chemist.

1913. Fox, Edward Carey, 27, Scarth Road, Toronto, Canada, Pork Packer.

1898. Fox, Jno., Varuna, Grappenhall, Cheshire, Analyst.

1911. Fox, Dr. John J., 6, Alkham Road, Stamford Hill, N., Government Analyst.

O.M. Fox, T., jun., c/o Fox Bros. and Co., Ltd., Wellington, Somerset, Wool Manufacturer.

1916. Foxwell, G. E., Coke Ovens Manager's House, Carnock Colliery, Cowie, by Bannockburn, Works Manager and Chemist.

1905. France, Edward W., Philadelphia Textile School, Broad and Pine Streets, Philadelphia, Pa., U.S.A., Director.

O.M. Francis, E. G., 29, Matheson Road, West Kensington, W., and (Jnls.) c/o T. Fitzgibbon, 115, Harbour Street, Fulham Palace Road, S.W., Glucose Works Manager.

O.M. Francis, G. Bult, The British Drug Houses, Ltd., 22–30, Graham Street, City Road, London, N., Wholesale Druggist.

O.M. Francis, W. H., 11, Bramham Gardens, South Kensington, London, S.W., Wholesale Druggist.

1894. Frank, Jerome W., 29, Broadway, New York City, U.S.A., Chemist.

1886. Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester, Indiarubber Manufacturer.

1912. Frankenburg, Sydney, on active service, Indiarubber Manufacturer.

1895. Frankforter, Dr. G. B., University of Minnesota, Minneapolis, Minn., U.S.A., Prof. of Chemistry.

O.M. Frankland, H., Streonshalh, The Crescent, Linthorpe, Middlesbrough, Analytical Chemist.

O.M. Frankland, Prof. P. F., F.R.S., The University, Edgbaston, Birmingham, Professor of Chemistry.

1901. Frasch, Hans A., 52, Broadway, New York City, U.S.A., Manager.

1910. Fraser, Arthur, Casilla 1464, Valparaiso, Chile, Analyst.

1891. Fraser, L. McG., Engineering Works, Dagenham, Essex, Chemical Engineer.

1902. Frederick, Geo. E., jun., P.O. Box 762, New York, City, U.S.A., Chemical Merchant.

1900. French, Thos., P.O. Box 324, Nelson, B.C., Canada, Chemist.

1911. French, Wm., Wheatfield, Dallas Road, Lancaster, Manager.

1903. Frerichs, Dr. F. W., 4320, Washington Boulevard, St. Louis, Mo., U.S.A., Manufacturing Chemist.

1913. Frew, John, Box 1, Johannesburg, South Africa, Chemist.

1907. Freytag, Henry, c/o O. Isler and Co., 35, Dickinson Street, Manchester, Chemical Merchant.

1886. Fries, Dr. Harold H., 92, Reade Street, New York City, U.S.A., Chemical Manufacturer.

1915. Frosst, Charles E., 259, Metcalfe Avenue, Westmount, P.Q., Canada, Manufacturing Chemist.

1916. Frost, F. A., c/o South Metropolitan Gas Co., and 144, Peckham Park Road, London, S.E., Sub-Manager (Chemical Works).

1884. Frost, Joe, Rocky Mount, Somerset Road, Huddersfield, Manufacturing Chemist.

O.M. Fryer, Dr. A. C., 13, Eaton Crescent, Clifton, Bristol, Alkali Works Inspector.

1904. Fryer, P. J., 12, Pembury Road, Tonbridge, Kent, Analyst.

1889. Fuerst, Jos. F. *See* Forster, Jos. F.

1895. Fuerst, W. F., 87, Nassau Street, New York City, U.S.A., Chemical Merchant.

1913. Fulks, Elbridge B., American Tar Products Co., 208, South La Salle Street, Chicago, Ill., U.S.A., Vice-President.

1894. Fuller, Chas. J. P., 603, Chorley New Road, Horwich, near Bolton, Analytical Chemist.

1914. Fuller, Cyril D., Aspinall's Enamel, Ltd., New Cross, S.E., Works Manager.

1902. Fuller, Henry C., Institute of Industrial Research, Washington, D.C., U.S.A., Analytical Chemist.

O.M. Fuller, Wm., Vanbrugh Cottage, Maze Hill, S.E., Chemist.

1898. Fulmer, Elton, Pullman, Wash., U.S.A., Professor of Chemistry.

1909. Fulweiler, W. H., 1706, North Broad Street, Philadelphia, Pa., U.S.A., Engineer.

1903. Fyleman, Dr. M. E., c/o Osram Lamp Works, Ltd., Brook Green, Hammersmith, W., Chemist.

G

1915. Gaby, F. A., Hydro-Electric Power Commission of Ontario, 709, Continental Life Building, Toronto, Canada, Chief Engineer.

1913. Gage, Roscoe M., 1083, Worthington Street, Springfield, Mass., U.S.A., Chemical Engineer.

1906. Gagnebin, Chas. L., 140, Oliver Street, Boston, Mass., U.S.A., Dyestuff Merchant.

1907. Gaines, Richard H., 49, Lafayette Street, New York City, U.S.A., Chemist (Board of Water Supply).

1904. Gair, C. J. Dickenson, 39, Cranston Road, Forest Hill, S.E., Analytical Chemist.

1912. Gajjar, M. J., Techno-chemical Laboratory, Girgaum, Bombay, India, Consulting Chemist.

1890. Gajjar, Prof. T. K., Girgaum Chemical Laboratory, Sandhurst Road, Bombay, India, Consulting Chemist.
1912. Gale, Lieut. R. C., on active service, Technical Chemist.
1884. Gall, Henry, 2, Rue Blanche, Paris, France, Technical Chemist.
1905. Gall, J. B., c/o Callender's Cable and Construction Co., Belvedere, Kent, Chemist.
1911. Gallagher, Jas. L., c/o Lever Bros., Ltd., Sydney, N.S.W., Australia, Chemist.
1897. Galletly, J. C., c/o Newiands and Warner, 135, St. Vincent Street, Glasgow, Rubber Chemist.
1901. Gallivan, Dr. Frank B., 113, Third Street, South Boston, Mass., U.S.A., Chemist.
1903. Gallum, Albert F., 1000, North Water Street, Milwaukee, Wis., U.S.A., Tanner.
1901. Gallup, W. Arthur, Arnold Printworks, North Adams, Mass., U.S.A., Printer.
1901. Galpin, Harry T., 57, West 57th Street, New York City, U.S.A., Chemist.
1891. Galt, Hugh Allen, Columbia Chemical Co., Barberton, Ohio, U.S.A., Works Manager.
1894. Gane, Eustace H., 91, Fulton Street, New York City, U.S.A., Pharmaceutical Chemist.
1901. Gansser, Dr. A., Albanring, 164, Basle, Switzerland, Chemical Engineer.
1911. Garbutt, C. Durham, 43, Island Road, Garston, Liverpool, Analytical Chemist.
1896. Gardair, Aimé 51, Rue St. Ferréol, Marseilles, France, Director of Chemical Co.
1910. Gardner, Arthur L., 138, Highland Avenue, Winchester, Mass., U.S.A., Chemical Engineer.
1907. Gardner, Edward, The Tryst, Bigwood Road, Meadway, Hendon, N.W., Metallurgical Chemist.
1909. Gardner, Henry A., 19th and B. Streets N.W., Washington, D.C., U.S.A., Chemist.
1913. Gardner, Henry D., jun., 11, Glenmore Road, Belsize Park, London, N.W., Technical Chemist.
1891. Gardner, Prof. Walter M., Technical College, Bradford, Director of Chemical and Dyeing Departments.
1897. Garfield, Jos., Thackley, Bradford, Yorks, Civil Engineer.
1888. Garibaldi, Joachim A., 21, Church Place, Gibraltar, Chemist.
1910. Garland, Charles S., 57, Garratt Lane, Wandsworth, S.W., Chemist and Works Manager.
1911. Garner, John H., Sewage Works, Deighton, Huddersfield, Chemist.
1915. Garrett, Dr. C. Scott, H.M. Factory, Coleford, Gloucestershire, Chemist.
1890. Garrett, Col. F. C., 27, Fern Avenue, Jesmond, Newcastle-on-Tyne, Teacher of Science.
1906. Garroway, Major John, 58, Buchanan Street, Glasgow, Chemist.
1908. Garson, Jas. W., c/o Lewis Berger and Sons, Ltd., Homerton, N.E., Managing Director.
O.M. Garton, Sir Richard, Messrs. Hill, Garton, and Co., Southampton Wharf, Battersea, S.W., Glucose Manufacturer.
1886. Gascoyne, Dr. W. J., 27, South Gay Street, Baltimore, Md., U.S.A., Analytical Chemist.
O.M. Gaskell, Holbrook, Erindale, Frodsham, Cheshire, Alkali Manufacturer.
1902. Gaskell, Holbrook, jun., Hillcroft, Church Road, Woolton, near Liverpool, Engineer.
1915. Gatecliff, John, 32, Delph Lane, Leeds, Works Chemist.
1908. Gatehouse, Frank B., "Maristowe," Butts Green Road, Hornchurch, Essex, Chemist and Technical Journalist.
1912. Gates, Alfred E., c/o Messrs. T. Lye and Sons, Luton, Beds, Works Chemist.
O.M. Gatheral, Geo., Beechwood, Sherbourne Road, Acocks Green, near Birmingham.
1906. Gaunt, Percy, Macclesfield Corporation Sewage Works, Prestbury, near Macclesfield, Chemist.
1912. Gee, Wm. J., 48, Kingsmead Road, Tulse Hill, London, S.W., Chemical Engineer.
1891. Geisler, Dr. Jos. F., New York Mercantile Exchange Building, 6, Harrison Street, New York City, U.S.A., Consulting Chemist.
1901. Gemmell, G. H., 4, Lindsay Place, George IV Bridge, Edinburgh, Analytical Chemist.
1907. Gemmell, Wm., 18, Framlington Place, Newcastle-on-Tyne, Analytical Chemist.
1901. Gent, Percy W., Trentholme, Misterton, near Gainsboro', Chemist.
1897. Gent, Wm. T., Springfield, Misterton, near Gainsboro', Metallurgical Chemist.
1913. Gepp, Herbert W., c/o Amalgamated Zinc (De Bavay's), Ltd., Broken Hill, N.S.W., Australia, General Manager.
1906. Gerkensmeyer, Henry H., 207, Mississippi Avenue, Joliet, Ill., U.S.A., Chemist.
1912. Ghislain, Raoul, Jefe de Fabricacion, Soc. Anon. des Fours a Coke Semet-Solvay du Nueva Montaña Compañia 22, 2° Izqda, Santander, Spain, Chemical Engineer.
1916. Ghose, A., c/o Mica Mining and Timber Co., and P.O., Ganwan, Dt. Hazaribagh, Prov. Behar, India, General Manager.
1911. Gibbings, W. Alan, P.O. Box Sannomiya 174, Kobe, Japan, Works Manager and Chemist.
1903. Gibbings, Wm., Woodside, Halebank, Widnes, Works Manager.
1910. Gibbins, Roland B., 18, Wheeley's Lane, Birmingham, Chemical Manufacturer.
1902. Gibbon, Edw., Belvedere, Park Road, Clydach, R.S.O., Glam., Works Chemist.
1915. Gibbon, John, The British Explosives Syndicate, Ltd., Factory, Pitsey, Essex, Chemist.
1904. Gibbs, A. E., c/o Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1913. Gibbs, Victor G., c/o Wm. Pearson, Ltd., Clough Road, Hull, Works Manager.
O.M. Gibbs, Wm. P., 7, South Square, Gray's Inn Road, London, W.C., Analytical Chemist.
O.M. Gibson, J. M., c/o Buckley Brick and Tile Co., Buckley, *viâ* Chester, Brick and Tile Manufacturer.
1905. Gibson, John, 360–366, Collins Street, Melbourne, Vic., Australia, Concrete Manufacturer.
1913. Gibson, R. M., 58, Chester Road, Buckley, *viâ* Chester, Clay Goods Manufacturer.
1913. Gibson, Stanton, 28, Lordship Park, Stoke Newington, N., Factory Chemist.
1905. Gibson, Wm. F., 72, Woodstock Avenue, Golders Green, N.W., Works Chemist.
1914. Gidden, W. T., Woodside, Abbey Road, Smethwick, near Birmingham, Technical Chemist.
1899. Gifford, Wm. E., 54, Austin Street, Newark, N.J., U.S.A., Chemist.
1892. Gilbard, J. Francis H., 245, Dalston Lane, Hackney, N.E., Analytical Chemist.
1905. Gilbertson, Isaac H., 33, Broad Street, Rhodes, near Middleton, Lancs, Calico Printer.
1903. Gilby, Joseph W., Kempfield House, Killingley, Knottingley, Yorks, Works Chemist.
O.M. Gilchrist, Percy Carlyle, F.R.S., A.R.S.M., M.Inst.C.E. & M.E., Reform Club, Pall Mall, London, S.W., Metallurgist.
1884. Gilchrist, Peter S., Charlotte, N.C., U.S.A., Chemical Engineer.
1900. Gildersleeve, W. H., Johnson City, Tenn., U.S.A., Chemist.
O.M. Giles, W. B., The Grange, Leyton, Essex, Chemical Manufacturer.
1915. Giles, W. H., The Grange, Leyton, Essex, Manufacturing Chemist.
1886. Gill, Dr. Aug. H., Massachusetts Institute of Technology, Boston, Mass., U.S.A., Professor of Technical Analysis.
1913. Gill, Harold W., South African School of Mines and Technology, Johannesburg, South Africa, Lecturer on Chemistry.

1915. Gill, Hubert A., 55-56, Chancery Lane, London, W.C., Chartered Patent Agent.

1909. Gill, John H., 16, Premier Road, Gregory Boulevard, Nottingham, Soapwork's Chemist.

1901. Gill, Wm. S., c/o Farquhar and Gill, North of Scotland Colour Works, Aberdeen, Colour and Varnish Manufacturer.

1901. Gilles, Wm. S., The Cottage, Bocking, near Braintree, Essex, Technical Chemist.

1888. [illegible], Gustave, 296 Avenida Sete Setembro, Petropolis, Via Rio de Janeiro, Brazil, Civil Engineer.

1891. Gimingham, Edw. A., Croyland, Clapton Common, N., Technical Electrician.

1886. Girdwood, Dr. G. P., 615, University Street, Montreal, Canada, Professor of Chemistry.

1906. Girtin, Thomas, H. L. Raphael's Refinery, 48, Thomas Street, Burdett Road, London, E., Bullion Refiner.

1903 Gladding, Thos. S., 181, Front Street, New York City, U.S.A., Analytical Chemist.

1886. Glaeser, F. A., Carpenters' Road, Stratford, E., Varnish Manufacturer.

1906. Glass, A. Melville, "Copley Dene," Park Avenue, Hampstead, N.W., Patent Agent.

1901. Glegg, Robt., Agricultural Laboratory, Marischal College, Aberdeen, Analytical Chemist.

1894. Glen, Chas., Glengowan Printworks, Caldercruix, Scotland, Calico Printer.

1884. Glendinning, H., Winnington House, Northwich, Cheshire, Technical Chemist.

1896. Glover, H., 6445, Emlen Street, Germantown, Philadelphia, Pa., U.S.A., Chemical Works Superintendent.

O.M Glover, William, Albareda 27, Seville, Spain, Technical Chemist.

1911. Gmach, Ludwig T., Kew Bridge Label Works, Waldeck Road, Chiswick, W., Manufacturer.

1916. Godber, Geo. E., 86, Wellington Street, New Whittington, near Chesterfield, Chemist (Tar Products).

1911. Goetchius, John M., c/o General Chemical Co., 25, Broad Street, New York City, U.S.A., Sales Manager.

1915. Goffin, Armand, Compagnie Commerciale du Nord, Dunstan House, Mincing Lane, London, E.C., Director.

1915. Golding, Geo., "Haverthwaite," Litherland Park, Liverpool, Analytical Chemist.

1898. Golding, Jno. on active service, Agricultural Chemist.

O.M. Goldschmidt, Dr. S. A., 11, Broadway, New York City, U.S.A., President (Columbia Chemical Works).

1895. Goldsmith, Byron B., 19, East 74th Street, New York City, U.S.A., Vice-President (American Lead Pencil Co.).

1899. Goldsmith, Dr. Jno. N., 67, Chancery Lane, London, W.C., Chemist.

1914. Goldsmith, L. D., 31, Colvestone Crescent, West Hackney, N.E., Research Chemist.

1916. Goldstein, W., Dunl ton, Burlington Road, Portishead, Somerset, Works Chemist.

1906. Goodall, Wm. Leslie, Finboro' Road, Stowmarket, Suffolk, Works Chemist.

1909. Goodban, Leonard, 43, Addison Gardens, Kensington, London, W., Works Chemist.

1912. Gooderham, J. Leys, 49, Wellington Street East, Toronto, Canada, Chemist.

1904. Gooding, E. Claude, Willow House, Washford, Somerset, Chemist.

1913. Goodman, Alexander, c/o Lever Bros., Ltd., Sunlight Wharf, Upper Thames Street, London, E.C., Manager.

1915. Goodman, V. E., c/o Waterlow and Sons, Ltd., 68-70, Worship Street, Finsbury, E.C., Manager of Cheque Department.

1898. Goodrich, Chas. C., 60, Broadway, New York City, U.S.A. Rubber Manufacturer.

1884. Goodwin, C. C., Racefield, St. Margaret's Road, Altrincham, Cheshire, Soapmaker.

1909. Goodwin, Capt. Camillo J., 60, Mark Lane, London, E.C., Chemical Engineer.

1913. Goodwin, H. W., c/o Charles Case and Sons, Westbury, Wilts, Analytical Chemist.

1894. Goodwin, Dr. W. L., Library Dept., Gordon Hall, School of Mining, Kingston, Canada, Professor of Chemistry.

O.M. Goppelsroeder, Prof. Dr. F., Leimenstrasse 51, Basel, Switzerland, Professor of Chemistry.

1884. Gordon, J. G., Queen Anne's Mansions, Westminster, S.W., Steel Manufacturer.

1904. Gotthelf, August H., Hastings-on-Hudson, N.Y., U.S.A., Chemist.

1914. Gotts, H. S., Corrisson Works, Carnwarth Road, Fulham, S.W., Sugar Manufacturers.

1890. Goulding, Sir Wm. J., Bart., c/o W. and H. M. Goulding, Ltd., Alexandra Road, East Wall, Dublin, Manure Manufacturer.

O.M. Gowland, Prof. W., F.R.S., 13, Russell Road, Kensington, W., Professor of Metallurgy (Royal School of Mines).

1890. Grablield, Dr. J. P., c/o Morris and Co., Chemical Laboratory, Union Stock Yards, Chicago, Ill., U.S.A., Chemist.

1916. Grace, Claude S., 36, Harvard Road, Gunnersbury, W., Analytical Chemist.

1906. Graesser, Norman H., Argoed Hall, Llangollen, N. Wales, Manufacturing Chemist.

O.M. Graham, C. C., Oriel House, Scarborough, Yorks, Technical Chemist.

1913. Graham, Jos. L., Chemical Laboratory, Bentley Colliery, Doncaster, Chemist.

1883. Grandage, H., c/o S. Smethurst and Sons, Woolfold Dye and Bleach Works, Bury, Lancashire, Dyer.

1897. Granger, Dr. J. Darnell, 57, Holmwood Street, Newtown, Sydney, N.S.W., Australia, Analytical Chemist.

1905. Grant, Alexander, 15, Hermitage Drive, Edinburgh, Baker.

1896. Graves, Geo. H., 219, West 81st Street, New York City, U.S.A., Manufacturing Chemist.

1896. Graves, Walter G., 1950, East 90th Street, Cleveland, Ohio, U.S.A., Chemist.

1914. Gray, George, 3, Victoria Drive, Rock Ferry, Cheshire, Technical Chemist.

1884. Gray, G. Watson, 8, Inner Temple, Dale Street, Liverpool, Consulting Chemist and Assayer.

1911. Gray, Dr. G. W., c/o The Texas Co., Houston, Texas, U.S.A., Chairman, Manufacturing Committee.

1910. Gray, H. Le Breton, c/o Eastman Kodak Co., Rochester, N.Y., U.S.A., Superintendent, Film Department.

1904. Gray, Jas., P.O. Box 5254, Johannesburg, Transvaal, Chemist.

1901. Gray, J. Campbell, The Cottage, Strines, near Stockport, Printworks Chemist.

1886. Gray, Jno., 3, Victoria Drive, Rock Ferry, near Birkenhead, Technical Chemist.

1896. Gray, Prof. Thos., Royal Technical College, Glasgow, Professor of Technical Chemistry.

1905. Gray, W. B., Messrs. Lever Bros., Durban, Natal, South Africa, Analytical Chemist.

1903. Gray, Wm. S., 76, William Street, New York City, U.S.A., Chemical Merchant.

1909. Greeff, R. H., Thames House, Queen Street Place, London, E.C., and (Jnls.) 80, Maiden Lane, New York City, U.S.A., Chemical Merchant.

1894. Greeff, R. W., Thames House, Queen Street Place, London, E.C., and (Jnls.) Elm Bank, Bromley, Kent, Chemical Merchant.

O.M. Green, Prof. Arthur G., F.R.S., 49, Cardigan Road, Headingley, Leeds, Professor of Tinctorial Chemistry.

1907. Green, Clarence, c/o Nicholson's Raincoat Co., Beaumont Works, St. Albans, Herts, Chemist.

1906. Green, Ernest, 98, Cheadle Road, Cheadle Hulme, Cheshire, Science Teacher.

O.M. Green, H., Hayle Mill, Maidstone, Paper Manufacturer.

O.M. Green, L., Lower Tovil, Maidstone, Paper Manufacturer.
1908. Green, Dr. W. Heber, Chemical Laboratory, The University, Melbourne, Victoria, Lecturer in Chemistry.
O.M. Greenaway, A. J., The Orchard, Chertsey, Surrey, Sub-Editor of Chemical Society's Journal.
1915. Greene, F. A., 7, Alexandra Mansions, West End Lane, London, N.W., Consulting Engineer.
1909. Greenhough, George D., 21, Mincing Lane, London, E.C., Chemical Broker.
1913. Greenough, Thomas R., Beechwood, Leigh, Lancashire, Analytical Chemist.
1907. Greenwood, Herbert W., c o Backhouse and Coppock, Ltd., Sutton Mill, Macclesfield, Metallurgical Chemist.
O.M. Greenwood, Holmes, Regent House, Hartmann Street, Accrington, Technical Chemist.
1907. Gregory, Joshua C., 3, Oak Villas, Bradford, Yorks, Analytical and Consulting Chemist.
1912. Gresham, Harold E., County Laboratories, 36, Dansie Street, Liverpool, Analytical Chemist.
1915. Greville, Henry, 30, Empress Road, Liscard, Cheshire, Research Chemist.
1890. Griffin, Jno. R., Kemble Street, Kingsway, London, W.C., Chemical Apparatus Maker.
1886. Griffin, Martin L., c/o Oxford Paper Co., Rumford, Maine, U.S.A., Manager of Chemical and Electro-Chemical Department.
1912. Griffiths, Clement S., Central Queensland Meat Export Co., Ltd., Lake's Creek, Rockhampton, Queensland, Chemist.
1909. Griffiths, E., 136, George Street N., Sydney, N.S.W., Australia, Chemist.
1902. Griffiths, Manfred E., Caizley House, Temple Road, Stowmarket, Suffolk, Explosives Chemist.
1912. Grimké-Drayton, Norman, Royal Mint Refinery, 19, Royal Mint Street, London, E., Metallurgist.
1902. Grimwade, Wilfrid R., 335—343, Spencer Street, West Melbourne, Vic., Australia, Manufacturing Chemist.
1900. Grimwood, Robt. G., 43, Leaside Avenue, Muswell Hill, N., Analytical Chemist.
O.M. Griudley, J., Upper North Street, Poplar, London, E., Tar Distiller.
1905. Grip, August E., 495, Columbia Street, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1888. Gripper, Harold, Great Central Railway, Gorton, Manchester, Analytical Chemist.
1916. Grisley, Geo. C., 40, Horace Road, Forest Gate, E., Chemical Engineer.
1909. Grist, John M., c/o Curtis's and Harvey, Ltd., Explosives Works, Cliffe-at-Hoo, Kent, Chemist.
1906. Groenewoud, Sidney H., 12, Alexandra Road, Birmingham, Analytical Chemist.
O.M. Grossmann, Dr. J., 157, Plymouth Grove, Manchester, Consulting Chemist and Chemical Engineer.
1896. Grosvenor, Dr. W. M., Chemists' Building, 50, East 41st Street, New York City, U.S.A., Consulting Chemical Engineer.
1909. Grove, Daniel, "Carmington," Canonbury Grove, Dulwich Hill, N.S.W., Australia, Diamond Buyer and Mine Owner.
O.M. Groves, C. E., F.R.S., 352, Kennington Road, London, S.E., Chemist (Thames Conservancy).
1907. Groves, J. Stuart, c/o E. I. du Pont de Nemours Powder Co., City Point, Va., U.S.A., Chemist.
1899. Gudemann, Dr. E., 903, Postal Telegraph Building, Chicago, Ill., U.S.A., Chemist.
1915. Guelpa di Luigi, G., 41, Corso Dante, Turin, Italy, Manufacturer and Engineer.
1899. Guild, Frank N., University of Arizona, Tucson, Arizona, U.S.A., Professor of Chemistry.
1909. Gullick, Wm. A., Government Printing Office, Sydney, N.S.W., Government Printer.
1906. Gulline, Percy, c o Columbia Textile Co., Lowell, Mass., U.S.A., Agent.
1904. Gundlach, Walter, 249, West 104th Street, New York City, U.S.A., Superintendent of Colour Works.
1905. Gundlich, Dr. Charles, c/o Thorium Chemical Co., Maywood, N.J., U.S.A., Technical Chemist.
1903. Gunn, Gilbert, 181, Bury New Road, Heywood, Lancs, Paper Mill Chemist.
1900. Gunther, Chas. E., Third Floor, Thames House, Queen Street Place, London, E.C., Merchant.
1910. Günther, C. M., Condong Mill, Tweed River, N.S.W., Sugar Chemist.
1903. Guthrie, Alan, The Leather Trades School, Washermanpet, Royapuram, Madras, India, Leather Chemist.
1901. Guthrie, John M., 199, Ferry Road, Leith, Scotland, Analytical Chemist.
1909. Guttmann, Camillo J. *See* Goodwin, C. J.
1912. Guy, Wm. W., 6, Cecil Road, Upton Manor, E., Analytical Chemist.
1916. Gwyer, Dr. A. G. C., c o British Aluminium Co., Ltd., Research Laboratory, Warrington, Metallurgical Chemist.
1913. Gyton, Walter J., British Standard Cement Works, Rainham, Kent, Chemist.

H

1904. Hacking, D. H., Enfield Soap Works, Clayton-le-Moors, near Accrington, Soap Manufacturer.
1887. Hadfield, Sir Robert A., F.R.S., Hecla Works, Sheffield: 22, Carlton House Terrace, London, S.W.; and (Journals) c o J. E. Motimer, 220, Newhall Road, Attercliffe, Sheffield, Steel Founder.
1904. Hadley, Geo., Waterfall Lane, Blackheath, Staffs, Spelter Works Manager.
1887. Haig, Robert, Dollarfield, Dollar, Scotland, Chemical Engineer.
1915. Haigh, Alfred, c/o Brittains Ltd., Cheddleton Paper Mills, near Leek, Staffs., Paper Manufacturer.
1904. Haigh, B. Wilson, By-Product Coke Oven Dept., Barnsley Main Colliery, Barnsley, Yorks, Chemical Engineer.
1896. Haigh, De Lagnel, 39, Hill Crest, Summit, N.J., U.S.A., Chemist.
1915. Haigh, Sam, 89, Johnson Avenue, Winthorp, Mass., U.S.A., Dyer and Chemist.
1888. Hailes, A. J. de, 15, Red Lion Square, London, W.C., Analytical Chemist.
1910. Hailstone, Harold J., 44, Cordley Street, West Bromwich, Works Chemist.
O.M. Hake, C. Napier, Jnls. to c/o Dr. A. W. Hake, Medical School, Caxton Street, Westminster, S.W., Chemical Adviser.
1903. Halbert, Thos., c/o British South African Explosives Co., Modderfontein, Transvaal, Chemist.
1888. Hale, Edw. P., Park End, Milnthorpe, Westmorland Analytical Chemist.
1887. Hall, Allan T., c/o Sissons Bros. and Co., Ltd., Hull, Oil Refiner and Varnish Manufacturer.
1898. Hall, Clarence A., The Chesheim Arms, Mount Airy, Philadelphia, Pa., U.S.A., Chemist.
1909. Hall, Harold, Chem. Laby., Loco. Dept., S.E.& C. Rly., Ashford, Kent, Analyst.
1885. Hall, Lt.-Col. Jno. A., Analytical Chemist.
1912. Hall, Robert H., Weardale Tar Works, Spennymoor, Co. Durham, Chemical Works Manager
1896. Hall, Capt. S. Godfrey, East London Soap Works, Bow, E., Soap Maker.
1914. Hall, William A., Hall Motor Fuel, Ltd., Wilson's Wharf, Angel Road, Edmonton, N., Chemical Engineer.
1886. Haller, Geo., Sussex House, 52, Leadenhall Street, London, E.C., Chemical Merchant.
1893. Haller, H. Loft, 26, Scale Lane, Hull, Analytical Chemist.
1912. Halliday, McDonald, Oficina Buen Retiro, Pozo Almante, Iquique, Chile, Analytical Chemist.
1895. Halliwell, Edw., c/o Ribble Joint Committee, 2, Stanley Place, Preston, Chief Inspector.

1900. Hallock, Dr. Albert P., 1253, St. Nicholas Avenue, New York City, U.S.A., Chemist.

1892. Hamaguchi, Gihei, Maedachō, Choshi Chibaken, Japan, Soy Manufacturer.

1897. Hambly, Fred J., Buckingham, Quebec, Canada, Chemist.

1901. Hambuechen, Carl, 4, Pennsylvania Avenue, Belleville, Ill., U.S.A., Secretary (American Carbon and Battery Co.).

1915. Hamilton, David, 31, Newlands Road, Newlands, Glasgow, Analytical Chemist.

1911. Hamilton, David J., Locksley, Helensburgh, Dumbatronshire, Oil Refiner and Paint Manufacturer.

1904. Hamilton, Edward H., c/o The Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, B.C., Canada, Metallurgist and Engineer.

1912. Hamilton, James, 9, Esplanade Avenue, Whitley Bay, Northumberland, Analytical Chemist.

1884. Hamilton, Robert, Glengarnock Chemical Co., Ltd., Glengarnock, Ayrshire, Works Manager.

1892. Hamilton, Robt., Jnl. to c/o Walter Scott, Ltd., Leeds Steel Works, Leeds, Analytical Chemist.

1898. Hammersley, W. Stanley, Rue Champbertrand, Sens (Yonne), France, Tanner.

O.M. Hammill, M. J., The Gables, St. Helens, Alkali Manufacturer.

1905. Hancock, Thos. J., Chemist.

1900. Hancock, Walter C., 10, Upper Chadwell Street, Myddelton Square, London, E.C., Chemist.

1896. Hand, Daniel, 30, Mount Pleasant Avenue, Newark, N.J., U.S.A., Chemist.

1888. Hanks, Abbot A., 630, Sacramento Street, San Francisco, Cal., U.S.A., Assayer.

1901. Hanna, Charles E., P.O. Box 600, Montreal, Canada, Secretary.

1916. Hannay, Jas. R., Knowmill House, Entwistle, near Bolton, Printworks Manager.

1905. Hanson, H. Norman, The Oaks, Huddersfield Road, Brighouse, Yorks, Research Assistant.

1908. Hanson, W. G., c/o United States Glue Co., Milwaukee, Wis., U.S.A.

1909. Harbord, F. W., 16, Victoria Street, Westminster, S.W., Consulting Metallurgist.

1905. Harcourt, Prof. R., Ontario Agricultural College, Guelph, Ont., Canada, Professor of Chemistry.

1904. Hard, Dr. James M. B., 422, Gravier Street, New Orleans, La., U.S.A., Chemist and Pathologist.

1901. Hardcastle, G. Fred., 307, East Park Road, Leicester, Teacher of Science and Technology.

1894. Harden, Dr. Arthur, F.R.S., 5, Cambridge Gardens, Marlborough Road, Richmond, Surrey, Lecturer in Chemistry.

1910. Hardie, Thos., Newcastle and Gateshead Gas Co., Tyneside Road, Newcastle-on-Tyne, Gas Engineer.

1915. Harding, Cpl. Gilbert, 47, Buttermarket Street, Warrington ; and (J.) 113544, 19th Section, 187 Special Co. R.E., G.H.Q., B.E.F., France, Chemist.

1912. Hardwick, Walter A. N., 26, West Kensington Mansions, London, W., Chemist.

1900. Hardwick, W. Roscoe, 13, Batavia Buildings, Hackins Hey, Liverpool, Chemist.

1905. Hardy, Chas. H., 16, Westbourne Avenue, Hull, Chemist.

1913. Harger, Dr. John, Grange Hollies, Gateacre, Liverpool.

1914. Hargreaves, C. H., 14, Charlwood Place, Westminster, S.W., Analyst.

1906. Hargreaves, c/o Brimsdown Lead Co., Brimsdown, Middlesex, Chemist.

O.M. Hargreaves, Jno., Widnes, Alkali Manufacturer.

1904. Harker, Dr. George, Dept. of Organic Chemistry, The University, Sydney, N.S.W., Australia, Chemist.

1909. Harland, Robert M., 37, Lombard Street, London, E.C., Analytical Chemist and Assayer.

1893. Harlock, E. B., Newton House, Middlewich, Chemical Manufacturer.

1898. Harman, Edw. A., Gas Works, Huddersfield, Gas Engineer, M.Inst.C.E.

1905. Harper, Dr. Henry W., University of Texas, 2216, Rio Grande Street Austin, Texas, U.S.A., Professor of Chemistry.

1912. Harper, J. G., Kynochtown, Stanford le Hope, Essex, Managing Chemist.

1913. Harper, William, 3, Gindera Cottages, Montrose, Scotland, Works Chemist.

1912. Harran, Dr. Edward B., Abbey Field, Sandbach, Cheshire, Chemist.

1885. Harris, Booth, jun., "Diconwyn," Woodford Green, Essex, Soap Maker.

1897. Harris, Fred. W., 20, Trongate, Glasgow, Public Analyst.

1915. Harris, John, "York House," 8, Main Road, Handsworth, Sheffield, Metallurgist.

1906. Harris, Jonathan W., c/o Western Electric Co., 463, West Street, New York City, U.S.A., Chemist.

1914. Harris, Joseph, H., 994, Danforth Avenue, Toronto, Canada, Superintendent.

1907. Harris, Thos. E., c/o The Union Acid Co., 17, Cooper Street, Manchester, Chemical Merchant.

1906. Harris, Wm. G., jun., 35, Fraser Avenue, Toronto, Canada, Metallurgist.

1905. Harrison, E. F., Langholm, Edgar Road, South Croydon, Analytical Chemist.

1909. Harrison, Edwin D., 86, Harrison Place, Irvington, N.J., U.S.A., Celluloid Manufacturer.

1883. Harrison, G. Herbert, Hagley, Stourbridge, Firebrick Maker.

1892. Harrison, Prof. John B., C.M.G., Government Laboratory, Georgetown, British Guiana, Chemist.

1907. Harrison, W., 28, Delph Lane, Hyde Park, Leeds, and (Jnls.) Fuel Dept., The University, Leeds, Technical Investigator.

1896. Hart, Bertram, Oakfield Cottage, Stamford Road, Bowdon, Cheshire, Analyst.

1886. Hart, Bertram H., Rosslyn, High Street, Sidcup, Kent, Analytical Chemist.

O.M. Hart, Dr. E., Gayley Hall, Lafayette College, Easton, Pa., U.S.A., Professor of Chemistry.

1890. Hart, H. W., Garth, Clifton Drive, Lytham, Lancashire, Analytical Chemist.

1897. Hart, Wm. Beamont, Manchester Laboratory, 8, Exchange Street, Manchester, Consulting Chemist.

1908. Hartley, Bernard C., 56, Wood View, Manningham, Bradford, Analytical Chemist.

1912. Hartley, Harold, c/o The Richmond Gas Stove and Meter Co., Ltd., Warrington, Research Chemist.

1883. Hartley, Joseph, 73, East Road, Stockport Road, Longsight, Manchester, Technical Chemist.

1912. Hartley, Thos., 64, Westlecot Road, Swindon, Wilts, Teacher of Technical Chemistry.

1905. Hartshorne, Wm. D., Arlington Mills, Methuen, Mass., U.S.A., Agent.

1901. Hartwell, S. Warren, 120, North Fourth Street, Easton, Pa., U.S.A., Chemist.

1908. Harvey, Arthur J., 18, Shoebury Road, East Ham, E., Chemist.

1885. Harvey, Ernest W., 36, Arthur Road, Wimbledon Park, London, S.W., A.R.S.M., Engineer.

1916. Harvey, Frank, Essex Works, Aston, Birmingham, Chemist.

1899. Harvey, Thos. F., 69, North Road, West Bridgford, Nottingham, Analyst (Drug Co.).

1906. Haskell, Walter F., 234, Bridge Street, Westbrook, Maine, U.S.A., Textile Chemist and Colourist.

1900. Haslwanter, Chas., 447, Spruce Street, Richmond Hill, Long Is., N.Y., U.S.A., Analytical Chemist.

1897. Hasslacher, Jacob, P.O. Box 1999, New York City, U.S.A., President, Roessler-Hasslacher Chemical Co.

1903. Hatschek, Emil, c/o S. Bornett and Co., Ltd., 19, St. Dunstan's Hill, London, E.C., Engineer.

1887. Hatton, Wm. P., c/o W. R. Hatton and Sons, Wormwood Scrubbs, W., Starch Works Manager.

1915. Hattori, T., c/o Miss Barles, 15, Ruthven Street, Hillhead, Glasgow, Chemical Expert.

1906. Hattrick, John M., 63, Pitts Street, Sydney, N.S.W., Australia, Potash Agent.
1906. Havercroft, Arthur E., Glenholme, Westbourne Road. Hornsea, Yorks, Chemist.
1899. Hawdon, H. S., Cleadon, near Sunderland, Chemical Works Manager.
1895. Hawker, E. W., Gladstone Chambers, Adelaide, South Australia, Metallurgist.
1910. Hawkes, Cornelius A., "Eastnor," Tufley Crescent, Gloucestor, Analytical Chemist.
1902. Hawkins, Clement C., c/o The Texas Co., Port Neches, Texas, U.S.A., Chemist.
1897. Hawkins, Ernest M., Watling Chambers, Canterbury, Analytical Chemist.
1905. Hawkins, Henry, Moyola Villa, Lansdown, Limerick, Ireland, Gas Engineer.
1887. Hawliczek, Dr. Josef, c/o United Alkali Co., Ltd., Intelligence Dept., Widnes, Consulting Chemical Expert.
1899. Haworth, Dr. Edw., Ivy Bank, Moughland Lane, Runcorn, Cheshire, Chemist.
1910. Haworth, John, 117, Millhouses Lane, Sheffield, Chemist and Sewage Works Superintendent.
1904. Hawthorn, J. H., Municipal Technical School, Leicester, Head Master.
1915. Hay, Alex H., Essex Wharf, Narrow Street, Limehouse, E., Caramel Manufacturer.
1914. Hay, George S., 24, Chetwynd Road, Highgate, N., Analytical Chemist.
1915. Hay, William, 121, St. Vincent Street, Glasgow, Secretary.
1909. Haydon, James R., 91, Ampthill Road, Aigburth, Liverpool, Works Manager and Chemist.
1916. Hayhurst, W., "Woodlands," Accrington, Technical Chemist.
1894. Haynes, David O., 82, Fulton Street, New York City, U.S.A., Proprietor, "Pharmaceutical Era."
1902. Hays, B. F., c/o E. R. Squibb and Sons, 80, Beekman Street, New York City, U.S.A., Pharmaceutical Chemist.
1906. Hayworth, W. P., 24, Tower Road, Dartford, Kent, Chemist.
1905. Hazard, Fred R., P.O. Box 2, Syracuse, N.Y., U.S.A., President (Solvay Process Co.).
1903. Hazen, Chas. R., 258, Prince Albert Avenue, Westmount, Quebec, Canada, Chemist.
1894. Heal, Carlton B., Hill Crest, Runcorn, Cheshire, Tanner.
1912. Healey, E., jun., St. Mary's Mills, Leicester, India-rubber Manufacturer.
1905. Heathcote, Henry L., c/o Rudge-Whitworth, Ltd., Coventry, Research Chemist.
1904. Heaton, Capt. Noel, on active service, Colour Manufacturer.
1905. Heberlein, Dr. Edw., c/o H. T. Enthoven and Sons, Ltd., 247, Rotherhithe Street, London, S.E., Works Manager.
1889. Hecht, Jos. L., c/o French and Hecht, Davenport, Iowa, U.S.A., Analytical Chemist.
1900. Heckman, J. Conrad, Larkin Soap Manufacturing Co., Seneca Street, Buffalo, N.Y., U.S.A., Chemist.
1914. Hector, Alex. B., c/o Burroughs, Wellcome and Co., 481, Kent Street, Sydney, N.S.W., Australia, Manager.
1912. Hedley, Dr. Edgar P., 38, Bessborough Road, Birkenhead, Chemist.
1902. Heebner, Prof. C. F., Ontario College of Pharmacy, Toronto, Canada, Professor of Chemistry.
O.M. Hehner, Otto, 11, Billiter Square, London, E.C., Analytical and Consulting Chemist.
1914. Heinemann, Dr. A., The D.R. Syndicate, Ltd., Ryder's Green, West Bromwich, Research Chemist.
1887. Hellier, E. A., Avonside Varnish Works, St. Philip's Marsh, Bristol, Varnish Manufacturer.
1885. Hellon, Dr. R., 40, New Lowther Street, Whitehaven, Analytical and Consulting Chemist.
1903. Helps, D. H., c/o Reading Gas Co., King's Road Works, Reading, Engineer and Manager.
1898. Hemingway, Frank C. R., 1, Broadway, New York City, and (Jnls.) 6, East Union Avenue, Bound Brook, N.J., U.S.A., Chemical Manufacturer.
1883. Hemingway, H., 9, Albemarle Mansions, Hampstead, N.W., Chemical Manufacturer.
1903. Hemstreet, George P., Hastings-on-Hudson, N.Y., U.S.A., Mechanical Engineer.
1910. Henderson, Ernest G., c/o Canadian Salt Co., Ltd., Windsor, Ont., Canada, Vice-President and Manager.
1883. Henderson, Prof. G. G., F.R.S., Royal Technical College, Glasgow, Professor of Chemistry.
1902. Henderson, Dr. Jas. A. Russell, 26, Brighton Grove, Rusholme, Manchester, Professor of Chemistry and Physics.
1894. Henderson, Jos., Eskbank Ironworks, Lithgow, N.S.W., Australia, Blast Furnace Manager.
1894. Henderson, Norman M., Broxburn Lodge, Broxburn, Scotland, Oil Works Manager.
1915. Henderson, T. A., 93, Roxborough Street West, Toronto, Canada, Chemical Works Manager.
O.M. Henderson, W. F., Moorfield, Claremont Gardens, Newcastle-on-Tyne.
1893. Hendrick, Prof. Jas., Marischal College, Aberdeen, Professor of Agriculture.
1906. Henius, Dr. Max, 1135—1147, Fullerton Avenue, Chicago, Ill., U.S.A., Secretary, Brewers' School.
1912. Henley, Andrew T., Lady's Well Brewery, Cork, Ireland, Technical Chemist.
1904. Henley, Hon. F. R., 49, Montagu Square, London, W., Brewer's Chemist.
1905. Henning, Albert, c/o Hedley and Co., 92, Harrow Road, Leytonstone, N.E., Ester Manufacturer.
1906. Henning, C. I. B., c/o E. I. du Pont de Nemours Powder Co., Experimental Station, P.O. Henry Clay, Del., U.S.A., Chemist.
1914. Henshaw, D. M., c/o W. C. Holmes and Co., Ltd., Whitestone Ironworks, Huddersfield, Chemical Engineer.
1894. Henshaw, Sam., Glenthorne, Wolstanton, Stoke-on-Trent, Chemical Works Manager.
1910. Hepburn, Edward, Priory Works, Dartford, Kent, Tanner.
1888. Hepworth-Collins, W., Junior Constitutional Club, Piccadilly, W.; retain Journals, Civil Engineer.
1914. Herdsman, Frank, 144, Wellington Street, Glasgow. Consulting Chemist and Metallurgist.
1906. Herig, Harry W., c/o General Chemical Co., Hudson River Works, Edgewater, N.J., U.S.A., Chemist.
1897. Heriot, T. H. P., Royal Technical College, Glasgow, Lecturer in Sugar Manufacture.
1916 Heritage, C. C., c/o Chattanooga Chemical Co., 4103, Tennessee Avenue, St. Elmo, Tenn., U.S.A., Assist. Superintendent.
O.M. Herman, W. D., Holm Lea, Rainhill, Lancashire, Glass Works Chemist.
1903. Herreshoff, J. B. F., 620, West End Avenue, New York City, U.S.A., Chemical Engineer.
1887. Herriot, Wm. Scott, Clarewood, Thorntonhall, Lanarkshire, Mechanical Engineer.
O.M. Herrmann, R. W., 59, Mark Lane, London, E.C., Chemical Merchant.
1891. Hersam, Ernest A., University of California, Berkeley, Cal., U.S.A., Associate Professor of Metallurgy.
1898. Hersey, Dr. Milton L., P.O. Box 1086, Montreal, Canada, Consulting Chemist.
1906. Herty, Prof. Chas. H., University of N. Carolina, Chapel Hill, N.C., U.S.A., Professor of Chemistry.
1907. Hess, Capt. Arthur F., c/o A. Hess and Bro., Ltd., Kirkstall Road, Leeds, Oil Distiller.
1891. Hetherington, Dr. Albert E., Ammonia Soda Works, Fleetwood, Lancashire, Analytical Chemist.
1894. Hewitt, A. H., The Green Island Cement Co., Ltd., Hong Kong, China, Engineer.
1910. Hewitt, Arthur, c/o Consumers' Gas Co., 19, Toronto Street, Toronto, Canada, General Manager.
O.M. Hewitt, Dr. D. B., 28, Queen's Gardens, Hyde Park, London, W., Alkali Manufacturer.

1896 Hewitt, Dr. J. Theo., F.R.S., Clifford House, Bedfont, Middlesex, Lecturer.

1890. Hewlett, John C., 40–42, Charlotte Street, Great Eastern Street, London, E.C., Manufacturing Chemist.

1907. Hewson, Geo. W., Grasmere, Field Terrace, Jarrow-on-Tyne, Analytical Chemist.

1893. Hey, Harry, 2, Ash Terrace, Savile Town, Dewsbury, Dyer.

1894. Heyl, G. Edward, 61—62, Lincoln's Inn Fields, London, W.C., Chemical and Electrical Engineer.

1906. Heys, Charles H., Toronto Arcade, Toronto, Canada, Consulting Chemist.

1915. Hibbert, Gilbert S., Buckton Vale Print Works, Stalybridge, Cheshire, Printworks Manager.

1906. Hicking, W. Norton, Queen's Road Works, Nottingham, Lace Dresser.

1906. Hickman, T. Moore, Oakleigh, Tettenhall Wood, Wolverhampton, Analyst.

1897. Hicks, Edwin F., 4837, Fairmount Avenue, Philadelphia, Pa., U.S.A., Chemical Engineer.

O.M. Higgin, W. H., c/o C. J. Schofield, Ltd., Alkali Works, Clayton, Manchester, Chemical Manufacturer.

1913. Higgins, A. Howard, Metallurgist.

1915. Higgins, C. A., c/o Union Powder Corporation, Parlin, N.J., U.S.A., Works Chemist.

1886. Higgins, C. L., 41, Knowsley Road, Cressington Park, Liverpool, Manufacturing Chemist.

1908. Higgins, S. H., Luncarty Bleachfield, Perth, Chemist and Asst. Manager.

1909. Higson, Frank, 52, Chapel Street, Salford, Manchester, Analytical Chemist.

1909 Higuchi, Ken-ichi, Central Laboratory, South Manchuria Railway Co., Dairen, Manchuria, Chemical Engineer.

1911. Hilditch, T. P., Birchdene, Cross Lane, Grappenhall, Warrington, Research Chemist.

1903. Hill, Chas. Alex., c/o British Drug Houses, Ltd., 22—30, Graham Street, City Road, N., Chemist.

1897. Hill, Dr. Herbert M., 20, West Eagle Street, Buffalo, N.Y., U.S.A., City Chemist.

1907. Hill, James A., 8, Highfield Crescent, Rock Ferry, Cheshire, Technical Chemist.

1908. Hill, J. H. F., c/o Broken Hill Proprietary Co., Steel Works, Newcastle, N.S.W., Australia, Superintendent, Coke and By-Product Plant.

O.M. Hill, J. K., 13, Osborne Place, Ibrox, Glasgow, Manufacturing Chemist.

1915. Hill, J. Rutherford, 36, York Place, Edinburgh, Pharmaceutical Chemist.

1892. Hill, Sydney, c/o Blundell, Spence, and Co., Ltd., Hull, Analytical Chemist.

1903. Hill, W. Basil, Foss Islands Tannery, York, Tanner.

1902. Hill, Wm. G., jun., c/o Apsley Rubber Co., Hudson, Mass., U.S.A., Chemist.

1894. Hills, Harold F., Commercial Gas Works, Stepney, London, E., Analytical Chemist.

O.M. Hills, W., Oxford Works, Tower Bridge Road, London, S.E., Pharmaceutical Chemist.

1899. Hinchley, J. W., 55, Redcliffe Road, London, S.W., Chemical Engineer.

1904. Hinckley, J. F., 69, Rugby Road, Brooklyn, N.Y., U.S.A., Chemical Engineer.

O.M. Hindle, J. H., 8, Cobham Street, Accrington, Dyeworks Manager.

1909. Hinks, Edward, 16, Southwark Street, London, S.E., Analyst.

1899. Hinks, Percy J., Danger Building Dept., Royal Laboratory, Woolwich Arsenal, S.E., Chemist.

1891. Hinman, Bertrand C., Coventry House, South Place, Finsbury, London, E.C., Metallurgical Chemist.

1909. Hirsch, Fritz, 51, Ferndale Avenue, Wallsend-on-Tyne, Analytical Chemist.

1914. Hirschberg, Dr. Leon, 20, Birchington Road, Crouch End, N., Chemical Engineer.

1914. Hirst, A. Norman, Box 1141, Durban, South Africa, Consulting Chemist.

1895. Hirst, H. Reginald, c/o Geo. H. Hirst and Co., Ltd., Victoria Mills, Savell Town, Dewsbury, Works Chemist.

1907. Hirt, Wilhelm B., c/o Cuming, Smith, and Co., Ltd., Yarra Junction, Vic., Australia, Analytical Chemist.

1916. Hiscock, W. G., c/o New Explosives Co., Ltd., Stowmarket, Suffolk, Works Chemist.

1896. Hislop, Geo. R., (Journals) Gas Works, (Communications) Greenhill House, Underwood Road, Paisley, Gas Engineer and Manager.

1915. Hitch, E. F., Equitable Powder Manufacturing Co., East Alton, Ill., U.S.A., Chemist.

1913. Hitchcock, Thos. J., 28, Albany Road, Manor Park, Essex, Technical Chemist.

1915. Hitchins, A. B., Research Laboratory, Ansco Co., Binghamton, New York, U.S.A., Research Chemist.

1914. Hoare, Major F. R. J., The Granary, Ashley Road, Farnborough, Hants, Ordnance Dept., South African Forces.

1906. Hobsbaum, I. B., c/o Messrs. Anthony Gibbs & Sons, 22, Bishopsgate, London, E.C., Chemist.

1905. Hobson, Alfred, Dantzic Brewery, Imperial Street, Regent Street, Leeds, Brewer and Wine Manufacturer.

1909. Hodgart, Matthew, Vulcan Works, Paisley, Engineer.

1894. Hodge, Andrew, Glenariff, Whaley Bridge, near Stockport, Printworks Chemist.

1913. Hodgetts, E. A. Brayley, 36, Elvaston Place, Queen's Gate, S.W.

1915. Hodgkinson, S. E., 5, Taylor Street, Heaton Park, Manchester, Works Analyst.

O.M. Hodgkinson, Dr. W. R., 89, Shooter's Hill Road, Blackheath, S.E., Professor of Chemistry.

1913. Hodgson, Cyril V., 181, Watlands View South, Wolstanton, Stoke-on-Trent, Works Chemist.

1897. Hodgson, Matthew, The Murrough, Wicklow, Ireland, Technical Chemist.

1890. Hodgson, Wm., 66, Deansgate, Manchester, Oil and Colour Broker.

1910 Hodsman, Henry J., Dept. of Fuel and Coal Gas Industries, The University, Leeds, Chemist.

1906. Hogarth, Julius W., The University, Sydney, N.S.W., Australia, Demonstrator of Chemistry.

1886. Hogben, W., Osborne House, Osborne Terrace, Edinburgh, Celluloid Works Manager.

O.M. Hogg, T. W., c/o John Spencer and Sons, Newburn Steelworks, Newcastle-on-Tyne, Metallurgical Chemist.

1905. Holcroft, Harold, Parkdale, Wolverhampton, Ironfounder.

1887. Holden, G. H., Manchester Oxide Co., Ltd., Canal Street, Miles Platting, Manchester, Chemist.

1904. Holden, Norman N., c/o Hardman and Holden, Ltd., Miles Platting, Manchester, Manufacturing Chemist.

1916. Holdredge, Leigh I., c/o Hilton Trading Co., 136, Liberty Street, New York City, U.S.A., Chemical Engineer.

1902. Holdsworth, Ernest T., "Holme Dene," Crossley Hall, Bradford, Dyer.

1885. Holgate, T. E., 173, Hollins Grove, Darwen, Lancashire, Metallurgist.

O.M. Holland, Philip, 22, Taviton Street, Gordon Square, London, W.C., Analytical Chemist.

1892. Holland, Philip H., 546, Sherbrooke Street West, Montreal, Canada, Merchant.

1915. Hollings, Harold, 1, Northwood Road, Forest Hill, S.E., Technical Chemist.

1896. Hollings, J. Spencer, Brymbo, North Wales, Works Manager.

1909. Hollingworth, David V., Birchenwood Collieries, Kidsgrove, Stoke-on-Trent, Gas Analyst.

1903. Hollinshead, Peter, The Beeches, Weston Road, Runcorn, Cheshire, Chemist.

1900. Hollinshead, Dr. Warren H., Wingrove Avenue, Nashville, Tenn., U.S.A., Teacher of Chemistry.

1904. Holloway, E. G., c/o Jas. S. Kirk and Co., 360, North Water Street, Chicago, Ill., U.S.A., Chemist.

1890. Holloway, G. T., 9–13, Emmett Street, Limehouse, London, E., Chemist and Metallurgist.

1883. Holmes, Ellwood, Wyncote, Jesmond Park East, Newcastle-on-Tyne, Colour Manufacturer.

O.M. Holmes, F. G., Thames Tar Works, Lower Road. Northfleet, Kent, Tar and Ammonia Distiller

1914. Holroyd, Thomas A., Carnatic House, Perambore Barracks, Madras, India, Colour Chemist.

1913. Holt. Dr. Alfred, Dowsefield, Allerton, Liverpool, University Reader in Physical Chemistry.

1900. Holthouse, Harold B., 106, Radcliffe Road, West Bridgford, Nottingham, Chemist.

1902. Holton, Alf. L., Chemical Dept., Gas Works, Bradford Road, Manchester, Chemist.

1892. Holton, E. C., 601. Canal Road, N.W., Cleveland, Ohio, U.S.A., Chemist.

1893. Holzapfel, Max, c/o Holzapfels, Ltd., Felling-on-Tyne, Manufacturer.

1893. Homfray, D., c/o The Hard Chemical Co., Santa Julia, Mexico City, Analytical Chemist.

1909. Hook, Russell W., 8, Holton Street, West Medford, Mass., U.S.A.

1904. Hooker, A. H., c/o Hooker Electrochemical Co., Niagara Falls, N.Y., U.S.A., Manufacturing Chemist.

O.M. Hooper, E. Grant, 16, Royal Avenue, Sloane Square, London. S.W., Chemist.

1889. Hooper, Ernest F., 10, The Elms West, Sunderland, Technical Chemist.

1888. Hope, Jas., The Knoll, Lenzie, near Glasgow, and (Journals) The Nickel Co., Kirkintilloch, by Glasgow, Nickel Works Manager.

1904. Hopewell, Fredk., 59, William Street, Montreal, Canada. Manager.

1915. Hopkins, E. M., c/o Thos. Jackson, Chemical Works, Clayton, Manchester, Manager and Chemist.

1892. Hopkins, Erastus, 511, Cutler Buildings, Rochester, N.Y., U.S.A., Consulting Chemical Engineer.

1905. Hoppenstedt, A. W., c/o Schoellkopf and Co., Perry and Mississippi Streets, Buffalo, N.Y., U.S.A., Chemist.

1895. Horne, Dr. W. D., 175, Park Avenue, Yonkers, N.Y., U.S.A., Consulting Chemist

1904. Hornsey, J. W., 233, Broadway, New York City, U.S.A., and (Journals) Summit, N.J., U.S.A., Chemical Engineer.

1913. Horrocks, Herbert, 670, Belmont Avenue, Newark, N.J., U.S.A., Chemist.

1914. Horrocks, John M., "Maywood," Osborne Road, Levenshulme, Manchester, Tar Distiller and Manufacturing Chemist.

1900. Horsfall, Jno., 4, Grange Avenue, Rawtenstall, Manchester, Analytical and Consulting Chemist.

1901. Horton, Edw., jun., Rothamsted Experimental Station, Harpenden, Herts, Chemist.

1916. Hose, Dr. Chas., The Lodge, Botisdale, Diss; (Juls.) H.M. Factory, King's Lynn, Norfolk, Acetone Manufacturer.

1906. Hoseason, Jas. H., Sun Buildings, 2, Bridge Street, Manchester, Chemical Manufacturer.

1890. Hoskins, A. Percy, Clonlee, Rosetta Park, Belfast. Ireland, Analytical Chemist.

1899. Hoskins, Wm., 2009, Harris Trust Building, 111. West Monroe Street, Chicago, Ill., U.S.A., Chemist.

1914. Hough, Alex. T., Halton Brook, Runcorn, Cheshire, Chemist.

1911. Hough, Samuel, c/o Lever Bros., Ltd., Balmain, Sydney, N.S.W., Australia, Chemist.

1899. Honlder, Bertram E., 50, Lady Margaret Road, Southall, Middlesex, Chemist.

1892. Houston, John, 30, Princess Street, Manchester, Drysalter

1915. Houston, R. H., 9, Margaretta Terrace, Oakley Street, Chelsea, S.W., General Manager (Aluminium Mills).

O.M. Howard, A. G., Burnt House, Chigwell, Essex, Chemical Manufacturer.

1901. Howard, Bernard F., Firbank, Loughton, Essex, Chemist.

O.M. Howard, D., Devon House, Buckhurst Hill, Essex, Chemical Manufacturer.

1887 Howard, D. Lloyd, Uphall Works, Ilford, Essex, Chemical Manufacturer.

1915. Howard, Dr. G. S., Lock Box 201, Carleton Place, Ontario, Canada, Research Chemist.

1898. Howard, Henry, 36, Amory Street, Brookline, Mass., U.S.A., Chemical Engineer.

1902. Howard, Nelson A., c/o General Chemical Co. of California, 705, Royal Insurance Building, San Francisco, Cal., U.S.A., General Manager.

1915. Howard, O. McG., Paint, Oil and Drug Review, 212. West Washington Street, Chicago, Ill., U.S.A., President and Journalist.

1913. Howard, Tom, 320, Wellington Road, Heaton Chapel, Stockport, Cheshire, Chemist.

1916. Howden, Robert, 12, Wolveleigh Terrace, Gosforth, near Newcastle-on-Tyne, Analytical Chemist.

1906. Howe, Chester A., 135, Oliver Street, Boston, Mass., U.S.A., Dyestuff Merchant.

1903. Howe, Jas. Lewis, Washington and Lee University, Lexington, Va., U.S.A., Professor of Chemistry.

1912. Howe, Dr. Percy R., 536, Pleasant Street, Belmont, Mass., U.S.A., Dentist.

1904. Howell, Walter L., Room 314, Custom House, New Orleans, La., U.S.A., Chemist.

1899. Howles, Fred., c/o McDougall Bros., 66—68, Port Street, Manchester, Chemist.

1889. Howorth, F. Wise, 10, New Court, Lincoln's Inn, W.C., Technical Chemist and Chartered Patent Agent.

1907. Howroyd, Richard R., c/o Calder Mersey Extract Co., Ltd., Ditton, near Widnes, Chemist.

1914. Howson, Herbert G., c/o Kynoch, Ltd., Umbogintwini, Natal, Analytical Chemist.

1906. Hoyler, Fritz, 93, Market Street, Perth Amboy, N.J., U.S.A., Chemist.

1896. Hoyte, Percy S., Gas Works, Coxside, Plymouth, Gas Engineer.

1909. Hudson, Baker, Public Library, Middlesbrough, Librarian.

1899. Hudson, Dr. Edw. J., c/o Pioneer Iron Co., Marquette, Mich., U.S.A., Chemist.

1915. Hudson, G. Inglis, "Gudvangen," Arden Street, Coogee, Sydney, N.S.W., Australia, Manufacturing Chemist.

1914. Hudson, Norman S. W., Eskbank Iron and Steel Works, Lithgow, New South Wales, Analytical Chemist.

1905. Hudson, O. F., The University, Edgbaston, Birmingham, Lecturer on Metallurgy.

1900. Huebner, Julius, Linden, Cheadle Hulme, Cheshire, Director of Dyeing and Papermaking Departments (Municipal School of Technology).

1916. Huggins, A. F., "Cartref," Cromford Road, West Bridgford, Nottingham, Analytical Chemist.

O.M. Hughes, J., 79, Mark Lane, London, E.C., Agricultural Chemist.

1915. Hulme, Chas., Gas Works, Uxbridge, Middlesex, Gas Engineer.

1906. Hulme, Robert B., 1162, Union Avenue, Memphis, Tenn., U.S.A., Chemical Engineer and Manager.

1909. Hultman, G. H., St. Paulsgatan 31, Stockholm, Sweden, Chemical Engineer.

1905. Hulton, H. F. E., 15, Oak Hill Court, Putney, S.W., Chemist.

1893. Humfrey, Chas., Homewood, Hartford, Cheshire, Alkali Works Manager.

1916. Humfrey, Wm. A., Seaton Lodge, Southbury Road, Enfield, Lead Products Works Manager.

1902. Humphrey, Richard L., 1001, Harrison Building, Philadelphia, Pa., U.S.A., Civil Engineer.

1903. Humphreys, A. C., 165, Broadway, New York City, and (Jnls.) Stevens Inst. of Technology, Hoboken, N.J., U.S.A., Engineer.

1908. Humphries, Albert E., Coxes Lock Mill, Weybridge, Surrey, Flour Miller.

1912 Humphries, Herbert B. P., Queen Anne's Chambers, Westminster, S.W., Consulting Chemist.

O.M. Humphrys, N. H., 5, Wyndham Road, Salisbury, Wilts., Gas Engineer.

1900. Hunt, Arthur V., 5, The Wiend, Lower Bebington, Cheshire, Analytical Chemist.

O.M. Hunt, Chas., 17, Victoria Street, Westminster, London, S.W., Civil Engineer.

1883. Hunt J. S., Appleton, Widnes.

1903. Hunt, P. C. Holmes, 360, Collins Street, Melbourne, Vic., Australia, Gas Engineer.

O.M. Hunt, W., Hampton House, Wood Green, Wednesbury, Staffordshire, Chemical Manufacturer.

1893. Hunter, Prof. Matthew, Rangoon College, Rangoon, Burmah, Professor of Chemistry.

1902. Huntly, Geo. N., 14, Old Queen Street, Westminster, S.W., Analytical and Consulting Chemist.

1904 Hurren, F. H., c/o The Rover Co., Ltd., Coventry, Analytical Chemist.

1894. Hurry, E. H., Llanover, Churt, Farnham, Surrey, Mechanical Engineer.

1894. Hutcheson, Jno. F., 39, St. Enoch's Square, Glasgow, Chemical Manufacturer.

1912. Hutchin, C. D., c/o Messrs. Meredith and Drew, Ltd., High Street, Shadwell, London, E., Biscuit Manufacturer.

1915. Hutchinson, Alfred, Manesty, Saltburn-by-the-Sea, General Manager, Skinningrove Iron Co.

O.M. Hutchinson, T. J., Aden House, Manchester Road, Bury, Analytical and Consulting Chemist.

1909. Hutchison, Chas. F., Eastman Kodak Co., Kodak Park, Rochester, N.Y., U.S.A., Photographic Emulsion Maker.

O.M. Huxley, Jas. H., c/o Vickers, Son, and Maxim, Ltd., River Don Works, Sheffield, Metallurgical Chemist.

1906. Huyett, Miles C., 1005, Morgan Building, Buffalo, N.Y., U.S.A., Mechanical Engineer.

1897. Hyams, Godfrey M., 312, Sears Building, Boston, Mass., U.S.A., Mines Manager.

1902. Hyde, Austin T., Box 98, Rumford Falls, Maine, U.S.A., Chemical Engineer.

1897. Hyde, B. T. Babbitt, 11, Broadway, New York City, U.S.A., Soap Manufacturer.

1899. Hyde, Fred. S., 215, Schermerhorn Street, Brooklyn, N.Y., U.S.A., Research Chemist.

1899. Hyde, Wm. Grantley, Garden Wharf, Church Road, Battersea, S.W., Assayer.

1901. Hyman, Leonard W., 342, South Pearl Street, Albany, N.Y., U.S.A., Analytical Chemist.

I

1900. Ichioka, Dr. Tajiro, 19, Maruyama, Shinmachi, Hongo, Tokio, Japan, Chemist (Imperial Japanese Navy).

1906. Iddings, Richard P., Arlington Mills, Lawrence, Mass., U.S.A., Chemist.

1885. Idris, T. H. W., M.P., 120, Pratt Street, Camden Town, N.W., Mineral Water Manufacturer.

1913. Illingworth, S. R., c/o Gas Lighting Improvement Co., Ltd., Pacific Wharf, West Ham, E., Works Chemist.

1909 Imison, C. S., The Cottage, Runcorn, Cheshire, Chemist, United Alkali Co.

1900. Imrie, John, 30, Osgathorpe Road, Sheffield, Producer Gas and By-Products Plant Manager.

1900. Ingalls, Walter R., "Engineering and Mining Journal," 10th Avenue at 36th Street, New York City, U.S.A., Mining Engineer and Metallurgist.

1889. Ingle, Dr. Harry, 26, Bond Street, Leeds, Organic Chemist.

1909. Ingleby, G. W., c/o John L. Seaton and Co., Ltd., Scnlcoates, Hull, Director.

1906. Inglis, Dr. Jno. K. H., University of Otago, Dunedin, New Zealand, Professor of Chemistry.

1912. Inglis, Robert J. C., c/o Curtis's and Harvey, Ltd., Explosives Factory, Faversham, Kent, Analytical Chemist.

1911. Innes, Dr. Alfred G., 22, Maybury Mansions, New Cavendish Street, London, W., Technical Chemist.

1909. Innes, R. Faraday, c/o The British Chrome Tanning Co., St. Andrew's Tannery, Northampton, Chemist.

1906. Innes, Dr. Wm. Ross, 19, St. James' Avenue, Cricklewood, N.W., Chemist.

1910. Irvine, Prof. J. C., Chemical Research Laboratory, The University, St. Andrews, Scotland, Professor of Chemistry.

1884. Irving, J. M., 17A, Dickinson Street, Cooper Street, Manchester, Chemical Merchant.

1911. Irwin, George C., c/o S. H. Johnson and Co., Ltd., Carpenter's Road, Stratford, E., Manager (Engineering Works).

O.M. Irwin, W., Derwent Lodge, Cockermouth, Analytical Chemist.

1901. Isakovics, Alois von, Synfleur Scientific Laboratories, Monticello, N.Y., U.S.A., Manufacturing Chemist.

1915. Isherwood, Dr. Percy C. C., c/o W. J. Bush & Co., Ltd., Hackney, N.E., and (Journals) Moss Cottage, Bushey Heath, Herts, Chief Chemist.

1900. Ittner, Dr. Martin H., c/o Colgate and Co., Jersey City, N.J., U.S.A., Soap and Essential Oil Chemist.

1912. Ivatt, Albert, The Engadine, Histon, Cambridge, Chemist (Foods).

1908. Ives, Herbert, 125, Pearl Street, Boston Mass., U.S.A., Manager (Dyestuffs, etc.).

J

1890. Jackman, E. J., 60, Belgrave Road, Ilford, Essex, Technical Chemist.

O.M. Jackson, Edward, Raven's Cliff, Oxford Road, Moseley, Birmingham, Alkali Works Inspector.

1904. Jackson, Ernest W., Godrevy, Saltburn, Yorks, Analytical Chemist.

1991. Jackson, F., Smedley Bridge Works, Cheetham, near Manchester, Bleacher and Dyer.

1883. Jackson, Frederick, 44, Chapel Street, Salford, Manchester, Laboratory Furnisher.

1886. Jackson, John, 98, Dobbie's Loan, Glasgow, Lubricant Manufacturer.

1901. Jackson, Percy G., c/o National Boiler Insurance Co., St. Mary's Parsonage, Manchester, Chemist.

1916. Jackson, R. S., c/o Kemp and Co., Ltd., Manufacturing Chemists, Bombay, India, Pharmacist and Analyst.

1890. Jackson, Saml., 3, Buckingham Gardens, Perumbore Barracks, Madras, N., India, Analytical Chemist.

1902. Jackson, Samuel, c/o Wm. Metcalf, Ltd., Church, near Accrington, Director (Tar Distillery).

1898. Jackson, Thos., 31, Brownsville Road, Heaton Moor, near Stockport, Chemical Manufacturer.

1900. Jackson, Dr. W. Hatchett, Radcliffe Library, Oxford, Librarian and Science Tutor (Keble College).

1893. Jackson, Rt. Hon. W. L., F.R.S. *See* Allerton, Rt. Hon. Lord.

1899. Jackson, W. Morton, c/o British Oxygen Co., Ltd., Great Marlborough Street, Manchester, Manager.

O.M. Jackson, W. P., Saxilby, near Lincoln, Chemical Works Manager.

1915. Jacobs, Lionel L., The Dominion Tar and Chemical Co., Box 445, Sault Ste. Marie, Ontario, Canada, Works Manager.

1900. Jacoby, Areli H., c/o American Dyewood Co., 80, Maiden Lane, New York City, U.S.A., Chemist.

1886. Jago, Wm., 17, Wilbury Avenue, Hove, Sussex, Barrister-at-Law.

1883. James, E. T., British Alizarin Co., Ltd., Silvertown, Victoria Docks, E., Secretary.

1915. James, Hugh W., South Metropolitan Gas Co., Tar Works, Ordnance Wharf, East Greenwich, S.E., Technical Chemist.

1905. James, Oscar S., 6, Leuty Avenue, Toronto, Canada, Analytical Chemist.

1914. Jaques, John, 66, Grove Road, Wanstead, N.E., Rubber Technologist.

1890. Jarmain, Geo. S., Dalton Lodge, Huddersfield, Wool Extracter.

O.M. Jarmay, G., Hartford Lodge, Hartford, Cheshire, Alkali Manufacturer.

1911. Jarrom, Harry G., 14, Goodwyn Avenue, Mill Hill, Middlesex, Managing Director (Gallenkamp and Co.).

1900. Jarvie, Jas., Ferndale, Kenmure Avenue, Bishopbriggs, Scotland, Chemist.

1910. Jayne, David W., c/o Barrett Manufacturing Co., 17, Battery Place, New York City, U.S.A., Manager.

1913. Jeans, Harold, 165, Strand, London, W.C. Metallurgist.

1892. Jenkin, W. A., 12, Bella Vista, Minas de Rio Tinto, Provincia de Huelva, Spain, Metallurgical Chemist.

1905. Jenkins, Chas. D., 1384, Commonwealth Avenue, Allston, Mass., U.S.A., Chemist.

1894. Jenkins, John H. B., Laboratory, G.E.R. Works, Stratford, E., Analytical Chemist.

1912. Jenkins, Leslie C. W., 26, Ulundi Road, Blackheath, S.E., Chemist (Wood Dyeing).

1912. Jenkins, Rees, 53, Shaftesbury Road, Ravenscourt Park, W., Analytical Chemist.

1894. Jenks, Robt. L., 1, Charnock Place, Calcutta, India, Chemist.

1905. Jennison, Jas., Mount Nod, London Road, Greenhithe, Kent, Chemist.

1904. Jepson, John Elliott, c/o Star Paper Mill Co., Ltd., Feniscowles, near Blackburn, Chemist.

1899. Jerdan, Dr. David S., Temora, Colinton, Midlothian, Chemist (Gelatin Works).

1899. Jessop, Louis V., Holmlea, 23, Woodville Road, Leytonstone, Essex, Chemist.

1904. Jewson, F. T., Earith, near St. Ives, Hunts, Chemist.

1896. Job, Robt., 649, Roslyn Avenue, Westmount, Quebec, Canada, Analytical Chemist.

1886. Johnson, A. E., 24, Parkdale, Wolverhampton, Analytical Chemist.

1908. Johnson, Arthur, 7, Carlton Road Bolton Road, Pendleton, Manchester, Chemist.

1904. Johnson, Cedric, Winnington Park, Northwich, Cheshire, Chemical Engineer.

1891. Johnson, Edmond E., c/o Adcocks, Drayton Park Works, Highbury, N., Chemical Engineer.

1904. Johnson, Dr. F. M. G., 286, Peel Street, Montreal, Canada, Chemist.

1904. Johnson, G. B., 7, Church Street, Liverpool, Wholesale Chemist.

1907. Johnson, H. Finnis, c/o Borax Consolidated, Ltd., 16, Eastcheap, London, E.C., Sales Manager.

1900. Johnson, John, c/o John Johnson and Co., 37th Street and Second Avenue, Brooklyn, N.Y., U.S.A., Chemical Engineer.

1913. Johnson, J. Carroll, on active service, Chemist.

O.M. Johnson, J. E. J., 133, Earlham Grove, Forest Gate, E., Manufacturing Chemist.

1900. Johnson, Jno. W. Haigh, West Riding Rivers Board, Wakefield, Yorks, Chemist.

1906. Johnson, Oliver L., c/o The Aspinook Co., Jewett City, Conn., U.S.A., Dye Works Manager.

1904. Johnson, S. Hearon, 7, Church Street, Liverpool, Wholesale Chemist.

1895. Johnston, Alex. R., 18, Percy Street, Ibrox, Glasgow, Analytical Chemist.

1906. Johnston, A. McA., Box 108, Germiston, Transvaal, Metallurgical Chemist.

1894. Johnston, G. Lawson. *See* Lawson-Johnston, G.

1904. Johnston, J. H., 8, Leopold Road, Wimbledon, S.W., Chemist and Bacteriologist.

1904. Johnston, Thos. J., 1, Brunswick Street, Edinburgh, Chemist.

1890. Johnston, Wm. A., The S. S. White Dental Manufacturing Co., Prince Bay, N.Y., U.S.A., Dental Enamel Manufacturer.

1894. Johnston, W. E. Lawson. *See* Lawson-Johnston, W. E.

1910. Johnstone, E. J., Factory Square, Watertown, N.Y., U.S.A., Consulting Engineer and Industrial Chemist.

O.M. Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow, Technical Chemist.

1905. Johnstone, J. Swanston, Natal Distilleries Co., Bond Street, Durban, Natal, Distiller.

1903. Johnstone, S. J., "Rousdon," Clifford Road, New Barnet, Herts, Research Chemist.

1907. Jolliffe, Ernest H., Central Technical School, Toronto, Canada, Works Chemist.

1905. Jolliffe, Frank, 51, Vancouver Road, Forest Hill, S.E., Chemist.

1904. Jones, Arthur B., 981, Central Avenue, Plainfield, N.J., U.S.A., Superintendent.

1912. Jones, B. Vaughan, P.O. Box 27 Petersburg, Va., U.S.A., Chemist and Manufacturer.

1912. Jones, Charles, Fieldgate House, Lepton, near Huddersfield, Coke Plant Manager.

1908. Jones, D. Trevor, 44, Ardrossan Road, Saltcoats, Ayrshire, Works Chemist.

1911. Jones, Edgar D., 157 Wakehurst Road, Clapham Common, S.W., Analytical Chemist.

1912. Jones, E. Gabriel, City Analyst's Laboratories, Ashton Street, Liverpool, Assistant Public Analyst for Liverpool.

1910. Jones, E. Protheroe, The Golden Horseshoe Estates Co., Salisbury House, London Wall, London, E.C., Secretary.

1902. Jones, E. Strangways, Sulphide Corporation, Ltd., Cockle Creek, N.S.W., Australia, Metallurgical Chemist.

1909. Jones, E. Willis, 22, Coleshill Terrace, Llanelly, South Wales, Chemical Manufacturer.

O.M. Jones, E. W. T., 10, Victoria Street, Wolverhampton, Analytical Chemist.

1897. Jones, Fred. W., 35, Addiscombe Road, Croydon, Technical Chemist.

1896. Jones, G. Cecil, 41, London Road, Forest Hill, S.E., Consulting Chemist.

1905. Jones, Harold, Morro Velho, Villa Nova de Lima, Minas Geraes, Brazil, Analyst and Assayer.

1893. Jones, Herbert. *See* Sefton-Jones, H.

1901. Jones, Herbert J., 40, Reginald Road, Forest Gate, E., Chemist.

1910. Jones, Ivor R., 54, Atlantic Chambers, Manchester, Chemical Merchant.

1905. Jones, J. E. Stacey, Hearsall Works, Coventry, Consulting Chemist and Technical Metallurgist.

1904. Jones, J. Shirley, Moscow, Idaho, U.S.A., Chemist.

1894. Jones, M. W., Stonebeck, Brislington, Bristol, Manager (Oil and Colour Works).

O.M. Jones, Walter Norris, Lancashire Metal Works, Widnes, Technical Chemist.

1915. Jones, W. B., Stamford Rubber Supply Co., Stamford, Conn., U.S.A., Research Chemist.

1903. Jones, Wm. App, c/o Boston Artificial Leather Co., 200, Fifth Avenue, New York City, U.S.A., Chemist.

1905. Jones, W. Ellis, 80, Arundel Avenue, Liverpool, Sugar Refiner.

1908. Joselin, Percy H., 81, Bennerley Road, New Wandsworth, S.W., Chemist.

1905. Joseph, A. F., Ceylon Technical College, Colombo, Ceylon, Lecturer on Chemistry.

1900. Josephson, Edgar, c/o Pantasote Leather Co., Passaic, N.J , U.S.A.

1891. Joslin, Omar T., 3223, Spring Grove Avenue, Cincinnati, Ohio, U.S.A., Chemical Engineer.

1887. Joüet, Dr. C. H., 238, East 2nd Avenue, Roselle, N.J., U.S.A., Technical Chemist.

1904. Jowett, Dr. H. A. D., Phœnix Mills, Dartford, Kent, Research Chemist.

1903. Joyce, Clarence M., Box 163, Leominster, Mass., U.S.A., Consulting Chemist (Nitrocellulose).

1916. Joyce, Sydney R., c/o Curtiss' and Harvey, Ltd., Cliff-at-Hoo, Kent, Analytical Chemist.

O.M. Justice, Philip M., 55–56, Chancery Lane, London, W.C., Patent Agent.

K

1896. Kalbfleisch, Franklin H., 31, Union Square West, New York City, U.S.A., Chemical Manufacturer.

1908. Kaliski, Dr. Maximilian S., 17, Battery Place, New York City, U.S.A., Technical Chemist.

1913. Kastle, Dr. Joseph H., Kentucky Agricultural Experiment Station, Lexington, Ky., U.S.A., Director.

1916. Katz, Israel, c/o Sulzberger and Sons Co., Union Stockyards, Chicago, Ill., U.S.A., Chief Chemist.

1901. Kauder, Dr. E. c/o Merck and Co., Rahway, N.J., U.S.A., Chemist.

1903. Kauffman, Milton H., American Smelting and Refining Co., Durango, Colo., U.S.A., Chemist.

1892. Kaufmann, Dr. Herbert M., c/o Mutual Chemical Co., Jersey City, N.J., U.S.A., Chemist.

1904. Kaus, Dr. Emil, c/o Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.

1915. Kawakami, Kaichi, c/o K. Oguri, Toyonishi-mura, Shizuokaken, Japan, Chemical Engineer.

1885. Kawakita, Prof. Michitada, Imperial Engineering College, Tokio, Japan, Professor of Applied Chemistry.

O.M. Kay, Edward, Bank Buildings, St. James' Street, S.W., Explosives Manufacturer.

1912. Kay, Jas. H., Fair Fields, Dundee Lane, Ramsbottom, Lancashire, Soap Manufacturer.

O.M. Kay, Wm. E., 349, The Cliff, Broughton Park, Manchester, Printworks Chemist.

1910. Kaye, Henry R., c/o Cuming, Smith, and Co., Port Melbourne, Vic., Australia, Analytical Chemist.

1904. Kaye, Thos., 26, Rose Crescent, Perth, Scotland, Analytical Chemist.

1884. Keane, Dr. Chas. A., Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C., Principal.

O.M. Kearns, H. W., Boothroyd, Brooklands, near Manchester, Dyer.

1897. Kearns, Jno. S., Cowpe Mills, Waterfoot, near Manchester, Chemist and Dyer.

1915. Keary, H. E., Thames Haven, Essex, Petrol Refinery Manager.

1910. Keeler, Warren L., 441, Arch Street, New Britain, Conn., U.S.A., Analytical Chemist.

1911. Keenan, Thomas J., 117, East 24th Street, New York City, U.S.A., Paper Chemist.

1915. Keetland, C. G., c/o The Standard Chemical Iron and Lumber Co., 524, St. Ambroise Street, Montreal, Canada, Montreal Manager.

1908. Keith, Jas. W., c/o Parry and Co., Ranipet, North Arcot, South India, Analytical Chemist.

1915. Keller, D. Raymond, 16, Canterbury Road, Watford, Herts., Works Chemist.

1907. Keller, Dr. Edward, P.O. Box 363, Perth Amboy, N.J., U.S.A., Chemist and Metallurgist.

1905. Keller, Robt. J., 89, Barclay Street, New York City, U.S.A., Dyestuff and Chemical Merchant.

1885. Kellner, Dr. Wm., 135, Victoria Road, Old Charlton, S.E., Chemist to War Department.

1908. Kellogg, H. W., c/o National Electrolytic Co., Niagara Falls, N.Y., U.S.A., General Manager.

1916. Kelly, Wm., c/o Canadian Explosives Co., Room 807, Transportation Building, Montreal, Canada, President's Assistant.

1907. Kendall, G. F., Chemical Works, Stratford-on-Avon, Chemical Manufacturer.

1912. Kennedy, Carl D., c/o General Rubber Co., Kisaran Asahan, Sumatra, D.E.I., Chemist.

1916. Kenner, James, c/o Chance and Hunt, Ltd., Government Department, Trinity Street, Oldbury, near Birmingham, Chemist.

1912. Kent, Raymond W., East Palistine, Ohio, U.S.A., Chemist.

1914. Kenyon, James, 23, Beech Street, Chapelfield, Radcliffe, Manchester, Analytical Chemist.

1903. Kenyon, Percy S., Park House, Cheadle Hulme, Cheshire, Drysalter.

1889. Kenyon, Thos., The Shrubbery, Hilton Park, Prestwich, near Manchester, Manufacturing Chemist.

1915. Kerfoot, Thos., Pole Bank Hall, Gee Cross, Cheshire, Manufacturing Chemist.

1899. Kern, Walter P., c/o General Chemical Co., 1642, Halle Street, Laurel Hill, Boro' of Queens, N.Y., U.S.A., Chemist.

1915. Kernot, Dr. J. C., 61, St. George's Terrace, Newcastle-on-Tyne, Doctor of Chemistry.

1906. Kerr, Charles H., c/o Pittsburg Plate Glass Co., Tarentum, Pa., U.S.A., Ceramic Research Chemist.

1912. Kerr, R. Vaughan, Saboaria Seixas Irmaos y Ca., Parahyba, Brazil, Technical Chemist.

1890. Kerr, Saml. T., 516, North Delaware Avenue, Philadelphia, Pa., U.S.A., Salt Manufacturer.

1897. Kerr, Wm. M., 712, La Fayette Building, Philadelphia, Pa., U.S.A., Manufacturing Chemist.

1896. Kershaw, Jno. B. C., West Lancashire Laboratory, Waterloo, Liverpool, Analytical Chemist.

1909. Kesava-Menon, A., Chittur-Palghat, South Malabar, Madras, India, Chemist.

1902. Kessler, Henry W., 720, Electric Building, Cleveland, Ohio, U.S.A., Manufacturing Chemist.

1893. Kestner, Paul, 16, Rue de Chabrol, Paris, France, Chemist.

1900. Kewley, Jas., The Refinery, Portishead, near Bristol, Oil Refinery Manager.

1890. Keys, W. H., Hall End Works, West Bromwich, Oil and Chemical Manufacturer.

1900. Kilgore, Benj. W., Raleigh, N.C., U.S.A., Chemist.

1901. Kilmer, Fred. B., c/o Messrs. Johnson and Johnson, New Brunswick, N.J., U.S.A., Chemical Manufacturer.

O.M. Kinch, Prof. E., "Sunnyside," Chislehurst, Kent, Professor of Chemistry.

O.M. King, A. J., Elleray, Windermere, Bleacher and Finisher.

1907. King, C. A., c/o The Farnley Iron Co., Farnley, near Leeds, Technical Chemist.

1913. King, Edward W., New Liverpool Rubber Works, Walton, Liverpool, Analytical Chemist.

1905. King, Frank E., 75, Gracechurch Street, London, E.C., Analytical Chemist.

1915. King, George, 25, Whitmore Road, Small Heath, Birmingham, Research Chemist.

1911. King, Harold, Wellcome Research Laboratories, King Street, Snow Hill, E.C., Chemist.

O.M. King, J. Falconer, 43, Stirling Road, Edinburgh, Consulting Chemist.

1910. King, John, Summerville Gardens, Latchford, Warrington, Lancashire, Works Manager.

1913. King, Dr. Robert C., Aptekarsky Prospect 8a, Petrograd, Russia, Chemist.

1895. King, Sidney J., Hazeldene, Avenue Road, Bexley Heath, Kent, Analytical Chemist.

O.M. King, Walter R., 16, Mincing Lane, London, E.C.; and (Journals) Torville, The Cliffs, Southend-on-Sea, Chemical Manufacturer.

1905. King, Warren C., 72, Front Street, New York City, U.S.A., President, Independent Chemical Co.

1916. King, Wm. E., 24, Tantallon Road, Balham, S.W., Research Chemist.

1896. Kingdon, Holman, c/o Joseph Crosfield and Sons, Warrington, Technical Chemist.

1908. Kingsbury, Percy C., German-American Stoneware Works, 50, Church Street, New York City, U.S.A., Chief Civil Engineer.

1883. Kingsford, T. P., Oswego, N.Y., U.S.A., Starch Manufacturer.

O.M. Kingzett, C. T., "Maplin," Frinton on Sea, Essex, and (Journals) Sanitas Co., Ltd., Locksley Street, Limehouse, E., Chemical Manufacturer.

1906. Kinnersley, H. W., Branscombe, Merry Hill Road, Bushey, Herts, Chemist and Manufacturer.

1897. Kipping, Dr. F. Stanley, F.R.S., University College Nottingham, Prof. of Chemistry.

1914. Kirby, William, 50, Mayhill Road, Charlton, Kent, Chemist.

1908. Kirkhope, P. Bertram, Sandbank, Gwithian, Hayle, Cornwall, Explosives Works Chemist.

1905. Kirkland, John, 2, Cranworth Gardens, Brixton Road, S.W., Technical Instructor.

1900. Kirkpatrick, Prof. Stafford F., 84, Gore Street, Kingston, Ont., Canada, Professor of Metallurgy.

1913. Kirsebom, Gustave, Braden Copper Co., Molino, Rancagua, Chile, Metallurgical Engineer.

1911. Kirstein, H. C. *See* Bingham, H. C.

1902. Kitchen, Wm. J., Port Melbourne North, Vic., Australia, Soap and Candle Manufacturer.

1883. Kitto, B., 26, Lancaster Road, Finsbury Park, London, N., Analytical Chemist.

1900. Kittredge, H. G., c/o The Kay and Ess Co., Dayton, Ohio, U.S.A., Chemist.

1908. Klaber, Wm., c/o Castle Kid Co., Camden, N.J., U.S.A., Chemist.

1900. Kleber, Dr. Clemens, Clifton Chemical Laboratory, Passaic, N.J., U.S.A., Director.

1911. Klein, C. A., 4, Brimsdown Avenue, Enfield Highway, Middlesex, Works Chemist.

1909. Klemm, Wilfred E., 25, Marmion Road, Liverpool, Chemist.

1908. Klien, Dr. J. L., 7, King Street, Cheapside, London, E.C., Works Manager.

1903 Kline, Clarence M., 429, Arch Street, Philadelphia Pa., U.S.A., Wholesale Druggist.

1889. Klipstein, A., Messrs. A. Klipstein and Co., 644—654, Greenwich Street, New York City, U.S.A., Chemical Manufacturer.

1902. Klipstein, Ernest C., 93, Prospect Street, East Orange, N.J., U.S.A., Chemical Merchant.

1913. Klotz, W. C., Canadian Ammonia Co., Ltd., Toronto, Canada, Chemist.

1891. Knaggs, Alfred B., c/o Dr. Knaggs, Oak House, New North Road, Huddersfield, Technical Chemist in Dyeworks.

1911. Knapp, Arthur W., c/o Cadbury Bros., Ltd., Bourneville, near Birmingham, Research Chemist.

1911. Knapp, Harry P., c/o Talbot Dyewood and Chemical Co., 38-44, Middle Street, Lowell, Mass., U.S.A., Chemical Manufacturer.

1892. Knecht, Dr. E., Beech Mount, Marple, Cheshire, Professor of Tinctorial Chemistry.

1904. Kniffen, Frederick, 823, North Franklin Street, Wilmington, Del., U.S.A., Chemist.

1887. Knight, A. H., 51, Highfield Street, Liverpool, Assayer.

1903. Knight, Harley F., 14, Old Queen Street, Westminster, S.W., Analyst.

1887. Knights, J. West, 67, Tenison Road, Cambridge, Analytical Chemist.

1885. Knipler, F., "Strathberg," Greensborough, near Melbourne, Victoria, Starch Manufacturer.

1907. Knoedler, E. L., c/o Welsbach Co., Gloucester City, N.J., U.S.A., Factory Foreman.

1910. Knott, E. Anthony F., The Priestman Collieries, Ltd., Ottovale Coke Works, Blaydon-on-Tyne, Works Chemist.

1904. Knowles, W. R., The Hollies, Wood Green, Wednesbury, Chemical Works Manager.

1886. Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and (subs.) c/o Parbury, Henty, and Co., 20, Eastcheap, London, E.C., Sugar Manufacturer and Refiner.

1906. Knudsen, Kristian Hv., 96, Maiden Lane, New York City, U.S.A., Chemist.

1904. Koch, J. A., Bluff and Pride Streets, Pittsburg, Pa., U.S.A., Chemist.

1911. Kochs, A. Victor. *See* Derry, A. V.

1904. Koebig, Dr. J., Suite 1026, Union Oil Building, Los Angeles, Cal., U.S.A., Consulting Chemical Engineer.

1915. Koenig, W. A., 1802, North Smallwood Street, Baltimore, Md., U.S.A., Chemist.

1884. Kohn, Dr. Charles A. *See* Keane, Dr. Chas. A.

1902. Kohnstamm, Lothair S., 87, Park Place, New York City, U.S.A., Chemist.

1915. Kondakow, Prof. I, Prudowaja, 74, Jurjew, Livland, Russia, Director of Pharmaceutical Institute.

1913. Kondo, K., 136, Yoyogi, Tokyo, Japan, Chemical Engineer.

O.M. Kraftmeier, E. *See* Kay, Edward.

1891. Krause, Dr. Albert H., 1444, West 98th Street, Cleveland, Ohio, U.S.A., Chemist (Grasselli Chemical Co.).

1898. Krebs, H. J., 806, Franklin Street, Wilmington, Del., U.S.A., Manufacturing Chemist.

1908. Kress, Otto, Forest Products Laboratory, Madison, Wis., U.S.A., Teacher of Science.

1915. Kübler, Ernest, c/o The West Indies Chemical Works, Ltd., 1, Brazennose Street, Manchester, Dyewoods Chemist.

1916. Kubota, S., c/o Suzuki and Co., 29, Mincing Lane, London, E.C., Chemical Engineer.

1900. Kunheim, Dr. Erich, Juls. to c/o E. Hilt, Worlands Wharf, Wharf Street, Canning Town, E., Chemist.

1904. Kunz, Dr. George F., c/o Tiffany and Co., 409, 5th Avenue, New York City, U.S.A., Gem Expert.

1905. Kurt, Franklin T., 553, Boylston Street, Boston, Mass., U.S.A., Professor of Chemistry, B.Y.M.C.A.

1900. Kuttroff, Fred., 128, Duane Street, New York City U.S.A., Merchant.

O.M. Kynaston, J. W., 3, Oak Terrace, Beech Street, Liverpool, Chemical Engineer.

1907. Kynaston, Wm. C. R. on active service, Analyst.

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1906. Lacell, Harold G., Ardoch, Nether Street, Finchley, N., Chemist.

1890. Lacey, E. C., St. Julian's Lodge, St. Julian's Farm Road, West Norwood, Manufacturing Chemist.

1903. Lachman, Dr. Arthur, 1926 Lake Street, San Francisco, Cal., U.S.A., Chemical Engineer.

1915. Lacy, Edwin, 2, Eia Street, Antrim Road, Belfast, Ireland, Engineering Works Chemist.

1913. Laib, Walter, Rittman, Wayne Co., Ohio, U.S.A., Chemist (Ohio Salt Co.).

O.M. Laidler, C. P., 20, Noble Terrace, Gateshead-on-Tyne, Analytical Chemist.

O.M. Lake, G., jun., Lee Mount, Glossop, Derbyshire, Analytical Chemist.

1907. Lake, Henry B., The Manbré Saccharine Co., Hammersmith, W., Manager.

1900. Lamar, Wm. R., 327, North 18th Street, East Orange, N.J., U.S.A., Chemical Manufacturer.

1898. Lamb, Morris Chas., Leathersellers' Technical College, 176, Tower Bridge Road, London, S.E., Chemist.

1912. Lancaster, Harry C., 39, Ladbroke Grove, Kensington, W., Managing Director.

1907. Lancaster, Harry M., Laboratory, Provincial Board of Health, 5, Queen's Park, Toronto, Canada, Chemist.

1916. Land, Henry S., c/o Hardman and Holden, Ltd., Tar Distillers, Manchester; (J.) 7, Amos Street, Church Lane, Moston, Manchester, Works Chemist.

1914. Lander, Dr. G. D., Royal Veterinary College, Camden Town, London, N.W., Consulting Chemist.

1910. Landrum, R. D., c/o The Harshaw, Fuller and Goodwin Co., Electric Building, Cleveland, Ohio, U.S.A., Chemical Engineer.

1904. Lane, C. Cyril P., Chemist.

1910. Lane, J. Henry, 3, Arbour Square, Stepney, London, E., Analytical and Consulting Chemist.

1903. Lane, Nathaniel J., U.S. Laboratory, 641, Washington Street, New York City, U.S.A., Chemist.

1915. Lane-Hall, R., 4, Lloyds Avenue, London, E.C., Chemical Merchant.

1893. Lang, Dr. Wm. R., University of Toronto, Canada, Professor of Chemistry.

1892. Langer, Dr. Carl, Bucklebury Place, Woolhampton, Berks, Analytical Chemist.

1914. Langlands, S. H. B., Glasgow Corporation Lighting Dept., 20, Trongate, Glasgow, Chief Inspector of Lighting.

1897. Langmuir, Arthur C., c/o Marx and Rawolle, 9, Van Brunt Street, Brooklyn, N.Y., U.S.A., Factory Manager.

1902. Langmuir, F. Leighton, 288, Bloor Street West, Toronto, Canada, Chemist.

1898. Langstaff, Wm., 39, Orchard Street, Elizabeth, N.J., U.S.A., Chemist.

1915. Langton, H. M., The Universal Oil Co., Ltd., Kynochtown, Stanford-le-Hope, Essex, Research Chemist.

1916. Lankshear, F. R., 63, Birchfields Road, Rusholme, Manchester, Works Manager.

1900. Lant, Herbert, "Ivy Bank," Wath-on-Dearne, near Rotherham, Yorks, Chemist and Manager.

1909. Lantsberry, Fred. C. A. H., Birmingham Small Arms Co., and (Journal) 63, Walford Road, Sparkbrook, Birmingham, Metallurgical Chemist.

1906. Lantz, Lieut. Alfred, 139, Rue La Fayette, Paris, France, Chemical and Colour Manufacturer.

1914. Laplante-Courville, H., Laval Dental School, Montreal, Canada, Lecturer.

1915. Lapworth, Prof. Arthur, F.R.S., The University, Manchester, Professor of Organic Chemistry.

1903. Larter, Alfred T., 5, Rookfield Avenue, Muswell Hill, N., Chemist.

1904. Lasher, F. G., 251, Bush Street, Brooklyn, N.Y., U.S.A., Chemist.

1915. Lass, W. P., Juneau, Alaska, U.S.A., Metallurgist.

1884. Latham, Baldwin, Parliament Mansions, Victoria Street, Westminster, S.W., Civil Engineer.

1889. Latham, J. J., Mill House, Bold, Widnes, Chemical Works Manager.

1907. Lathwood, Arthur, c/o Borax Consolidated, Ltd., 16, Eastcheap, London, E.C., and (Jnls.) The Briars, Maidstone Road, Bounds Green, N., Chemist.

1914. Lauder, Dr. Alex., College of Agriculture, 13, George Square, Edinburgh, Lecturer in Chemistry.

1914. Laurie, Dr. A. P., Heriot Watt College, Chambers Street, Edinburgh, Principal.

1915. Lavender, John H., c/o E. G. Wrigley and Co., Ltd., Foundry Lane Works, Soho, Birmingham, Metallurgical Chemist.

1909. Law, Douglas J., 9, Seely Road, Lenton Sands, Nottingham, Chemist.

1915. Law, Dr. H. Drake, Castle Fields, Rastrick, Brighouse, Yorks, Chemist.

1913. Law, John A., c/o Barry, Ostlere, and Shepherd, Ltd., Forth Works, Kirkcaldy, Scotland, Linoleum Works Director.

1907. La Wall, Chas. H. 39, South 10th Street, Philadelphia, Pa., U.S.A., Analytical Chemist.

O.M. Lawrence, Jas., c/o Dr. T. P. Grant, Montraive, Blantyre, Scotland, Explosives Manufacturer.

1911. Lawrence, Wm. A., Laboratory, 11, Vandewater Street, New York City, U.S.A., Director.

1916. Lawrenson, Thos., Glen Lea, King Edward Street, Middlewich, Cheshire, Manufacturing Chemist.

1904. Lawson, Jos. H. S., Rodney Street Works, Oldham Road, Manchester, Salesman.

1894. Lawson-Johnston, G., (Journals) 29, Portman Square, W., and 1, King's Arms Yard, London, E.C., Chairman of Bovril, Ltd.

1894. Lawson-Johnston, W. E., c/o Bovril, Ltd., 152 Old Street, London, E.C., Director.

1907. Leach, Dr. F. P., Kingsway House, Frodsham, Cheshire, Research Chemist.

1908. Leake, Percy C., Deanbank Terrace, Ferryhill Village, Co. Durham, Tar Works Manager.

1898. Lean, Geo., 3, Park Quadrant, Glasgow, Chemist.

O.M. Leather, Major J. Walter, 3rd Garrison Battn., Cheshire Regt., Ramsey, Isle of Man, retain Journals; Government Chemist.

1893. Le Boutillier, Clement, c/o Taylor Iron and Steel Co., High Bridge, N.J., U.S.A., Chemist.

1904. Le Chatelier, Prof. H., 75, Rue Notre Dame des Champs, Paris, France, Professor (l'Ecole des Mines).

1896. Lecomber, W. G., Cambridge Works, Knott Mill, Manchester, Engineer.

1896. Lederle, Dr. E. J., 39, West 38th Street, New York City, U.S.A. Chemist.

1892. Ledoff, Prof. A., Technological Institute, Kharkoff, Russia, Professor of Chemistry.

1895. Ledoux, Dr. Albert R., 99, John Street, New York City, U.S.A., Chemist.

1903. Ledoux, Aug. D., 15, William Street, New York City, U.S.A., Importer of Pyrites.

1915. Ledoux, F., Société Minière Métallurgique de Peñarroya, 12, Place Vendome, Paris, Director-General.

1915. Ledwidge, Jos. G., Municipal Technical School, Drogheda, Ireland, Analytical Chemist.

1905. Lee, Ashton, Lawrence, Mass., U.S.A., Manufacturing Chemist.

1905. Lee, Frank W., Lawrence, Mass., U.S.A., Manufacturing Chemist.

1905. Lee, John C., Wellesley, Mass., U.S.A., Assistant Engineer (American Telegraph and Telephone Co.).

1898. Lee, Jno. L., Woodfield, Lytham, Lancashire, Dyer and Bleacher.

1885. Lee, S. Wright, 6–10, Whitechapel, Liverpool, Wholesale Druggist.

1906. Lee, William, 28, Sherard Gardens, Eltham, Kent, Works Chemist.

1915. Leech, Ben., 77, Pownall Street, Macclesfield, Consulting Chemist.

1916. Leech, Herbert L., Cornbrook Chemical Co., Stockport, Director and Works Manager.

1912. Lees, Arnold, Loidis, Aulaby Park, Hull, Analytical Chemist.

1915. Leese, Ernest, c/o Wilson's Portland Cement Co., Warkworth, Auckland, New Zealand, Works Chemist.

1901. Leffler, Rudolf L., c/o Thos. Firth and Sons, Ltd., Norfolk Works, Sheffield, Metallurgical Chemist.

1914. Legg, Bertram, Minas de Rio Tinto, Prov. Huelva, Spain, Chemist and Assayer.

1915. Leggett, T. S. L., 296, New Chester Road, Port Sunlight, Cheshire, Chemist.

1907. Lehmann, Dr. Adolf, University of Alberta, Strathcona, Alberta, Canada, Professor of Chemistry.

1888. Leigh, Cecil, Birmingham Metal and Munition Co., Adderley Park Rolling Mills, Birmingham, Technical Chemist.

1902. Leighton, A. E., Commonwealth Cordite Factory, Maribyrnong, Victoria, Australia, Analytical Chemist.

1894. Leitch, Jno. W., Milnsbridge Chemical Works, near Huddersfield, Aniline Dye Manufacturer.

1904. Le Maistre, Fred. J., Ridley Park, Pa., U.S.A., Research Chemist.

1898. Leman, Wm. T., P.O. Box 747, Chicago, Ill., U.S.A., Oil and Asphalt Agent.

1883. Lennard, F., c/o Forbes Abbott, and Lennard, Ltd., Chemical Works, Shoreham, Sussex, Chemical Manufacturer.

1884. Leonard, Wm. J., 1, Lindfield Gardens, Hampstead, N.W., Naphtha Distiller.

1904. Lesley, R. W., 604, Pennsylvania Building, Philadelphia, Pa., U.S.A., Cement Manufacturer.

1907 Leslie, Dr. Fred. A., College of Pharmacy, 115, West 68th Street, New York City, U.S.A., Chemist.

1904. Lessing, Dr. Rudolf, Southampton House, 317, High Holborn, London, W.C., Consulting Chemist.

1912. Lessner, C., Carril, Spain, Metallurgical Chemist.

1892. Lester, J. H., The Laboratory, 56, Oxford Street, Manchester, Analytical Chemist.

1899. Lo Sueur, Dr. Henry R., Chemical Laboratory, St. Thomas' Hospital, London, S.E., Demonstrator.

1891. Lever, Sir Wm. H., Bart., Thornton House, Thornton Hough, Cheshire, Soap Manufacturer.

1909. Lever, W. Hulme, Heathfield, Bebington, Cheshire, Soap Manufacturer.

1901. Levett, Walter, Holmlands, Stanford-le-Hope; and (Journals) Mines Safety Explosives Co., Stanford-le-Hope, Essex, Factory Manager.

1915. Levey, Alfred E., 21, Willoughby Road, Waterloo, Liverpool, Works Chemist.

1903 Levi, Dr. Louis E., 731, Sherman Boulevard, Milwaukee, Wis., U.S.A., Chemist.

1912. Levin, Isaac H., 186, Hillside Avenue, Newark, N.J., U.S.A., Chemist.

1906. Levinstein, Edgar, 74, India Street, Boston, Mass., U.S.A., Chemical Manufacturer.

1901. Levinstein, Dr. Herbert, c/o Levinstein, Ltd., Blackley, near Manchester, Chemist.

1903. Levy, Arthur G., 1923, Madison Avenue, New York City, U.S.A., Chemist.

1909. Levy, Louis S., 80, Maiden Lane, New York City, U.S.A., Editor "American Perfumer."

1901. Levy-Mond, Dr. Albert. *See* Mond, Dr. Albert L.

1898. Lewin, H. James, Royal Clarence Yard, Gosport, Hants, Analytical Chemist.

1914. Lewis, C. Preston, 223, Brixton Hill, London, S.W., Technical Chemist.

1896. Lewis, Daniel C., c/o Millville Manufacturing Co., Millville, N.J., U.S.A., Dye Works Chemist.

1904. Lewis, Edw. W., c/o J. G. Ingram and Sons, London India Rubber Works, Hackney Wick, N.E., Chemist.

1900. Lewis, Ernest A., 310, Dudley Road, Birmingham, Chemist and Metallurgist.

1900. Lewis, John, 76, Underhill Road, Lordship Lane, S.E., Cashier (Paint Works).

1909. Lewis, Reginald J., Govt. Explosives Office, 423, Flinders Lane, Melbourne, Australia, Chemist.

1900. Lewis, Dr. S. Judd, The Laboratories, Staple Inn Buildings, High Holborn, London, W.C., Analytical Chemist.

1914. Lewis, Prof. W. C. McC., Muspratt Laboratory, The University, Liverpool, Professor of Physical Chemistry.

1913. Lewkowitsch, Mrs. K. J., The Lewkowitsch Laboratories, 71, Priory Road, West Hampstead, N.W.

1907. Leyson, Lewis T., Pencynor, near Neath, S. Wales, Analytical Chemist.

1901. Lichtenstein, Alf. F., c/o Geisenheimer and Co., P.O. Box 994, New York City, U.S.A., Chemist.

1913. Lichtenstein, L. M., Royal Albert and Victoria Docks Chemical Works, Silvertown, London, E., Manufacturing Chemist.

O.M. Liebmann, Dr. A., The Whim, Weybridge, Surrey, Consulting Chemist.

O.M. Lightfoot, T. E., Fernleigh, Accrington, Calico Printer's Chemist.

1905. Liley, Thos. A., 46, Westover Road, Bramley, Leeds, Chemist.

1898. Lilly, Josiah K., c/o Eli Lilly and Co., Indianapolis, Ind., U.S.A., Manufacturing Pharmacist.

1904. Lindemann, Ottocar, 53, Victoria Street, Westminster, S.W., Managing Director (Korting Bros., Ltd.)

1908. Lindfield, James H., c/o Messrs. Martineau, King Edward Street, Whitechapel, E., Technical Chemist.

1897. Lindsay, Robt., Transvaal G.M. Estates, Ltd., Pilgrim's Rest, Lydenburg, Transvaal, Chemist.

1890. Ling, Arthur R., Laboratory, 74, Great Tower Street, London, E.C., Consulting Chemist.

1896. Lishman, Geo. P., Lambton Coke Works, Fence Houses, Co. Durham, Colliery Chemist.

1905. Little, Arthur D., 93, Broad Street, Boston, Mass., U.S.A., Consulting Chemist.

O.M. Littlejohn, Jas., c/o Littlejohn and Whitby, P.O. Box 849, Johannesburg, Transvaal, Analytical Chemist.

1904. Livermore, W. D., Washington Mill, Lawrence, Mass., U.S.A.,, Chemist.

1886. Liversedge, A. J., 63, Northampton Road, Croydon, Mechanical Engineer.

1914. Liversedge, John A., The Whangarei Freezing Works, Restahi, New Zealand, Assistant Lead Mill Manager.

O.M. Liversidge, Prof. A., F.R.S., Field Head, Coombe Warren, Kingston, Surrey, Professor of Chemistry.

1883. Livingston, W. J., 30, Fountayne Road, Stoke Newington Common, London, N., Analytical Chemist.

1903. Llewellyn, Ivor P., 149, Moorland Road, Stockport, Chemist.

1907. Llewellyn, W. B., 114, Belgrave Road, New Moston, Manchester, Chemist.

1909. Lloyd, Edward, 27, Broomgrove Road, Sheffield, Chemical Engineer.

1913. Lloyd, Prof. Francis E., Dept. of Botany, McGill University, Montreal, Canada, Prof. of Botany.

1904. Lloyd, Leonard B., Whitehall Street, Yarraville, Victoria, Australia, Tanner.

1907. Lloyd, Dr. Lorenzo L., Technical College, Bradford, Yorks, Lecturer in Chemistry.

1916. Lloyd, Prof. Stewart J., University, Alabama, U.S.A., Professor of Chemistry.

1914. Lockett, William T., 74, Victoria Road, Urmston, Manchester, Research Chemist.

1915. Lockie, J. R., Ascog, Meikleriggs, Paisley, Scotland, Analytical Chemist.

1916. Lockwood, Jos. H., c/o Brimsdown Lead Co., Brimsdown, Middlesex, Analytical Chemist.

1888. Lodge, Edw., 35, Scale Hill, Cowcliffe, Huddersfield, Teacher of Wool Dyeing.

1916. Lodge, Wm. C., c/o Canadian Inspection Co., 603, Canadian Express Building, Montreal, Canada, Chemist.

1907. Lomax, E. Lawson, c/o Hall Motor Fuel, Ltd., Thames Haven, Essex, Chemist.

1916. Long, Allan L., c/o Matthews-Blackwell, Ltd, Toronto, Canada, Chemical Engineer.

1901. Long, Eugene J., c/o E. O'Callaghan and Son City Tannery, Limerick, Ireland, Tanner.

1909. Long, George, Cudahy, Wis., U.S.A., Glue Maker.

1898. Longstaff, Dr. Jas. P., Chemical Department, The University, Edinburgh, Assistant.

1890. Lord, F. J., Winmarleigh, Southbourne, Bournemouth, Hants, Analytical Chemist.

1896. Lord, Jno. Lloyd, Wellington Cement Works, Elton, Bury, Lancs, Chemist and Manager.

O.M. Lorenz, H., 7 and 8, Idol Lane, London, E.C., Chemical Merchant.

1905. Loring, Lindsley, 40, Central Street, Boston, Mass., U.S.A., Vice-President (Cochrane Chemical Co.).

1909. Lorleberg, C., c/o R. W. Greeff and Co., Thames House, Queen Street Place, London, E.C., Chemical Merchant.

O.M. Lott, F. E., The Laboratory, Bridge Chambers Burton-on-Trent, Consulting Brewing Chemist.

1894. Louis, Prof Henry, Armstrong College, Newcastle-on-Tyne, Professor of Mining.

O.M. Love, Dr. E. G., 124, East 15th Street, New York City, U.S.A., Analytical Chemist.

1899. Love, Wm., 28, Royal Exchange Square, Glasgow, Managing Director (Broxburn Oil Co., Ltd.).

O.M. Lovibond, T. W., West Jesmond House, Newcastle-on-Tyne, Brewer.

1913. Low, Frank S., c/o Cutler-Hammer Manufacturing Co., 144th Street and Southern Boulevard, New York City, U.S.A., Chemical Engineer.

1900. Low, Prof. Wilson H., Cudahy Packing Co., South Omaha, Neb., U.S.A., Chemist.

1911. Lowcock, J. Harold, 39, Wickham Way, Park Langley, Beckenham, Kent, Chemist.

1913. Lowe, Austin, 39, Chelverton Road, Putney, S.W., Research Chemist.

1887. Lowe, Clement W., Thorneyholme, Knutsford, Cheshire, Manufacturing Chemist.

O.M. Lowe, W. F., 18, Hough Green, Chester, Analytical Chemist.

1906. Lowson, Wm., The University, Leeds, Chemical Lecturer.

1895. Lucas, Alf., Laboratories, Public Works Ministry Gardens, Cairo, Egypt, Analyst.

1892. Lucas, Bernard R., Winnington Park, Northwich, Alkali Works Manager.

O.M. Luck, A. Courtenay, San Martin 475, Buenos Aires, Argentina, Explosives Chemist.

1913. Lucy, Arthur J., Newbury, Upper Broadheath, near Worcester, Consulting Engineer.

1916. Luff, B. D. W., 85, Ashley Terrace, Edinburgh, Technical Chemist.

1915. Lumley, Edgar P., 37, General Graham Street, Chester Road, Sunderland, Chemist.

1900. Lummus, Walter E., 39, Bassett Street, Lynn, Mass. U.S.A., Manager.

1903. Lumsden, Alex. A., Forth Chemical Works, Bo'ness Scotland, Technical Chemist.

1910. Lumsden, William W., 39, Caledonia Road, Saltcoats, Scotland.

1888. Lund, Jas., 112, Hawthorne Street, Malden, Mass., U.S.A., Ammonia Works Manager.

1915. Lund, W. Jackson, 8, Temple Road, Stowmarket, Suffolk, Chemist.

1888. Lundholm, Carl O., 220, Winchester House, Old Broad Street, London, E.C., Explosives Works Manager.

O.M. Lunge, Dr. G., Carmenstrasse 37, Zürich, Switzerland, Professor of Chemistry.

1885. Lupton, Sydney, 102, Park Street, Grosvenor Square, London, W.

1884. Lüthy, Otto, Hackensack, N.J., U.S.A., Analytical Chemist.

1903. Lye, Ernest B., Leagrave Hall, near Luton, Beds, Straw Plait Dyer and Bleacher.

1885. Lye, W. T., Leagrave Hall, near Luton, Beds, Straw Dyer.

1915. Lyle, C. E. Leonard, 21, Mincing Lane, London, E.C., Sugar Refiner.

1884. Lyle, James, Ardesco, West Silvertown, E., Sugar Refiner.

1896. Lymn, Arthur H., Sanctuary House, Tothill Street, Westminster, S.W., Consulting Chemical and Gas Engineer.

1899. Lynn, R. Rankine, 8, Windsor Quadrant, Kelvinside, Glasgow, Chemical Engineer.

1906. Lyons, Robert H., c/o Canadian Explosives, Ltd., Beloeil Station, Quebec, Canada, Chemist.

O.M. Lytle, A. M., North of Ireland Chemical Co., Ltd., 34 Victoria Street, Belfast, Ireland, Chemical Manufacturer.

M

1908. Maas, Milton A., 92, William Street, New York City, U.S.A., Manufacturing Chemist.

1911. Mabbitt, Alan T., 3, Wallwood Road, Leytonstone, N.E., Analytical Chemist.

1887. Mabery, Prof. Chas. F., Case School of Applied Science, Cleveland, Ohio, U.S.A., Professor of Chemistry.

1891. Macadam, Herbert E., Dalkeith, Glengall Road, Woodford Green, Essex, Manure Works Manager.

1894. Macadam, Stevenson, 55, York Place, Edinburgh, Analytical Chemist.

1912. McAfee, Dr. A. M., c/o The Gulf Refining Co., Port Arthur, Texas, U.S.A., Chemist.

1894. McAlley, Robt., Bankside, Falkirk, Scotland, Paint Works Manager.

1892. Macara, Thos., jun., 20, Denton Road, Stroud Green, N., Chemist.

1912. McArly, T. P., Mount Lyell Mining and Railway Co., Queenstown, Tasmania, Chemist and Assayer.

1887. McArthur, James B., Price's Patent Candle Co., Limited, Belmont Works, Battersea, S.W., Chemist.

O.M. McArthur, J. S., Loch Lomond Radium Works, Balloch, Dumbartonshire, Consulting Chemist and Metallurgist.

1901. Macarthur, Jno. S., 15, St. John's Road, Pollokshields, Glasgow, Paint and Varnish Manufacturer.

1892. McArthur, Thos., 711, Tower Building, Water Street, Liverpool, Drysalter and Dyewood Extractor.

1912. Macaulay, J. W., Holwell Iron Works, Asfordby, near Melton Mowbray, Leicestershire, Metallurgical Chemist.

1898. MacCallum, D. A., 389, Central Chambers, 93, Hope Street, Glasgow, Chemist.

O.M. McCallum, Sir J. M., M.P., Southdene, Paisley, Scotland, Soap Manufacturer.

1914. McCarthy, Robt. A., Bertram Street, Mortlake, Sydney, N.S.W., Australia, Gas Chemist.

1905. McCaw, Lt.-Col. W. D., Library, Surgeon General's Office, Washington, D.C., U.S.A., Officer, Medical Department, U.S. Army.

1915. McCleak, G. E., 88, Weston Road, Strood, Rochester, Explosives Chemist.

1905. McCleary, Wm., 61, Station Road, Pendlebury, near Manchester, Finisher.

1910. McColl, A. L., 60, Addingham Road, Mosseley Hill, Liverpool, Chemist.

1903. McCourt, Cyril D., 29, Criffel Avenue, Streatham Hill, S.W., Chemist.

1913. McCrady, McH., 9, St. James' Street, Montreal, Canada, Chemist and Bacteriologist.

1897. McCrae, Dr. John, Government Laboratories, P.O. Box 1080, Johannesburg, Transvaal, Government Analyst.

1898. McCreath, Wm. D., Quantock Vale Cider Works, North Petherton, Bridgewater, Cider Manufacturer.

1900. McCulloch, John, Glencoe, Lostock Gralam, near Northwich, Cheshire, Chemical Engineer.

1911. McCulloch, Norman G., Rhodes Works, Rhodes Manchester, Chemist and Calico Printer.

1903. McCully, R. E. J., c/o Indian Cement Co., Norbandar, Kathiawar, India, and (Jnls.) 13, Lance Lane, Wavertree, Liverpool, Analytical Chemist.

1916. McDermott, F. A., c/o Corby Co., Station K., Washington, D.C., U.S.A., Research Chemist.

1910. Macdonald, Alexander, Netherlea, Matilda Road, Pollokshields, Glasgow, Manufacturing Chemist.

1912. McDonald, Allan D., "Belgrano," Milngavie, near Glasgow, Manufacturing Chemist.

O.M. Macdonald, Andrew, 72, Great Clyde Street, Glasgow.

1912. McDonald, Donald, 95, Clarence Gate Gardens, Regent's Park, London, N.W., Analytical Chemist.

1897. MacDonald, G. W., Whitefriars, Rochester, Kent, Chief Explosives Research Chemist (Curtis's and Harvey, Ltd.).

1910. Macdonald, J. L. A., 13, Howard Place, St. Andrews, Fife, Scotland.

O.M. Macdonald, J. W., c/o Henry Tate and Sons, Ltd., Thames Sugar Refinery, Silvertown, E., Analytical Chemist.

O.M. McDonald, T. McG., Walilabo Estate, St. Vincent, West Indies, Sugar Chemist.

1890. McDougall, J. T., Dunolly, Morden Road, Blackheath, S.E., Manufacturing Chemist.

1906. McDowall, Wm., c/o Anglo Chilian Nitrate and Railway Co., Tocopilla, Chili, Analytical Chemist.

1889. MacEwan, Peter, 64, Southwood Lane, Highgate, N., Editor of "Chemist and Druggist."

1901. McEwen, Duncan C., c/o Chosen Gold Mines, Ltd., Kok-Kang-Kol Mine, Chung-An, Korea, Metallurgical Chemist.

1914. McFadyen, F. H., Canadian Rubber Co., Cor. Notre Dame and Papineau, Montreal, Canada, Chemist.
1902. McFarland, Alan R., c/o Solvay Process Co., Syracuse, N.Y., U.S.A., Alkali Works Manager,
1910. McFarlane, John, 6, Gordon Terrace, Shettleston, Glasgow, Metallurgist.
1893. McGhie, T. Burns, c/o Dr. Goodall, 1, Annandale Road, East Greenwich, S.E., Metallurgist.
1904 McGill, Dr. A., 317, Queen Street. Ottawa, Canada. Analytical Chemist.
1899. MacGillivray, Wm. A., c/o Swansea Safety Fuse Co., Pipe House Wharf, Swansea, Analytical Chemist.
1887. McGlashan, John, Post Office, Tolodi Balapur, Dist. Chanda, C.P., India, Technical Chemist.
1896. McIlhiney, Dr. Parker C., 50, East 41st Street, New York City. U.S.A., Chemist.
O.M. McIlwaine, Alf. W., Stoneferry, Hull, Oil Manufacturer.
O.M. MacIndoe, G. D., Ness Street, Invercargill, New Zealand, Public Analyst and Consulting Chemist.
1914. MacInnes, Wm., 126, Dixon Avenue, Crosshill, Glasgow, Fire Surveyor.
1903. Macintire, Benj. Gould, c/o du Pont Powder Co., Georgetown, S.C., U.S.A., Chemist.
1913. MacIntosh, George, c/o Marx and Rawolle, of Canada, Ltd., 516, St. Ambroise Street, Montreal, Canada, Glycerin Works Manager.
1909. McIntyre, George D., Beaver Knitting Mills, Alton, Ontario, Canada, Technical Chemist.
1914. MacIvor, R. W. Emerson, c/o Metals Recovery, Ltd., 47, Victoria Street, Westminster, S.W., Consulting Chemist.
1910. Mackay, Angus, Laboratory, Wellpark Brewery, Glasgow, Brewer's Chemist.
1911. Mackay, F., Oficina Agua Santa, Negreiros, Iquique, Chille, Analytical Chemist.
1912. McKechnie, Alex., Chad Hill Cottage, Edgbaston, Birmingham, Copper Smelter.
1904. McKechnie, R. D., c/o British Aluminium Co., Ltd., Larne Harbour, co. Antrim, Ireland, Chemical Engineer.
1887. McKellar, W. G., c/o United Alkali Co., Ltd., St. Rollox Works, Glasgow, Technical Chemist.
1895. McKenna, Dr. Chas. F., 50, Church Street, New York City, U.S.A., Chemist.
1899. McKenzie, Alex. H., 17, North Street, North Adams, Mass., U.S.A., Colour Mixer.
1915. MacKenzie, John, 312, Grosvenor Terrace, Linthorpe Road, Middlesborough, Engineer.
1909. Mackenzie, Kenneth G., c/o The Texas Co., Bayonne, N.J., U.S.A., Chemist.
1893. McKerrow, C. A., 8, Berners Street Mansions, London, W.; and (Journals) c/o Mitchells, Ashworth, and Co., 23 24, Old Bailey, London, E.C. Consulting Chemist.
1893. McKesson, John, 91, Fulton Street, New York City, U.S.A., Manufacturing Chemist.
1911. McKey, Arthur W., 216, Milk Street, Boston, Mass., U.S.A.. Sales Agent.
1891. Mackey, W. McD., Victoria Chambers, Leeds, Analytical Chemist.
1912. McKillop, G. F., Oilworks, Broxburn, West Lothian, Scotland, Works Chemist.
1890. McKillop, Jno., 32, Aynho Road. Hammersmith, W., and (Jnls.) c/o W. Müller, 69A, Great Queen Street, Kingsway, W.C., Metallurgist.
1902. McKim, Wm., 37, Fairview Street, Yonkers, N.Y., U.S.A., Colour Maker.
1915. MacKusick, M. H., The Rubber Regenerating Co., Westinghouse Road, Trafford Park, Manchester, Managing Director.
1908. McLaren, Alex., c/o W. P. Hartley, Aintree, Liverpool, Analytical Chemist.
1908. McLaren, Alex. W., Ramsden Dock, Barrow-in-Furness, Analytical Chemist.
1916. McLaren, Geo., 25, Lytton Avenue, Palmers Green, N., Analytical Chemist.
1898. McLaurin, Robt., Homesteads, Cambusbarron, Stirling, Chemist.
1905. McLellan, Basil G., c/o Rowntree and Co., Ltd., The Cocoa Works, York, Technical Chemist.
1910. MacLellan, George A., 1, Montague Terrace, Glasgow, W., Rubber Manufacturer.
1908. Macleod, Alex., Mount Pleasant, Old Kilpatrick, Dumbartonshire, Analytical Chemist.
1914. MacLeod, Fred. L., 694, Duke Street, Glasgow, Chemical Manufacturer.
1892. McLeod, Jas., Gas Works, Greenock, Manager.
1912. McMaster, Prof. Le Roy, Washington University, St. Louis, Mo., U.S.A., Assoc. Prof. of Chemistry.
1904. McMullen, Alan, Saint James' Gate, Dublin, Ireland, Brewer.
1895. McMurtry, G. C., Templemore, Richmond, Nelson, New Zealand, Manager.
O.M. Macnab, W., 10, Cromwell Crescent, London, S.W., Analytical Chemist.
1907. McNaughton, Wm. G., Port Edwards, Wis., U.S.A., Chemist.
1908. McQueen, James, jun., on active service, Chemical Manufacturer.
1912. McRae, J. A., 184, University Avenue, Kingston, Ont., Canada, Research Chemist.
1914. McTavish, D. D., 626, Roslyn Avenue, Westmount, Quebec, Canada, General Manager, Canada Carbide Co.
1909. McWhirter, James, c/o Wm. Beardmore and Co., Laboratory, Parkhead Forge, Glasgow, Metallurgical Chemist.
1910. Madge, Norman, c/o Continental Rubber Co. of New York, 11, Vandewater Street, New York City, U.S.A., Chemist.
1901. Magruder, Egbert W., Department of Agriculture, Richmond, Va., U.S.A., Chemist.
1912. Main, Hugh, Almondale, Buckingham Road, South Woodford, N.E., Analytical Chemist.
1898. Main, Wm., Piermont, N.Y., U.S.A., Chemist.
1915. Maitland, Prof. W., Robert Gordon's Technical College, Aberdeen, Professor of Chemistry.
1905. Major, Ernest, c/o Major Bros. and Co., Johnstone's Bay, Balmain, Sydney, N.S.W., Paint and Chemical Manufacturer.
O.M. Major, J. Lewis, Welton Garth, Brough, East Yorks, Tar Distiller and Chemical Manufacturer.
1910. Male, C. E., c/o Bankoku Toryo Seizosho, P.O. Box No. 141, Kobe, Japan, Chemist.
1886. Mallinckrodt, Edw., Library, Mallinckrodt Chemical Works, St. Louis, Mo., U.S.A., Manufacturing Chemist.
1916. Malpas, A. E., "Inglenook," Flint, North Wales, Manager (Perchlorate Works).
1915. Manahan, E. H., c/o J. C. Wiarda and Co., and (Journals) 1672, 46th Street, Brooklyn, N.Y., U.S.A., Manager.
1912. Manley, Chas. E., 8, Wilmington Gardens, Barking, Essex, Paint and Colour Works Manager.
1893. Mann, Harold H., Agricultural College, Poona, Bombay, India, Research Chemist.
1899. Mann, Jas. S., 19, Stopford Road, Upton Manor, Essex, Analyst.
1891. Mann, John C., 33, Nicholls Street, West Bromwich, Staffs, Chemist.
1914. Mann, William, Messrs. Mann and Cook, 27, St. Mary Axe, London, E.C., Oil and Chemical Merchant.
1892. Mansbridge, Wm., 4, Norwich Road, Wavertree, Liverpool, Chemist.
1915. Mansfield, John, 433, Beverley Road, Hull, Manufacturer of Oils and Fats.
1883. Markel, Dr. K. E., 20, Queen's Gate Terrace, South Kensington, S.W., Technical Chemist.
1905. Marland, Percy, c/o Major and Co., Ltd., Sculcoates, Hull, Technical Chemist.
1905. Marlatt, Wilbur T., Oakville, Ont., Canada, Leather Manufacturer.
1912. Marly, Dr. Simon M., 34, Arbour Street, Southport, Analytical Chemist.
1914. Marples, Morris E., 7, Alfred Road, Birkenhead, Chemist.

1916. Marriott, A. W., 21, Tennyson Street, Nottingham, Analytical Chemist.
1904. Marris, H. C., 68, Schlüsselburg Prospect, Petrograd, Russia, Analytical Chemist.
1901. Marsden, Dr. Fred., Technical Institute, Madura, South India, Chemist.
1906. Marsden, Oliver, Manor Road Mill, Victoria Road, Leeds, Cashier.
O.M. Marsh, J. T., Ammonia Soda Works, Fleetwood, Lancashire, Chemist.
1883. Marsh, W., Union Alkali Co., Soho Works, Ancoats, Manchester, Chemical Manufacturer.
1895. Marshall, Arthur, Waverley Cottage, Naini Tal, India, Chief Chemical Examiner.
1895. Marshall, Francis G., 56, Bewick Road, Gateshead. Technical Chemist.
1908. Marshall, John, Cudbear Street, Hunslet, Leeds. Dyeware Manufacturer.
1913. Marshall. Philip W., c/o The Fred. Crane Chemical Co., Armoury Close, Bordesley Green, Birmingham. Lacquer Manufacturer (retired).
1883. Marshall, Wm., Laboratory, Ladybrook Road, Cheadle Hulme. Cheshire, Dyer.
1884. Marshall, Wm., 9. Castello Avenue, Putney Park, S.W., Analytical Chemist.
1904. Marston, John P., 247, Atlantic Avenue, Boston, Mass., U.S.A., Merchant.
1894. Martin, Alex. M., Hillview, Twechar by Glasgow, Analytical Chemist.
1895. Martin, Chas. H., 50, Longmead Road, Claremont, Pendleton, Manchester, Oil and Soap Works Manager.
1913. Martin, Edwin J., c/o Jas. Martin and Sons, Luton, Beds, Bleacher and Dyer.
1911. Martin, Dr. G., 21, Hamilton Crescent. Palmers Green. N., Science Teacher and Industrial Chemist.
O.M. Martin. N. H., Ravenswood, Low Fell, Gateshead-on-Tyne, Manufacturing Chemist.
1916. Martin, V. M., 68, Upper Thames Street, London, E.C., Fur Skin Dyer and Dresser.
1899. Martin, Wm. E., 111, Belle Vue Road, Durban, Natal, South Africa, Chemist.
1887. Martineau, Sydney, Streatham Grove, Norwood, S.E., Sugar Chemist.
1894. Martyn, T. Graham, Box 5, Maraisburg, Transvaal, South Africa, Metallurgist.
1909. Marx, Robert J., 133–139, Finsbury Pavement, London, E.C., Engineer.
1904. Mason, Dr. Edward D., 32, Vernon Road, Edgbaston, Birmingham, Scientific Apparatus Dealer.
1911. Mason, Francis A., c/o Murphy and Lonsdale, 4, Queen Square, Leeds, Analytical Chemist.
1915. Mason, Dr. Fredk. A., 21, Queen Square, London, W.C., Demonstrator in Chemistry.
1906. Mason, Dr. Frederic S., 90, Beckman Street, New York City, U.S.A., Manufacturing Chemist.
1887. Mason, J. Francis, Eynsham Hall, Witney. Oxon.
1914. Mason, William O. S., Bankside, Meopham, near Gravesend, Kent, Analytical Chemist.
1915. Masse, René, Syndicat Professionnel de l'Industrie du Gaz, 94, Rue Saint Lazare, Paris IX., France, President.
O.M. Masson, Prof. D. Orme, University of Melbourne, Victoria, Australia, Professor of Chemistry.
1908. Masson, P. Duncan, c/o Messrs. R. Silcock and Sons, Stanley Hall, Union Street, Liverpool, Analytical Chemist.
1902. Masujima, Prof. Bunjiro, c/o K. Takebe, 16, Gazenbocho, Azabuku, Tokyo, Japan, Prof. of Applied Chemistry.
1910. Matchet, Andrew S., 13, Bute Gardens, Muirend, Cathcart, Glasgow, Analytical Chemist.
1911. Mather, Hubert, Lonsdale Terrace, Whitefield, Lancashire, Chemist.
O.M. Mather, J., Blaydon Chemical Works, Blaydon-on-Tyne, Manager.
1900. Mather, Wm., c/o The Standard Chemical Iron and Lumber Co., Montreal, Canada, Chemist.
1907. Matheson, A. Greville E., Sark Bank, Gretna, Carlisle, Engineer.
1890. Matheson, W. J., c/o Cassella Color Co., 182, Front Street, New York City, U.S.A., Chemical Merchant.
1901. Mathew, W. E. B. de Vere, Dinham, Hillside Gardens, Wallington, Surrey, Analytical Chemist.
1898. Mathewson, E. P., Anaconda, Mont., U.S.A., Metallurgist.
1888. Matos, Dr. Louis J., (Comms.) 103, North 19th Street. East Orange, N.J., and (Jnls.) c/o Cassella Color Co., 182–4, Front Street, New York City, U.S.A., Chemist.
1896. Matsui, G., 10, Nishikatamachi. Hongo, Tokio, Japan. Chemical Engineer.
1912. Matthewman, Fred. P., Analyst's Office, L.B. and S.C. Railway Co., Brighton, Chief Chemist.
O.M. Matthews, Chas. G., 31, Stapenhill Road, Burton-on-Trent, Brewing Chemist.
1907. Matthews, Dr. F. E., Ashlawn, The Glebe. Blackheath, S.E., Technical Research Chemist.
1899. Matthews. Dr. J. Merritt, 5, Berwyn Street, East Orange, N.J., U.S.A., Professor of Chemistry and Dyeing.
1889. Mawdsley, W. H., on active service, Chemist.
1903. Maxim, Hudson, 698, St. Mark's Avenue, Brooklyn, N.Y., U.S.A., Chemist and Mechanical Engineer,
1916. Maxted, Dr. Edw. B., 63, Highgate Road, Walsall. Staffs, Chemist.
1894. Maxwell, Jno., Solway Chemical Works, Silloth, Cumberland, and (communications) English Street, Carlisle, Chemical Manure Manufacturer.
1903. Maxwell, Orin P., c/o West Virginia Pulp and Paper Co., Luke, Md., U.S.A., Chemist.
1911. May, Clarence E., 320, South Walnut Street, Bloomington, Ind., U.S.A.
1897. May, George H., 35, Grayeliff Road, Newton Centre, Mass., U.S.A., Assistant Chemist.
1914. May, Dr. Percy, 126, Cazenove Road, Stamford Hill, London, N., Chemist.
1884. Mayenfeld, Dr. E. von Salis. *See* Salis-Mayenfeld, Dr. E. von.
1903. Mayer, Andrew, jun., 176, Sixth Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1896. Mayfield, A. S., Oakdene, Newland Park, Hull, Analyst.
1892. Mayfield, H. B., Normanhurst, Mundy Street, Heanor, near Nottingham, Dyer.
1885. Mayhew, E. W. A., Library, Technical College, Perth, Western Australia, Manufacturing Chemist.
1909. Meanwell, Chas. W., 15, Woodlands Crescent, Muswell Hill Road, London, N., Analytical Chemist.
1896. Meggitt, Loxley, Wheatsheaf Works, Alexandria, Sydney, N.S.W.. Australia, Analytical Chemist.
1901. Meier, Dr. Franz, c/o Society of Chemical Industry in Basle, Basle, Switzerland, Chemist.
1888. Meikle, Jno., 8, Melrose Street, Great Western Road, Glasgow, Journalist.
1915. Meister, Fred, Laboratory Distiller Co., Ltd., Menstrie, Scotland, Analytical Chemist.
1902. Melcher, Arthur C., 58, Bowen Street, Newton Centre, Mass., U.S.A., Research Chemist.
1912. Melling, S. E., Bank House, The Cliff, Higher Broughton, Manchester, Analytical Chemist.
O.M Mellon, W. W., Woodlands, Blackrock, Co. Dublin, Ireland, Manufacturing Chemist.
1910. Mellor, Dr. Jas. W., Sandon House, Regent Street, Stoke-on-Trent, Ceramic Chemist.
1915. Mendonça, M. S. de, 100, Rua S. Julião, Lisbon, Portugal, Chemist.
1912. Mennell, Harold, 41, Wolverton Road, Stony Stratford, Bucks, Analytical Chemist.
1893. Mensching, Dr. C., Journals to Mersey Chemical Works, Bromborough Port, Birkenhead, Chemist.
1915. Menzies, R. C., Chemical Dept., The University, St. Andrews, Scotland, Chemist.

1892. Mercer, C. A., 34, Camomile Street, London, E.C., Chemical Apparatus Maker.

1890. Merck, Dr. E., 66, Crutched Friars, E.C., Manufacturing Chemist.

1905. Merck, George, Merck and Co., 45, Park Place, New York City, U.S.A., Manufacturing Chemist.

1916. Merreywether, J. E., 27, Agnes Street Meadows, Nottingham, Analytical Chemist.

1899. Merrill, Frank H., 2420, Ocean View Avenue, Los Angeles, Cal., U.S.A., Factory Superintendent.

1906. Merrils, Fred. J., 25, Figtree Lane, Sheffield, Analytical Chemist.

1909. Merriman. C. E. B., 74, Trent Boulevard, West Bridgford, Nottingham, Technical Chemist.

1909. Merriman, H. J., 244, Victoria Park Road, South Hackney, N.E., Research Chemist.

1905. Merrin, A. C., 194–200, Bishopsgate, London, E.C., Assistant Editor and Analyst.

1904. Merry, Jno. B., 74, Park Hill Road, Harborne, Birmingham, Metallurgical Chemist.

1903. Mersan, Ferdinand de, Fairfield, Chestnut Avenue, Boston Spa, Yorks, Chemist.

1905. Merz, Eugene, Newark, N.J., U.S.A., Superintendent, Heller and Merz Co.

1897. Meslans, Prof. M., 6, Rue de Navarin, Paris, France, Professor of Chemistry.

O.M. Messel, Dr. R., F.R.S., 147, Victoria Street, London, S.W.. Chemical Manufacturer.

1899. Metcalf, Howard F., Farr Alpaca Co., Holyoke, Mass., U.S.A.

1886. Metcalf, Jno., Moorfield Chemical Works, Altham, near Accrington, Tar Distiller.

1908. Metcalfe, Ernest D., Messrs. Curtis's and Harvey, Ltd., Cannon Street House, London, E.C., Secretary.

1906. Methley, Bernard, Ferndale, Moorgate, Rotherham, Yorks, Engineering Chemist.

1898. Metz, Herman A., P.O. Box 753, New York City, U.S.A., Chemical Merchant.

1900. Mewborne, Robt. G., c/o Kentucky Tobacco Products Co., Louisville, Ky., U.S.A., Chemist.

1907. Meyer, Dr. Erwin, c/o Morgan and Wright, Detroit, Mich., U.S.A., Chemist.

1902. Meyrick, L. J., 137, City Road, Birmingham, Assistant Analyst.

1915. Miall, Dr. S., 28, Belsize Grove, Hampstead, N.W., Chairman of the Brimsdown Lead Co.

1912. Michie, Arthur C., The Wallsend Laboratories, Wallsend-on-Tyne, Technical Chemist.

1909. Michie, John L., c/o Peter Scott and Co., Limited, Buccleuch Street, Hawick, Scotland.

1907. Micklethwait, Miss Frances M. G., 5, Manor Place, Paddington Green, W., Chemist.

1916. Middleditch, B., Hillside, Peterborough Hill, Harrow, Chemistry Master.

1911. Middlemass, Alphonso, 59, Promenade, Portobello, Midlothian, Works Chemist.

1904. Mighill, Dr. Thos. A., 37, Wareham Street, Boston, Mass., U.S.A., Chemist.

1896. Miles, G. Wellington, Room 214, 88, Broad Street, Boston, Mass., U.S.A., Analytical Chemist.

1889. Milestone, W. C., 45, Heathfield Road, Wandsworth Common, S.W.. Chemical Works Manager.

1899. Millar, Jas. H., P.O. Box 4975, Johannesburg, Transvaal, Manufacturing and Analytical Chemist.

1909. Millar, Jas. Hill, Chief Chemist's Laboratory, St. James' Gate Brewery, Dublin, Chemist.

1883. Miller, Dr. A. K., Kilvert's Buildings, Withy Grove, Manchester, Analytical Chemist.

O.M. Miller, E. V., Sugar Works, Chelsea, Auckland, New Zealand, Sugar Works Chemist.

1914. Miller, Eric J., Carnbuck Club, Perambur Barracks, Madras, India, Chemist.

1889. Miller, Geo., Thornlea, Beaconsfield Road, Farnworth, Widnes, Technical Chemist.

1893. Miller, Dr. Harry E., 305, Palm Avenue, Oakland, Cal., U.S.A., Chemist.

1894. Miller, Dr. John A., 44–45, Lewis Block, Buffalo, N.Y., U.S.A., Consulting Chemist, State Analyst.

1888. Miller, J. Hopkins, 86, North Frederick Street, Glasgow, Dyeworks Chemist.

1889. Miller, Jno. Poynter, Sandilands Chemical Works Aberdeen, Technical Chemist.

1901. Miller, Stuart B., c/o Du Pont Powder Co., High Explosives Operating Dept., Wilmington, Del., U.S.A., Chemical Engineer.

1901. Miller, Dr. W. Lash, 50, St. Alban Street, Toronto, Canada, Associate Professor of Physical Chemistry.

1884. Miller, W. M., Caledonia Estate, Prov. Wellesley, Penang, S.S., Sugar Chemist.

1902. Milligan, R. E., New York Continental Jewell Filtration Co., 15, Broad Street, New York City, U.S.A., Chemical Engineer.

O.M. Mills, Prof. E. J., F.R.S., 64, Twylord Avenue, West Acton, W., Emeritus Professor of Technical Chemistry and Consulting Chemist.

1916. Mills, Frederick Peter, Colliery Fire and Rescue Station, 854, Scotswood Road, Newcastle-on-Tyne, Mining Engineer.

1904. Mills, Dr. J. E., University of South Carolina, Columbia, S.C., U.S.A., Analytical and Consulting Chemist.

1905. Mills, Wm. Henry, 120, Broadway, New York City, U.S.A., Merchant.

1915. Milne, John, 1, St. Mary's Place, Inverurie, Aberdeenshire, Merchant.

1905. Milne, Thomas, c/o The Gas Light and Coke Co., Ltd., Finsbury Court, Finsbury Pavement, London, E.C., Chemical Products Salesman.

1916. Milner, David W., Well Close Place, Lofthouse, Wakefield, Works Chemist.

1903. Milnes, Cresswell, The Cedars, Holborough, near Rochester, Cement Works Manager.

1887. Milnes, Edmund, Seedfield, Bury, Lancashire, Dyeing Extract Maker.

1902. Milnes, Ernest E., Park Print Works, Halifax, Yorks, Chemist.

1909. Mindeleff, Chas., c/o American Smelting and Refining Co., Maurer, N.J., U.S.A., Chemist.

1895. Miner, Harlan S., c/o Welsbach Light Co., Gloucester City, N.J., U.S.A., Technical Chemist.

1916. Mingaye, J. C. H., Chemical Laboratory, Dept of Mines; (Journals) Campbell Street, Parramatta N.S.W., Australia, Chemist and Assayer.

1915. Misell, D., c/o R. Lane-Hall and Co., 4, Lloyds' Avenue, London, E.C.. Chemical Merchant.

1895. Mitchell, Chas. A., c/o Beaufoy and Co., South Lambeth Road, S.W., Analyst.

1898. Mitchell, G. D. H., 309, North Fullerton Avenue, Montclair, N.J., U.S.A., Chemist.

1904. Mitsugi, R., c/o Tokio Gas Co., By-products Works, Oshimamachi, near Tokio, Japan, Chemist.

O.M. Mitting, E. Kennard, 38, Harold Road, Norwood, S.E., Technical Chemist.

1909. Miyoshi, K., Osaka Gas Works, Iwasakicho, Nishiku, Osaka, Japan, Engineer.

1905. Modi, Dr. E. M., Meher Buildings, Tardeo, Bombay, India, Manufacturing and Analytical Chemist.

1910. Moe. Carl, c/o Louisiana Fibre Board Co., Boyalusa, La., U.S.A., Chemist.

1906. Moe, Eldor H., Box 266, Salt Lake City, Utah, U.S.A., Chemist.

1914. Moffitt, Francis A., 72, Hawley Street, Binghamton, N.Y., U.S.A., Chemist.

O.M. Mohr, Dr. B., 69A, Parliament Hill, Hampstead, N.W., Consulting Chemist and Metallurgist.

1894. Mole, Herbert B., Royal Albert Brewery, Queen's Road, Reading, Brewer.

1901. Mond, Dr. Albert L., c/o Hubers and Mond, 19, Southampton Buildings, Chancery Lane, London, W.C., Chemical Engineer.

1899. Mond, Emile S., 22, Hyde Park Square, London, W., Technical Chemist.

1891. Mond, Dr. Robt. L., Combe Bank, near Sevenoaks, Kent, Chemist.

1906. Monier-Williams, G. W., 32, St. Leonard's Terrace, Chelsea, S.W.

1908 Monk, Chas. W., 102, Bloomfield Road, Plumstead, Kent, Chemist.

1890. Moodie, Wm. E., Alexandria Works, Alexandria, Scotland, Analytical Chemist.

1905. Moody, Dr. Gerald T., Lorne House, North Dulwich. S.E., Barrister-at-Law.

1898. Moody, Dr. Herbert R., College of the City of New York, and (Journals) 330, Convent Avenue, New York City, U.S.A., Professor of Chemistry

1903. Mooney, F. Morgan, 118, Pembroke Road, Dublin, Chemical Manure Manufacturer.

1902. Mooney, Luke, Box 435, Woodbridge, N.J., U.S.A.,

1887. Moore, Chas. C., 33, Clarendon Road, Garston, Liverpool, Chemist.

1901. Moore, Dr. Chas. W., c/o Crosfield and Sons, Ltd., Laboratory, Warrington, Chemist.

1907. Moore, Ernest P., c/o Steel Co. of Canada, 34, Jackson Street East, Hamilton, Ont., Canada, Chemist.

1911. Moore, Ernest W., c/o Messrs. T. G. Tickler, Ltd., Southall, Middlesex, Analytical Chemist.

1902. Moore, Fred., Victoria Chemical Co., Ltd., Victoria, B.C., Canada, Manufacturing Chemist.

1906. Moore, F. H., Messrs. G. H. Ogston and Moore, 87–89, Aldgate, London, E., Analytical Chemist.

1892. Moore, Dr. Geo. D., 201, Salisbury Street, Worcester, Mass., U.S.A., Professor of Chemistry.

1914. Moore, Harold, c/o Mirrlees, Bickerton, and Day, Hazel Grove, Stockport, Chemist.

1912. Moore, Joseph W., Kinderton House, Runcorn, Works Chemist.

1914. Moore, Lawrence, 26, Welbeck St., Wakefield, Dyer.

1905. Moore, Leslie R., 14, Elm Street, Concord, Mass., U.S.A., Chemist.

1899. Moore, Quintin, jun., Garrowbank House, Riddrie, Glasgow, Works Manager.

1885. Moore, R. T., 142, St. Vincent Street, Glasgow, Mining Engineer.

1899. Moore, Dr. Russell W., 121, Madison Avenue, New York City, U.S.A.: and Journals to University Library, Princeton, N.J., U.S.A., Chemist.

1890. Moore, Thos., 3, Tamworth Road, Sutton Coldfield, Analytical Chemist.

1910. Moorhouse, Samuel, 48, Oakworth Street, Blackley Manchester, Secretary and Oil Specialist.

1903. Moran, Geo. A., 98, Massachusetts Avenue, North Andover, Mass., U.S.A., Chemist.

1902. More, Andrew, Ellesmere, King's Road, Walton-on-Thames, Analytical Chemist.

1908. Morfey, Harold, c/o The Mitchell Main Colliery Co., Wombwell, near Barnsley, Yorks, Manager of By-Products Works.

1901. Morgan, Dr. Gilbert T., Royal College of Science for Ireland, Dublin, Ireland, Professor of Chemistry.

1912. Morgan, Sidney, Petaling Estate, Selangor, Federated Malay States, Analytical Chemist.

1906. Morgan, Thos., all comms. c/o R. H. Morgan and Co., Ltd., Custom House Buildings, Liverpool, Manufacturing Chemist.

1898. Morgan, T. M., 370, Wood Avenue, Westmount, Quebec, Canada, Cement Works Manager.

O.M. Moritz, Dr. E. R., 45, Great Tower Street, London, E.C., Brewing Chemist.

1885. Morley, Dr. H. Forster, 5, Lyndhurst Road. Hampstead, N.W., Professor of Chemistry.

1902. Morrell, Dr. R. S., Messrs. Mander Bros., Colour and Varnish Works, Wolverhampton, Chemist.

1884. Morrice, Jas. A., 1, Prince's Terrace, Dowanhill, Glasgow, Starch and Gum Manufacturer.

1906, Morris, A. H., 152, Chorley New Road, Bolton, Lancs, Brewer.

1898. Morris, Edgar F., Holly Bank, Roby, near Liverpool, Research Chemist.

1897. Morris, Harry, The Hall, Hexthorpe, Doncaster, Chemical Merchant.

1890. Morris, Herbert N., Alpha Works, Denton, near Manchester, Technical Chemist.

1908. Morris, Wm. J., 31, Prince Alfred Road, Wavertree, Liverpool, Chemist.

1911. Morrison, G. R., Oficina Reducto, Santa Catalina, Iquique, Chile, Chemist.

1910. Morrison, J. A. S., c/o Clark, Son, and Morland, Ltd., Glastonbury, Somerset, Leather Chemist.

1904. Morson, Thos. D., 14, Elm Street, Gray's Inn Road, London, W.C., Chemist.

1906. Morson, T. Pierre, 14, Elm Street, Gray's Inn Road, London, W.C., Chemical Manufacturer.

1916. Morton, Allan, 167, Trent Boulevard, West Bridgford, Nottingham, Technical Chemist.

1907. Morton, George A., "Silverbirch," Station Road, Wylde Green, Birmingham, Chemist and Works Manager.

1897. Morton, Jno., North Road, St. Helens, Lancashire, Analytical Chemist.

1902. Mosbaugh, F. R., c/o Anglo-Canadian Leather Co., Huntsville, Ont., Canada, Chemist.

1911. Mosenthal, E. Macqueron de, 9, Rue Neuve, Versailles, France, Chemist.

1915. Moss, Gerald L., 13, Barkly Grove, Beeston, Leeds; Chemical Engineer.

1897. Motion, Jno., c/o The Joseph Dixon Crucible Co., Jersey City, N.J., U.S.A., Assistant Superintendent.

1887. Moul, Frank, Aldersgate Chemical Works, Southall, Technical Chemist.

1898. Moulton, Prof. Chas. W., Vassar College, Poughkeepsie, N.Y., U.S.A., Professor of Chemistry.

1905. Moulton, Rt. Hon. Lord, K.C.B., F.R.S., 57, Onslow Square, London, S.W.

1915. Moulton, P. P., Oxford House, Newton Road, Faversham, Kent, Explosives Chemist.

1916. Mounsey, O. R., Broad Sanctuary Chambers, Westminster, S.W., Explosives Manufacturer.

1892. Mount, Edw., Oaklands, Aughton, near Ormskirk, Assistant Secretary (United Alkali Company).

1905. Mrazek, F. M., 31, West Cromwell Road, London, S.W., Consulting Chemist.

1890. Muir, Jas. Stanley, 23, Lilybank Gardens, Glasgow, Chemist.

1896. Mundy, Lionel, 27, Merton Road, Kensington, W., Importer of Unfermented Wines.

1914. Munn, W. F., 518, Main Street, East Orange, N.J., U.S.A., Chemist.

1887. Munroe, Prof. Chas. E., George Washington University, Washington, D.C., U.S.A., Professor of Chemistry and Dean.

1900. Munton, Fred. T., c/o The Salt Union, Ltd., Engineer's Office, Winsford, Cheshire, A.R.S.M., Analytical Chemist.

1904. Murdoch, Alexander, Garden Suburb, Westerton, Glasgow, Analytical Chemist.

1886. Murdoch, R. H. M., Norwood, Saltcoats, Ayrshire. Explosives Chemist.

1899. Murphy, Albert J., 3 and 4, Queen Square, Leeds, Brewer's Chemist.

1901. Murray, Benjamin L., c/o Merck and Co., Rahway, N.J., U.S.A., Chemist.

1903. Murray, Chas. B., 407, Perry Payne Building, Cleveland, Ohio, U.S.A., Chemist.

1914. Murray, James P., The Canadian Oil Producing and Refining Co., Ltd., Petrolea, Ont., Canada, Mining Director.

1914. Murray, John E., c/o Emerson Drug Co., 64, Spadina Avenue, Toronto, Canada, Laboratory Superintendent.

1898. Murray, Rd., c/o Brotherton and Co., Ltd., Ammonia Works, Holmes Street, Leeds, Analyst.

1916. Murray, Salamon, W. H., Ferry Road, Rainham, Essex, Chemical Manufacturer.

1908. Murray, Dr. Thos. J., O.C., 9th Sanitary Section, 1st Cavalry Division, B.E.F., Lecturer on Chemistry.

1905. Murrill, Dr. Paul I., Copperhill, Tenn., U.S.A., Representative.

O.M. Muspratt, Dr. E. K., Seaforth Hall, near Liverpool, Alkali Manufacturer.

1894. Muspratt, Max, The Grange, Fulwood Park, Liverpool, Technical Chemist.

O.M. Muspratt, S. K., Alkali Manufacturer.

1907. Musso, Louis A., Box 956, G.P.O., Sydney, N.S.W., Australia, Technical Chemist.

1911. Myers, Ernest M., 6, Lower Crescent, Harpfield, Stoke-on-Trent, Coke Oven Manager and Chemist.
1891. Myers, Dr. Wm. S., 25, Madison Avenue, New York City, U.S.A., Director.

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1902. Naef, Dr. Ernest E., 17, Park Road, Clydach, Swansea, South Wales, Chemist.
1913. Nagase, Denzo, Ichijio Senbon, Kyoto, Japan, Engineer.
1908. Nagle, J. C., c/o Nichholls, Nagle and Co., Ltd., Trafford Park, Manchester, Glucose and Starch Manufacturer.
1913. Nair, Valiyil G., Société Cotonniere du Tonkin, Nam-Dinh, Tonkin, French Indo-China, Chemist and Colourist.
1897. Nairn, Sir Michael, Bart., Dysart House, Fife, Linoleum Manufacturer.
1909. Nakai, S., Miike Colliery Office, Omuta-machi, Chikugo, Japan, Engineer.
1903. Nakayama, T., 94, Samoncho, Yotsuya, Tokyo, Japan, Chemist.
1893. Napier, Jno. W., Gas Works, Alloa, Scotland, Manager and Chemist.
1904. Napper, Sidney S., c/o S. Courtauld and Co., Ltd., Foleshill Road, Coventry, Chemist.
1897. Nash, L. Myddleton, Westlands, Princess Road, Finsbury Park, N., Industrial Chemist.
1910. Nash, N. C., Treleaven, Darling Street, Balmain East, Sydney, N.S.W., Works Chemist.
1908. Nasmith, M. E., c/o The Canadian Smelting and Refining Co., Orillia, Ontario, Canada, Chemist.
1900. Nathan, Col. Sir Frederic L., 37, Cornwall Gardens, South Kensington, S.W., Superintendent Nobel's Explosives Works.
1916. Naylor, J. H., 1, Roseleigh Avenue, Burnage Lane, Levenshulme, Manchester, Explosives Works Manager.
O.M. Naylor, W. A. H., The British Drug Houses, Ltd., 22–30, Graham Street, City Road, London, N., Manufacturing Chemist.
1909. Neal, C. S., Acme White Lead and Colour Works, Detroit, Mich., U.S.A., Manager.
1899. Neate, Percy J., 49, Frognal, Hampstead, N.W., Director of Cement Co.
1905. Neech, Herbert R., Doddington Lane, Swallowbeck, Lincoln, Chemical Engineer.
1905. Neff, Robert W., 22, India Square, Boston, Mass., U.S.A., Chemical Manufacturer.
1906. Neil, Dr. Archibald A., c/o Brunner, Mond, and Co., Caxton House, Westminster, S.W., Chemical Engineer.
1890. Neill, Geo. D., 78, Drum Frochar Road, Greenock, Sugar Refiner.
1898. Neilson, Alex. McG., Umbilo, Durban, Natal, Analytical Chemist.
1911. Neilson, R. G., c/o Anglo-Persian Oil Co., Mohammerah, Persia (viâ Bombay), Assistant Works Manager.
1902. Neish, Dr. Arthur C., Columbia University, New York City, U.S.A., Chemist.
1911. Nello, Vincent, Baldwin's Hill, Loughton, Artists' Colour Manufacturer.
1916. Nelson, Sir E. Montague, K.C.M.G., Emscote Mills, Warwick, Gelatin Manufacturer.
1916. Nelson, Percy S., Christchurch Meat Co., and 10, Flockton Street, St. Albans, Christchurch, New Zealand, Assistant Chemist.
1913. Nesbitt, Cosby T., 17, Rupert Road, Nether Edge, Sheffield, Metallurgical Chemist.
1906. Nestell, Raymond J., c/o Western Precipitation Co., 1016, West Ninth Street, Los Angeles, Cal., U.S.A., Analytical Chemist.
1902. Neumann, Dr. Edgar, Chemical Supply Co., Old Barking Gas Works, Abbey Road, Barking, E.
O.M. Newall, F. S., Washington Station R.S.O., Co. Durham, Chemical Manufacturer.
1905. Newall, Jos., Hill Cliffe, Heath Road, Runcorn, Cheshire, Chemist.
1889. Newberry, Spencer B., Sandusky Portland Cement Co., Baybridge, Eric Co., Ohio, U.S.A., Manager.
O.M. Newlands, W. P. R.. 10, Cricklade Avenue, Streatham Hill, S.W., Sugar Chemist.
1914. Newman, Alex. R., on active service, Chemical Engineer.
O.M. Newton, Jno., Verney Road, Rotherhithe New Road, London, S.E., Manure Manufacturer.
1912. Newton, Leonard O., 41, Bennett Park, Blackheath, S.E., Analytical Chemist.
1901. Nibelius, Axel W. T., c/o Aetna Explosives Co., Emporium, Pa., U.S.A., Chemist.
1915. Nicholls, H. V., c/o G. and C. Hoskins, Ltd., Eskbank Iron and Steel Works, Lithgow, N.S.W., Australia, Chemist.
1904. Nichols, C. W., 25, Broad Street, New York City, U.S.A., Manufacturing Chemist.
1905. Nichols, E. Remington, 25, Broad Street, New York City, U.S.A., Treasurer (Nichols Chemical Co.).
1888. Nichols, Dr. Wm. H., 25, Broad Street, New York City, U.S.A., Chemical Manufacturer.
1905. Nichols, W. H., jun., 25, Broad Street, New York City, U.S.A., Chemical Manufacturer.
1904. Nicholson, Wilfred E., Hunslet Chemical Works, Leeds, Chemical Manufacturer.
1897. Nicholson, Wm. J., Ardeer, Stevenston, Ayrshire, Chemist.
1903. Nicoll, Frank, 28, Coudray Road, Southport, Chemist.
1905. Nieghorn, Albert, 120, Mill Street, Toronto, Canada, Agent.
1900. Nield, J. H., c/o General Chemical Co., Edgewater, N.J., U.S.A., Superintendent.
1916. Nightingale, Ernest, 20, Swain Street, Hyde, Cheshire, Works Chemist.
1898. Nightscales, Geo., 642, Holderness Road, Hull, Oil Merchant.
O.M. Nimmo, Jas., 35, Whitworth Road, South Norwood, S.E., Analytical Chemist.
1907. Nims, H. E., c/o The Fiberloid Co., Indian Orchard, Mass., U.S.A., Chemist.
1885. Nishigawa, T., 5, Hikawa Cho, Akasaka, Tokyo, Japan, Works Director and Chemical Engineer.
1898. Nishikawa, Dr. T., Dept. of Applied Chemistry, Kyushu Imp. University, Fukuoka, Japan, Prof. of Applied Chemistry.
O.M. Noelting, Prof. Dr. E., Ecole de Chimie, Geneva, Switzerland, Professor of Chemistry.
O.M. Norman, Sir Frederick J., Lyndhurst, Higher Runcorn, Cheshire, Chemical Manufacturer.
1892. Norman, J. T., 23, Leadenhall Street, London, E.C., Consulting Chemist.
1913. Norman, T. Stanley, Lyndhurst, Runcorn, Cheshire, Chemical Manager.
1890. Norman-Bott, Dr. Wm., c/o Brotherton and Co., Litherland, near Liverpool, Consulting Chemist.
1915. Norris, Edward W., 22, Woodfield Road, Crumpsall, Manchester, Works Chemist.
1908. Norris, Wm. H. H., Aetna Explosives Works, Pittsburgh, Pa., U.S.A., Chemist.
1902. North, Barker, 33, Ashgrove, Great Horton Road, Bradford, Assistant Professor of Chemistry.
1915. Northing, H. C., Johnstown House, Johnstown, Arklow, Co. Wicklow, Ireland, Technical Chemist.
1916. Northwood, T. G., 182, Northgate Road, Edgeley, Stockport, Works Chemist.
1905. Norton, Arthur L., 36, Purchase Street, Boston, Mass., U.S.A., Dyestuff Merchant.
O.M. Norton, Dr. S. A., 363, East Town Street, Columbus, Ohio, U.S.A., Professor of Chemistry (Ohio State University).
1911. Norton, Samuel J., 22, Bushnell Road, Balham, S.W., Engineer and Manager.
1887. Norton, Dr. T. H., c/o Wm. Bryce, 54, Lothian Street, Edinburgh, U.S. Consul.
1899. Noyes, Henry, 499-501, Bourke Street, Melbourne, Victoria, Engineer.

1901. Noyes, Prof. Wm. A., University of Illinois, Urbana, Ill., U.S.A., Editor (J. Amer. Chem. Society).

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1910. Oakden, W. E., 11, Lonsdale Road, Barnes, S.W., Director of Research Laboratory.
1905. Oakes, F. J., jun., 141, Milk Street, Boston, Mass., U.S.A., Secretary, Oakes Manufacturing Co.
1904. Oberländer, Dr. Otto, 29, Queen Street, London, E.C., Research and Consulting Chemist.
1904. O'Brien, Claude H., c/o Central Cane Price Board, Dept. of Agriculture Brisbane, North Queensland, Supervising Chemist.
1900. O'Brien, Frederick, Pineleigh, Saltford, near Bristol, Analytical Chemist.
1905. Oburg, W. F., 33, Broad Street, Boston, Mass., U.S.A., Assistant Treasurer (Merrimac Chem. Co.).
1901. O'Connor, Chas. P., 7, Fairfield Street, Montclair, N.J., U.S.A., Analytical Chemist.
1908. O'Day, John, 15, Custom House Street, Boston, Mass., U.S.A., Dyestuff and Chemical Merchant.
1888. Oddy, Robert W., Abbey Street, Toad Lane, Rochdale, Chemist.
1911. Oehler, Prof. John, Carlstadt, N.J., U.S.A., Assoc. Professor of Chemistry (Columbia University).
1908. Ogilvie, Jas. P., Homedale, Hendon Lane, Church End, Finchley, N., Chemist.
1901. Ogston, Alex. G., Heath Park, near Aberdeen, Soap Manufacturer.
1903. Ohlenschlager, J. G., jun., Shanghai House, Botolph Lane, London, E.C., Chemical Merchant.
1905. Ohliger, Willard, c/o F. Stearns and Co., Detroit, Mich., U.S.A., Chemist.
1907. Oke, Alfred W., 32, Denmark Villas, Hove, Sussex, Solicitor.
1884. Oliver, F., 31, Horsley Hill Road, Westoe, South Shields, Analytical Chemist.
1888. Oliver, Wm. Letts, 251, Vernon Street, Oakland, Cal., U.S.A., Mining Engineer.
1910. Oliver, Willie, 30, Woodstock Street, Spotland, Rochdale, Works Chemist.
1914. Ollé, Arch. D., "Kareema," Charlotte Street, Ashfield, N.S.W., Australia, Electro-therapeutist.
O.M. Ollerenshaw, S., 94, Davyhulme Lane, Urmston, Manchester, Technical Chemist.
1906. Olmsted, Fred. A., c/o Willamette Pulp and Paper Co., Oregon City, Oregon, U.S.A., Chemical Engineer.
1904. Olney, Prof. L. A., 118, Riverside Street, Lowell, Mass., U.S.A., Professor of Chemistry and Dyeing.
1916. Olssen-Seffer, R., 1, Royal Exchange Place Calcutta, India, Nitrate Agent.
1902. O'Neill, Chas., c/o Bleachers' Association, Ltd., 4, Norfolk Street, Manchester, Chemist and Colourist.
1905. Ormandy, Dr. W. R., Imperial House, Kingsway, London, W.C., Consulting Chemist.
1898. Ormerod, Dr. Ernest, 62, Dale Street, Liverpool, Consulting and Analytical Chemist.
1894. Ormerod, John, Globe Leather Works, Castleton, Manchester, Tanner and Currier.
1915. Ormsby, Irwin, "Calcula," Allison Road, Randwick, New South Wales, Australia, Factory Assistant.
O.M. Orr, J. B., Crossacres, Woolton, Liverpool, Chemical Manufacturer.
1907. Ortved, Niels C., c/o Hiram Walker and Sons, Ltd., Walkerville, Ont., Canada, Chemist and Fermentologist.
1900. Osbourne, Jno. P., 6, Garrioch Drive, Maryhill, Glasgow, Analytical Chemist.
1900. O'Shaughnessy, Francis R., 42, Temple Street, Birmingham, Consulting Chemist.
1885. O'Shea, Prof. L. T., Dept. of Applied Science, St. George's Square, Sheffield, Professor of Applied Chemistry (University of Sheffield).
1912. Osius, George, Canadian Ammonia Co., Ltd., Foot of Meldrum Street, Detroit, Mich., U.S.A., Secretary and Treasurer.
1883. O'Sullivan, J., High Bank, Burton-on-Trent, Brewing Chemist.
1912. Oswald, Jacob, c/o Messrs. Fels and Co., 73rd Street and Woodland Avenue, Philadelphia, Pa., U.S.A., Soap Works Technical Manager.
1898. Oushkoff, John P., Warwarka 5, Moscow, Russia, Chemical Manufacturer.
1906. Oxley, Horace F., c/o Jos. Crosfield and Sons, Ltd., Warrington, Chemist.
1908. Oxley, John C., Claycroft, Guiseley, near Leeds, Aniline Colour Merchant.

P

1904. Packard, C. T., Millbank, Bramford, near Ipswich, Manager of Chemical Works.
1915. Paddock, Horace, c/o Messrs. Greenwood and Batley, Ltd., 84 Armley Road, Leeds, Yorks, Analytical Chemist.
1886. Pagès, Albert, 34, Boulevard Henri IV., Paris, Technical Chemist.
1916. Pallister, Chas., c/o Philipp Bros., 133, Fenchurch Street, London, E.C., Metallurgical Chemist.
1906. Palm, Otto G., 41, Colborne Street, Toronto, Canada, President (Atteaux Dye and Chemical Co.).
1903. Palmenberg, O. W., 50, East 41st Street, New York City, U.S.A., Consulting Chemist and Fuel Engineer.
1916. Palmer, Chas. W., c/o Manchester Oxide Co.: and Heaton House, Wilmslow Road, Withington, Manchester, Chemist.
1902. Palmer, Fred. G., c/o Curtis's and Harvey, Cliffe, Kent, Chemist and Acid Superintendent.
1887. Palmer, T. Chalkley, c/o American Dyewood Co., Chester, Pa., U.S.A., Manufacturing Chemist.
1887. Palmer, Thos. C., c/o W. J. Fraser and Co., Ltd., Dagenham, Essex, Engineer.
1907. Palmer, Wm. J., 25, Beech Hill Road, Eltham, Kent, Analytical Chemist.
1915. Pandya, Prof. Kantilal, Bag Mazaffar Khan, Agra, India, Professor of Chemistry.
1911. Paniker, Ramni, Ancha 27, Barcelona, Spain, Leather Trades Chemist.
1915. Pansky, Dr. A., c/o Williamson and Corder, Ltd., Low Walker, Newcastle-on-Tyne, Chemical Engineer.
1891. Parker, Edw., Laburnam House, Rushford Avenue, Levenshulme, Manchester, and (Jnls.) 142, Manchester Road, Denton, Manchester, Analytical Chemist.
1916. Parker, Harry, Clay Hall Works, Old Ford Road, Bow, E., Manufacturing Chemist.
1694. Parker, Dr. J. Gordon, Leathersellers' Technical College, 176, Tower Bridge Road, London, S.E., Principal.
1897. Parker, Prof. Matthew A., University of Manitoba, Winnipeg, Canada, Professor of Chemistry.
1915. Parker, R. G., 63, Gondar Gardens, Hampstead, N.W., Chemist.
1901. Parker, Richard H., 147, Seymour Avenue, Newark, N.J., U.S.A., Analytical Chemist.
1894. Parker, Thos. J., 100, William Street, New York City; and (Journals) Bayonne, N.J., U.S.A., Chemical Works Manager.
1903. Parker, Wm. B., 1, Murray Road, Rugby, Chief Chemist (British Thomson-Houston Co., Ltd.).
1901. Parkes, Albert E., 43, Whitehorse Street, Stepney, E., Analytical Chemist.
1915. Parrish, Percy, c/o South Metropolitan Gas Co., East Greenwich, S.E., Chemical Works Manager.
1898. Parrish, Saml., 80, Grange Avenue, Chapeltown Road, Leeds, Teacher of Chemistry.
1914. Pascoe, Charles F., 3055, Notre Dame Est, Montreal, Canada, Metallurgist.
1909. Passmore, Dr. Francis W., 81, Queen Victoria Street, London, E.C., Consulting Chemist.

1897. Patchett, Col. Jas., Oakworth, Hadley, Wellington, Salop, Ironmaster.
1915. Paterson, Dr. J. H., 3, Park Villas, The Green, Wallsend-on-Tyne, Analytical Chemist.
1884. Paterson, John, Belle Isle Place, Workington, Cumberland, Mechanical Engineer.
1901. Patterson, Chas. A., Woodbury, N.J., U.S.A., Analytical Chemist.
O.M. Patterson, Geo., c/o The Manbré Saccharine Co., Ltd., Fulham Palace Road, Hammersmith. W. Technical Chemist.
1893. Patterson, Harry J., College Park, Prince George's Co., Md., U.S.A., Agricultural Chemist.
1902. Patterson, Wm., Hamilton; Clayton Aniline Co., Clayton. Manchester, Technical Chemist.
O.M. Pattison, Jas., Drimnamona, Kilmalcolm, Chemical Merchant.
1889. Pattison, Percy J., St. Budeaux, Devonshire Road, Hornchurch, Essex, Technical Chemist.
1909. Patton, H. G., c/o Fred Rueping Leather Co., Fond du Lac, Wis., U.S.A., Chemist.
1908. Paul, David M., Chance and Hunt, Ltd., Site A, Oldbury, Chemist.
1891. Paul, Jas. H., 11, Glenluce Road, Blackheath, S.E., Analytical Chemist.
1900. Paul, Dr. L. Gordon, Market Hall Chambers, King Street, Huddersfield, Consulting Chemist.
1904. Payne, A. G. C., 6, Bradford Place, Penarth, near Cardiff, Chemist.
O.M. Payne, J. B., 13, Mosley Street, Newcastle-on-Tyne, Manufacturing Chemist.
1912. Peachey, S. J., "Tullamore," Priestnall Road, Heaton Mersey, Manchester, Lecturer in Chemistry.
1894. Pearce, Jas. Stanley, Priest's Mere, Tadworth, Surrey, Chemical Manufacturer.
1897. Pearce, Richard, 6, Beach Lawn, Waterloo, Liverpool, Metallurgist.
1883. Pearce, Sir W., M.P., 14, Park Crescent, Portland Place, W., Chemical Manufacturer.
1903. Pearcy, A. C., 43, Marlborough Mansions, Finchley Road, London, N.W., Director, Explosives Co.
1915. Pearson. Geo. E., c/o Burroughs, Wellcome and Co., Snow Hill Buildings, London, E.C., Chemist and General Manager.
1915. Pearson, Stanley, 21, Kingsway, Coventry, Works Chemist.
1904. Pease, Fred N., P.O. Box 503, Altoona, Pa., U.S.A., Chemist.
1898. Peck, Dr. Ernest L., High Lawn, Bromborough, Cheshire, Chemist.
O.M. Pedler, Sir Alexander. C.I.E., F.R.S., 28, Stanhope Gardens, Queen's Gate, London, S.W., Director of Public Instruction (retired).
1886. Pedler, J. R., 47, Tregunter Road. South Kensington, S.W., Clerk.
1906. Peile, Henry, Millburn House, Newcastle-on-Tyne, and (Journals) c/o F. J. Willott, Victoria Garesfield Colliery, Rowlands Gill, Co. Durham, Colliery Owner.
1897. Pellew, Chas. E., 111, East 78th Street, New York City, U.S.A., Adjunct Professor of Chemistry.
1904. Pelly, Russell George, 3, Wingate Road, Hammersmith, W., Analytical Chemist.
1915. Pemberton, W. G., c/o F. Reddaway and Co., Ltd., Pendleton, Manchester, Works Chemist.
1914. Penfold, A. R., 34, Alt Street, Ashfield, Sydney, N.S.W., Australia, Research Chemist.
1896. Penney, Mulgrave D., 11, High Street, Hull, Analytical Chemist.
1890. Pennock, J. D., c/o Solvay Process Co., Syracuse, N.Y., U.S.A., Technical Chemist.
1885 Pentecost, S. J., Alexandra Mount, Mapperly Hill, and (Journals) Lenton Works, Nottingham, Lace Dresser.
1892. Peploe, D. H. T., Underriver House, Sevenoaks. Kent.
1885. Perkin, A. G., F.R.S., Grosvenor Lodge, Grosvenor Road, Leeds, Technical Chemist.
1898. Perkin, Dr. F. Mollwo, 199, Piccadilly, London, W., Head of Chemical Department, Borough Polytechnic.
1887. Perkin, Dr. W. H., F.R.S., 5, Charlbury Road, Oxford. Professor of Chemistry.
1916. Perkins, M., 29, Whites View, Manningham, Bradford, Technical Chemist.
1893. Perkins, T. S., 30, Tiffany Place, Brooklyn, N.Y., U.S.A., Chemist.
1901. Perry, Chas. M., Greene, Kent County, R.I., U.S.A., Bleach and Dyeworks Chemist.
1887. Perry, David, 15, Woodlands Terrace, Glasgow, and (Journals) Forth and Clyde Chemical Works, Nitshill, near Glasgow, Manufacturing Chemist.
1895. Perry, Jos. H., 276, Highland Street, Worcester, Mass., U.S.A., Teacher of Chemistry.
1903. Perry, M. J. T., Australian Drug Co., O'Connell Street, Sydney. N.S.W., Australia, Manufacturing Chemist.
1903. Perry, Robt. Swain, 3500, Grays Ferry Road, and (Journals) Station D., Philadelphia, Pa., U.S.A., President (Harrison Bros. and Co.).
1914. Perry, R. W., 419, Keele Street, Toronto, Canada, Superintendent and Chief Analyst, Gums, Ltd.
1897. Peter, D. A. H., 2508, Broadway, New York City, U.S.A., Chemist.
1908. Peters, John M., c/o National Lead Co., 111, Broadway, New York City, U.S.A., White Lead Manufacturer.
1909. Petrie, A. Swanston, 12, Walmer Terrace, Ibrox, Glasgow, Analytical Chemist.
1903. Petrie, Dr. Jas. M., The University, Sydney, N.S.W., Australia, Chemist.
1906. Pettee, Chas. L. W., c/o Hartford Laboratory Co., Hartford, Conn., U.S.A., Chemist.
1916. Pettersen, M. G., c/o Planters Margarine Co., and Valby House, Sheffield Road, Godley, near Hyde, Chief Chemist.
1892. Pettigrew, Robert, c/o Mersey and Irwell Joint Committee, 44, Mosley Street, Manchester, Electro-Chemist.
1902. Pettitt, Alf., c/o Chestnut Ridge Brick Co., 7, West 45th Street, New York City, N.Y., U.S.A., Chemist.
1916. Philbert, Pierre, French Commission of Munitions, Empire House, Kingsway, London, W.C., Leather Manufacturer.
1888. Philip, Arnold. Admiralty Chemist's Dept., H.M. Dockyard, Portsmouth, Electro-Metallurgist and Electrical Engineer.
1908. Philip, Prof. James C., Imperial College of Science and Technology, South Kensington, S.W., Professor of Physical Chemistry.
1903. Phillipp, Herbert, 178, Market Street, Perth Amboy, N.J., U.S.A., Chemist and Electrochemical Engineer.
1912. Phillips, G. A., Laboratory, The Powell Duffryn Co., Aberdare, Mon., Chemist.
1911. Phillips, Henry A., Royal Gunpowder Factory, Waltham Abbey, Essex, Chemist.
1910. Phillips, Prof. Percy P., Thomason College, Rurki, United Provinces, India, Professor of Chemistry.
1915. Phillips, Richard, 35, Linacre Road. Litherland, Liverpool. Chemist.
1895. Phillips, S. Chas., 47, Cannon Street, London, E.C., Chemical Engineer.
1911. Phillips, Capt. William E.
1898. Phillips, Wm. H., 100, Milton Avenue, East Ham, E., Soap Works Chemist.
1911. Philpotts, Wilfred C., 35, Sandford Avenue, Toronto, Canada, Gasworks Chemist.
1894. Picard, Hugh F. K., 44, London Wall, London, E.C., Metallurgist.
1904. Pickard, Glenn H., c/o American Linseed Co., 2209, Lumber Street, Chicago, Ill., U.S.A., Manager of Oils Dept.
1905. Pickard, Greenleaf W., Amesbury, Mass., U.S.A., Electrical Engineer.
1902. Pickard, Dr. R. H., Billinge View, Blackburn, Teacher and Analyst.

1914. Pickering, Walter J., Central Laboratory, City Gas Works, Nechells, Birmingham, Works Chemist.
1915. Pickles, R. H., Prussiate Works, Droylsden, near Manchester, Chemical Manufacturer.
1915. Pickles, R. W., 16, Bertram Road, Bradford, Yorks, Pharmacist.
1904. Pickup, Edgar H., 348, Great Clowes Street, Higher Broughton, Manchester, Calico Printer.
1913. Pierce, Jas. B., jun., Lock Box 932, Charleston, W. Va., U.S.A., Chemist, Barium Products Co.
1915. Pilkington, A. C., Briars Hey, Rainhill, Lancs, Glass Manufacturer.
1888. Pilkington, G., 9, Knowsley Street, Bury, Lancashire, Analytical Chemist.
1893. Pilley, Thos. W., 33, Grove Hill Road, Denmark Hill, S.E., Analytical Chemist.
1894. Pilling, John E., 229, Hornby Road, Blackpool, Chemist.
1906. Pincott, Emile S., 222, St. James' Street, Montreal, Canada, Manager (Nichols Chemical Co. of Canada, Ltd.).
1914. Pinkerton, Corporal Andrew, 106250, Sect. 77., N. Coy., 4th Batt., Spec. Brigade, R.E., G.H.Q. B.E.F., France, Analytical Chemist.
1910. Pinnock, Douglas R., c/o The Nucoa Butter Co., 4th Street and Avenue A, Bayonne, N.J., U.S.A., Chemist.
1905. Pinnock, H. T., 11, Fountain Road, Edgbaston, Birmingham, Chemist.
1896. Piper, Walter E., Boston Rubber Shoe Co., Malden, Mass., U.S.A., Chemist.
1916. Pirrie, Noble W., Imperial Munitions Board, Union Bank Building, Ottawa, Ont., Canada, Technical Chemist.
1907. Pitman, Brig.-Gen. John, 167, Berkeley Avenue, Orange, N.J., U.S.A., U.S. Army (retired).
1913. Pitt, Septimus A., Central Public Library, Coventry, Librarian.
1902. Pittard, Jno., West Ham Chemical Works, West Ham, E., Chemical Manufacturer.
1884. Pittuck, F. W., 19, Stratford Grove, Heaton, Newcastle-on-Tyne, Technical Chemist.
1909. Piutti, Prof. Dr. Arnaldo, Instituto Chimico-farmaceutico, R. Universita, Napoli, Italy, Director.
1899. Pizey, Jas. H., 38, Lewisham Road, Highgate Road, London, N.W., Chemist.
1915. Platt, J. H., 47, Cleveland Road, Crumpsall, Manchester, Technical Chemist.
1894. Platten, Frank, c/o Elliot's Metal Co., Selly Oak Works, near Birmingham, Metallurgical Chemist.
1890. Platts, Jno. C., c/o Armstrong, Whitworth of Canada, Ltd., Montreal, Canada, Metallurgical Chemist.
1914. Plews, George, jun., c/o Braden Copper Co., Molino, Rancagua, Chile, Chemist.
1907. Poetschke, Paul, c/o L. D. Caulk Co., Milford, Del., U.S.A., Chemist.
1915. Polack, W. G., Beacon Mount, Highlands Road, Runcorn, Cheshire, Alkali Works Manager.
1901. Pollard, Wm., Oakfield, Hitchin, Herts., Chemist.
1904. Pollitt, Dr. Geo. P., 4, Whitehall Court, London, S.W., Chemist.
1902. Pollitt, Jas. C. T., Sharrow, The Lickey, near Bromsgrove, Worcestershire, Managing Chemist.
1883. Pollock, A., Kirkland, Bonhill, Dumbartonshire, Dyeworks Manager.
1890. Pomeroy, Dr. Chas. T., R. F. D. No. 1, Scotch Plains, N.J., U.S.A., Ink Manufacturer.
1909. Pond, Dr. Francis J., Stevens Institute of Technology, Hoboken, N.J., U.S.A., Professor of Chemistry.
1896. Pond, Prof. G. G., State College, Centre Co., Pa., U.S.A., Professor of Chemistry
O.M. Pond, J. A., 99, Queen Street, Auckland, New Zealand, Analytical Chemist.
1914. Pondal, Prof. M. Leguizamon, 726, Str. Mexico, Buenos-Aires, Argentina, Doctor of Chemistry.
1906. Pont, A. Felix du, Box 31, Wilmington, Del., U.S.A., Explosives Manufacturer.
1895. Pont, Pierre S. du, c/o Dr. C. L. Reese, E. I. du Pont de Nemours Powder Co., Wilmington, Del., U.S.A., Explosives Manufacturer.
1912. Pope, Chester H., 34, Brookfield Road, Winthrop, Mass., U.S.A., Ink Manufacturer.
O.M. Pope, S., 49, Provis Road, Chorlton-cum-Hardy, Manchester, Chemical Works Manager.
1899. Pope, Thos. H., The University, Edmund Street, Birmingham, Chemist and Lecturer on Brewing.
1900. Pope, Prof. W. J., F.R.S., University Chemical Laboratory, and (Journals) Holmesdale, Brooklands Avenue, Cambridge, Professor of Chemistry.
1912. Porritt, B. D., c/o North British Rubber Co., Ltd., Castle Mills, Edinburgh, Chief Chemist.
1911. Porteous, Jas. W., c/o Bolckow, Vaughan, and Co., Ltd., Grange Hill, Bishop Auckland, Co. Durham, Chemist and Coke Oven Manager.
1902. Porter, J. Edw., P.O. Box 785, Syracuse, N.Y., U.S.A., Chemist.
1901. Porter, Jno. L., 8401, Panola Street, New Orleans, La., U.S.A., Chemist.
1915. Potter, Alfred, 16, Nelson Street, Lower Broughton, Manchester, Rubber Works Chemist.
1884. Potter, Chas. E., Love Lane Sugar Refinery, Liverpool, Sugar Works Chemist.
1888. Potter, Chas. J., Heaton Hall, Newcastle-on-Tyne, Cement Manufacturer.
O.M. Potter, E. P., Chemical Works, Little Lever, near Bolton, Alkali Manufacturer.
1915. Potter, F. M., H.M. Factory, Penrhyn-Deudraeth, N. Wales, Chemist.
1915. Potter, H. V., 98, Bradford Street, Birmingham, Manager and Chief Chemist.
1910. Potts, Harold E., c/o W. P. Thompson and Co., 6, Lord Street, Liverpool, Patent Agent.
1915. Poulenc, Camille, 122, Boulevard St. Germain, Paris, France, Chemical Manufacturer.
1915. Pound, E. H., c/o General Rubber Co., Kisaran, Asahan, Sumatra, Rubber Technologist.
1916. Powell, A. D., 152, Robin Hood Chase, Nottingham, Analytical Chemist.
1915. Powell, A. R., 264, Neville Road, Forest Gate, E., Analytical Chemist.
1900. Powell, Harry J., 125, Thurlow Park Road, Dulwich, S.E., Glass Manufacturer.
1897. Power, Dr. Fred. B., 535, Warren Street, Hudson, N.Y., U.S.A., Research Chemist.
1907. Powers, Wm. A., c/o A. T. and S. F. R. R. Co., Topeka, Kans., U.S.A., Chief Chemist.
1902. Powney, Wm. E. F., 35, Priory Avenue, Hornsey, N., Analytical Chemist.
1912. Prasad, Prof. H., Government College, Ajmer, India, Professor of Science.
1897. Prentice, Dr. Bertram, Royal Technical Institute, Salford, Lecturer on Chemistry.
1902. Prentice, Dr. David, Teesholme, Walton New Road, Lower Walton, near Warrington, Chemist.
1903. Prentice, Jas., Cossipore Sugar Works, Cossipore, Calcutta, India, Chemist.
1911. Prescott, Alfred, 63, Corporation Street, Manchester, Chemical Agent.
1900. Prescott, Prof. Saml. C., 585, Boylston Street, Boston, Mass., U.S.A., Prof. of Ind. Biology.
1905. Preston, Jas. F., 403, Andover Street, Lowell, Mass., U.S.A., Manufacturing Chemist.
O.M. Price, Arthur F., 503, Market Street, San Francisco, Cal., U.S.A., Analytical Chemist.
1905. Price, Dr. T. Slater, The Technical School, Birmingham, Lecturer on Chemistry.
1904. Prichard, Norman B., 40, Quebec Street, Sherbrooke, Quebec, Canada, Superintendent.
1905. Priest, Geo. Wesley, 78, Beech Street, East Orange, N.J., U.S.A., General Manager.
1915. Priestley, Donald, 19, Balcarres Road, Leyland, Lancs, Works Chemist.
1899. Prinsen-Geerligs, H. C., Wanningstraat 17, Amsterdam, Holland, Director of Sugar Cane Experimental Station.

1912. Prittie, Frank H., Southern Pacific Railway Laboratory, Sacramento, Cal., U.S.A., Assistant Chemist.

1896. Prochazka, Dr. Geo. A., c/o Central Dyestuff and Chemical Co., Newark, N.J., U.S.A., Colour Manufacturer.

O.M. Procter, Prof. H. R., The Grange, Ilkley; and (Jnls.) The University, Leeds, Emeritus Professor of Tanning.

1884. Procter, J. W., Skeldergate Bridge, York, Manure Manufacturer.

1890. Proctor, Miss Anne J., Free Library, Widnes, Librarian.

O.M. Proctor, C., 118, Grosvenor Road, London, S.W., Analytical Chemist.

1905. Pugh, John V., Guiting House, Allesley, near Coventry, Works Director (Rudge-Whitworth, Ltd.).

1899. Pullar, Edmund, Keirfield, Bridge of Allan, Scotland, Manufacturer.

O.M. Pullar, R. D., Pullar's Dyeworks, Perth, Scotland, Dyer.

1913. Pulsifer, Lanson V., c/o Messrs. Valentine and Co., 364, Manhattan Avenue, Brooklyn, N.Y., U.S.A., Chemist.

1902. Puntan, H. H. C., 10, London Chambers, Durban, Natal, Public Analyst.

1894. Purdie, Dr. Thos., F.R.S., 14, South Street, St. Andrews, Professor of Chemistry.

1913. Purves, G. Thomson, Coke Ovens Dept., Auchengeich Colliery, Chryston, Scotland, Manager.

1905. Pyman, Dr. Frank Lee, "Sedgley," Selborne Road, Sidcup, Kent, Chemist.

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1903. Queeny, Jno. F., Monsanto Chemical Works, 1800, South 2nd Street, St. Louis, Mo., U.S.A., Chemical Manufacturer.

1887. Quibell, Oliver, Shalem Lodge, Newark-on-Trent, Manure Manufacturer.

1902. Quinan, Kenneth B., Cape Explosives Works, Somerset West, C.C., South Africa, and (subscriptions) c/o Cape Explosives Works, Ltd., 15, St. Swithin's Lane, E.C., Superintendent.

R

1911. Race, Joseph, City Hall, Ottawa, Canada, City Bacteriologist.

1915. Radcliffe, L. Guy, 929, Chester Road, Stretford, Manchester, Chemist.

1900. Radley, Ernest G., 49, Ernest Street, West Norwood, S.E.

1902. Ramsay, A. Alexander, Laboratory, Department of Agriculture, 136, George Street, Sydney, N.S.W., Australia, Assistant Chemist.

O.M. Ramsay, Sir William, K.C.B., F.R.S., Hazelmere, Bucks, Professor of Chemistry.

1885. Ramsay, W., c/o Cammell, Laird, and Co., Ltd., Birkenhead Ironworks, Birkenhead, Chemist and Assayer.

1911. Ramsay, Wm. G., Beechcroft, Hazelmere, Bucks., Research Chemist; retain Journals.

1913. Ramsbottom, Dr. J. E., 98, Peabody Road, South Farnborough, Hants, Chemist.

1906. Ranck, Samuel H., Ryerson Public Library Building, Grand Rapids, Mich., U.S.A., Librarian.

1909. Randall, George, Severn Bank Tannery, Worcester, Tanner.

1910. Ranken, Charles, 19, Stockton Road, Sunderland, Analytical and Consulting Chemist.

1901. Ransom, Francis, The Chilterns, Hitchin, Herts, Manufacturing Pharmaceutical Chemist.

1905. Ransom, H. B., St. Stephen's House, Victoria Embankment, Westminster, S.W., Consulting Engineer.

1898. Raschen, Dr. Julius, The Highlands, Runcorn, Cheshire, Consulting Chemist (United Alkali Co.).

1905. Raschig, Dr. F., c/o S. W. Hoekstra, Amsterdam, Manufacturing Chemist.

1915. Rashid, Dr. S. A., "Dar-ul-Fazl," Gujrat, Punjab, India, Pharmacist.

1908. Rassow, Prof. Dr. Berthold, General Secretary.

1893. Ratcliff, Frank D., Stourbank House, Stourport, Vinegar Brewer.

1904. Ratcliffe, C. F., Haigh Park Chemical Works, Stourton, near Leeds, Tar Distiller.

1914. Ratcliffe, Henry, Leeds Phosphate Works, Ltd., Midland Road, Hunslet, Leeds, Technical Chemist.

1916. Ratcliffe, Norman, 16, Park Road, Clydach, near Swansea, Analyst.

1898. Ratcliffe, Walter, 21, Mawdsley Street, Bolton, Analytical Chemist.

1901. Rawlins, Herbert J. L., The Crossways, Rainhill, Lancashire, Managing Director.

1903. Rawolle, Frederick C., c/o Marx and Rawolle, 100, William Street, New York City, U.S.A., Chemist.

O.M. Rawson, Chris., 22, Cumberland Street, Manchester, Consulting Chemist.

1909. Rawson, H. Wyatt, c/o Chartered Bank of India, Australia, and China, 38, Bishopsgate, E.C.

1909. Rayner, Arthur B., Normanhurst, Alexandra Park Road, Muswell Hill, N., Chemical Broker.

1912. Rayner, Edgar A., c/o Messrs. Johnson and Sons, 23, Cross Street, Finsbury, E.C., Analytical Chemist.

1915. Razzack, Syed A., c/o S. A. Razzack and Co., Charkaman, Hyderabad, Deccan, South India, Pharmaceutical Chemist.

1895. Read, E. J., c/o Pretoria Portland Cement Co., Ltd., P.O. Box 405, Pretoria, South Africa, Analyst.

1914. Read, Harold M., The Briers, North Park Avenue, Roundhay, Leeds, Manufacturing Chemist.

1913. Read, Prof. John, The University, Sydney, N.S.W., Australia, Prof. of Organic Chemistry.

1890. Reade, Thos., 118, Tettenhall Road, Wolverhampton, Manufacturing Chemist.

1908. Reavell, J. Arthur, 37, Parliament Street, Westminster, S.W., Engineer.

1912. Reddie, J. A., Sewage Disposal Works, Halifax, Yorks, Chemist.

1902. Redfern, C. G., 15, South Street, Finsbury, London, E.C., Patent Agent.

1915. Redfield, C. S., P.O. Box 502, Trenton, N.J., U.S.A., Rubber Chemist.

1915. Redman, L. V., Redmanol Chemical Products Co., 636, West 22nd Street, Chicago, Ill., U.S.A., Chemical Manufacturer.

1916. Redmayne, Leonard, c/o The British Engineering Co. of Russia and Siberia, Ltd., Central House, Kingsway, London, W.C., Engineer and Manager.

1914. Redpath, G. C., 10, Dean Street, Newcastle-on-Tyne, Analytical Chemist.

O.M. Redwood, Sir Boverton, Bart., 4, Bishopsgate, London, E.C., Petroleum Expert.

1887. Redwood, Robt., 4, Bishopsgate, London, E.C., Secretary.

1886. Rée, Dr. A., 15, Mauldeth Road, Withington, Manchester, Aniline Dye Manufacturer.

1902. Reed, Herbert C., 227-229, Fulton Street, New York City, U.S.A., Cons. Tanning Chemist.

1906. Reed, William, Bridge House, Bridge Road, Millwall, E., Works Manager.

1893. Reekie, J. A., Buckton Grange, Stalybridge, Calico Printer's Colour Mixer.

1883. Reeks, T. H., 106, Queen Victoria Street, London, E.C., Analytical and Consulting Chemist.

1897. Rees, W. H., El Dorado Oil Works, West Berkeley, Cal., U.S.A., Chemist.

1906. Rees, Walter J., 36, Holly Lane, West Smethwick, near Birmingham, Glass Works Chemist.

1900. Reese, Dr. Chas. L., Eastern Laboratory, P.O. Box 424, Chester, Pa., U.S.A., Chemist.

1915. Reeve, H. T., American Optical Co., Southbridge, Mass., U.S.A., Metallurgist.

1913. Regan, Colston J., 14, Penerley Road, Catford, S.E., Analytical Chemist.

1916. Reid, Alexander F., 3, Dalmarnock Road, Glasgow, Chemist.

1897. Reid, Andrew, c/o L. and J. McLellan, 65, Port Dundas Road, Glasgow, Chemist.

1909. Reid, David E., Kodak Park, Rochester, N.Y., U.S.A., Chemist.

1906. Reid, James, Caldercruix Mills, by Airdrie, Scotland, Chemist.

1905. Reid, Dr. John H., Westgarth, Eccles Road, Formby, Lancs, Chemist.

1907. Reid, Robert, Agencia de Tharsis, Huelva, Spain, Analytical Chemist.

1896. Reid, Robt., Oil Mills, Horbury Bridge, near Wakefield, Chemist.

O.M. Reid, Walter F., Fieldside, Addlestone, Surrey, Technical Chemist.

1893. Reid, Wm., jun., Bombay Dyeworks, Dadur, Bombay, India, Dyer.

-1904. Reinherz, Otto. *See* Reynard, Otto.

1898. Reitmeyer, Robt. E. D., 63, Crutched Friars, London, E.C., Chemical Merchant.

1916. Relyea, P. J., 327, High Park Avenue, Toronto, Canada, Chemical Engineer.

1904. Remington, Prof. Joseph P., 1832, Pine Street, Philadelphia, Pa., U.S.A., Author, U.S. Pharmacopœia.

1903. Remsen, Professor Ira, Johns Hopkins University, Baltimore, Md., U.S.A., Professor of Chemistry.

1911. Renaud, Paul, 8, Rue Nouvelle, Paris (9^e), France, Consulting Engineer.

O.M. Rennie, Dr. E. H., University of Adelaide, South Australia, Professor of Chemistry.

1911. Rentschler, Mahlon J., 82, Ocean Avenue, New Dorp, Staten Is., N.Y., U.S.A., Chemist.

1901. Renwick, Frank F., Sunny Side, Weald Road, Brentwood, Essex, Chemist (Photographic Works).

1907. Reoch, Robert A. S., Pacific Mills Printworks, Laurence, Mass., U.S.A., Printworks Superintendent.

1894. Rettie, Theodore, 12, Ann Street, Edinburgh, Metallurgical Chemist.

1895. Reubena, Chas. M., 68, Cliff Street, New York City, U.S.A., Chemist.

1915. Reuschle, Wm. C., 471, Summer Avenue, Newark, N.J., U.S.A., Manufacturing Chemist.

1905. Revis, Cecil, 5, Carlton Villas, Station Road, Barnes, S.W., Analyst.

1904. Reynard, Otto, 3, Selborne Villas, Manningham, Bradford, Yorks, Chemist.

1916. Reynolds, Clayton W., c/o The Paterson Manufacturing Co., 2021, St. Hubert Street, Montreal, Canada, Manufacturing Chemist.

O.M. Reynolds, Dr. J. Emerson, F.R.S., 3, Inverness Gardens, Kensington, W., Professor of Chemistry.

1912. Reynolds, Wm. Colebrook, "Wharfedale," Upminster, Essex, Manufacturing Chemist.

1913. Rhead, T. F. Eric, 780, Washwood Heath Road, Ward End, Birmingham, Research Chemist.

1908. Rhoads, J. Edgar, 2211, Shallcross Avenue, Wilmington, Del., U.S.A., Leather Chemist.

1892. Rhodea, P. J., Bridge House, Church, Accrington, Dye and Print Works Manager.

1889. Richarda, Edgar, 60, Ayrault Street, Newport, R.I., U.S.A., Analytical Chemist.

1888. Richardson, Dr. Clifford, Room 1615, Woolworth Building, 233, Broadway, New York City, U.S.A., Chemical Engineer.

1884. Richardson, F. W., County Analyst's Office, Bradford, Yorkshire, Analytical Chemist.

1900. Richardson, Jno. H., 14, Cavendish Drive, Rock Ferry, Cheshire, Manager.

1891. Richardson, Walter W., Aldingham, Park View Crescent, Roundhay, Leeds, Manufacturing Chemist.

1903. Richardson, Wm., Linfield, Wood Lane, Headingley, Leeds, Drysalter.

1894. Richardson, Wm. H., Newsky Thread Mills, Malaja, Bolotnaja, Petrograd, Russia, Textile Chemist.

1898. Richmond, Jno. R., "Maisonette," Park Drive, Trentham, Staffs, Alkali Works Manager.

1884. Rideal, Dr. Samuel, Laboratory, 28, Victoria Street, Westminster, S.W., Consulting Chemist.

1905. Ridge, H. M., The Ridge Roasting Furnace and Engineering Co., 2, Great Winchester Street, London, E.C., Mining Engineer.

O.M. Ridsdale, C. H., Laboratory, 3, Wilson Street, Middlesbrough, Analytical Chemist.

1899. Riederer, Emil J., Forcite Works, Landing, N.J., U.S.A., Superintendent.

1902. Riederer, Dr. Herman S., 2016, Cecil Avenue, Baltimore, Md., U.S.A., Chemist.

1916. Rigg, Geo. F., 154, Titford Road, Langley, near Birmingham, Metallurgical Chemist.

1907. Rigg, Gilbert, c/o New Jersey Zinc Co., Palmerton, Carbon Co., Pa., U.S.A., Chemist

1892. Riker, Jno. J., 19, Cedar Street, New York City, U.S.A., Merchant.

1913. Riley, George, Effra Works, South Lambeth Road, London, S.W., Chemical Engineer.

1915. Riley, Lt.-Col. J. J., 400, St. James Street, Montreal, Canada, Explosives Manufacturer.

1905. Riley, Louis J., 8, Newton Road, London, W., Chemist.

1912. Riley, Walter A., 100, King Street, Norwich, Brewer.

1899. Rink, Arnold, 11, Bridgewater Street, Barbican, London, E.C., Tannin Extract Manufacturer.

1889. Rintoul, Wm., "Lauriston," Ardrossan, Ayrshire, Explosives Chemist.

1901. Ripley, Philip F., 7, Abbott Street, Andover, Mass., U.S.A., Chemist.

1914. Ritchie, P. B., Box 894 G.P.O., Sydney, N.S.W., Australia, Manufacturer.

1916. Roast, Harold J., c/o The James Robertson Co., Ltd., 142, William Street, Montreal, Canada, Analyst.

1915. Roberts, Alfred A., Director of Strontia Works.

1907. Roberts, Chester, Swarthmore College, Swarthmore, Pa., U.S.A., Superintendent.

O.M. Roberts, F. G. Adair, Oak Hill Lodge, Hampstead, N.W., and Jnls. to Madame Brook, c/o Messrs. A. Boake, Roberts and Co., Ltd., Carpenters' Road, Stratford, E., Chemical Manufacturer.

1916. Roberts, Frederic, Broad Oak Printworks, Broad Oak, near Accrington, Calico Printworks Manager.

1901. Roberts, H. E. U., c/o British Explosives Synd., Pitsea, Essex, Chemist.

1911. Roberts, H. W., H.M. Factory, Queensferry, near Chester, Chemist.

1916. Roberts, Joseph G., c/o Shanks and Co., Ltd., Tubal Works, Barrhead, Glasgow, Chemist.

1902. Roberts, Wm. H., City Analyst's Office, Ashton Street, Liverpool, Analytical Chemist.

1891. Robertson, Alex. A., Riversdale, Cressington Park, Liverpool, Technical Chemist.

1916. Robertson, Arthur F., c/o National Drug and Chemical Co., Montreal, Canada, Chemical Engineer.

1910. Robertson, Charles, c/o Messrs. S. Allsopp and Sons, Ltd., Burton-on-Trent, Brewer.

1915. Robertson, G. S., East Anglian Institute of Agriculture, Chemlsford, Essex, Agricultural Chemist.

1900. Robertson, Jas., Barncraig, South Medrox, by Glenboig, Scotland, Analytical Chemist.

1910. Robertson, Dr. Joseph G., 19, Broomhill Terrace, Partick, Glasgow, Manufacturer.

1891. Robertson, Dr. Robt., Research Dept., Royal Arsenal, Woolwich; and (Journals) 29, Charlton Road, Blackheath, S.E., Research Chemist.

1910. Robertson, William, 21, Worfield Street, Battersea Park, S.W., Research Chemist.

1916. Robertson, W. O., The Bungalow, Redbridge, Hants., Chemist.

1913. Robins, Edmund A., c/o Messrs. Kodak, Ltd., Wealdstone, Middlesex, Assistant Works Manager.
1913. Robinson, C. Stanley, H.M. Factory, Queen's Ferry, near Chester, Works Chemist.
1897. Robinson, Clarence J., 708, Jewett Avenue, West New Brighton, N.Y., U.S.A., Chemist.
1916. Robinson, Frederic, "The Hollies," Mile End, Stockport, Cheshire, Brewing Chemist.
1902. Robinson, Hy. Fishwick, Culcheth Chemical Works, Newton Heath, Manchester, Manufacturing Chemist.
O.M. Robinson, H. H., 42, Penywern Road, Earl's Court, S.W., Analytical Chemist.
1907. Robinson, Herbert W., Robinson Bros., Ltd., Ryders Green, West Bromwich, Staffordshire, Tar Distiller.
1913. Robinson, I. H., 164, Cheetham Hill Road, Manchester, Technical Chemist.
1911. Robinson, Jas. H., 11, East Street, Rugby, Analytical Chemist.
O.M. Robinson, Jos., Farnworth, Widnes, Chemical Manufacturer.
1915. Robinson, Prof. R., Organic Chemistry Dept., The University, Liverpool, Professor of Organic Chemistry.
1887. Robinson, Thomas, (Journals) 401, West Street, Glasgow; and (communications), The Villa, Nitshill, Chemical Works Manager.
1902. Robitschek, Carl, 200, Worth Street, New York City, U.S.A., Scientific Brewer.
1915. Robson, J. C., Gas Works, Dundee, Gas Works Chemist.
1915. Rocha, João, Villa Nova de Lima, Minas Geraes, Brazil, Assayer and Chemist.
1884. Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
1904. Rodger, Robert, Government Laboratory, Clement's Inn Passage, Strand, London, W.C., Chemist.
1909. Rody, Franz A., c/o American Zinc and Chemical Co., Langeloth, Pa., U.S.A., Chemist.
1903. Roelofsen, Dr. J. A., c/o Coal Distillation Co., Middlesbrough, Yorks, Works Manager.
1910. Roessler, Dr. F., 89, High Street, Perth Amboy, N.J., U.S.A., Chemist.
1905 Rogers, Dr. Allen, Pratt Institute, Brooklyn, N.Y., U.S.A., Research Chemist.
1915. Rogers, Dr. F. M., c/o Standard Oil Co., Whiting, Ind., U.S.A., Chemist.
1900. Rogers, Geo. J., 32, Chudleigh Road, Brockley, S.E., Chemist.
1908. Rogers, Harry V., Ash Street, Ilkeston, Derbyshire, Engineer.
1909. Rogers, Herbert, c/o James Lyne Hancock, Ltd., 266, Goswell Road, London, E.C., Rubber Works Chemist.
1915. Rogers, J. E., "Quarry Bank," Hawthorn Road, Bootle, Liverpool, Chemist.
1899. Rogers, John, c/o Nobel's Explosives Co., Ltd., Nobel House, Glasgow, Chemist.
1898. Roller, H. C., 493, Central Avenue, Newark, N.J., U.S.A., Superintendent.
1899. Rollin, Chas., Bylton, East Jarrow-on-Tyne, Chemical Manufacturer.
1909. Rollin, Hugh, 1558, Kanawha St., Charleston, West Va., U.S.A., Chemical Manufacturer.
O.M. Rollin, J.C., 1, St. Nicholas Buildings, Newcastle-on-Tyne, Chemical Manufacturer.
1907. Rolph, George M., c/o California and Hawaiian Sugar Refining Co., Crockett, Cal., U.S.A., Sugar Refiner.
1905. Romanes, J. W., Craig Knowe, Slateford, Edinburgh, Chemical Engineer.
1904. Rose, Jno., Wicken House, Stretton, near Warrington, Technical Chemist.
1901. Rose, Jno. Leonard, 14, St. Vincent Road, Westcliff-on-Sea, Chemist.
1916. Rosebrugh, R. M., 2425, South State Street, Syracuse, N.Y., U.S.A., Chemical Engineer.
1897. Rosengarten, Dr. Geo. D., P.O. Box 1625, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1913. Rosenplaenter, Carlos B., c/o Henry S. King and Co., 65, Cornhill, London, E.C., Petroleum Technologist.
1916. Rosenstamm, B., King Street, Perth, Western Australia, Tanner.
1893. Ross, Arthur, 1, Glengall Road, Old Kent Road, London, S.E., Analytical Chemist.
1900. Ross, Raymond, Public Analyst's Office, Burnley, Lancashire, Analytical Chemist.
1910. Ross, Thos. M., Burmah Oil Co., Yenangyat, via Myingyay, Up. Burmah, Analytical Chemist.
1910. Rossati, Guido, 226, Lafayette Street, New York City, U.S.A., Agricultural Chemist.
1911. Rossi, Dr. Carlo, 29, Via Leopardi, Milano, Italy, Electro-chemist.
1906. Rossi, Louis M., c/o General Bakelite Co., Perth Amboy, N.J., U.S.A., Works Manager.
1913. Rossini, Jas. L., c/o Anglo-American Oil Co., Mode Wheel, Manchester, Oil Works Manager.
1906. Rossiter, E. C., Brougham, West Hagley, Worcestershire, Chemical Engineer.
1888. Rothwell, C. F. Seymour, Photographic Works, Mobberley, Cheshire, Chemist.
O.M. Rottenburg, Dr. Paul, 55, West Regent Street, Glasgow, Chemical Merchant.
1903. Rouse, Wm., The Knowe, Carlibar Road, Barrhead by Glasgow, Chemist.
1906. Rowell, Herbert W., c/o Power Gas Corporation, Stockton-on-Tees, Analytical Chemist.
O.M. Rowland, W. L., 2815, Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemist.
1904. Rowley, Ernest W, Chemical Laboratory, C.M.E. Department, North Eastern Railway, Darlington, Analytical Chemist.
1908. Rowley, Frank, 8, Tufnell Park Road, London, N., Metallurgist.
1901. Rowley, Walter Eugene, c/o National Aniline and Chemical Co., 100, William Street, New York City, U.S.A., Chemist.
1904. Rowling, S. R., 1, Beechwood, Kendal, Westmoreland, Chemist.
1913. Rowse, Walter W., 39, Oliver Street, Boston, Mass., U.S.A., Representative of Cassella Color Co.
1915. Roy, Dr. Charles S., 4, Farnley Road, Chingford, Essex, Chemist.
1896. Royal-Dawson, H., Chemist.
1916. Royce, Septimus, 14, Melton Road, West Bridgford, Nottingham, Analytical Chemist.
1898. Royle, Chas. L., Sugar Chemist.
O.M. Royse, Sir Samuel W., St. Andrew's Chambers, 20, Albert Square, Manchester, Chemical Engineer.
1913. Rubinstein, I. H., *See* Robinson, I. H.
1916. Ruck, Edwin, 19, Bryn Road, Swansea, Works Manager.
1902. Rücker, Dr. Hermann von, The Windsor, Anderson Place, Buffalo, N.Y., U.S.A., Chemist.
1896. Ruddock, Fred. G., Corporation Street, Warrington, Analytical Chemist.
1895. Rudge, Alfred, United Alkali Co., Ltd., Allhusen Works, Gateshead-on-Tyne, Analytical Chemist.
1911. Rudnick, Paul, c/o Armour and Co., Union Stock Yards, Chicago, Ill., U.S.A., Chemist.
1908. Rudolf, Prof. Norman S., Post Box 12A, Royal Automobile Club, London, S.W., Professor of Applied Chemistry.
1909. Rudorf, Dr. G., 52, Cranley Gardens, Muswell Hill, N., Manufacturing Chemist.
1884. Ruffle, Jno., Musley, Ware, Herts, Consulting Chemist and Electrician.
1898. Ruhl, Louis, c/o Roessler and Hasslacher Chemical Co., 100, William Street, and (Jnls.) Box 0101, New York City, U.S.A., Chemical Merchant.
1909. Ruiloba, J. A., c/o U.S. Steel Corporation, 71, Broadway, New York City, U.S.A., Engineer.
1910. Rule, Dr. Alexander, H.M. Wood Distillation Works, Bideford, Devon, Technical Manager.

1915. Rule, Dr. H. G., Chemistry Department, The University, Edinburgh, Lecturer on Chemistry.
O.M. Rumble, C., 169, Gleneldon Road, Streatham, S.W., Chemist.
1899. Rumbold, Wm. R., Electro-metallurgist.
1913. Rumi, Dr. Tomás J., Salta 947, Buenos Aires, Argentina, Doctor of Chemistry.
1911. Runeckles, A. R., c/o Brotherton and Co., Ltd., Lonsdale Dock, Workington, Cumberland, Technical Chemist.
1903. Runyan, Elmer G., Hutchins Building, Washington, D.C., U.S.A., Chemist and Gas Inspector.
1899. Rushby, Wm., Oakview, Batley, Yorks, Analyst.
1906. Russell, David, Rothes, Markinch, Fife, Scotland, Paper Maker.
1912. Russell, George H., c/o Michaelis, Hallenstein, and Co. Propy., Ltd., Footscray, Vic., Australia, Leather Trades Chemist.
1913. Russell, Stanley, Savonnerie Sunlight, Olten, Switzerland, Works Manager.
1912. Russell, Thomas F., 131, Steade Road, Sheffield, Analytical Chemist.
1910. Russell, William, 88, Peel House Lane, Widnes; Jnls. to c/o United Alkali Co., Pilkington-Sullivan Works, Widnes, Lancashire, Chemist.
1905. Ruttan, Prof. R. F., Medical Faculty, McGill University, Montreal, Canada, Professor of Chemistry.
1909. Ryall, W. E., c/o North-West Soap Co., 63, Garden Reach, Calcutta, India, Soapworks Chemist.
1905. Ryan, Prof. F. G., c/o Parke, Davis, and Co., Detroit, Mich, U.S.A., Manufacturing Chemist.

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1895. Saalfeld, Adolphe, Royds Street, Stockport Road, C.-on-M., Manchester, Chemical Merchant.
1905. Sabio, Alvah H., 432, Sandford Avenue, Flushing, N.Y., U.S.A., Chemist, Varnish Works.
1883. Sadler, A. E., Sand Hall, Ulverston, Lancashire, Manufacturing Chemist.
1884. Sadtler, Dr. S. P., 210, South 13th Street, Philadelphia, Pa., U.S.A., Consulting Chemist.
1896. Sadtler, Dr. S. S., 210, South 13th Street, Philadelphia, Pa., U.S.A., Analytical and Consulting Chemist.
1897. Sage, C. Edward, 10, London Street, London, E.C., Consulting Chemist.
1902. Sahm, Louis N., c/o The Heller and Merz Co., 505, Hudson Street, New York City, U.S.A., Chemist.
1884. Salamon, A. Gordon, 1, Fenchurch Avenue, London, E.C., Consulting Chemist.
1911. Salamon, Maurice S., 79, Mark Lane, London, E.C., Consulting Analyst.
1884. Salis-Mayenfeld, Dr. E. von, 24, South Allen Street, Albany, N.Y., U.S.A., Technical Chemist.
1907. Samuel, Marcus R. A., c/o Compania General de Tabacos Filipinas, 37, Fenchurch Street, London, E.C., Merchant.
O.M. Samuel, W. Cobden, 66, Croxted Road, West Dulwich, S.E., Analytical Chemist.
1896. Samuelson, Francis A. E., Sir B. Samuelson and Co., Ltd., Middlesbrough, Ironmaster.
1904. Sand, Dr. Henry J. S., Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C., Lecturer and Demonstrator.
1910. Sandeman, Archibald, Ruchill Oil Works, Glasgow, Chemist.
1906. Sanders, J. McConnell, Cia Mexicana de Petrole, "El Aguila, S.A.," Tampico, Mexico, Analytical and Consulting Chemist.
1915. Sanders, W. W., Factory Library, Goodyear Tire and Rubber Co., Akron, Ohio, U.S.A., Chemist.
1895. Sanderson, John, c/o B. S. Cohen, Ltd., Neasden Lane, London, N.W., Chemist.
1890. Saniter, E. H., Strafford Villa, Moorgate, Rotherham, Analytical Chemist.
1901. Sargent, Dr. Geo. W., c/o Crucible Steel Co. of America, Oliver Building, Pittsburgh, Pa., U.S.A., Chemist and Metallurgist.
1910. Sargent, R. N., c/o Roessler and Hasslacher Chem. Co., Perth Amboy, N.J., U.S.A., Chemical Engineer.
1911. Sauer, J. N. A., Joh Verhulststraat 43, Amsterdam, Holland, Sugar Chemist.
1903. Saunders, Lewis E., 123, Buffalo Avenue, Niagara Falls, N.Y., U.S.A., Electro-Chemical Engineer.
1896. Saunders, Walter M., 20, Dewey Street, Olneyville, R.I., U.S.A., Analytical Chemist.
1911. Saville, W. B., 35, North Side, Clapham Common, S.W., Analytical Chemist
1895. Sawers, Wm. D., 7, Minard Road, Partick Hill Glasgow, Chemist.
1907. Saxe, Joel B., 84, St. Antoine Street, Montreal, Canada, Chemist.
1898. Saxe, Sigmond, 107, Manhattan Avenue, New York City, U.S.A., Manufacturing Chemist.
1890. Sayers, Jos. J., c/o Nobel's Explosives Co., Pembrey, South Wales, Explosives Chemist.
1915. Scafe, Captain R. C., H.M. Factory, Penrhyndeudraeth, N. Wales, Manager of Explosives Works.
1913. Scarfe, H. Crespin, "Chikatoo," Willifield Way, Hendon, N.W., Public Officer.
1899. Schaak, Dr. Milton J., 108, Penn Street, Brooklyn, N.Y., U.S.A., Chemist.
O.M. Schack-Sommer, Dr. G., 87, Victoria Street, London, S.W., Sugar Refiner.
1908. Schad, Dr. Philip, The Gables, Hartford, Cheshire, Manufacturing Chemist.
1910. Schaefer, Dr. George L., New York Quinine and Chemical Works, 105, North 11th Street, Brooklyn, N.Y., U.S.A., Chemist and Technical Manager.
1912. Schapiro, Hugo H. B., Wadsworth, Ohio, U.S.A., Chemist.
1908. Schatzmann, Dr. Paul, Isleben bei Fluelen, Switzerland, Chemist.
1908. Scheele, Edward H., 3, Lloyds Avenue, London, E.C., Chemical Merchant.
1903. Scheidel, Dr. Aug., c/o Commonwealth Portland Cement Co., 4, O'Connell Street, Sydney, N.S.W., Australia, Managing Director.
1886. Schellhaas, Henry Alf., Thornhill, Beech Road, Hartford, Northwich, Mechanical Engineer.
1904. Schenck, Henry, "Beaumont," West Orange, N.J., U.S.A.
1894. Schidrowitz, Dr. P., 57, Chancery Lane, London, W.C., Research Chemist.
1909. Schlagintweit, Theo., 94, Market Street, Manchester, Imperial German Consul.
1902. Schlegel, Jno. Wm., New York Sugar Refinery, Long Island City, N.Y., U.S.A., Chemist.
1893. Schleicher, Francis J., 38, West Tenth Street, Long Island City, N.Y., U.S.A., Technical Chemist.
1901. Schlichting, Emil, 1270, Madison Avenue, New York City, U.S.A., Chemist.
1906. Schmidt, J., 52, Camberwell Green, London, S.E., Works Manager.
1907. Schmitt, Charles A., The Carter's Ink Co., Cambridge "C.," Boston, Mass., U.S.A., Chemist.
1904. Schniewind, Heinrich, jun., Susquehanna Silk Mills, 18, West 18th Street, New York City, U.S.A., Vice-President and Treasurer.
1901. Schoeller, Dr. Walter R., 57, York Street, Baker Street, London, W., Metallurgical Research Chemist.
1902. Schofield, Prof. Jas. A., The University, Sydney, N.S.W., Australia, Lecturer in Chemistry.
O.M. Scholefield, H. E., Edge Hill Chemical Works, Liverpool, Chemical Manufacturer.
1906. Schroeder, C. M. E., Rutherford, N.J., U.S.A., Analytical Chemist.
1895. Schroeder, E. August, c/o Church and Dwight Co., 1416, Willis Avenue, Syracuse, N.Y., U.S.A., Chemist.
1904. Schultz, Carl R., 440, First Avenue, New York City, U.S.A., Mineral Water Manufacturer.

1901. Schultze, Wm., c/o General Chemical Co., Laurel Hill, Long Island, N.Y., U.S.A., Chemist.
1907. Schwamm, Chas. A., c/o Antoine Chiris, 20, Platt Street, New York City, U.S.A., Chemist.
1889. Schweich, Emile. *See* Mond, Emile S.
1894. Schweitzer, Dr. H., Riverside Mansions, corner 113th Street and Riverside Avenue, New York City, U.S.A., Chemical Expert.
1906. Schwerin, Lorenz R., c/o Casein Co. of America, Bainbridge, N.Y., U.S.A., Vice-President.
1891. Scott, Andrew, Royal Gunpowder Factory, Waltham Abbey, Essex, Analytical Chemist.
1889. Scott. Ernest G., c/o Ernest Scott and Co., Ltd., Kingsway House,· Kingsway, London, W.C., Chemical Engineer.
1912. Scott, Harold M., 11, Woodfield Road, Cheadle Hulme, Cheshire, Works Chemist.
1898. Scott, Jas., Cawnpore Woollen Mills, Cawnpore, India, Chemist.
1894. Scott, Jno. Gillespie, Annislea, Clermiston Road, Corstorphine, Edinburgh, Analytical Chemist.
1912. Scott, Jno. William, 576, Church Street, Toronto, Canada.
1916. Scott, Robert, c/o Miss Cornell, 19, Ipswich Road, Stowmarket, Suffolk, Chemist.
1907. Scott, Wm. F., c/o Madison Woollen Co., Madison, Maine. U.S.A., Manager.
1894. Scott-Smith, G. E., 67, Surrey Street, Sheffield, Analytical and Consulting Chemist.
1904. Scoville, Wilbur L., c/o Parke, Davis, and Co. Detroit, Mich., U.S.A., Analytical Chemist.
1915. Scragg, Harold, c/o Locke, Blackett and Co., Ltd., St. Anthony's, Newcastle-on-Tyne, Analytical Chemist.
O.M. Scudder, F., Mersey and Irwell Joint Committee, 44, Mosley Street, Manchester, Chemist.
1889. Searl, Albert, 7, Palmeira Avenue, Westcliff-on-Sea, Technical Chemist.
1898. Searle, Alfred B., The White Building, Sheffield, Consulting Chemist (Classes VIII. and IX.).
1915. Seaton, Cecil, 3, Victoria Villas, Sneinton Dale, Nottingham, Technical Chemist.
1905. Seeker, A. F., 160, Midwood Street, Brooklyn, N.Y., U.S.A., Food Analyst.
1896. Seldner, Rudolph, 383, St. John's Place, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
1904. Seligman, Dr. Richard, Point Pleasant, Putney Bridge Road, Wandsworth, S.W., Chemist.
1908. Sellen, Elijah, Gasworks Laboratory, M.L.H. & P. Co., Elm Station, Montreal, Canada, Chemist.
1905. Sellers, Geo. E., Hopton Lane, Mirfield, near Huddersfield, Aniline Colour Maker.
1915. Sellers, R. A., 194, Goodshaw Lane, Crawshawbooth, Manchester, Print and Dye Works Chemist.
1898. Sen (Kaviraj), Nagendra Nath, 18, Lower Chitpur Road, Calcutta, India, Physician and Chemist.
1910. Sen, Prof. Rajendra Nath, Engineering College, Sibpur, Bengal, India, Professor of Tinctorial Chemistry.
1905. Sewell, B. F. Brooke, P.O. Box 1334, Washington, D.C., U.S.A., Chemical Engineer.
1896. Seyler, Clarence A., Public Analysts' Office, Nelson Terrace, Swansea, Chemist and Assayer.
1907. Seymour, Tom G., Kilton, Northway, Wavertree, Liverpool, Analytical Chemist.
1903. Shacklady, T. G., Hope Point, Cliffe at Hoo, Kent, Technical Chemist.
1906. Shah, Prof. S. J., Dhanasutar's Street, Ahmedabad, India, Consulting Chemist.
1892. Shanks, Arch., 5, Green Lodge Terrace, Greenhead, Glasgow, Chemist.
1908. Shanks, John, Dalmeny Park, Barrhead near Glasgow, Sanitary Engineer.
1916. Sharp, F. L., 4, Rushworth Avenue, West Bridgford, Nottingham, Technical Chemist.
1904. Sharples, G. H., 255, Onslow Drive, Glasgow, Works Chemist.
1905. Sharples, Philip P., 90, Porter Place, Montclair, N.J., U.S.A., President (Natl. Coal Tar Co.).
1884. Sharples, Stephen P., 22, Concord Avenue, Cambridge, Mass., U.S.A., Analytical Chemist.
1911. Sharrock, Charles W., Lion Works, West Thurrock, Grays, Essex, Cement Manufacturer.
1900. Sharwood, Dr. Wm. J., c/o Homestake Mining Co., Lead, South Dakota, U.S.A., Metallurgical Chemist.
1900. Shattuck, A. F., c/o Solvay Process Co., Detroit, Mich., U.S.A., Chemist.
1915. Shaw, John H., Public Library, Bury, Lancashire, Librarian.
1913. Shaw, T. W. A., "Springfield," Dee View Road, Heswall, Cheshire, Process Manager.
1912. Shearman, Cecil H., The Tees Bone Mills, Thornaby-on-Tees, Managing Director.
1904. Shedden, Frank, 25, Middleborough Road, Coventry, Science Master.
1903. Sheldon, Dr. N. L., Cordite Factory, Aruvankad, Nilgiri Hills, India, Works Manager.
1912. Shelley, F. F., Apothecaries' Hall, Blackfriars, London, E.C., Analytical Chemist.
1912. Shelley, Wm. E., 20, Mount Street, Manchester, Engineer.
1911. Shelton, James, Government Laboratories, Singapore, S.S., Chemist.
1913. Shengle, J. C., c/o Major Bros., Ltd., Kiangsu Chemical Works, Shanghai, China, General Manager.
1892. Shenton, Jas. P., 37, Torbay Road, Chorlton-cum-Hardy, near Manchester, Analytical Chemist.
1906. Shepard, Jas. H., Experiment Station, Brookinga, S. Dak., U.S.A., Agricultural Chemist.
1907. Shepheard, Fred. G., Hetland Cottage, Ruthwell, Dumfriesshire, Chemist.
1904. Shepherd, A. B., Copenhagen Oil Mills, Limehouse, London, E., Analytical Chemist.
1893. Shepherd, H. H. B., 8, The Park, Sidcup, Kent, Chemist.
1898. Shepherd, Reginald des F., Central Laboratory, Rhodes, Manchester, Printworks Chemist.
1909. Shepherd, Stephen W., c/o Eastern Chemical Co., Ltd., Rowlee Hill, Dharavi, Bombay, India, Works Manager.
1899. Shero, John E., c/o Aluminium Co. of America, Niagara Falls, N.Y., U.S.A., Chemist.
1893. Shields, Dr. John, Minas de Rio Tinto, Prov. de Huelva, Spain, Chemist.
1896. Shimomura, Prof. K., Shinkarasumaru Kojinguchi Sagaru, Kyoto, Japan, Professor of Chemistry.
1915. Shingler, S. V., 90, Grove Avenue, Hanwell, W., Schoolmaster.
1905. Shoffstall, Arthur S., 153, Henderson Avenue, New Brighton, Staten Is., N.Y., U.S.A., Chemist.
1899. Sholes, Chas. E., 80, Maiden Lane, New York City, U.S.A., Chemical Agent.
1900. Shonk, Albert, 9, Lambton Road, Cottenham Park, Wimbledon, Analytical Chemist.
1897. Shores, Dr. Jeff. H., Kingsway, Frodsham, Cheshire, Chemist.
1904. Short, Andrew, 23, Hotspur Street, Tynemouth, Northumberland, Works Chemist.
1902. Shoubridge, Sydney Y., M.I.C.E., Gasworks, Lower Sydenham, S.E., Gas Engineer.
1901. Shukoff, Dr. Alexis A., Borowaja No. 86, Petrograd, Russia, Technical Chemist.
1915. Shulman, Harry, 21, Tredegar Square, Bow, E., Analytical Chemist.
1916. Shulman, Isaac, 5, Byron Street, Leeds, Yorks, Colour Chemist.
1890. Shutt, Frank T., Central Experimental Farm, Ottawa, Canada, Agricultural Chemist.
1906. Shuttleworth, E. B., 220, Sherbourne Street, Toronto, Canada, Chemist.
1901. Siau, Raymond L., Springfield Brewery, Wolverhampton, Research Chemist.
1902. Sibley, Samuel E., c/o Mauri Bros. and Thomson, Ltd., 121, Castlereagh, Sydney, N.S.W., Australia, Technical Chemist.
1912. Siddons-Wilson, S., 4, Northfield Road, East Ham, E., Analytical Chemist.

1915. Siderfin, N. E., c/o The Gas Light and Coke Co., Tar and Liquor Works, Beckton, E., Works Chemist.
1907. Siebel, Fred. P., 960–962, Montana Street, Chicago, Ill., U.S.A., Analytical Chemist.
1902. Siebold, Alfred, c/o Lactose Ltd., Hibernia Works, Tipperary, Ireland, Technical Chemist.
1901. Silberrad, Dr. Oswald, Sunny Croft, Buckhurst Hill, Essex, Research Chemist.
1912. Sillars, Daniel, The Laboratory, Bolckow, Vaughan, and Co., Ltd., South Bank, S.O., Yorks, Metallurgical Chemist.
1892. Silvester, Harry, 78, Holyhead Road, Handsworth, Birmingham, Analytical and Consulting Chemist.
1901. Sim, Wilfrid A., c/o Wm. Sim and Sons, 40, Jane Street, Leith, Scotland, Colour Manufacturer.
1912. Simmance, John F., 25A, Westminster Palace Gardens, Victoria Street, Westminster, S.W., Managing Director (Alexander Wright and Co.).
1911. Simmons, Thos. A., "Sarum" Wilton Road, Shirley Southampton, Technical Chemist.
1903. Simmons, Wm. H., Oakleigh, Stoke Newington Common, N., Analytical Chemist.
1898. Simon, Dr. A., 80, Bishopsgate, London, E.C., Chemical Engineer.
1905. Simons, Albert J., Pontianak, Dutch West Borneo, viâ Singapore, S.S., Engineer.
1902. Simonson, Wm., 126, West 9th Street, Cincinnati, Ohio, U.S.A., Chemist.
1905. Simpson, Henry, 26, Austen Avenue, Sherwood Rise, Nottingham, Works Chemical Assistant.
O.M. Simpson, W. S., The Gables, Cannon Hill, Southgate, N., Analytical Chemist.
1900. Sims, W. Edgar, Colinswell House, Burntisland, Fifeshire, Manager (British Aluminium Co.)
1894. Sinclair, Dr. W., 250, Ferry Road, Leith, Scotland, Chemist.
1890. Sindall, R. W., 2, Oxford Court, Cannon Street, London, E.C., Paper Chemist.
1911. Singh, Shersingh W., N.W. Railway, Jind Railway Station, Punjab, India, Engineer.
1899. Singmaster, J. Arthur, c/o New Jersey Zinc Co. of Penna., Palmerton, Carbon Co., Pa., U.S.A., Chemist.
1901. Sinnatt, Frank S., 321, Great Clowes Street, Higher Broughton, Manchester, Demonstrator of Chemistry.
1914. Sjōdahl, H.A., c/o The Chatfield Manufacturing Co., Station P., Cincinnati, Ohio, U.S.A., Chemist.
1912. Skellon, Herbert, Newlands, Water Street, Leyland, near Preston, Chemist.
1894. Skelton, John R., c/o Norwich Crape Co. (1856), Ltd., St. Augustine's, Norwich, Managing Director.
1897. Skertchly, W. P., Laboratory, 11, Billiter Square, London, E.C., Analytical Chemist.
1891. Skilton, C. F. E., c/o Beamish and Crawford, Ltd., Cork, Ireland, Brewer.
1901. Skinner, Hervey J., 71, West Chestnut Street, Wakefield, Mass., U.S.A., Chemist.
1908. Skinner, Wm., 38, Sauchiehall Street, Glasgow, Analytical Chemist.
1904. Skirrow, Dr. F. W., Macdonald Chemistry Building, McGill University, Montreal, Canada, Assistant Professor of Chemistry.
1911. Skjold, E., Erith Oil Works, Erith, Kent, Technical Manager and Chemist.
1904. Skowronski, S., c/o Raritan Copper Works, Perth Amboy, N.J., U.S.A., Chemist.
1891. Skurray, Thos., The Brewery, 40, Ock Street, Abingdon, Berks, Brewer.
1913. Slade, Dr. Roland E., on active service, Lecturer in Physical Chemistry.
1915. Slater, John, Royal Australian Naval College, Jervis Bay, N.S.W., Chemist.
1904. Slator, Dr. Arthur, 174, Ashby Road, Burton-on-Trent, Lecturer and Demonstrator.
1912. Slattery, F. J., 42, Mathews Park Avenue, Stratford, E., Analytical Chemist.
1906. Sleeper, Robt. R., 112, Charles Street, Lowell, Mass., U.S.A., Instructor in Dyeing.
1895. Slocum, Dr. Frank L., 401, South Linden Avenue, E.E., Pittsburg, Pa., U.S.A., Chemist.
1913. Slusser, Holland B., 1340, Arnold Avenue, N.W., Canton, Ohio, U.S.A., Analytical Chemist.
1898. Small, Fritz H., 38, Berwick Street, Worcester, Mass., U.S.A., Chemist.
1915. Smalley, Oliver, 13, Albany Gardens, Whitley Bay, Northumberland, Metallurgist.
1904. Smart, Bertram J., Testing Branch, Dept. of Public Works, Sydney, N.S.W., Australia, Chemist.
O.M. Smetham, A., 16, Brunswick Street, Liverpool, Analytical Chemist.
1916. Smith, Albert E., c/o New Bradford and Agawam Finishing Co., East Wareham, Mass., U.S.A., Bleaching Agent.
1905. Smith, Prof. Albert W., Case Library, Cleveland, Ohio, U.S.A., Professor of Chemistry.
1916. Smith, Alfred, Excelsior Works, Clayton, Manchester, Chemical Manufacturer.
1898. Smith, Alf. B., Ryecroft, Glossop, Derbyshire, Bleacher and Dyers' Manager.
1897. Smith, Allan, 30, Fountainhall Road, Edinburgh, Chemist.
1914. Smith, Andrew, c/o Leech, Neal, and Co., Ltd., Spondon, Derby, Colour Manufacturer.
1896. Smith, Andrew T., c/o Castner-Kellner Alkali Co., Ltd., 257, Royal Liver Building, Liverpool, General Manager.
1905. Smith, Arthur, Town End Chemical Works, Bramley, Leeds, Chemical Manufacturer.
1912. Smith, Arthur R., c/o British Aluminium Co., Larne Harbour, Co. Antrim, Chemist.
1893. Smith, Edgar B., c/o Dominion Tar and Chemical Co., Box D, Transcona, Manitoba, Canada, Manager.
1906. Smith, E. A. Cappelen, c/o M. Guggerheim's Sons, 120, Broadway, New York City, U.S.A., Metallurgical Engineer.
1913. Smith, Edward C., 18, Constance Street, and c/o Canadian National Carbon Co., Ltd., 99, Paton Road, Toronto, Canada, Superintendent.
1895. Smith, Dr. E. Ellsworth, Suite 80, Chemists' Building, 50, East 41st Street, New York City, U.S.A., Consulting Physiological Chemist.
1892. Smith, Ernest A., The Assay Office, Leopold Street, Sheffield, Assayer.
1911. Smith, E. Woodhouse, Central Laboratory, City Gasworks, Nechells, Birmingham, Chief Chemist.
1891. Smith, Francis P., 131—133, East 23rd Street, New York City, U.S.A., Chemist.
1907. Smith, Frank Morse, 100, William Street, New York City, U.S.A., Chemical Merchant.
1908. Smith, George A., 1433, President Street, Brooklyn, N.Y., U.S.A., Chemist (Printing Ink Manufacturing).
1907. Smith, George D., 247, Atlantic Avenue, Boston, Mass., U.S.A., Salesman.
1916. Smith, Harold P., c/o Brett's Oil Co., 90, Pilgrim Street, Newcastle-on-Tyne, Works Chemist.
1890. Smith, Harry E., 36, Beersford Place, East Cleveland, Ohio, U.S.A., Analytical Chemist.
1904. Smith Henry, 83, Brownlow Road, Horwich, Bolton-le-Moors, Lancs. Analytical Chemist.
1902. Smith, Hy. Geo., Technological Museum, Harris Street, Ultimo, Sydney, N.S.W., Australia, Assistant Curator and Chemist.
1915. Smith, Herbert, 24, Windy Bank, Port Sunlight, Cheshire, Works Chemist.
1901. Smith, H. Procter, Highfield, Shotton Lane, Shotton, Flintshire, Metallurgical Chemist.
O.M. Smith, H. R., 1, Aubert Park, Highbury, London, N., Analytical Chemist.
1905. Smith, Hugh Dunford, 7 and 9, The Side, Newcastle-on-Tyne, Analytical Chemist.
1906. Smith, Irwin J., 21, Lyon Avenue, Menands, Albany Co., N.Y., U.S.A., Salesman.
O.M. Smith, Jas., Ash Grove House, Radcliffe, Manchester.
1897. Smith, James, Sunnyside, Groes Road, Cressington, near Liverpool, Analytical Chemist.

1903. Smith, James, "Lyndhurst," Frodsham, and (Jnls.) Ditton Copper Works, Widnes, Metallurgist.

1907. Smith, Jas. C., c/o Edward Ripley and Son, Ltd., Bowling Dyeworks, Bradford, Dyer.

1893. Smith, Jas. F., 9, Alexandra Park, Scarborough, Yorks, Analytical Chemist.

1901. Smith, J. Cruickshank, King's House, King Street, London, E.C., Technical Chemist.

O.M. Smith, Dr. J. H., Photographic Dept., Municipal School of Technology, Manchester, Chemist.

1888. Smith, J. Tertius, Richmond House, Plaistow, Essex, Technical Chemist.

O.M. Smith, Jno. W., 7, Brookfield Street, Roslindale, Boston, Mass., U.S.A., Analytical Chemist.

1890. Smith, J. Wm., 1615, West Genesee Street, Syracuse, N.Y., U.S.A., Alkali Works Manager.

1916. Smith, Julian C., c/o Shawinigan Water and Power Co., 611, Power Building, Montreal, Canada, Chief Engineer.

1911. Smith, N. Garrett, Heathside, Treville Street, Roehampton, S.W., Analytical Chemist.

1898. Smith, R. F. Wood, 90, Lower Thames Street, London, E.C., Consulting Chemist.

1890. Smith, Dr. R. Greig, Linnean Society's House, Elizabeth Bay, Sydney, N.S.W., Bacteriologist and Chemist.

1890. Smith, Robert Watson, c/o The New Transvaal Chemical Co., Ltd., Delmore, Transvaal, South Africa, Chemical Works Manager.

1914. Smith, Stanley, The Ammonia Soda Co., Ltd., Lostock Gralam, near Northwich, Chemist.

1907. Smith, Thorn, 49, West Larned Street, Detroit, Mich., U.S.A., Chemist.

1910. Smith, Vincent, 107, Swinderby Road, Wembley, Middlesex, Technical Chemist.

1903. Smith, Dr. Warren R., Lewis Institute, Chicago, Ill., U.S.A., Teacher.

O.M. Smith, Watson, 34, Upper Park Road, Haverstock Hill, N.W., Retired Editor and Chemist.

1908. Smith, Dr. Watson, jun., Cape Explosives Works, Somerset West, C.C., South Africa, Chemist.

O.M. Smith, Wilfred, 182, West Street, Glasgow, Chemical Manufacturer.

1910. Smith, W. C., c/o The Anchor Cable Co., Leigh, Lancashire, Analytical Chemist.

'1909. Smith, Wm. G., 23, Wickham Way, Park Langley, Beckenham, Kent, Chemical Merchant.

O.M. Smithells, Prof. A., F.R.S., The University, Leeds, Professor of Chemistry.

1902. Smoot, Albert M., 99, John Street, New York City, U.S.A., Analytical Chemist.

1909. Smoot, Chas. C., III., c/o C. C. Smoot and Sons Co., North Wilkesboro', N.C., U.S.A., Tanning Chemist.

1888. Snape, Dr. H. Lloyd, Balholm, Lathom Road, Southport, Director of Education for Lancashire.

1908. Snell, Professor John F., Macdonald College P.O., Prov. Quebec, Canada. Professor of Chemistry.

1915. Snowber, John L., 3671, Broadway, New York City, U.S.A., Manufacturing Chemist.

1896. Snowdon, J., jun., Messrs. Snowdon, Sons and Co., Millwall, E., Chemical and Oil Manufacturer.

1894. Soane, Chas. E., 31, Mattison Road, Hornsey, N., Analyst.

1903. Sohlman, Ragnar, Bofors, Sweden, Manager (A. B. Bofors Nobelkrut).

1894. Sohn, Chas. E. *See* Soane, Chas. E.

1906. Solomon, M., Birmingham Carbon Works, Witton, Birmingham, Manager.

1914. Somerville, C. Winthorpe, South Metropolitan Gas Company, East Greenwich, S.E., Works Chemist.

1884. Sommer, Adolf, Corner 1st and Binney Streets, East Cambridge, Boston, Mass., U.S.A., Pharmaceutical Chemist.

1912. Sorley, Jas., Novara, Mount Vernon, Glasgow, Analytical Chemist.

1904. Southall, A. W., Lower Priory, Birmingham, Manufacturing Chemist.

1904. Southerden, F., 11, Gordon Road, Exeter, Teacher of Chemistry.

1890. Sowerby, Thos. H., Canal Soap Works, Verney Road, Rotherhithe, S.E., Soap Manufacturer.

O.M. Sowerby, W. M., c/o United Alkali Co., Ltd., Allhusen Works, Gateshead-on-Tyne, Manager.

1887. Spackman, Chas., Rosehaugh, Clitheroe, Lancashire, Portland Cement Manufacturer.

1910. Spackman, Henry S., 2211, Chestnut Street, Philadelphia, Pa., U.S.A., President of Engineering Co.

1904. Sparre, Fin, c/o E. I. du Pont de Nemours Powder Co., Experimental Station, Henry Clay P.O., Del., U.S.A., Director.

1913. Speedy, Alan, 2, Lydeard Road, Burges Road, East Ham, Essex, Technical Chemist.

1904. Speiden, C. C., 46, Cliff Street, New York City, U.S.A., Chemical Merchant.

1905. Speight, W. E., Hacken Sewage Works, Great Lever, Bolton Chemist.

1911. Spence, Dr. David, Norwalk, Conn., U.S.A., Research Chemist.

1900. Spence, Howard, Journals to Manchester Alum Works, Manchester, Chemical Manufacturer.

1909. Spence, Jno., Drumcroil, Paisley, Scotland, Analyst.

1883. Spence, Jno. W., Tiviot Colour Works, Manchester Road, Stockport, Drysalter.

1903. Spencer, A. Gordon, 601—603, Canadian Express Building, Montreal, Canada, Chemist.

1903. Spielmann, Dr. P. E., The Arts Club, 40, Dover Street, London, W., Chemist.

1906. Spiera, Dr. V. G., c/o Inchiostrificio-Veneto, Treviso, Italy, Chemist.

1889. Spies, Adolph, 21, Broadwater Down, Tunbridge Wells, Chemical Merchant.

1885. Spiller, A., 20, Holly Avenue, Newcastle-on-Tyne, Electrician.

O.M. Spiller, J., 2, St. Mary's Road, Canonbury, London, N., Consulting Chemist.

1914. Spilman, G. H., c/o The Chiswick Polish Co., Chiswick, W., Works Chemist.

1896. Spoor, J. L., Rede Court, Rochester, Kent, Portland Cement Manufacturer.

1909. Sprague, F. O., c/o Cattarangus Tanning Co., Olean, N.Y., U.S.A., Chemist.

O.M. Squire P. W., 413, Oxford Street, London, W., Pharmaceutical Chemist.

1916. Srivastava, J. P., Department of Industries for United Provinces, Cawnpore, India, Technical Chemist.

O.M Stahl, Dr. K. F., 57th Street and A. V. Ry., Pittsburgh, Pa., U.S.A., Consulting Chemist.

1912. Stancourt, Fred., 24, Walbrook, London, E.C., Chemical Manufacturer.

1904. Standfast, Jno. T., Prince Regent's Wharf, Silvertown, E., Chemist.

1906. Stanley, Wm., Great Barrington, Mass., U.S.A., Engineer.

1897. Stannard, Dr. Oscar J., c/o Twite and Stannard, 65, London Wall, E.C., Consulting Metallurgist.

1888. Stantial, Frank G., c/o Cochrane Chemical Co., Everett, Mass., U.S.A., Technical Chemist.

1885. Staples, H. J., The Old Hall, Spondon, Derby, Colour Manufacturer.

O.M. Stark, J. F., Rosedale, Bromborough, Cheshire, Works Manager.

1916. Starrels, Joel, 250, Front Street, New York City, U.S.A., Chemical Engineer.

1896. Statham, Noel, c/o West Virginia Pulp and Paper Co., 200, Fifth Avenue, New York City, U.S.A., Engineer.

1907. Staud, Joseph E., c/o W. W. Lawrence and Co., West Carson Street, S.S., Pittsburgh, Pa., U.S.A, Chemist.

1904. Stauffacher, W., 64, Oberwilerstrasse, Basle, Switzerland, Chemical Works Manager.

1895. Stead, J. Christopher, 57, Chancery Lane, London W.C., Technical Chemist.

O.M. Stead, Dr. J. E., F.R.S., 11, Queen's Terrace, Middlesbrough-on-Tees, Analytical Chemist.

O.M. Stebbins, Dr. J. H., 50, East 41st Street, New York City, U.S.A., Analytical Chemist.

1915. Steedman, Geo., Annickburn, Irvine, Ayrshire, Chemical Manufacturer.

1896. Steel, Fred. W., c/o General Chemical Co., Ltd., Auburn, Sydney, Australia, Works Manager.

1900. Steel, Jno. S., Achernar, Blackburn, Melbourne, Vic., Australia, Chemist.

O.M. Steel, Thos., Colonial Sugar Refining Co., O'Connell Street, Sydney, N.S.W., Australia, Sugar Chemist.

1914. Steele, George Francis, Room 604, 18 East 41st Street, New York City, U.S.A., Paper Manufacturer.

1915. Steger, Prof. Alph. M. A. A., Technical University of Delft, and (Jnls.) Bibliotheek van het Scheikundig Laboratorium der Technische Hoogeschool, Delft, Holland, Chemical Technologist.

1912. Steiner, Bernard C., Enoch Pratt Free Library, Baltimore, Md., U.S.A., Librarian.

1897. Steinhart, Dr. Oscar J. *See* Stannard, Dr. Oscar J.

1912. Steinhoff, Fred., *See* Stancourt, Fred.

1887. Stenhouse, T., 166, Drake Street, Rochdale, Analytical Chemist.

1908. Stenhouse, Thos., jun., Chemical Laboratory, H.M. Dockyard, Portsmouth, Analytical Chemist.

1904. Stephen, A. E., 67, Castlereagh Street, Sydney, N.S.W., Australia, Analytical Chemist.

1915. Stephen, A. Y., 185, Liverpool Road, Cadishead, near Manchester, Works Chemist.

1911. Stephens, C. E., Messrs. Stephens and Morgan, 2, Bury Court, St. Mary Axe, E.C., Chemical Merchant.

1884. Stephens, H. Chas., Avenue House, Finchley, N., Ink Manufacturer.

1892. Stephens, M. E., 57—60, Aldersgate Street, London, E.C., Ink Manufacturer.

1909. Stephenson, Henry H., "Pentillee," Chapel Terrace, Hayle, Cornwall, Technical Chemist.

1909. Stephenson, Herbert F., 8, The Park, Mitcham, Surrey, Analytical Chemist.

1889. Stern, Arthur L., 148, High Street, Burton-on-Trent, Brewing Chemist.

1912. Sterne, Edward T., School of Mining, Queen's University, Kingston, Ont., Canada, Chemist.

O.M. Steuart, D. R., Osborne Cottage, Broxburn, West Lothian, Oilworks Chemist.

1903. Steven, A. B., Royal Technical College, Glasgow, Lecturer on Dyeing.

1914. Steven, George, 23, Denstone Road, Pendleton, Manchester, Pharmaceutical Chemist.

1907. Steven, Michael M., c/o The Murree Brewery Co., Ltd., Rawalpindi, Punjab, India, Analytical Chemist.

1916. Steven, Thos. W., 7, West George Street, Glasgow, General Manager.

1899. Stevenot, G. A., 280, Baltic Street, Brooklyn, N.Y., U.S.A., Chemist.

1902. Stevens, Dr. Hy. P., Laboratory, 15, Borough, London Bridge, S.E., Consulting Chemist.

1894. Stevens, Jno. H., c/o Librarian, The Celluloid Co., 3, Westcott Street, Newark, N.J., U.S.A., Manufacturing Chemist.

1908. Stevens, J. Venn, 147a, Clapton Common, London, N.E., Analytical Chemist.

1902. Stevens, M. White, on active service, Chemist.

1916. Stevenson, C. E., 80, Polwarth Terrace, Edinburgh, Dyer and Manufacturer.

O.M. Stevenson, W., Standard Works, 95A, Southwark Street, London, S.E., Chemical Manufacturer.

1913. Steward, H. Bernard, Rose Hill House, Coseley, near Bilston, Staffs, Enamel Chemist.

1912. Stewart, Allan E., 136, Bedford Road, Toronto, Canada, Chemist.

1901. Stewart, David B. D., Aberdeen Comb Works, Hutcheon Street, Aberdeen, Managing Director.

1903. Stewart, Jas., "The Gas World," 8, Bouverie Street, Fleet Street, London, E.C., Editor.

1909. Stewart Jeffrey, India Refining Co., McKean and Swanston Streets, Philadelphia, Pa., U.S.A., Works Manager.

1890. Stewart, Robt., 46, Westbourne Road, Luton, Chemical Works Manager.

1915. Stewart, R. P., Carricklea, Kirkintilloch, Scotland, Analytical and Manufacturing Chemist.

O.M. Stewart, S, c/o Michael Nairn and Co., Ltd., Kirkcaldy, Fife, Technical Chemist.

1906. Stickland, Oliver W., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Works Chemist.

1904. Stieglitz, Dr. Julius, University of Chicago, Chicago, Ill., U.S.A., Associate Professor of Chemistry.

1904. Stiff, John T., 68, Dover Road, Northfleet, Kent, Works Chemist.

1903. Stillwell, Albert G., 76½, Pine Street, New York City, U.S.A., Chemist.

1914. Stock, Cyril J. H., 9, Houndgate, Darlington, Analytical Chemist.

1900. Stockdale, Edgar, c/o R. Dewhurst and Co., Ltd. Printworks, Batley, Yorks, Colour Mixer.

1888. Stockdale, Wm., Rosebank Printworks, Ramsbottom, near Manchester, Calico Printer.

1887. Stocks, H. B., 33, Prenton Park Road, Birkenhead, Cheshire, Analytical Chemist.

1903. Stoddard, Jesse D., 674, Woodward Avenue, Detroit, Mich., U.S.A.

1885. Stoddart, F. Wallis, Grafton Lodge, Sneyd Park, Bristol, Analytical Chemist.

1899. Stokes, Alf. W., Laboratory, Town Hall, Paddington Green, W., Public Analyst.

1910. Stokes, Edward S., c/o Metropolitan Board of Water Supply and Sewerage, Pitt Street, Sydney, N.S.W., Australia, Medical Officer.

1900. Stone, Geo. C., c/o New Jersey Zinc Co., 55, Wall Street, New York City, U.S.A., Engineer.

1899. Stone, I. F., 100, William Street, New York City, U.S.A., Chemical Merchant.

O.M. Storey, I. H., Haverbreaks, Lancaster, Chemical Manufacturer.

1914. Storie, George B., 62, Vineyard Hill Road, Wimbledon, S.W., Works Manager.

1902. Storr, Bertram V., 26, The Square, Garden Suburb, Ilford, Essex, Chemist.

1914. Stott, Augustus P., 20-26, Brunswick Place, City Road, London, N., Manager.

1909. Strachan, Jas. T., c/o The Canada Paper Co., Ltd., Windsor Mills, P.Q., Canada, Technical Chemist.

1912. Strevens, J. E., Broken Hill Chambers, 31, Queen Street, Melbourne, Australia, Technical Chemist.

1903. Strickler, Emerson H., c/o General Chemical Co., 25, Broad Street, New York City, U.S.A., Chemist.

1909. Strivens, Percy R., 20, Cartmel Road, St. Annes-on-Sea, Lancs, Analytical Chemist.

1896. Stuart, Harry T. R., Fir Bank, Woolfold, near Bury, Printworks Manager.

O.M. Stuart, T. W., 7, Livingston Drive, Sefton Park, Liverpool, Alkali Works Manager.

1896. Stubbs, Augustus J., Castellon de la Plana, Spain.

1903. Sturrock, Major G. C., R.A., Indian Cordite Factory, Aruvankad, Nilgiris, India, Assistant Superintendent.

1908. Suart, Arthur B., c/o Johnson and Sons' Smelting Works, Paul Street, Finsbury, London, E.C., Bullion Refiner.

1895. Sudborough, Dr. J. J., Indian Institute of Science, Bangalore, India, Lecturer in Chemistry.

1916. Sullivan, E. C., Corning Glass Works, Corning, N.Y., U.S.A., Chemist.

1889. Sulman, H. L., 44, London Wall, London, E.C., Chemist and Metallurgist.

1910. Sulzer, Albert F., 16, Beverly Street, Rochester, N.Y., U.S.A., Chemical Engineer.

1895. Summers, Bertrand S., c/o The Summers Fiber Co., Port Huron, Mich., U.S.A., Electro-Chemist.

1907. Sundar-Ram, Minakshi, c/o Parry and Co., Ranipettai, N. Arcot, Madras, India, Agricultural Chemist.

1912. Sutcliffe, J. A. L., c/o Price's Co., Ltd., Belvedere, Kent, Analytical Chemist.

1906. Sutermeister. Edwin, c/o S. D. Warren and Co., Cumberland Mills, Westbrook, Maine, U.S.A. Chemist.

1884. Sutherland, D. A., 26, Victoria Street, Westminster, S.W., and (Jnls.) Fairfield Lodge, Twickenham, Consulting Technical Chemist.

1909. Sutherland, Daniel M., Ashgrove, Sunbury Common, Middlesex, Works Manager.

1894. Sutherland, Geo., Croft Cottage, Bonhill, Scotland, Chemist.

1887. Sutherland. Jas., c/o British Aluminium Co., Ltd., Larne Harbour, Co. Antrim, Ireland, Chemist.

1906. Sutherland, John, Vril Lodge, Larne Harbour, Co. Antrim, Ireland, Chemical Engineer.

O.M. Sutherland, R. M., Lime Wharf Chemical Works, Falkirk; and Solsgirth, Dollar, Chemical Manufacturer.

1886. Sutton, F. Napier, 21, Lydford Road, Cricklewood, N.W., Alkali Works Inspector.

1900. Sutton, W. Lincolne, Redwell Street, Norwich, Public Analyst.

1913. Swan, J. Waldron, "Purleighs," The Downs, Luton, Beds., Gas Works Chemist.

1905. Swenarton, W. Hastings, 2, Rector Street, New York City, U.S.A., Patent Lawyer.

1904. Swindells, Seth, Liverpool Road, Kidsgrove, Stoke-on-Trent, Chemist.

1912. Swinden, Dr. Thos., 12, Nether Edge Road, Sheffield, Metallurgist.

1912. Sykes, Charles D., Ivy House, Langley, near Birmingham, Chemical Works Manager.

1902. Sylow, Paul L. P. G., New Farm Sugar Refinery Brisbane, Queensland, Analytical Chemist.

1906. Symes, Langford P., Belfast Freezing Works, Christchurch, New Zealand, Chemist.

1906. Symonds, Abram E., Wiek Lane Colour Works, Old Ford Road, Bow, E., Colour Manufacturer.

1910. Szilagyi, L. F., 39, Belsize Avenue, London, N.W., Consulting Engineer.

T

1895. Taber, G. H., 18th floor, Friek Building Annex, Pittsburg, Pa., U.S.A., General Manager (Gulf Refining Co.).

1915. Taberner, E., 1, White Friars, Chester, Technical Chemist.

1914. Taek, Howarth K., Acid Plant, La Refineria, El Aguila S.A., Minatitlan, Vera Cruz, Mexico, Chemical Engineer.

1910. Tainsh, Peter, 36, Green Lawn, Rock Ferry, Cheshire, Technical Chemist.

1915. Tait, J. W., Holly House, Hamilton Street, Saltcoats, Ayrshire, Lecturer in Chemistry.

1909. Tait, Walter Scott, Innelian, Bebington, Cheshire, Works Manager.

O.M. Takamatsu, T., 13, Nishikatamachi, Hongo, Tokyo, Japan, Analytical Chemist.

O.M. Takamine, Dr. Jokichi, 550, West 173rd Street, New York City, U.S.A., Engineer.

1915. Tallantyre, S. B., 159, Withen's Lane, Liscard, Cheshire, Technical Chemist.

1912. Talley, Herbert, c/o Hercules Powder Co., Wilmington, Del., U.S.A., General Manager

1910. Tanahashi, Dr. T., 486, Sendamachi, Fukagawa, Tokyo, Japan, Manufacturing Chemist.

1898. Tanaka, Keishin, Matsuba Hotel, Kudansaka, Uye, Tokyo, Japan, Chemist.

1915. Tangye, Albert W., Thorn, Hartford, Cheshire, Chemical Works Manager (Brunner, Mond & Co.).

1900. Tankard, Arnold R., 67, Ferens Avenue, Cottingham Road, Hull, Analytical Chemist.

1911. Tarver, Percy, 2095, East 36th Street, Cleveland, Ohio, U.S.A., Chemist.

O.M. Tate, F. H., 9, Hackins Hey, Liverpool, Analytical and Technical Chemist.

O.M. Tatlock, R. R., 156, Bath Street, Glasgow, Consulting Chemist.

1902. Tatters, Hugh Lee, 21, Park Road, Hebburn-on-Tyne, Analytical Chemist.

1906. Tattersfield, Frederick, 96, Bewick Road, Gateshead-on-Tyne, Analyst.

1905. Taveau, René de Mortemer, Experimental Station, E. I. du Pont de Nemours Powder Co., Wilmington, Del., U.S.A., Chemist.

1903. Taylor, Alvin M., c/o General Chemical Co., Hegewisch, Ill., U.S.A., Chemist.

1902. Taylor, Arthur P., c/o John Taylor and Co., 531, Front Street East, Toronto, Canada, Soap Manufacturer.

1886. Taylor, G. Crosland, Crane House, Crane Wharf, Chester, Electrical Engineer.

1894. Taylor, G. Midgley, Caxton House, Westminster, S.W., Analytical Chemist.

O.M. Taylor, H. E., 1, Alexandra Park Gardens, Glasgow, Lead Works Manager.

1883. Taylor, Jas., "Cartref," Brierley Street, Mosman, N.S.W., Australia, Government Metallurgist.

1898. Taylor, Jas. M., Tynevale, Groes Road, Cressington, Liverpool, Analytical Chemist.

1888. Taylor, J. Scott, North London Colour Works, Spring Place, Kentish Town, N.W., Technical Chemist.

1896. Taylor, Martin, Abbotsmead, St. Albans, Herts., Chemical Works Manager.

1901. Taylor, Sidney H., 63, Wolstenholme Road, Sharrow, Sheffield, Works Chemist.

1898. Taylor, Walter, 475, Grosvenor Place, Limefield, Bury, Lancs, Technical Chemist.

1915. Taylor, W. Ivan, c/o Kynoch, Ltd., Umbogintwini, Natal, Chemical Works Manager.

1905. Taylor, Wm. H., 36, Glenhouse Road, Eltham Park, Kent, Chemist.

1916. Tcherniac, Dr. Jos., 49, Palace Road, Streatham Hill, S.W., Consulting Chemist.

1887. Teanby, G. W. A., Elvin Lodge, East Dereham, Norfolk, Analytical Chemist.

1899. Teas, Wm. Holmes, Marion, Va., U.S.A., Chemist.

O.M. Teed, Dr. F. L., Chem. Laby., 9, Mincing Lane, London, E.C., Analytical Chemist.

1905. Teeple, Dr. J. E., 50, East 41st Street, New York City, U.S.A., Director.

1915. Tefft, H. Delano, 75, Chelsea Avenue, Toronto, Canada, Chemist.

1904. Teller, George L., 31, North State Street, Chicago, Ill., U.S.A., Chemist.

1906. Tempany, Dr. Harold A., Government Laboratory, St. John's, Antigua, West Indies, Analyst.

1884. Tennant, Jas., Fairlie, Ayrshire, Lead and Colour Manufacturer.

1913. Tennant, Robt., on active service, Analytical Chemist.

1896. Tennille, Geo. F., c/o Southern Cotton Oil Co., 206, Bay Street East, Savannah, Ga., U.S.A., Chemist.

1908. Terleski, Fred. H., Oakwood, Hilton Lane, Prestwich, Manchester, Technical Chemist.

1911. Terrey, Augustus G., 6, Alexandra Road, South Woodford, Essex, Chemist.

1884. Terry, Hubert L., (Journals) Fairfield House, Brook Road, Fallowfield, Manchester; and (Laboratory) 23, Hopwood Avenue, Manchester, Technical Chemist.

O.M. Tervet, R., 68, Windsor Road, Leyton, Essex, Oil Works Manager.

1893. Tetley, C. F., Messrs. Jos. Tetley and Son, The Brewery, Leeds, Brewer.

1915. Thaberg, N. T., A.B. Lina Myr, Stureplan 13, Stockholm, Sweden, Technical Chemist.

1903. Thatcher, Ed. J., The Manor House, Chew Magna, near Bristol, Merchant and Manufacturer.

1909. Thaxter, Gerald N., c/o Brewer and Co., Worcester, Mass., U.S.A., Chemist.

1908. Thom, Wm. H., 131, Oakwood Avenue, Toronto, Canada, Chemist.

1911. Thomas, D. Hibbert, 56, Waun Road, Morriston, Glamorganshire, Chemical Works Manager.

1912. Thomas, Frederick, c/o Williams Bros. and Co., Colour Manufacturers, Hounslow, Middlesex, Chemist and Works Manager.

1894. Thomas, H. Russell, Broad Plain Soap Works, Bristol, Soap Manufacturer.

1909. Thomas, John, Highfield, Brettell Lane, near Stourbridge, Analytical Chemist.

1916. Thomas, John S. G., 234, Turney Road, Dulwich Village, S.E., Physicist.

1902. Thomas, Nehemiah M., Wellesley Road, Pymble, N.S.W., Australia, Inspector.

1901. Thomas, Octavius, Gas and Water Offices, Pentre, Glamorganshire, Gas and Water Engineer.

1908. Thomas, Oswald J. D., c/o Canadian Brakeshoe Co., Sherbrooke, Quebec, Canada, Chemist and Metallurgist.

1888 Thomas, S. Percy, c/o Baird and Tatlock, 14, Cross Street, Hatton Garden, London, E.C., Technical Chemist.

1898. Thomas, Wm. Harrison, jun., c/o The Apponang Co., Apponang, R.I., U.S.A., Printworks Chemist.

1905. Thomlinson, Wm., Seaton Carew Ironworks, West Hartlepool, Ironmaster.

1905. Thompson, Alf. J., c/o R. W. Greeff and Co., Thames House, Queen Street Place, London, E.C., Chemical Merchant.

1885. Thompson, Prof. Claude M., 38, Park Place, Cardiff, Professor of Chemistry.

1898 Thompson, Edw. C., Froyle House, 42, Westcombe Park Road, Blackheath, S.E., Manufacturing Chemist.

1909. Thompson, Edwin, 25, Sefton Drive, Liverpool, Manufacturing Chemist.

1914. Thompson, F. C., 183, Hyde Park Road, Leeds, Demonstrator in Leather Industries Department.

1893. Thompson, G. Rudd, 69, Dock Street, Newport, Mon., Analytical and Consulting Chemist.

1895. Thompson, Gustave W., 129, York Street, Brooklyn, N.Y., U.S.A., Chemist.

1913. Thompson, Howard, 32, Ryde Street, Hull, Analytical Chemist.

1907. Thompson, Jas. G., Donegall Quay Mills, Belfast, Ireland, Corn Miller.

1903. Thompson, Jno. T., Corporation Sewage Works, Knostrop, Leeds, Analyst.

1912. Thompson, Kenworthy J., c/o Mansfield Tire and Rubber Co., Mansfield, Ohio, U.S.A., Rubber Works Chemist.

1907. Thompson, Milton S., 72, Broad Street, Boston, Mass., U.S.A., Manufacturer.

O.M. Thompson, W. P., Patent Office, 6, Lord Street, Liverpool, Patent Agent.

1896. Thomsen, Alonzo L., Maryland Club, 1, East Eager Street, Baltimore, Md., U.S.A., Manufacturing Chemist.

1884. Thomson, G. Carruthers, 53, Bedford Road, Rock Ferry, Birkenhead, Engineer.

1907. Thomson, H. N., P.O. Box, 295, Clarkdale, Arizona, U.S.A., Metallurgist.

1891. Thomson, Jas. M., Royal Gunpowder Factory, and (Jnls.) Powder Mill Lane, Waltham Abbey, Essex, Manager (Cordite Branch).

1884. Thomson, Robt. T., 156, Bath Street, Glasgow, Analytical Chemist.

1899. Thomson, Thos., c/o Waterproofing Co., Barrhead, near Glasgow, Manufacturer.

O.M. Thomson, W., Royal Institution Laboratory, 79A, Princess Street, Manchester, Analytical and Consulting Chemist.

1915. Thomson, W. Lockerie, 34, Craighoun Avenue, Morningside, Edinburgh, Chemist.

1890. Thomson, Wm. Thos., "Stanton," Parkstone Road, Poole, Dorset, Explosives Chemist.

1902. Thorburn, Jas., 30, Cromartie Avenue, Newlands, Glasgow, Analytical Chemist.

1910. Thorne, Carl B., c/o Riordan Paper Co., Hawkesbury, Ontario, Canada, Manager.

O.M. Thorne, Dr. L. T., Highlands, The Crescent, Belmont, Surrey, and (Journals) Southampton Wharf, Battersea, S.W., Technical Chemist.

1907. Thornewell, A. R., 163, Rood End Road, Oldbury, Birmingham, Works Chemist.

O.M. Thorneycroft, Wallace, (Jnls.) Plean House, Plean, Stirling, and 113, St. Vincent Street, Glasgow, Technical Chemist.

1904. Thornley, Thomas, 19, Hope Street, Glasgow, Chemical Manufacturer.

1895. Thorp, Dr. Frank H., Mass. Inst. of Technology, Boston, Mass., U.S.A., Assistant Professor of Industrial Chemistry.

1906. Thorp, Walter, Sorrentoville, Dalkey, Co. Dublin, Ireland, Analytical Chemist.

O.M. Thorpe, Sir Edward, C.B., F.R.S., Whinfield, Salcombe, South Devon, Professor of Chemistry.

1905. Thorpe, Prof. J. F., F.R.S., The Imperial College, South Kensington, London, S.W., Professor of Organic Chemistry.

1915. Threlfall, Prof. R., F.R.S., Oakhurst, Church Road, Edgbaston, Birmingham, Chemical Manufacturer.

1905. Thresh, Dr. John C., Chelmsford, Essex, Medical Officer of Health and Sanitary Expert.

1898. Thurnauer, Dr. Gustav, c/o Aurora Metal Co., Aurora, Ill., U.S.A., Chemist.

1904. Thurston, Azor, Grand Rapids, Ohio, U.S.A., Chemist.

1904. Tickle, Thos., Laboratory, 83, Queen Street, Exeter, Analyst.

1913. Tilburn, Charles, The Australian Explosives and Chemical Co., Ltd., Brabrook, Vic., Australia, Works Manager and Explosives Chemist.

1908. Tillberg, Erik W., Westervik, Sweden, Extract Manufacturer.

1900. Tilley, Jas. W., 95A, Southwark Street, London, S.E., Research Chemist.

1906. Tillson, Henry E., 5946, Christian Street, Philadelphia, Pa., U.S.A., Dyer.

1901. Timmans, W. G., The Basford Chemical Co., Ltd., Basford, Nottingham, Chemical Manufacturer.

1894. Tipler, Fred. C., 2, Wellington Villas, Crewe, Analytical Chemist.

1907. Tischbein, Dr. Robert, The Heyden Chemical Works, Garfield, N.J., U.S.A., Chemist.

1894. Toch, Maximilian, 320, Fifth Avenue, New York City, U.S.A., Chemist.

1915. Tocher, Dr. J. F., Crown Mansions, Union Street, Aberdeen, Public Analyst.

1886. Todd, A. M., c/o The A. M. Todd Co., Kalamazoo, Mich., U.S.A., Manufacturing Chemist and Distiller of Essential Oils.

1911. Todd, Fred W., Joyce Green Works, Dartford, Kent, Chemist.

1913. Tomlinson, George G., Anglo-Chilian Nitrate and Railway Co., Tocopilla, Chile, South America, Chemist.

1914. Tompkin, Albert, 101, Lenton Boulevard, Nottingham, Pharmacist.

O.M. Toms, F. Woodland, States Analyst's Office, St. Heliers, Jersey, Analytical Chemist.

1902. Tone, Frank Jerome, c/o The Carborundum Co., Niagara Falls, N.Y., U.S.A., Manager.

1909. Tonry, Wm. S., Passaic Street, near Elm Street, Maywood, N.J., U.S.A., Chemical Engineer.

1913. Toppin, Richmond D., Millett Street, Hurstville, Sydney, N.S.W., Chemist.

1907. Torrey, Dr. Joseph, Park Drive, Blundellsands, Liverpool, Engineer.

O.M. Towers, J. W., Widnes, Lancashire, Analytical Chemist.

1907. Towler, A. E., c/o Sulphide Corporation, Cockle Creek, N.S.W., Australia, Chemist.

1915. Townsend, Clinton P., 918, F. St. N.W., Washington, D.C., U.S.A., Patent Lawyer.

1897. Towse, Walter, Elswick Leather Works, Newcastle-on-Tyne, Technical Chemist.

1904. Toyne, Francis D., c/o Kelsal, and Kemp, Ltd., Woodhouse Mills, Norden, near Rochdale, Chemist.

1899. Trantom, Dr. Wm., Borås, Grappenhall, near Warrington, Chemist.
1894. Traphagen, Dr. Frank W., Colorado School of Mines, Golden, Colo., U.S.A., Professor of Metallurgy and Assaying.
1900. Traquair, Jno., Ayer, Mass., U.S.A., Analytical Chemist.
1906. Travell, Norman E., Grosvenor Avenue, Mapperley Park, Nottingham, Lace Dresser.
1893. Travers, Dr. Morris W., F.R.S., 17, Lexham Gardens, London, W.
1889. Trechmann, A. O., The Old Palace. Rochester, Kent, Cement Manufacturer.
1911. Trechmann, C. T., Warren Cement Works, Hartlepool, Cement Manufacturer.
1895. Treharne. F. Gwilym, Wrangbrook, Llanishen, near Cardiff, Analytical Chemist.
1901. Trigger, Oliver, Chem. Dept., Royal Arsenal, Woolwich, S.E., Analytical Chemist.
1898. Tripp, Dr. E. Howard, 3, Milton Road, Bedford, Science Master.
O.M. Trobridge, A., c/o Trobridge and Co., Ltd., Heworth Shore, Felling-on-Tyne, Technical Chemist.
1897. Trotman, Saml. R., The City Laboratory, 1, Regent Street, Nottingham, City Analyst.
1887. Tsukiyama, S., 2nd of No. 2116, Fukiai-chō, Kobe, Japan, Paper Mills Chemist.
1894. Tucker, Alex. E., 55, Station Street, Birmingham, Metallurgist and Chemist.
1897. Tucker, Samuel A.. Columbia University. New York City, U.S.A., Tutor in Industrial Chemistry.
1886. Tuer, Arthur H., Douglas House, Worthington, near Wigan, Analytical Chemist.
1903. Tufts, C. G., c/o Semet-Solvay Co., Syracuse, N.Y., U.S.A., Chemical Engineer.
1909. Tulloch, Capt. T. G., Bank Buildings, St. James' Street, London, S.W., Director of Public Companies.
1901. Tulloch, Wm. F., c/o Joseph Watson and Sons, Ltd., Whitehall Soap Works, Leeds, Merchant.
1914. Tungay, Sydney J., Haughton's Ltd., 30, St. Mary at Hill, London, E.C., Chemical Engineer.
1909. Tunks, Dr. F. R., Powder Mills, Tonbridge, Kent, Manager.
1904. Tunnell, Raymond W., 251, West Walnut Lane, Germantown, Philadelphia, Pa., U.S.A., Manufacturer.
1899. Turnbull, Dr. Andrew, 18, Hackins Hey, Liverpool, Consulting Chemist.
1888. Turnbull, G. W., Ash Cottage, North Road, Carnforth, Lancashire, Metallurgical Chemist.
1916. Turnbull. John. 38. Waynflete Street. Earlsfield. S.W., Analytical Chemist.
1904. Turnbull, R. H., Messrs. Turnbull's (Glasgow) Ltd., 10, Strand Road, Calcutta, India, Chemist.
1884. Turnbull, W. S., 38, Bath Street, Glasgow, Chemical Manufacturer.
1911. Turner, Prof. A. J., Technical Institute, Byculla, Bombay, India, Professor of Chemistry.
1902. Turner, Basil, 83, Pitt Street, Sydney, N.S.W., Australia, Metallurgist.
1915. Turner. James, c/o Read. Holliday and Sons. 8—10. West Market Street. Toronto, Canada. Manufacturing Chemist.
1902. Turner. Jos., c/o British Dyes. Ltd., and (Jnls.) Azo House. Birkby. Huddersfield. Director.
1905. Turner, Prof. Thomas, 75, Middleton Hall Road, King's Norton, Birmingham, Professor of Metallurgy.
1887. Turney, Sir J., Trent Bridge Leather Works, Nottingham, Tanner.
1905. Tutwiler, Carrington C., Real Estate Trust Building, Philadelphia, Pa., U.S.A., Consulting Gas Chemist.
1890. Tweedy, Jas., 245, Burdett Road, Limehouse, E., Metallurgical Chemist.
1905. Twigg, Geo. F., 57, Val Plaisant, St. Heliers, Jersey, Gas Works Chemist.
1915. Twiss, Dr. D. F., "Glendevon," Royal Road, Sutton Coldfield, Chief Chemist, Dunlop Rubber Co.
1891. Twitchell, E., Wyoming, Ohio, U.S.A., Candle Works Manager.
1913. Twomey, Jerome, 21, Onslow Road, Elm Park, Liverpool, Research Chemist.
O.M. Twynam, T., Wynyard House, Coatham Road, Redcar, Yorks, Metallurgist.
1904. Tyler, Chas. R., c/o Dr. Francis Wyatt, 402, West 23rd Street, New York City, U.S.A., Analytical Chemist.
O.M. Typke, P. G. W., Lawn House, New Malden Surrey, Chemical Manufacturer.
O.M. Tyrer, Thos., Stirling Chemical Works, Stratford, E.; and (Journals) 14, Sandwell Mansions, West End Lane, N.W., Chemical Manufacturer.

U

1907. Udal, John P., c/o Kynoch, Ltd., Witton, Birmingham, Engineer.
1904. Ueda, Toyokitsu, 54, Matsugaye hō Kitaku, Osaka, Japan, Chemist (Ceramic).
1894. Uhlig, E. C., c/o The Brooklyn Union Gas Co., 191, St. James' Place, Brooklyn, N.Y., U.S.A., Chemist.
1900. Uhlig, W. C., 143, North Clinton Street, East Orange, N.J., U.S.A., Chemist.
1915. Ullmann, Dr. H. M., Chemical Laboratory, Lehigh University, South Bethlehem, Pa., U.S.A., Prof. of Chemistry.
O.M. Umney, C., Fernbrake, Branksome Wood Road, Bournemouth; and (Journals) 48, Southwark Street, London, S.E., Manufacturing Chemist.
1905. Umney, John C., 48, Southwark Street, London, S.E., Wholesale Druggist.
1889. Underhill, Thos. J., 53, Lanercost Road, Tulse Hill, S.W., Inspector of Stores.
1885. Underwood, G. R., 10, Emerson Street, Peabody, Mass., U.S.A., Glue Works Chemist.
1915. Upton, W. C., Tara Cook Street, Randwick, Sydney, N.S.W., Soap and Candle Manufacturer.

V

1911. Vakil, Kapibram H., No. 5, Santa Cruz, Bombay, India, Chemist.
1915. Valentine, Geo., Engineer's Dept., St. James' Gate Brewery, Dublin, Chemical Engineer.
1896. Van der Linde, Dr. Harold, c/o National Synthetic Co., Inc., Perth Amboy, N.J., U.S.A., Rubber Chemist.
1895. Vanderpoel, Dr. Frank, 175, Park Avenue, Orange, N.J., U.S.A., Chemist.
1903. Van Dyck, Edwin M., 57, Greene Street, New York City, U.S.A., Chemist and Ink Maker.
1897. Van Gelder, Arthur P., c/o Hercules Powder Co., Kenvil, N.J., U.S.A., Superintendent.
1891. Van Gundy, Chas. P., Laboratory, B. and O. R. R., Baltimore, Md., U.S.A., Metallurgical Chemist.
1896. Van Laer, Norbert, Truman's Brewery, Burton-on Trent, Brewer and Chemist.
1897. Van Marken, J. C., 10, Amalia Straat, The Hague, Holland, Chemical Engineer.
1888. Vargas-Vergara, J. M., Apartado No. 120, Bogota, Colombia, S. America, Metallurgical Chemist.
1910. Vass, David, Gas Works, Perth, Manager.
1915. Vaughan, F. W., H. R. Vaughan and Co., Ltd., South Shore Road, Gateshead-on-Tyne, Roofing Felt Manufacturer.
1912. Ventress, Ernest W. S., c/o Messrs. Lever Bros., Kabushiki Kaisha, P.O. Box Sannomiya 174, Kobe, Japan, Oil Mill Manager.
1898. Verity, Ben., 550, Hood Street, Fall River, Mass., U.S.A., Print Works Chemist.
1908. Vickers, Benj. Threlfall, Gascoigne Street, Boar Lane, Leeds, Oil Merchant.
O.M. Vickers, Wm., c/o Thos. Vickers and Sons, Miles Platting, Manchester, Chemical Manufacturer.

1916. Vincent, F. D'Abernon, Branksome Court, Fleet, Hants., Explosives Manufacturer.

1909. Virolleaud, Leopold, 3, Rue de Paris, St. Denis, Seine, France, Chemical Engineer.

1897. Vlies, Leonard E., Belmont, Gowan Road, Alexandra Park, Manchester, Aniline Dye Manufacturer.

O.M. Voelcker, E. W., 1, Tudor Street, London, E.C., Analytical and Consulting Chemist.

1887. Voelcker, Dr. J. A., 20, Upper Phillimore Gardens, Kensington, W., Agricultural Chemist.

1897. Vogel, Julius L. F., High Speed Steel Alloys, Ltd., Ditton Road, Widnes, Engineer.

1897. Voorhees, Louis A., 111, Carroll Place, New Brunswick N.J., U.S.A., Agricultural Chemist.

1899. Voorhees, Samuel S., Bureau of Standards, Washington, D.C., U.S.A., Chemist.

1915. Vorce, L. D., c/o Pennsylvania Salt Manufacturing Co., Wyandotte, Mich., U.S.A., Superintendent.

1899. Voss, Walter A., Carlton Chemical Works, Glengall Road, Millwall, E., Manufacturing Chemist.

W

1905. Waddell, Montgomery, 30, Church Street, New York City, U.S.A., Consulting Engineer.

1911. Waddock, Wm. P., 666, Harris Street, Ultimo, Sydney, N.S.W., Milk Analyst.

1913. Wade, Albert J., 66, Manor Park Road, Manor Park, E., Sugar Analyst.

1902. Wade, Frank, 26, St. Ronan's Avenue, Southsea, Analytical Chemist.

1890. Wade, Jas. L., 28, West Kensington Gardens, London, W., Chemical Manufacturer.

1915. Wade-Wilton, E., Planet Works, Bramley, near Leeds, Chemical Manufacturer.

1889. Wadman, W. E., 102, Lord Avenue, Bayonne, N.J., U.S.A., Manufacturing Chemist.

1911. Waele, Armand de, Paripan Works, Egham, Surrey, Technical Chemist.

1897. Wagner, Dr. Theodore B., Room 2229, 17, Battery Place, New York City, U.S.A., Chemist.

1893. Wagner, W. G., 12, North Common Road, Ealing, W., Manufacturing Chemist.

1906. Wagstaffe, Dr. E. A., 22, Blackfriars Street, Manchester, Analytical Chemist.

1906. Wahl, Dr. Robert, 1135—1147, Fullerton Avenue, Chicago, Ill., U.S.A., President, Brewers' School.

1895. Wainwright, Wm., Dublin Vitriol Works, Ballybough, Dublin, Chemist.

1908. Wait, Douglas, c/o R. Gay and Co., Ltd., Langthorne Works, Stratford Market, London, E., Analytical Chemist.

1899. Wakefield, Wm. C., Mill Street East, Savile Town, Dewsbury, Chemical Manufacturer.

1915. Waldo, Dr. Leonard, 49, Wall Street, New York City, U.S.A., Consulting Engineer.

1895. Waldstein, Dr. Martin E., 23, Broadwater Down, Tunbridge Wells, Kent, Manufacturing Chemist.

1887. Walker, Archibald, Newark Castle, Ayr, Scotland, Distiller.

1915. Walker, Arthur, "Woodbourne," Ancaster Road, Far Headingley, Leeds, Chemical Manufacturer.

1908. Walker, George, c/o Burmah Oil Co., Ltd., P.O. Box 67, Rangoon, Burmah, Analytical Chemist.

1913. Walker, Henry, 10, Melrose Terrace, West Kensington Park, London, W., Chemical Engineer.

1897. Walker, H. V., 323, Ridge Street, Newark, N.J., U.S.A., Chemist.

1891. Walker, Prof. Jas., D.Sc., F.R.S., 5, Wester Coates Road, Edinburgh, Professor of Chemistry (University of Edinburgh).

1897. Walker, Jas. W., Gailes Road, Irvine, Scotland, Chemical Manufacturer.

1906. Walker, Jas. W., Farley, Oakamoor, Stoke-on-Trent, Assayer.

1902. Walker, Jno. H., Gourepore Works, Naihati, E.B.S.R., Bengal, India, Chemist.

1910. Walker, John S., Hiratsuka, Sagami, Japan, Explosives Chemist.

1884. Walker, S. R., Fern Bank, Starling Road, Radcliffe, Manchester, Foreman Dyer.

1912. Walker, Prof. W. O., Dept. of Chemistry, School of Mining, Kingston, Ont., Canada, Professor of Chemistry.

1895. Walker, W. Sloane, c/o Walker, Ltd., Litherland, near Liverpool, Tanner.

1916. Wall, Prof. E. J., Syracuse University, Syracuse, N.Y., U.S.A., Professor of Photography.

1897. Wallace, Edwin C., 92, Corey Street, West Roxbury, Mass., U.S.A., Chemist.

1897. Wallace, Robt. A., 66, Holland Road, London, W., Chemical Manufacturer.

O.M. Waller, Dr. Elwyn, 7, Franklin Place, Morristown, N.J., U.S.A., Professor of Chemistry.

1906. Wallerstein, Leo, 171, Madison Avenue, New York City, U.S.A., Chemist.

1899. Wallerstein, Dr. Max, 171, Madison Avenue, New York City, U.S.A., Chemist.

1913. Walmsley, Samuel R., c/o Mammoth Copper Mining Co., Cardross, via Cairns, North Queensland, Australia, Assayer.

1886. Walsh, F. T., 12, Valentine Street, West Newton, Mass., U.S.A., Colour Printer.

1901. Walsh, Lionel O. P., c/o Dominion Tar and Chemical Co., Ltd., Sydney, Cape Breton, Canada, Chemist.

1903. Walsh, Peter H., P.O. Box 569, Magog, Quebec, Canada, Analytical Chemist.

1915. Walter, Albert, c/o Stauffer Chemical Co., Chauncey, New York, U.S.A., Works Manager.

1904. Walther, Wm., Holzapfel's Compositions Co., Ltd., Heworth Shore, Felling-on-Tyne, Chemist and Works Manager.

1908. Walton, Robert H., Railway Stores, Newtown, Sydney, N.S.W., Analyst.

1902. Walton, Thos. U., Colonial Sugar Refining Co., Ltd., O'Connell Street, Sydney, N.S.W., Australia, Analytical Chemist.

1911. Walton, Wm. Keighley, Beechwood, Upper Rushton Road, Thornbury, Bradford, Analyst.

1895. Want, W. Philip, 194—200, Bishopsgate, London, E.C., Pharmacist and Editor.

1901. Warburton, Frank, 50, Rosebery Road, Muswell Hill, N., Manager.

1916. Warburton, F. W., "The Homsted," Norman Road, Runcorn, Technical Chemist.

1904. Warburton, George H., 75, Mill Lane, West Hampstead, N.W., Analytical Chemist.

1915. Warburton, Stanley, Titaghur Paper Mills, Ltd., Titaghur, Calcutta, India, Analytical Chemist.

1896. Warburton, Thos., Rathlin, Birch Hall Lane, Rusholme, Manchester, Chemist.

O.M. Ward, Geo., Messrs. Hirst, Brooke, and Hirst, Ltd. Millgarth Mills, Leeds, Chemical Manufacturer

1891. Ward, G. J., Hallam Fields, Ilkeston, Notts Civil Engineer.

1898. Ward, John, Barnstone Blue Lias Lime Co., Ltd., Barnstone, Notts, Manager.

1899. Ward, Wm. J., 28, Sefton Road, Sale, Manchester, Chemist.

1908. Wardleworth, Theo. H., 32, St. Gabriel Street, Montreal, Canada, Manufacturing Chemist.

1902. Waring, W. Geo., Webb City, Mo., U.S.A., Metallurgical Chemist.

1913. Warner, Arthur L. D., P.O. Box 203, Edgewater, N.J., U.S.A., Sugar Refiner.

1899. Warnes, Arthur R., 47, Cranbrook Avenue, Cottingham Road, Hull. Consulting Technical Chemist.

1912. Warren, E. Bruce, c/o Indian Rubber and Gutta Percha Telegraph Works Co., Silvertown, E., Consulting Analytical Chemist.

1890. Warren, Fiske, c/o S. D. Warren and Co., Laboratory, Cumberland Mills, Maine, U.S.A., Paper Manufacturer.

1901. Warren, Jno. E., Eagle Chemical Works, Barchester Street, Poplar, E., Tar Distiller.

1911. Washburn, Frank S., (Jnls.) c/o American Cynamid Co., Niagara Falls, Ont., Canada, President, American Cynamid Co.

1902. Watkins, E. J., 72, King's Road, Peckham, S.E., Works Chemist.

1898. Watkins, Willard H., c/o Schoellkopf, Hartford, and Hanna Co., P.O. Drawer 57, Buffalo, N.Y., U.S.A., Chemist.

1894. Watmough, Benj., c/o Brotherton and Co., Ltd., Ammonia Works, Wakefield, Chemist.

1884. Watson, Chas., Rose Bank, School Road, Moseley, Birmingham, Manufacturing Chemist.

1894. Watson, Chas. Ernest, 33, Oxford Road, St. Anne's on Sea, Lancashire, Chemical Assistant.

1908. Watson, C. I. Wilkinson, c/o Wailuku Sugar Co., Wailuku, Mani, Hawaiian Islands, Chemist.

1901. Watson, Herbert J., 64, Peel House Lane, Widnes, Chemist.

1894. Watson, Jas., Tyne View, Hebburn-on-Tyne, Alkali Works Manager.

1891. Watson, Jno., Langdon, Beaconsfield Road, Blackheath, S.E., Analytical Chemist.

O.M. Watson, Jno. C., Arnold Printworks, North Adams, Mass., U.S.A., Printworks Chemist.

O.M. Watt, A., c/o Macfie and Sons, 3t. Moorfields, Liverpool, Sugar Works Chemist.

1901. Watt, Francis L., City Mart Building, 5, Hamilton Street, Sydney, N.S.W., Australia, Analytical Chemist.

1906. Watt, Dr. H. E., Blandfield Chemical Works, Wheatfield Road, Edinburgh, Chemist.

1916. Wattleworth, D. R., 6, Dean Street, Workington, Cumberland, Technical Chemist.

1893. Watts, Jno. Isaac, Fairleigh, Hartford, Cheshire, Alkali Works Manager.

1908. Watts, Jno. Wm., Newcastle Tar Works, Blaydon-on-Tyne, Manager.

1907. Waumsley, Harry, 12, Rowhill Mansions, Clapton, N.E., Chemical Engineer.

1903. Wayland, Wm. A., 12, Albert Road, Brockley, S.E., Manufacturing Chemist.

1906. Webb, Frank H., 7, Dustin Street, Haverhill, Mass., U.S.A., Chemist.

1915. Webber, Arthur H., 16, Thorndike Street, Beverly, Mass., U.S.A., Chemist.

1912. Weber, Dr. Max G., 151, Water Street, Perth Amboy, N.J., U.S.A., Works Manager.

1901. Webster, Geo. J., P.O. Box 1003, Marquette, Mich., U.S.A., Secretary.

1897. Wedge, Utley, Ardmore, Pa., U.S.A., Chemist.

1902. Weed, Hy. T., 471, Stratford Road, Brooklyn, N.Y., U.S.A., Teacher of Chemistry.

1893. Weeks, H. B., 2, Infield Park Road, Barrow-in-Furness, Analytical Chemist.

1904. Weil, Jacob A., 4, Bowesfield Lane, Stockton-on-Tees, Chemical Engineer.

1906. Weir, James, c/o Imperial Varnish and Color Co., 6—24, Morse Street, Toronto, Canada, Chemist.

1902. Weiskopf, Dr. Eric H. *See* Whytehead, Dr. Eric H.

1910. Weiss, John M., c/o Barrett Manufacturing Co., Research Dept., Hudson Heights, N.J., U.S.A., Chemist.

1908. Weissmüller, Edward F., Spring Lodge, Helsby, Cheshire, Chemist.

1905. Weissmüller, Ernest C., Rockcliffe, Helsby, Cheshire, Research Chemist.

1910. Welch, Bertie M., 80, Hunter Street, Sydney, N.S.W., Australia, Assayer.

1912. Weld, Fred. C., 263, Fairmount Street, Lowell, Mass., U.S.A., Analytical Chemist.

1899. Weldon, Leonard E., Hadleigh, Alma Street, Sherwood Rise, Nottingham, Dyer.

1903. Wellcome, Henry S., Snow Hill Buildings, London, E.C., Manufacturing Chemist.

1914. Wells, E. E., 9, Dalhousie Street, Montreal, Quebec, Canada, Chemical Engineer.

1912. Wells, Jas. H., "Tralee," Sketty Road, Swansea, S. Wales, Metallurgist.

1885. Welsh, Jas., Standard Mills, Ferguson Road, Bombay, India, Printworks Manager.

1890. Welsh, Thos. L., 3, Prince's Gardens, Dowanhill, Glasgow, Analytical Chemist.

O.M. Welsh, W., Holt Town Oil Works, Manchester.

1905. Welt, Dr. Ida, 25, Quai de Mont Blanc, Geneva, Switzerland, Chemist.

1906. Wenger, Capt. Francis E., The Brampton, Newcastle, Staffs., Ceramic Colour Manufacturer.

1909. Wescott, J. P., jr., 55, Washington Park, Newtonville, Mass., U.S.A., Manager, Atlas Chemical Co,

1903. Wesener, Dr. John A., 31, North State Street, Chicago, Ill., U.S.A., Consulting Chemist.

1889. Wesson, D., 111, South Mountain Avenue, Montclair, N.J., U.S.A., Cotton-oil Expert.

1908. West, Chas. A., c/o American Camphor Refining Co., 14, Fulton Street, Boston, Mass., U.S.A., President.

1909. West, Percy C. H., 61—62, Chancery Lane, London, W.C., Analytical Chemist.

1885. Westmoreland, J. W., 12, Arthington Terrace, Hunslet, Leeds, Metallurgical Chemist.

1898. Weston, David B., Sharon, Mass., U.S.A., Chemist.

1894. Weston, Robt. S., 14, Beacon Street, Boston, Mass., U.S.A., Chemist and Bacteriologist.

1890. Wetter, Jasper, Room 23, Holborn Hall, Gray's Inn Road, London, W.C., Patent Agent.

1912. Weyman, Geoffrey, The Cwm, Saltwell Road, Low Fell, Co. Durham, Technical Chemist.

O.M. Whalley, L. J. de, 18, Brandram Road, Lee, S.E., Sugar Chemist.

1909. Wharton, Fredk. M., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Chemist.

1908. Wheaton, H. J., 5, Walton New Road, Lower Walton, Cheshire, Chemical Engineer.

1909. Wheeler, Edward, 117, Main Road, Sidcup, Kent, Demonstrator of Chemistry.

1898. Wheeler, Dr. Edwd. J., 79, Chapel Street, Albany, N.Y., U.S.A., Analytical Chemist.

1903. Wheeler, Ernest, 1567, Ashton Old Road, Higher Openshaw, Manchester, Metallurgical Chemist.

1906. Wheeler, Frank G., 683, Harris Street, Appleton, Wis., U.S.A., Chemist.

1907. Wheeler, R. Vernon, Home Office Experimental Station, Eskmeals, Cumberland, Chemist.

1912. Wheeler, Thorne L., c/o Edible Products Co., 156—186, East 22nd Street, Bayonne, N.J., U.S.A., Chemist.

1895. Wheelwright, Dr. E. W., 14, Carisbrooke Road, Edgbaston, Birmingham.

1915. Whetmore, S. A. H., c/o British Dyes, Ltd., Empire House, Kingsway, London, W.C., Secretary.

1909. Whiffen, G. Goodman, Lombard Road, Battersea, London, S.W., Chemical Engineer.

O.M. Whiffen, Thos. J., Cerris House, West Hill, Putney, S.W., Manufacturing Chemist.

O.M. Whiffen, W. G., Lombard Road, Battersea, London, S.W., Manufacturing Chemist.

1916. Whinyates, Leonard, 27, King Street, Moston, Manchester, Anilin Colour Works Chemist.

1899. Whitaker, Milton C., Columbia University, New York City, U.S.A., Chemist.

1895. Whitaker, Thos., Aire Vale Dye Works, Newlay, near Leeds, Dyer.

O.M. Whitaker, Thorpe, (Journals) Bradford Dyers' Association, Ltd., and 35, Pemberton Drive, Bradford, Yorks, Dyer's Chemist.

1893. White, Arthur F., 2, Melbourne Grove, Thornbury, Bradford, Yorks, Manufacturing Druggist.

1915. White, A. S., "Fairlawn," Bromborough, Cheshire, Chemist.

1915. White, Gerald N., 15, West End Avenue, Pinner, Middlesex, Research Chemist.

1898. White, Jno., County Offices, St. Mary's Gate, Derby, Public Analyst to County of Derby.

1911. White, John W., c/o E.C. Powder Co., Green Street Green, Dartford, Kent, Works Chemist.

O.M. White, Paul T., Hortonfield House, West Drayton, Chemical Manufacturer.

1910. White, P. Winzar, Mayfield, Hayes, Middlesex, Manufacturing Chemist.

1911. White, Walter W., c/o Citro Chemical Co., Maywood, N.J., U.S.A., Secretary and Manager.

12. Whitehead, Charles E., Devonshire Villas, Barrow Hill, near Chesterfield, Derbyshire. Chemist.
1903. Whitehouse, P. L., 16, Lombard Street, West Bromwich, Staffordshire, Oil Chemist.
1906. Whiteley, C. E., 21, Brudenell View, Leeds, Demonstrator of Chemistry.
1885. Whiteley, R. Lloyd, The Institute, West Bromwich, Staffordshire, Principal.
1892. Whiteside. Jno. L., 376, St. Helen's Road, Bolton-le-Moors, Chemical Lecturer.
1912. Whitney, Wm. L., c o U.S. Graphite Co., Saginaw, Mich., U.S.A., Chemist.
1885. Whittaker, C. J., Somerville, Fairhaven, Lytham, Lancashire, Chemical Engineer.
1913. Whittelsey, Dr. Theodore. c o U.S. Rubber Co., 11th Avenue and 58th Street, New York City, U.S.A., Chemical Director.
1904. Whittier. Charles T., 78. Brinkerhoff Street, Jersey City, N.J., U.S.A., Manager.
1901. Whitton, Jas. T., Nobel Villa. Ardeer. Stevenston, Explosives Chemist.
1884. Whowell. F.. Croich Hey, Tottington, Bury, Lancs. Bleacher.
1910. Whymper, R., St. Clare's, St. Mary's Road, Ditton Hill. Surbiton, Chemist.
1902. Whytehead, Dr. Eric H., c o Brotherton and Co., Ltd., Leeds. Works Manager.
1899. Wiarda, Jno. C.. 259–273. Green Street. Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
1915. Wibberley, Geo., c/o Jas. Robinson and Co., Ltd., Cudbear Works. Hillhouse Lane. Huddersfield, Technical Chemist.
1913. Wickenden, Leonard, c o West Virginia Paper and Pulp Co., 521, West 23rd Street, New York City, U.S.A.. Research Chemist.
1908. Wickes, Clarence S.. 28, Franklin Avenue, Merchantville, N.J., U.S.A., Factory Superintendent.
1915. Wickstead. J. B., H.M. Factory, West Gorton Chemical Works, Manchester, S.E.. Chemical Engineer.
1916. Wiegand, Wm. B., c o Canadian Consolidated Rubber Co.. Papineau Square, Montreal. Canada. Chief Chemist.
1904. Wieler, Eric E., Northern Assurance Buildings, Albert Square, Manchester, Chemical Merchant.
1906. Wiffen, Henry J., 17, Albany Road, Manor Park, Essex. Manufacturing Chemist.
1883. Wiggin, W. W.. 55, George Street Parade, Birmingham, Nickel Refiner.
1897. Wigglesworth, H., 25, Broad Street, New York City, U.S.A., Manufacturing Chemist.
1913. Wigner. J. H.. The White Cottage. Helsby, Cheshire, Works Chemist.
1906. Wikner, Sigurd A., "Lynton." Kingsbury Road, Gravelly Hill, Birmingham. Tar Works Chemist.
1915. Wilbraham. Dr. Evelyn C. B.. 6, Bury Court, St. Mary Axe. E.C.. Chemical Manufacturer.
1899. Wild, Roland C., The Grange, New Eltham, Kent, Analytical Chemist.
1893. Wilder. F. L., Morro Velho. Minas Geraes. Brazil. Assayer.
1902. Wilder, Salmon W., jun., 33, Broad Street, Boston, Mass., U.S.A., Treasurer.
1911. Wildt, Dr. Edwin. 85. Clarendon Park Road. Leicester, Technical Chemist.
1912. Wiley, Samuel W., 7, South Gay Street, Baltimore, Md., U.S.A.. Analytical Chemist.
1916. Wilford. A. F.. "Eversleigh." Ashville Avenue, Norton-on-Tees. Works Chemist.
1906. Wilke, Wm., 86, Norwood Avenue, Buffalo, N.Y., U.S.A., Chemical Engineer.
1903. Wilkie, Jno. M., 38, South Road, West Bridgford, Nottingham, Analytical Chemist.
1885. Wilkin. Sir Walter, K.C.M.G., Appold Street, Finsbury, E.C., Yeast Manufacturer.
1915. Wilkins, C. R., 8, Crookston Road, Eltham, S.E., Works Chemist.
1911. Wilkinson, Frank, West Lodge, Handsworth, near Sheffield, Chemical Manufacturer.
1916. Wilkinson, Herbert Tatlock, c/o The Wardle Engineering Co., Ltd., 196, Deansgate, Manchester, Engineer.
1904. Wilkinson, Prof. J. A., South African School of Mines and Technology, P.O. Box 1176, Johannesburg, Transvaal. Professor of Chemistry.
1886. Wilkinson, J. B., Tong Street. Dudley Hill, Bradford. Yorks, Chemical Manufacturer.
1893. Willcox, Benjamin, 47. Lincoln's Inn Fields, London, W.C., Patent Agent.
1911. Willcox, Stuart J., 34, Westbourne Road, Birkdale, Southport, Chemist.
1903. Williams, Chas. E., Thornhayes. Sleaford. Seed Crusher.
1895. Williams, David T., 42, Finsbury Square, London, E.C., Chemist and Assayer.
1912. Williams, Egbert R., c o Shawinigan Electro-Metals Co., Shawinigan Falls, P.Q.. Canada, Chemist.
1891. Williams, Henry J., 30, Norfolk Road, Chestnut Hill, Mass., U.S.A., Chemical Engineer.
1908. Williams. Herbert E., 22. Heywood Road, Polefield Hall Estate, Prestwich, Manchester, Chemist.
1914. Williams, J. A., Mackenzie, c/o A. E. Ames and Co., Union Bank Building, Toronto, Canada.
1904. Williams, Jno. T., 100, Broadway. New York City, U.S.A.
1913. Williams, Jos. H., 54, Dangan Road, Wanstead, Essex, Works Chemist.
1904. Williams, Naboth, 28, Rolleston Street, Warrington. Technical Chemist.
1902. Williams, Percy, 94, Telford Avenue, Streatham Hill, S.W., Chemist.
1885. Williams, Rowland, 79, Queen Square, Lancaster, Analytical Chemist.
1912. Williams, Samuel B.. Homestead. Roskear, Camborne, Cornwall, Metallurgist.
1900. Williams, Saml. H., Glastonbury, Conn., U.S.A. Soap Manufacturer.
1903. Williams, S. M., 269, Springdale Avenue. East Orange, N.J., U.S.A., Chemist.
1885 Williams, T. Howell. *See* Idris, T. H. W.
1884. Williams, Prof. W. Carleton, Broomgrove, Goring-on-Thames, Professor of Chemistry.
1902. Williams, Walter Scott, Baker's Corner, Attleboro', Mass., U.S.A., Textile Engineer.
1887. Williams, W. Collingwood, 36, Dansie Street, Liverpool, Analytical Chemist.
O·M. Williams, W. J., 1503. Foulkrod Street, Frankford, Philadelphia, Pa., U.S.A., Analytical Chemist.
1894. Williamson, J. Alex., The Croft, Chase Court Gardens, Enfield, N., Analytical Chemist.
1911. Williamson, John, jun., Alne Hill, Camp Road, Maryport, Cumberland. Tanner.
1903. Wills, J. Lainson, 3457, Crittenden Street, St. Louis, Mo., U.S.A., Technical and Brewing Chemist.
1888. Wilson, Cecil H., c/o Sheffield Smelting Co., Ltd., Royds Mills Street, Sheffield, Chemist.
1888. Wilson. Dr. David, Carbeth. Killearn. by Glasgow.
1910. Wilson, Dr. Forsyth J., Royal Technical College, Glasgow, Lecturer.
1885. Wilson, Frank, 7, Bedford Square, London, W.C., Brewer.
O.M. Wilson, G. E.. The Chemical Works, Oldbury, near Birmingham, Chemical Manufacturer.
1899. Wilson, Gordon, c/o Consuledo Ingles, Zacatecas, Mexico, Chemist and Assayer.
1916. Wilson, Jas. H., 4, Warneford Road, Cowdersley, Huddersfield, Works Chemist.
1886. Wilson, Jno., Tyneside, 381, Hagley Road, Birmingham, Technical Chemist.
1896. Wilson. Jno.. Orme Crest. Penrhyn Avenue, Rhos-on-Sea. N. Wales, Chemical Engineer.
1909. Wilson, Jno., Battersea Polytechnic, London, S.W., Head of Chemical Dept.
1905. Wilson, J. E., c/o General Chemical Co., 25, Broad Street, New York City, U.S.A., Chemical Salesman.
1915. Wilson, J. H., Caledonia Engine Works, MacDowall Street, Paisley, Scotland, Engineer.

1902. Wilson, Leonard P., Rosemount, Holyhead Road, Coventry, Technical Chemist.

1910. Wilson, Leslie, West Bank, Doxey, near Stafford.

O.M. Wilson, R. H., Egglecliffe P.O., Co. Durham, Chemical Manufacturer.

1912. Wilson, S. Siddons. *See* Siddons Wilson, S.

1908. Wilson, William James, Whangarei Club, Whangarei, New Zealand, Consulting Cement Engineer.

1909. Wilson, Wm. J., 12, Vicarage Road, Plumstead, Kent, Chemist.

1890. Wilson, W. W., Dalmonach House, Alexandria, Dumbartonshire, Analytical Chemist.

1884. Wilton, Lieut.-Col. Thos., Rosslyn, Redborough Road, Golders Green, N.W., Tar Works Manager.

1912. Windsor, P. L., Library, University of Illinois, Urbana, Ill., U.S.A., Librarian.

1913. Windsor-Richards, W., c/o British Ebonite Co., Nightingale Road, Hanwell, Middlesex, Chemist.

O.M. Wingham, A., 57, Victoria Road South, Southsea, Hants, Metallurgical Chemist.

1907. Winsloe, Louis S., 1, Booth Street, Manchester, Manufacturing Chemist.

1892. Winstanley, W. Hy., Birch House, Cheadle Hulme, Cheshire, Technical Chemist.

1886. Winstone, E. H., Members' Mansions, 36, Victoria Street, London, S.W., Ink Manufacturer.

1892. Wirtz, Dr. Quirin, 28, Great Ormond Street, London, W.C., Consulting Chemist.

1889. Wishart, Jno., Oakbank Oil Co., Ltd., 29, St. Vincent Place, Glasgow, General Manager.

1902. Withers, Prof. W. A., State A. and M. College, West Raleigh, N.C., U.S.A., Professor of Chemistry.

1915. Witmer, H. E., 310, Board of Trade Building, Toronto, Canada, Manufacturers' Agent.

1903. Wolf, Jacques, c/o Jacques Wolf and Co., Passaic, N.J., U.S.A., Manufacturing Chemist.

1912. Wolff, Dr. Salamon, 13, Brighton Grove, Rusholme, Manchester, Chemical Engineer.

1911. Wollaston, T. Roland, Dirleton House, Priory Road, Sale, Cheshire, Consulting Engineer.

1903. Wolton, Wm. R., c/o Joseph Fison and Co., Ltd., Ipswich, Manager.

1914. Wood, A. S., Municipal Technical School, Suffolk Street, Birmingham, Works Chemist.

1906. Wood, E. Escott, Hurricane House, Brymbo, near Wrexham, North Wales, Chemist and Metallurgist.

1900. Wood, Frank, Ardsley House, near Barnsley, Yorks, Assistant Manager (Glass Works).

1901. Wood, Frank S., 12, Carlton Avenue, Hornsea, East Yorks, Cement Works Chemist.

1909. Wood, Hubert R., c/o Fenner and Alder and Co., Fenner's Wharf, Millwall, E., Works Chemist.

1887. Wood, Jos. T., 62, Park Road, Nottingham, Tanner.

1915. Wood, William, Royal Gunpowder Factory, Waltham Cross, Essex, Chemical Manufacturer.

1906. Woodall, Sir Corbett, Palace Chambers, Westminster, London, S.W., Civil Engineer.

O.M. Woodcock, R. C., c/o Sanitas Co., Ltd., Locksley Street, Limehouse, London, E., Chemist.

1910. Woodhead, Arthur E., Bemerside, Cornwall Road, Harrogate, Yorks, Research Chemist.

1884. Woodhead, Jas., Inglewood, Slaithwaite, near Huddersfield, Tar Distiller.

1915. Woodmansey, A., 12, Ridgeway Terrace, Delph Lane, Leeds, Analyst and Chemical Engineer.

1915. Wood-Mason, Harold, H.M. Factory, Queen's Ferry, Chester, Chemist.

1914. Woodroffe, David, c/o P. E. Fisher, Leather Manufacturer, Basingstoke, Research Assistant.

1900. Woodrow, John, 84, Harpenden Road, Manor Park, E., Chemist.

1906. Woodward, Horace A., Cowell Avenue, West Orange, N.J., U.S.A., Chemist.

1904. Woolcott, Geo. H., Lady's Well Brewery, Cork, Ireland, Brewer's Chemist.

O.M. Woolley, G. S., Victoria Bridge, Manchester, Pharmaceutical Chemist.

1905. Woore, N. L., c/o South Australian Gas Co., Brompton, Adelaide, South Australia, Works Chemist.

1901. Worden, Edw. C., Millburn, N.J., U.S.A., Manufacturing Chemist.

1909. Work, Charles O., 22, Cambridge Road, Great Crosby, Liverpool, Chemist.

1911. Worley, Prof. Fred. P., University College, Auckland, New Zealand, Prof. of Chemistry.

O.M. Worrall, H., Culmington House, Stanton Lacey, Ludlow, Dyer.

1903. Worstall, Robt. A., 21, North La Salle Street, Chicago, Ill., U.S.A., Paint and Varnish Specialist.

1900. Worthington, Arthur, Lynwood, Great Lever, Bolton, Chemist and Manager.

1896. Wrampelmeier, T. J., 565, Monadnock Building, San Francisco, Cal., U.S.A., Chemist.

1914. Wray, Edward, 65, Manchester Road, Fairfield, near Manchester, Chemist.

O.M. Wray, O. J. P., Hazlemere, Coleraine Road, Blackheath, S.E., Technical Chemist.

1904. Wright, Allister M., Box 617, G.P.O., Christchurch, N.Z., Chemist (Christchurch Meat Co.).

1912. Wright, Arthur, 45, Markwood Road, Forest Hills, Long Island, N.Y., U.S.A., Lawyer.

1895. Wright, Arthur C., c/o Turner, Morrison, and Co., 6, Lyons Range, Calcutta, India, Chemist.

1908. Wright, C. Harold, Dept. of Agriculture, Suva, Fiji, Agricultural Chemist.

1915. Wright, E. W., 51, Bertram Road, Hendon, N.W., Analytical Chemist.

1901. Wright, Harold E., c/o Sir B. Samuelson and Co., Ltd., Middlesbrough, Chemist.

1907. Wright, John Henry, 16, Norwood Avenue, Shipley, Yorks, Technical Chemist.

1885. Wright, Jos., 19, Arboretum Street, Nottingham, Lace Dresser.

O.M. Wright, L. T., Junior Constitutional Club, Piccadilly, London, W., Chemical Engineer.

1911. Wright, Robt., c/o Thos. Adams, Ltd., Sherwood Hill Works, Nottingham, Bleacher and Dyer.

1900. Wright, Walter J., 48, The Mall, Faversham, Kent, Chief Chemist (Cotton Powder Co.).

1907. Würster, Oscar H., c/o Morris and Co., Union Stockyards, Chicago, Ill., U.S.A., Soap Works Chemist.

1890. Wyatt, Dr. Francis, 402, West 23rd Street, New York City, U.S.A., Consulting Chemist.

1905. Wyer, Malcolm G., The Library, State University, Iowa City, Iowa, U.S.A., Librarian.

O.M. Wyld, Jno., c/o Willfrid Wyld, Gothic Villa, Mount Street, Nechells, Birmingham, Chemical Works Manager.

1908. Wyler, Dr. Max, c/o Levinstein, Ltd., Blackley, Manchester, Manufacturing Chemist.

1906. Wynne, Prof. W. Palmer, F.R.S., The University, Sheffield, and (Journals) 17, Taptonville Road, Sheffield, Professor of Chemistry.

Y

1901. Yardley, Frank, c/o Henry Jutson and Sons, Liverpool Street, Birmingham, Chemical Manufacturer.

1897. Yates, W. H., Durley Park, Keynsham, Bristol, Technical Chemist.

1915. Yeoman, Ernest W., 1, Regent Square, London, W.C., Analyst and Metallurgist.

1913 Yeomans, Wm. W., 40, Alleghany Street, Buffalo, N.Y., U.S.A., Chemist.

1906. Yerkes, Leonard A., c/o Jos. Bancroft and Sons Co. Wilmington, Del., U.S.A., Bleacher and Finisher.

1898 Yetton, Thos., 86, Bow Road, London, E., Consulting Distiller's Chemist.

1894. Yocum, Dr. Jno. H., 325, Academy Street, Newark, N.J., U.S.A., Chemist.

1886. Yoshida, Prof. H., Imperial University of Kyoto, Kyoto, Japan, Professor of Chemistry.

[illegible] Y[illegible] [illegible] hi. Koishikawa, Tokyo, Japan, [illegible]

[illegible] Young, A[illegible] [illegible]s Hill, Lewisham, S.E.

[illegible] Young, [illegible] 2[illegible], Sgdon Road, Dalston, N.E., [illegible]al Chemist.

[illegible] [illegible] o The Bayer Co., 117, Hudson [illegible] New York City, U.S.A., Colourist.

1890. Young, Dr. Geo., Bradda, Church Crescent, Church End, Finchley, N., Chemist.

1913 Young, Hamish, Springfield, Brownside Road, Cambuslang, by Glasgow, Chemist.

1901. Young, James, 2, Montague Terrace, Kelvinside, Glasgow, Chemist.

O.M. Young, Jno., 2, Montague Terrace, Kelvinside, Glasgow, Technical Chemist.

1886. Young, Jno., Claremont House, Beverley Road, Hull, Gas Engineer.

1909. Young, John, 610, Weber Avenue, Akron, Ohio, U.S.A., Analytical Chemist.

1904. Young, Jno H., c/o The Cassel Cyanide Co., Ltd., Shuna Street, Maryhill, Glasgow, Technical Chemist.

1898. Young, J. W., 22, Maxwell Drive, Glasgow, S., Inspector under Alkali Acts.

1883. Young, Prof. Sydney, F.R.S., University Chemical Laboratory, Trinity College, Dublin, Professor of Chemistry.

O.M. Young, W. C., Laboratory, 24, Aldgate, London, E., Gas Examiner and Consulting Chemist.

1898. Young, W. Gathorne, Analyst's Dept., G.N.R., Doncaster, Yorks, Chief Chemist.

Z

1899. Zabriskie, C. B., c/o Pacific Coast Borax Co., 100, William Street, New York City, U.S.A. Manager.

1897. Zacharias, Dr. P. D., Philhellinon Street 22, Athens, Greece, Industrial Chemist.

1912. Zanetti, Joaquin E., Columbia University, New York City, U.S.A., Chemist.

1906. Zaremba, Edw., 707, D. S. Morgan Building, Buffalo, N.Y., U.S.A., President (Zaremba Co.).

1906. Zdanowicz, Joseph, 2, Waverton Street, Mayfair, W., Chemical Engineer (Artificial Silk).

1899. Zilz, Henry, 54, Halford Road, Richmond, S.W., Merchant.

O.M. Zimmermann, A., 3, Lloyd's Avenue, London, E.C., Chemical Agent.

1905. Zimmermann, Chas., 9 and 10, St. Mary-at-Hill, London, E.C., Chemical Merchant.

1897. Zinsser, Dr. Fred. G., Hastings-upon-Hudson, N.Y., U.S.A., Manufacturing Chemist.

1912. Zwingenberger, Dr. Otto K., c/o Roessler and Hasslacher Chem. Co., Perth Amboy, N.J., U.S.A., Chemical Engineer.

List of Members on Active Service in whose cases the Application of By-law 12 has been waived.

1913. Acland, L. H. Dyke.
1903. Acton, J. Rowland.
1907. Adam, Capt. Wm. Anol.
1913. Allmand, Dr. A. J.
1901. Barber, Capt. René R.
1913. Bridge, Stanley W.
1910. Campbell, James Robertson.
1911. Cochrane, Capt. John Bray.
1913. Deakin, Lieut. John Bertram.
1914. Dunn, Ralph John.
1914. Fell, Harry.
1912. Gloag, Vivian Ford.
1903. Goodwin, Major Leo. F.
1905. Higgins, Dr. Eric B.
1908. Hughes, William Earl.
1907. McConnan, Dr. James.
1908. Mason, Capt. Douglas H. Campbell.
1912. Millar, Charles James.
1913. Mumford, Capt. Ernest Moore.
1914. Rodger, Lawton H.
1913. Stephenson, Guy.
1913. Walker, Lieut. Frederick Handel, jun.

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